Townsville

Planning Together... For *Townsville's* Future

TOWNSVILLE CITYPLAN

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Citation and commencement

This planning scheme may be cited as the Townsville City Plan.

A notice was published in the Government Gazette No. 37 on 17 October, 2014 for the planning scheme for the City of Townsville.

The commencement date for the planning scheme was 27 October, 2014.

The Townsville City Plan was amended for alignment with the *Planning Act 2016* (the Act) by the Minister's rules under section 293 of the Act on 27 June 2017.

Amendments to the planning scheme are included at Appendix 2.

Strategic vision

In 2021, our community will be defined by the statement:

Townsville is the northern gateway to Queensland. Our well-built city connects people to their community, via an active lifestyle that is enjoyed by all who live and visit. We are leaders of positive environmental action. We are acclaimed for our business entrepreneurship, government enterprise, innovation, technology and cultural stewardship.

Four Community Plan themes expand on this vision statement:

Strong, connected community
A community that draws on the diversity, skills and expertise of residents to build a community that has pride in its culture and lifestyle.

Environmentally sustainable future
Our community recognises and values the natural environment. We acknowledge the need for a more sustainable future and seek to achieve this through solutions that minimise our impact on the environment.

Sustaining economic growth
The community recognise that it is fundamental to have a strong and balanced economic growth in order to enhance our city's way of life.

Shaping Townsville
Our city will meet the diverse and changing infrastructure and service needs of the community.

(Leading, creating, connecting: shaping a place to be proud of, Townsville Community Plan 2011-2021)

Editor's note—The Strategic vision is extrinsic material to the planning scheme.

Part 1 About the planning scheme

1.1 Introduction

(1) The Townsville City Plan (planning scheme) has been prepared in accordance with the *Sustainable Planning Act 2009* (the SP Act) as a framework for managing development in a way that advances the purpose of the SP Act.

(2) The planning scheme was amended for alignment with the *Planning Act 2016* (the Act) by the Minister's rules under section 293 of the SP Act on 27 June 2017.

(3) In seeking to achieve this purpose, the planning scheme sets out Townsville City Council's intention for the future development in the planning scheme area, over the next 25 years.

(4) The planning scheme seeks to advance state and regional strategies, including state planning policies, through more detailed local responses, taking into account the local context.

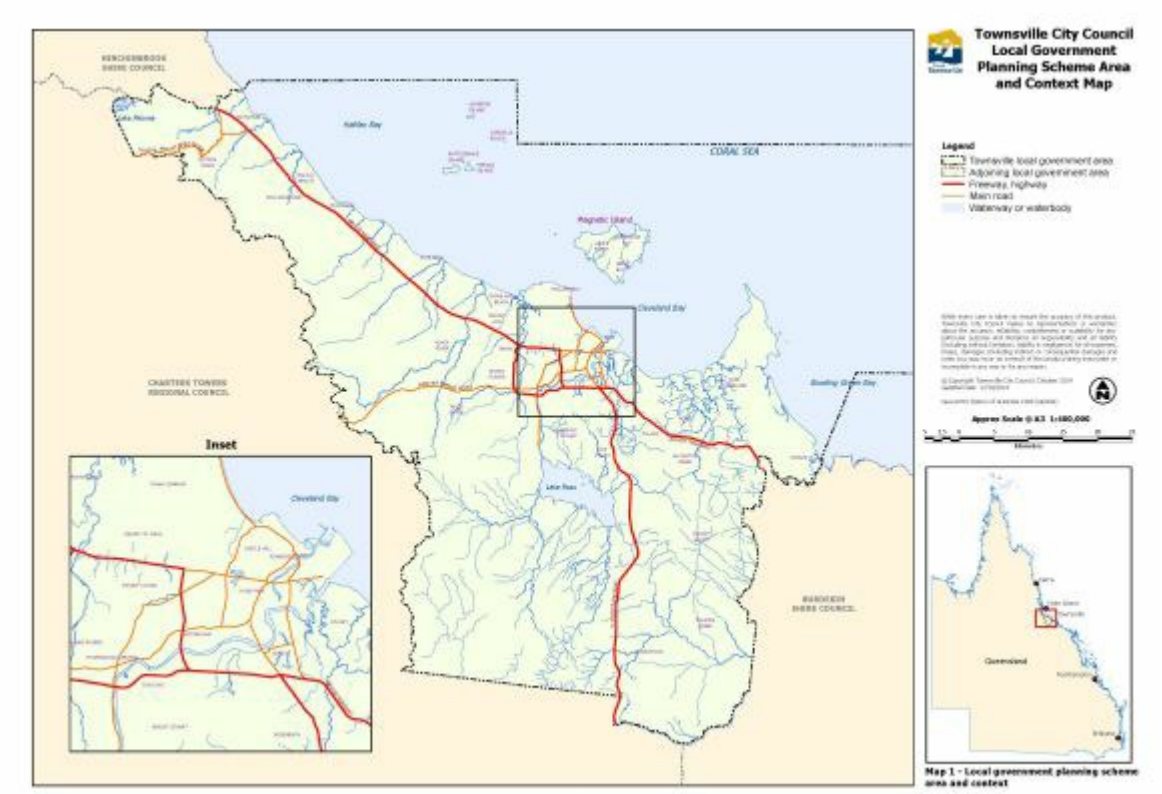
(5) While the planning scheme has been prepared with a 25-year planning horizon, it will be reviewed periodically in accordance with the Act to ensure that it responds appropriately to the changes of the community at a local, regional and state level.

(6) The planning scheme applies to the planning scheme area of Townsville City Council including all premises, roads, internal waterways and interrelates with the surrounding local government areas illustrated in Map 1.

Editor's note—In accordance with section 5(2)(a) of the Planning Regulation 2017, the regulated requirements apply to this planning scheme only where specifically identified as regulated requirements in the section containing the administrative definition for minor building work.

Editor's note—Areas which are not subject to the jurisdiction of the planning scheme are noted in the relevant zone codes in Part 6. They include the Department of Defence Estate, strategic port land and certain other major land holdings. In addition, land subject to a community infrastructure designation is listed in Schedule 5.

Editor's note—Under section 26 of the *Sustainable Ports Development Act 2015*, a master plan and port overlay may apply to Port of Townsville land outside designated areas of strategic port land. Where there is a port overlay, it prevails over the planning scheme, to the extent of any inconsistency.



Click here to view PDF high resolution map.

Map 1 - Local government planning scheme area and context

1.2 Planning scheme components

(1) The planning scheme comprises the following components:

- (a) about the planning scheme;
- (b) state planning provisions;
- (c) the Strategic framework;
- (d) the Local government infrastructure plan;
- (e) tables of assessment;
- (f) the following zones:
  - (i) Low density residential zone:
    - (A) Ross River Road corridor precinct;
    - (B) Stables precinct;
    - (C) Marlow Street precinct;
  - (ii) Medium density residential zone:
    - (A) Thuringowa South precinct;
    - (B) Thuringowa East precinct;
    - (C) Rossiter Park precinct;
    - (D) Aitkenvale medium density precinct;
    - (E) Aitkenvale village precinct;
    - (F) Hyde Park medium density precinct;
    - (G) Kings Road medium density precinct;
    - (H) The Strand precinct;
    - (I) North Ward gateway precinct;
    - (J) North Ward villages precinct;

(K) North Ward medium density precinct;

(L) Magnetic Island medium density precinct;

(M) Picnic Bay precinct;

(N) Nelly Bay tourist precinct;

(O) Wills Street precinct;

(iii) High density residential zone:

(A) Palmer Street precinct;

(B) Flinders Street West precinct;

(C) Railway Estate precinct;

(iv) Rural residential zone;

(v) Character residential zone:

(A) 1950s Post War Expansion precinct;

(B) 1960s Defence Housing and 1960s Housing Commission precinct;

(C) Worker's Cottages precinct;

(D) South Townsville precinct;

(E) Queenslanders precinct;

(F) Interwar Gables and Queensland Bungalows precinct;

(G) Interwar to 1950s Asymmetrical Gables precinct;

(H) Churchill Street precinct;

(I) Park Street precinct;

(J) Grand Queenslanders precinct;

(K) French Street precinct;

(L) Mixed 1950s precinct;

(vi) Neighbourhood centre zone;

(vii) Local centre zone:

(A) Rising Sun local centre precinct;

(B) North Ward local centre precinct;

(viii) District centre zone:

(A) Idalia district centre precinct;

(B) Annandale district centre precinct;

(C) Deeragun district centre precinct;

(D) Rasmussen district centre precinct;

(ix) Major centre zone:

(A) Aitkenvale major centre precinct:

Aitkenvale centre core sub-precinct;

Aitkenvale centre frame sub-precinct;

(B) Thuringowa Central major centre precinct:

Thuringowa town centre heart sub-precinct;

Willows sub-precinct;

Thuringowa Drive sub-precinct;

Thuringowa centre support sub-precinct;

(C) Hyde Park major centre precinct;

(x) Principal centre (CBD) zone:

(A) Civic and administration precinct;

(B) Flinders Street retail precinct;

(C) Flinders Street East precinct;

(xi) Specialised centre zone:

(A) Townsville Airport precinct;

(B) Port of Townsville precinct;

(C) Lavarack Barracks precinct;

(D) Domain Central precinct;

(E) Fulham Road medical precinct;

(F) Bayswater Road medical precinct;

(G) James Cook University-Townsville Hospital precinct:

Discovery Central sub-precinct;

Discovery Village sub-precinct;

(xii) Mixed use zone:

(A) Magnetic Island villages precinct:

Nelly Bay sub-precinct;

Picnic Bay sub-precinct;

Horseshoe Bay sub-precinct;

(B) Nelly Bay gateway precinct;

(C) Arcadia Central precinct;

(D) Kirwan Traders precinct;

(E) Charters Towers Road business precinct;

(F) CBD gateway precinct;

(G) South Townsville Railyards and Dean Park precinct;

(H) Wotton Street precinct;

(I) Breakwater precinct;

(J) King Street quarter precinct;

(K) King Road precinct;

(xiii) Sport and recreation zone:

(A) Balgal Beach golf course precinct;

(B) Cluden precinct;

(xiv) Open space zone:

(A) Riverway precinct;

(xv) Community facilities zone:

(A) Picnic Bay community facilities precinct;

(xvi) Environmental management and conservation zone;

(xvii) Low impact industry zone:

(A) Nelly Bay low impact industry precinct;

(xviii) Medium impact industry zone:

(A) Roseneath medium impact industry precinct;

(xix) High impact industry zone;

(xx) Rural zone:

(A) Horticulture precinct;

(B) Mixed farming precinct;

(C) Grazing precinct;

(D) Cungulla precinct;

(E) Jensen precinct;

(xxi) Emerging community zone;

(A) Burdell precinct;

(xxii) Special purpose zone;

(g) the following overlays:

(i) Airport environs overlay;

(ii) Bushfire hazard overlay;

(iii) Coastal environment overlay;

(iv) Cultural heritage overlay;

(v) Extractive resources overlay;

(vi) Flood hazard overlay;

(vii) Landslide hazard overlay;

(viii) Natural assets overlay;

(ix) Water resource catchment overlay;

(h) the following development codes:

(i) Advertising devices code;

(ii) Healthy waters code;

(iii) Landscape code;

(iv) Reconfiguring a lot code;

(v) Telecommunications facilities and utilities code;

(vi) Transport impact, access and parking code;

(vii) Works code;

(i) the following other plans:

(i) Oonoonba development scheme; and

(ii) Townsville City Waterfront Priority Development Area;

(j) schedules and appendices.

(2) The following planning scheme policies support the planning scheme:

(a) SC6.1 Planning scheme policy index;

(b) SC6.2 Character residential planning scheme policy;

(c) SC6.3 Cultural heritage planning scheme policy;

(d) SC6.4 Development manual planning scheme policy;

(e) SC6.5 Economic impact assessment planning scheme policy;

(f) SC6.6 Emerging community planning scheme policy;

(g) SC6.7 Flood hazard planning scheme policy;

(h) SC6.8 Mitigating bushfire hazards planning scheme policy;

(i) SC6.9 Natural assets planning scheme policy;

(j) SC6.10 Parking rates planning scheme policy.

1.3 Interpretation

1.3.1 Definitions

(1) A term used in the planning scheme has the meaning assigned to that term by one of the following:

(a) the *Planning Act 2016* (the Act)

(b) the Planning Regulation 2017 (the Regulation)

(c) the definitions in Schedule 1 of the planning scheme

(d) the *Acts Interpretation Act 1954*

(e) the ordinary meaning where that term is not defined in any of the above.

(2) In the event a term has been assigned a meaning in more than one of the instruments listed in sub-section 1.3.1(1), the meaning contained in the instrument highest on the list will prevail.

(3) A reference in the planning scheme to any act includes any regulation or instrument made under it, and where amended or replaced, if the context permits, means the amended or replaced act.

(4) A reference in the planning scheme to a specific resource document or standard, means the latest version of the resource document or standard.

(5) A reference to a part, section, table or schedule is a reference to a part, section, table or schedule of the planning scheme.

Editor's note—In accordance with section 5(2)(a) of the Planning Regulation 2017, the regulated requirements apply to this planning scheme only where specifically identified as regulated requirements in the section containing the administrative definition for minor building work.

1.3.2 Standard drawings, maps, notes, editor's notes and footnotes

(1) Standard drawings contained in codes or schedules are part of the planning scheme.

(2) Maps provide information to support the outcomes and are part of the planning scheme.

(3) Notes are identified by the title 'note' and are part of the planning scheme.

(4) Editor's notes and footnotes are extrinsic material, as per the *Acts Interpretation Act 1954*, and are identified by the title 'editor's note' and 'footnote' and are provided to assist in the interpretation of the planning scheme; they do not have the force of law.

Note—This is an example of a note.

Editor's note—This is an example of an editor's note.

Footnote[1]—Footnote—This is an example of a footnote.

1.3.3 Punctuation

(1) A word followed by ';' or ', and' is considered to be 'and'

(2) A word followed by '; or' means either or both options can apply.

1.3.4 Zones for roads, closed roads, waterways and reclaimed land

(1) The following applies to a road, closed road, waterway or reclaimed land in the planning scheme area:

(a) if adjoined on both sides by land in the same zone—the road, waterway or reclaimed land is in the same zone as the adjoining land;

(b) if adjoined on one side by land in a zone and adjoined on the other side by land in another zone—the road, waterway or reclaimed land is in the same zone as the adjoining land when measured from a point equidistant from the adjoining boundaries;

(c) if the road, waterway or reclaimed land is adjoined on one side only by land in a zone—the entire waterway or reclaimed land is in the same zone as the adjoining land;

(d) if the road, waterway or reclaimed land is covered by a zone then that zone applies.

Editor's note—The boundaries of the local government area are described by the maps referred to within the *Local Government Regulation 2012*.

1.4 Categories of development

(1) The categories of development under the Act are:

(a) accepted development

Editor's note—A development approval is not required for development that is accepted development. Under section 44(6)(a) of the Act, if a categorising instrument does not apply a category of development to a particular development, the development is accepted development. Schedule 7 of the Regulation also prescribes accepted development.

(b) assessable development

i. code assessment

ii. impact assessment

Editor's note—A development approval is required for assessable development. Schedules 9, 10 and 12 of the Regulation also prescribe assessable development..

(c) prohibited development

Editor's note—A development application may not be made for prohibited development. Schedule 10 of the Regulation prescribes prohibited development.

(2) The planning scheme also states the category of development for certain types of development, and specifies the category of assessment for assessable development in the planning scheme area in Part 5.

Editor's note—Section 43 of the Act identifies that a categorising instrument categorises development and specifies categories of assessment and may be a regulation or local categorising instrument. A local categorising instrument includes a planning scheme, a TLPI or a variation approval.

1.5 Hierarchy of assessment benchmarks

(1) Where there is inconsistency between provisions within the planning scheme, the following rules apply:

(a) relevant codes specified in schedules 6 and 10 of the Regulation prevail over all other components to the extent of the inconsistency;

(b) the strategic framework prevails over all other components to the extent of the inconsistency for impact assessment;

(c) overlays prevail over all other elements (other than the matters mentioned in (a) and (b)) to the extent of the inconsistency;

(d) zone codes prevail over use codes and other development codes to the extent of the inconsistency;

(e) provisions of Part 10 may override any of the above.

1.6 Building work regulated under the planning scheme

(1) Section 17(b) of the Regulation identifies that a local planning instrument must not be inconsistent with the effect of the building assessment provisions stated in the *Building Act 1975*.

(2) The building assessment provisions are listed in section 30 of the *Building Act 1975*.

Editor's note—The building assessment provisions are stated in section 30 of the *Building Act 1975* and are assessment benchmarks for the carrying out of building assessment work or building work that is accepted development subject to any requirements (see also section 31 of the *Building Act 1975*).

(3) This planning scheme, through Part 5, regulates building work in accordance with sections 32 and 33 of the *Building Act 1975*.

Editor's note—The *Building Act 1975* permits planning schemes to:

- regulate, for the *Building Code of Australia* (BCA) or the *Queensland Development Code* (QDC), matters prescribed under a regulation under the *Building Act 1975* (section 32). These include variations to provisions contained in parts MP1.1, MP1.2 and MP1.3 of the QDC such as heights of buildings related to obstruction and overshadowing, siting and design of buildings to provide visual privacy and adequate sight lines, on-site parking and outdoor living spaces. It may also regulate other matters, such as designating land liable to flooding, designating land as bushfire prone areas and transport noise corridors.
- deal with an aspect of, or matter related or incidental to building work prescribed under a regulation under section 32 of the *Building Act 1975*;
- specify alternative boundary clearances and site cover provisions for Class 1 and 10 structures under section 33 of the *Building Act 1975*.

Refer to Schedule 9 of the Regulation to determine assessable development, the type of assessment and any referrals applying to the building work.

(4) The building assessment provisions and designations in the planning scheme are contained in Table 1.6.1.

Table 1.6.1 Designations and Building assessment provisions in the planning scheme for the purpose for the *Building Act 1975*:

Description of designation and Building assessment provisions	Planning Scheme Part	*Building Act 1975* (BA), *Building Regulation* (BR) *2006* or *Queensland Development Code* (QDC) Reference
Bushfire Prone Areas		
Designated bushfire prone area	Schedule 2 – Development constraints overlay map OM-02 (Bushfire hazard)	Section 32(a) BA and section 12 BR; QDC MP 2.4 – Construction in Bushfire Prone Areas; and AS 3959-2009
Flood hazard **Note-** In accordance with section 13 (2) of the *Building Regulation 2006*, the following designation is made under section 13 of the *Building Regulation 2006* for the Flood hazard area in the Townsville City Plan (planning scheme).		
Flood hazard area **Note-** In accordance with section 13 (4) of the *Building Regulation 2006*, the Flood hazard area was designated on 27 October 2014.	Schedule 2 – Development constraints overlay map OM-06.1 and OM-06.2 (Flood hazard)	Section 32(a) BA and section 13(1)(a) BR; and QDC MP 3.5 – Construction of buildings in flood hazard areas
Defined flood level (DFL)	Schedule 1, Table SC1.2.2 Administrative Definitions "defined flood level' and Table 8.2.6.3(a) Flood overlay code, Editor's Note, PO1 and PO4	Section 32(a) BA and section 13(1)(b)(i) BR; and QDC MP 3.5 – Construction of buildings in flood hazard areas
The finished floor level of class 1 buildings built in all or part of the flood hazard area	Table 8.2.6.3(a) Flood hazard overlay code	Section 32(a) BA and section 13(1)(b)(v) BR; and QDC MP 3.5 – Construction of buildings in flood hazard areas
Transport Noise Corridors		
Designated Transport Noise Corridor (State Controlled Road and railway land) **Editor's note**-for the purposes of the *Building Act 1975* and application of the *Queensland Development Code* in relation to declaration of local government transport noise corridors, the planning scheme has not declared such transport noise corridors.	Schedule 2 – Infrastructure overlay map OM-10 (Noise corridors)	Section 246Z and s246ZA(3) BA; Section 32(b) BA; and QDC MP 4.4 – Buildings in a transport noise corridor
Character Residential Zone		
Building assessment provisions – regulated building work in accordance with sections 32 and 33 of the *Building Act 1975*	Character Residential Zone **Editor's note**—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the *Queensland Development Code* (MP 1.1, MP 1.2 and MP1.3) , for the purposes of section 33 of the *Building Act 1975* .	Sections 32 and 33 BA

Editor's note—A decision in relation to building work that is assessable development under the planning scheme can only be issued as a preliminary approval. See section 83(b) of the *Building Act 1975*.

Editor's note—In a development application, the applicant may request preliminary approval for building work. The decision on that development application can also be taken to be a referral agency's response under section 56 of the Act, for building work assessable against the *Building Act 1975*. The decision notice must state this.

1.7 Local government administrative matters

1.7.1 Declared Mall

(1) A Declared Mall, under section 80A of the *Local Government Act 2009*, exists in the Townsville Local Government Area. The Declared Mall was established by council resolution on 9 June 2011. The Declared Mall is established on Stokes Street, between Flinders Street and Ogden Street.

1.7.2 Declared locality and building form for amenity and aesthetic referral agency assessment

For the purpose of Schedule 9, of the Planning Regulation, building work for a building or structure which is a single detached class 1(a)(i) building, class 1(a)(ii) building comprising not more than 2 attached dwellings or a class 10 building or structure in a locality identified in Table 1.7.2 that does not comply with the relevant QDC acceptable solutions or the acceptable outcomes in the codes identified in Table 1.7.2, is declared to:

(a) have an extremely adverse effect on the amenity or likely amenity of the locality; or

(b) be in extreme conflict with the character of the locality

1.7.2 Declared locality and building form for amenity and aesthetic referral agency assessment

Locality	Codes
Land in the Character residential zone	Character residential zone code
Land in the Flood hazard overlay	Flood hazard overlay code
Land in the Coastal protection overlay	Coastal hazard protection overlay code
Land in the Cultural heritage overlay	Cultural heritage overlay code

Part 2 State planning provisions

2.1 State planning policy

The Minister has identified that the state planning policy July 2014 is integrated in the planning scheme in the following ways:

State interests in the state planning policy appropriately integrated
All

State interests in the state planning policy not integrated
None

State interests in the state planning policy not relevant to Townsville City Council
None

Editor's note–In accordance with section 8(4)(a) of the Act the State Planning Policy applies to the extent of any inconsistency.

2.2 Regional plan

There was no regional plan relevant to the planning scheme area on commencement of the planning scheme.

Editor's note–Schedule 1 of the Regulation identifies the North Queensland region which was declared 8 July 2016.

2.3 Referral agency delegations

Schedule 10 of the Regulation identifies referral agencies for certain aspects of development. The following referral agencies have delegated the following referral agency jurisdictions to Townsville City Council:

Table 2.3.1 - Delegated referral agency jurisdictions

Column 1 **Application involving**	**Column 2** **Referral agency and type**	**Column 3** **Referral jurisdiction**
None	None	None

Editor's note—For the above listed referral agency delegations the applicant is not required to refer the application to the referral agency listed under Schedule 10 of the Regulation because the local government will undertake this assessment role.

2.4 Regulated requirements

The following regulated requirements prescribed in the Planning Regulation 2017 dated 3 July 2017 are appropriately reflected in the planning scheme.

- Administrative definition for Minor Building Work

Editor's note—Otherwise the planning scheme complies with QPPV 4 and does not apply any other aspects of the regulated requirements.

Part 3 Strategic framework

3.1 Preliminary

(1) The strategic framework sets the policy direction for the planning scheme and forms the basis for ensuring appropriate development occurs within the planning scheme area for the life of the planning scheme.

(2) Mapping for the strategic framework is included in Part 3 and Schedule 2.

(3) For the purpose of describing policy direction for the planning scheme, the strategic framework is structured in the following way:

- (a) the strategic intent;
- (b) the following four themes that collectively represent the policy intent of the scheme:
  - (i) Shaping Townsville;
  - (ii) Strong, connected community;
  - (iii) Environmentally sustainable future;
  - (iv) Sustaining economic growth;
- (c) the strategic outcomes proposed for development in the planning scheme area for each theme;
- (d) the elements that refine and further describe the strategic outcomes;
- (e) the specific outcomes sought for each, or a number of, elements;
- (f) the land use strategies for achieving these outcomes.

(4) Although each theme has its own section, the strategic framework in its entirety represents the policy intent for the planning scheme.

Editor's note—The planning scheme has adopted a 25-year planning horizon. However, the planning scheme itself (as a statutory document) is likely to have an operational life of up to 10 years before it is substantively reviewed.

3.2 Strategic intent

3.2.1 Townsville today

Townsville is on the cusp of significant growth and change. It is already the largest city in Queensland outside the south-east. Its population of around 190,000 in 2011 is set to grow to between 270,000 and 300,000 people by 2031.

Townsville is the major economic and service centre for North Queensland. It is the primary port and freight hub, particularly for the agricultural areas of the surrounding region and for the North West minerals province. It provides the highest order community and commercial services for the region, including health and education facilities which serve the whole of North and North West Queensland. As a consequence of its strategic regional position, Townsville enjoys a diverse economic base, with strong projected growth (Figure 3.1 – Regional context plan).

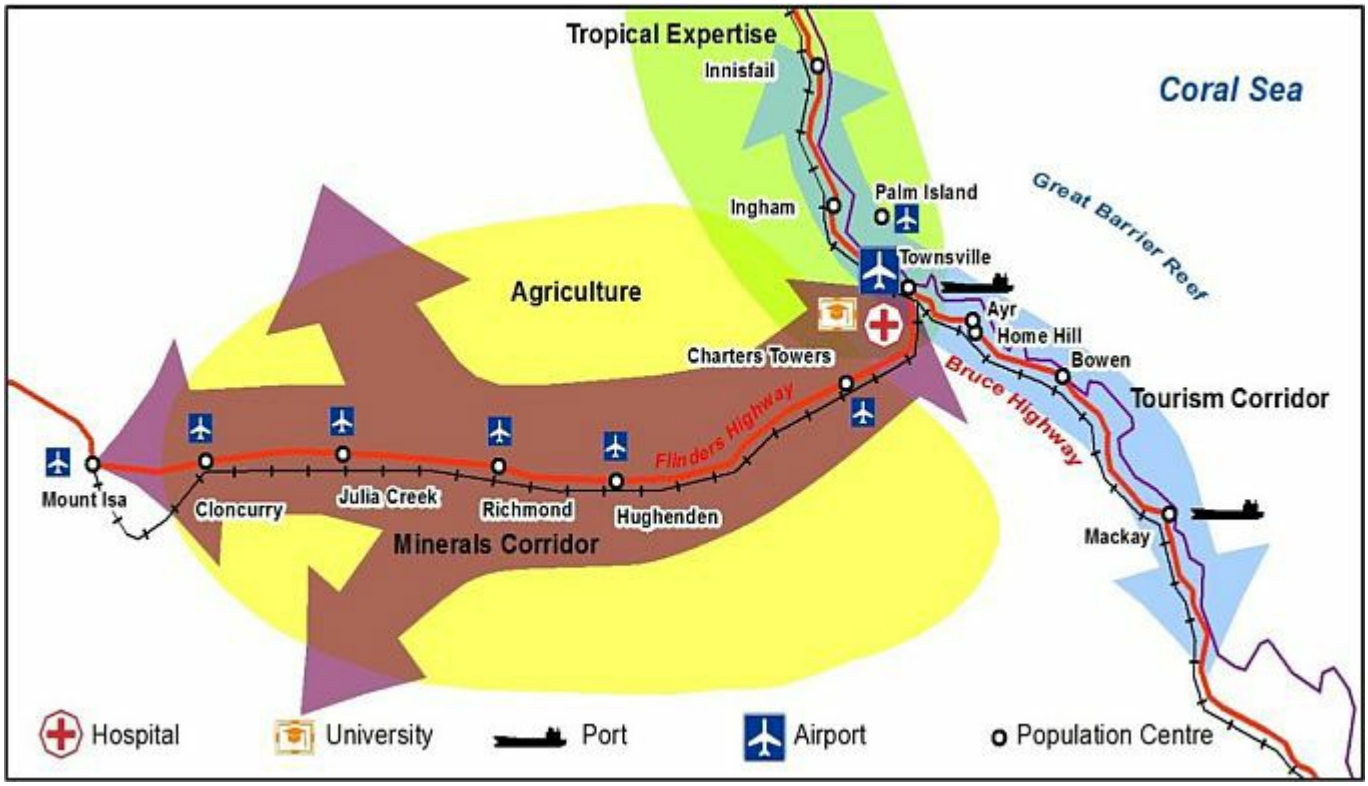


Figure 3.1 – Regional context plan

Townsville is a bioregional junction for the Wet Tropics, Brigalow Belt and Einsleigh Uplands bioregions. In addition, the region includes the UNESCO World Heritage-listed Great Barrier Reef and Wet Tropics as well as the Ramsar-listed Bowling Green Bay wetlands. Townsville's geographic location, tropical climate and unique environmental features are part of what makes Townsville a great place to live and underpins the region's economy.

3.2.2 A second capital for Queensland

Townsville will continue to evolve as the second capital of Queensland and the largest city in Northern Australia. Statewide growth, a focus on regional development and the potential for decentralisation policies will contribute to the city's increasing significance.

This enhanced role is reflected in significant growth in the city's economy, population and cultural status. Planning, new development and infrastructure investment are part of this evolution.

The increasing sustainability of the city and the protection of its natural assets will be key hallmarks of Townsville's growth and development.

3.2.3 Strong and connected community

As the Townsville Community Plan explains, a strong and connected community is cohesive even when people come from diverse backgrounds and abilities. It is a community that is safe and feels safe, enjoys sport and recreation activities, has a say in decision making including planning, and has pride in its culture and lifestyle.

Development, including buildings, streets and public spaces will be well-designed and contribute to the creation of exceptional places within the city. High-quality public spaces will be created to optimise community interaction. Good design also means places will feel safe.

Townsville's open space network will meet the community's needs and integrate with the natural landscape without compromising environmental and hydrological values. An emphasis on co-location and consolidation of sports and community activities will be followed, to best utilise resources.

Magnetic Island, Castle Hill, Mount Stuart, Mount Louisa, Mount Elliot, the Pinnacles, Cape Pallarenda, the Town Common and Cape Cleveland are some of the best known natural features of Townsville. The scenic amenity of such places is to be maintained.

The many small townships around Townsville, including Magnetic Island, Paluma and the beach communities north of

Black River, continue to be enjoyed and appreciated for their special attributes. Substantial changes to the function, scale and character of these communities are not anticipated.

3.2.4 Environmentally sustainable future

Townsville is a biodiverse city with unique tropical landscapes and interconnected areas of high environmental significance. Townsville has some internationally recognised iconic environmental features such as the Great Barrier Reef (including, significantly, Magnetic Island) and Wet Tropics UNESCO World Heritage-listed areas and the Bowling Green Bay Ramsar wetlands as well as national, state and regionally significant environmental features.

Natural areas also underpin Townsville's character and identity and provide the basis for its economic prosperity. Significant landscape values are associated with the coast, the islands, rural areas and elevated, vegetated mountains and ranges. The urban area is defined by prominent natural landscape features such as Castle Hill, Mount Louisa, Mount Stuart, the Town Common, the coastline and the Ross River and Bohle River corridors.

An environmentally sustainable future requires strong and connected biological communities and fully functioning ecological processes. This will provide for a more robust and resilient landscape capable of withstanding minor and even extreme natural disturbances.

New development, including the growth of the city broadly, will protect the integrity of these natural assets and environmental values. The shape of the city has been determined in part to avoid expansion into sensitive and vulnerable areas and corridors.

The significant ecological, landscape and recreation values of Magnetic Island will be protected, including:

- the bold and dramatic landscape of rocky headlands and vegetated ridges;
- the secluded and natural sandy beaches;
- the natural character of the settled bays created by unbroken tree canopies and prominent fringe of coastal vegetation;
- the environmental parks and reserves, including the nationally significant Magnetic Island National Park and foreshore reserves such as Picnic Bay, Nelly Bay, Alma Bay, Geoffrey Bay and Horseshoe Bay;
- the high-value habitats, sensitive marine environments, including the fringing reef and middle reef; and
- the World Heritage values of the Great Barrier Reef.

Fragmentation, loss of habitat and other impacts of development (for example on hydrological regimes, water quality and spread of pest species), will be avoided. In areas where development is intended to occur, impacts will be minimised and mitigated. The ecosystem services provided by these natural assets and their importance in building resilience to the impacts of climate change are recognised and are to be protected.

Exposure of communities to natural hazards, such as bushfire, landslide, flood and coastal risks such as storm surge and sea level rise, will be avoided wherever possible.

3.2.5 Shaping Townsville

To house Townsville's growing population, about 45,000 new homes will be needed over the next 25 years. New and expanded workplaces, shops and all the other activities associated with modern life will be needed in equal measure. This growth needs to be accommodated in a sustainable city form and through the creation of a series of great places within the city.

As the population grows so will its makeup change. Average ages are increasing and the typical household is reducing in size. By 2031, couple-only families are expected to be the dominant household type in Townsville. These changes mean that more housing options are needed in the future. There is also a need to facilitate affordable housing types in locations that support affordable living.

Whether traditional detached homes, inner city apartments or something in between, choice is needed to provide the lifestyle options that residents expect in a capital city, as well as options that everyone can afford. While detached houses will continue to be the most common housing option in Townsville's new and existing areas, about one third of new dwellings need to be smaller and in the form of townhouses or apartments, in order to meet these overall community needs, preferences and budgets.

A cornerstone of Townsville's evolution will be the revitalisation of the central business district (CBD) into a more vibrant and cosmopolitan place. The CBD will re-establish itself as the heart of the city, and attract the greatest investment in a diverse range of city uses, including residential. The CBD will be a great destination for the community and visitors.

The emphasis on the CBD as the city's principal centre is part of a broader strategy to make Townsville a more compact city, structured around a network of activity centres. Major centres at Aitkenvale, Thuringowa Central and Hyde Park, and new centres at Burdell and Julago, will be economic and community hubs. Over time, mixed use development within these centres will broaden their function beyond shopping to become great places to live, work, access services and recreate. New infill residential development will underpin these changes, comprising about a fifth of the city's residential growth to 2031. Similar changes at smaller scales – in keeping with an established activity centres hierarchy - will be promoted at other district, local and neighbourhood centres around the city.

All these changes will help sustain an enhanced public and active (walking and cycling) transport network over time. In particular, Ross River Road will become an initial focus for public transport linking the CBD, Aitkenvale and Thuringowa Central major centres and the James Cook University-Townsville Hospital precinct.

Inner urban lifestyles and sustainable built forms will be supported by green spaces and public places in the city's activity centres. Wherever possible, these spaces will connect with the wider open space network.

New communities at Burdell, Shaw, Cosgrove and Julago will emerge within the designated urban areas of Townsville. These places will be well-connected to the rest of the city and will boast ample local services and jobs, while protecting important natural assets.

A large majority of residential growth will continue to be implemented through greenfield development. Similar to infill areas, a mix of dwelling types will be provided in greenfield developments to meet existing and future community needs.

This planning scheme designates sufficient land supply for future greenfield development, well beyond the requirements of the next few decades. The city will not grow outwards beyond the areas designated in the foreseeable future. This will avoid further encroachment on natural assets and vulnerable coastal areas. The focus on infill development and major greenfield communities will also concentrate infrastructure investment, costing less than continued outwards growth in many directions. The Local Government infrastructure plan (Part 4) is based on this approach. Overall, this will help support a more sustainable Townsville.

Similarly, substantial lands have been allocated for rural residential development. Rural residential areas provide for semi-rural lifestyles, but no additional land for rural residential development beyond what is allocated in this planning scheme is intended.

Older suburbs will not experience substantial change. However, some new housing options in accessible locations are intended, allowing residents to continue to live in their neighbourhood as they age or their housing needs change.

The particular character of special neighbourhoods will remain identifiable and intact. Places of indigenous and non-indigenous cultural heritage are also protected.

The shape of the city will be such that an effective public transport system, focussed on the CBD and activity centres, can be achieved. Greater transport choice, beyond solely the car, is a goal of this planning scheme. Walking and cycling options will be enhanced through new development and new infrastructure investment. National, state and regional road, rail, sea and air freight networks are also identified, their prospects enhanced, and their future use protected from incompatible development.

3.2.6 Sustaining economic growth

Townsville has a diverse and healthy economy. This is driven by population growth, by the traditionally strong defence, port and transport sectors and by Townsville's regional position as the capital of North Queensland and transport hub for the North West minerals province and North Queensland agricultural sector.

Strategic transport links, a skilled workforce and an attractive lifestyle, the metals manufacturing cluster and the presence of major institutions creating capacity for a knowledge-based economy, all provide Townsville's primary

competitive strengths. Revitalisation of the CBD, and improving links between key economic precincts in the city, are also important opportunities to attract investment. The importance of the city's natural environment and attractive lifestyle in underpinning its attractiveness to business investment is also recognised.

Growth is anticipated in transport, storage and logistics industries, manufacturing (metals, food and beverage), defence, the knowledge economy (including education and research), the aviation industry, health, professional services, building and building supplies and tourism. Further economic growth in these and other sectors is required to maintain quality of life for the city's residents. About 50,000 new jobs are required by 2031.

Townsville's key productive precincts needed to accommodate much of this growth include:

- the CBD;
- Port of Townsville, Stuart industrial precinct and Townsville State Development Area;
- James Cook University-Townsville Hospital;
- Lavarack Barracks and other Department of Defence landholdings;
- Townsville Airport and RAAF Base Townsville; and
- Thuringowa Central, Aitkenvale and Hyde Park major centres.

In planning for industrial land, twin strategies are being pursued. Consolidation is promoted in existing industrial areas like Shaw Road and Garbutt, while new land is also made available for industrial development at the Townsville Airport, Roseneath and the Townsville State Development Area. The significance and potential of the Townsville State Development Area is recognised. Industrial land is a valuable resource and is to be used for industrial purposes.

Industrial land, including potential future land resources at Woodstock and Bohle Plains, Department of Defence landholdings and key infrastructure corridors and facilities are to be protected from encroachment of sensitive activities.

Rural, extractive and other natural resources are also recognised as important contributors to Townsville's economy. Their continued viability is ensured and their orderly development managed.

Tourism is also a major part of the regional economy, including nature-based and eco-tourism in key tourism areas at Magnetic Island, and at a smaller scale in Paluma, Rollingstone, Balgal Beach, Toomulla, Toolakea and Saunders Beach. The CBD remains a major focus for tourism activities and infrastructure.

3.3 Theme - Shaping Townsville

Editor's note—What did the Townsville Community Plan 2011-2021 say about *Shaping Townsville*?
Our city will meet the diverse and changing infrastructure and service needs of the community.
Five guiding principles were also set out:

- *A vibrant, sustainable, connected urban form: creating places that provide for a great lifestyle.*
- *Preserve and enhance Townsville's heritage and character: the traditional character, identity and heritage of the city is retained, enhanced or complemented by development.*
- *A lively, diverse and connected city centre: Townsville's CBD will be recognised as Townsville's heart bustling with activity and creativity.*
- *Effective and adequate public infrastructure: the effective design and timely provision of adequate infrastructure will allow a growing population to enjoy a great lifestyle.*
- *Well-connected Townsville: the provision of infrastructure such as public transport, roads, walking and bike paths, communications and digital networks enables access for all in our community.*

3.3.1 Strategic outcome

(1) This planning scheme allocates land for housing, business and community uses, sufficient to meet Townsville's needs for at least 25 years.

(2) The shape of the city becomes more compact and efficient, led by intensified development in and around the principal centre (CBD) and the major activity centres at Aitkenvale, Thuringowa Central and Hyde Park. This makes public transport, walking and cycling more convenient and viable, and supports investment in community facilities and other infrastructure.

(3) A range of housing and lifestyle choices, including affordable and social housing choices, is provided in accessible and affordable locations.

(4) Limited areas for rural residential lifestyles provide residents with a semi-rural living option. These areas do not create conflicts with other rural uses, extractive industry operations or natural assets and environmental values, and do not expand further.

(5) Townsville has areas of special residential character derived primarily from their architecture. Character residential areas are identified in which character is maintained by retaining character houses and ensuring sensitive redevelopment within these streetscapes.

(6) The special character and scenic and environmental values of Magnetic Island and the small townships of Paluma and the northern beaches (Rollingstone, Balgal Beach, Toomulla, Toolakea and Saunders Beach) are protected. These townships do not expand or accommodate any significant additional growth.

(7) The history of Townsville and its people make a major contribution to the identity of the city and its communities. The cultural heritage of Townsville is conserved for the present and future Townsville communities.

(8) The city is structured around a network of activity centres, ranging from the principal centre (CBD) to small neighbourhood centres. These activity centres are focal points for the city and its community. They accommodate the majority of future employment, community and commercial activities. Activity centres are also the focus for transport systems.

(9) A hierarchy of activity centres exists to ensure that the scale and form of development is appropriate to the location, and that the centre plays an appropriate role within the wider city. The hierarchy contributes to an efficient, well-functioning and accessible city. While the scale and form of activity centres varies, all activity centres are founded on a mix of land uses, and are supported by residential areas that enhance each centre's viability.

(10) Efficient, reliable and safe passenger and freight transport networks are provided to support the city's population and economic growth.

(11) Infrastructure and community services are provided in an efficient way and at a standard that best meets community and environmental requirements.

3.3.2 Element - City shape and housing

3.3.2.1 Specific outcomes

City shape and urban containment

(1) The growth of Townsville will occur within the city's existing urban and rural residential areas, and in areas identified for urban expansion through the Emerging community zone. Urban and rural residential development does not occur outside land identified for these purposes.

(2) On the edges of the urban area, urban uses are adequately buffered from nearby rural land and natural assets so that the productive use of rural land and ecological and biophysical processes and values are not compromised.

Infill development

Editor's note—The term "infill" refers to development within existing built up areas that generally involves higher density forms of housing.

(3) Locations for significant infill development include the principal centre (CBD) and surrounds, North Ward, and in and around the Aitkenvale, Thuringowa Central and Hyde Park major centres. This infill development will have a focus on "place making" and enhancement of the public realm. These areas will boast a wide range of housing choices, taking advantage of nearby amenities and existing or planned public transport, and creating more compact, walkable and vibrant urban neighbourhoods.

(4) Development in and around the principal centre (CBD) provides for a highly desirable inner city lifestyle. The highest and most intensive built form is focussed on the centre, framed by high-medium rise buildings. View corridors to Castle Hill along roads are maintained and access to and along Ross Creek and The Strand is maximised (Figure 3.2 – CBD and environs strategy plan).

Click here to view PDF high resolution map.

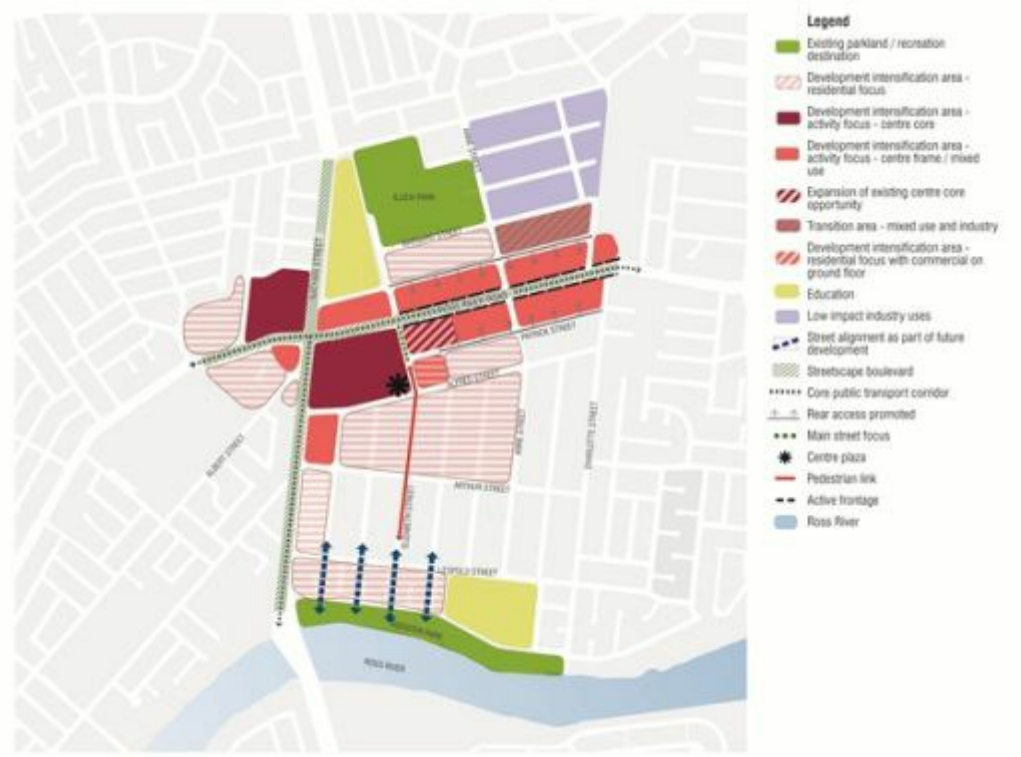
Figure 3.2 – CBD and environs strategy plan

(5) Development in North Ward facilitates medium density residential choices within a high amenity environment. Development is primarily focussed on walkable, mixed use village nodes, with a pedestrian-friendly, active frontage along The Strand. Built form reinforces gateway corridors along Gregory and Landsborough Streets, but does not intensify uses in areas subject to likely flooding or storm surge risk. Buildings exceeding 5 storeys in height do not occur in the Medium density residential zone fronting The Strand. Open space and strong visual connections are maintained between Castle Hill and The Strand (Figure 3.3 – North Ward strategy plan).

Click here to view PDF high resolution map.

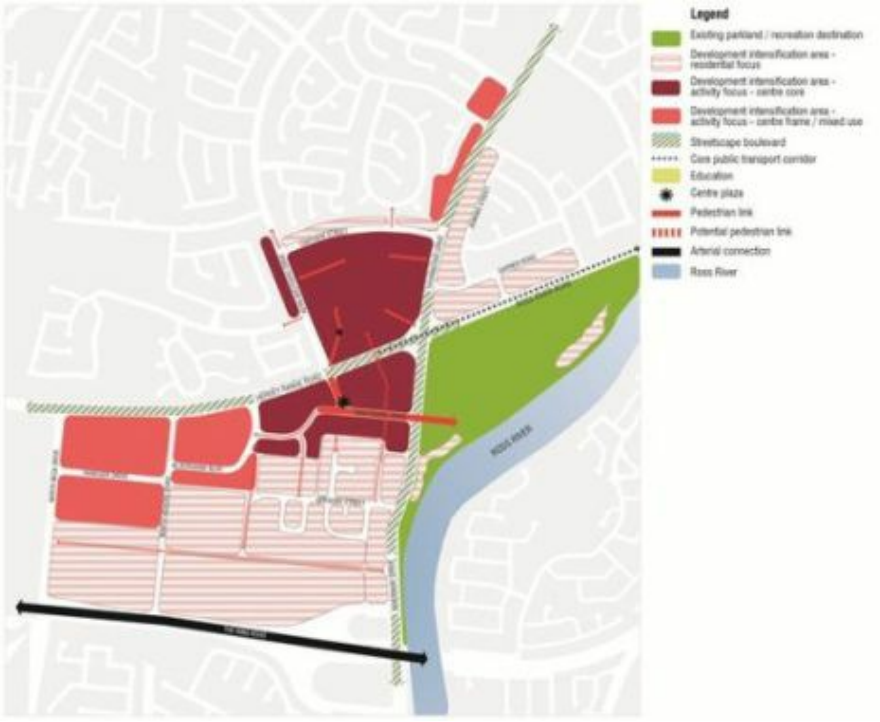
Figure 3.3 – North Ward strategy plan

(6) Development in and around the Aitkenvale, Thuringowa Central and Hyde Park major centres assists in the evolution of vibrant urban neighbourhoods. A mix of uses is established within the centres and surrounding neighbourhoods are well-connected and integrated with the centres. A strong and positive sense of place is created by the establishment of active main street environments, more outward-oriented, street-focussed shopping centres and a boulevard-like streetscape along the major roads. Medium density residential uses increasingly occur within the centres and in the precincts surrounding them. Accessibility by walking, cycling and public transport is maximised (Figure 3.4 – Aitkenvale strategy plan, Figure 3.5 – Thuringowa Central strategy plan and Figure 3.6 – Hyde Park strategy plan).



Click here to view PDF high resolution map.

Figure 3.4 - Aitkenvale strategy plan



Click here to view PDF high resolution map.

Figure 3.5 - Thuringowa Central strategy plan

Click here to view PDF high resolution map.

Figure 3.6 - Hyde Park strategy plan

(7) Outside the identified focus areas for infill development, smaller scale opportunities for greater housing choice (such as housing on smaller lots, townhouses, housing for the aged) are generally limited to locations near shops, community facilities or major streets, and avoiding Character residential zoned areas.

(8) Design of neighbourhoods, streets and buildings is appropriate for Townsville's tropical climate and facilitates sustainable built forms. Infill development is well-integrated with existing communities, infrastructure and open space.

(9) The scale of buildings is well-matched to the size of lots, allowing for primary orientation of buildings to the street and provision of open space at ground level that is appropriate to the character of the neighbourhood.

Greenfield developments

Editor's note—The term "greenfield" refers to development areas that have not previously been used for urban purposes.

(10) Greenfield developments use land and infrastructure efficiently. They accommodate a net residential density of at least 15 dwellings per hectare of land, achieved through a mix of lot sizes and house types, such as detached houses and dual occupancies, units, apartments and townhouses in appropriate locations.

(11) Greenfield developments are designed to be well-connected and easy to get around, both within their boundaries and to the rest of the city. They are planned to support sustainable lifestyles, including pedestrian and cycle transport.

(12) Design of greenfield developments will also:

- (a) provide attractive streets;
- (b) be climate responsive and sustainable;
- (c) protect significant natural assets and ecological and biophysical processes;
- (d) protect significant landscape features and areas of high scenic value;
- (e) avoid natural hazards;
- (f) provide residents with convenient and functional parks, community facilities and activity centres; and
- (g) have their own recognisable character.

Island, Beach and mountain townships

(13) Townsville's northern beach and mountain townships (Paluma, Rollingstone, Balgal Beach, Toomulla, Toolakea and Saunders Beach) do not accommodate any significant additional growth and do not expand beyond current zoned land. Urban and rural residential development is subordinate to the natural character of the townships and respects and maintains the low-rise, village character and scale.

(14) While some short-term, low-density, eco-tourism style accommodation may occur, the special character and

scenic and environmental values of these areas is protected.

(15) No further growth is anticipated in the southern beach communities of Cungulla and Cleveland Palms, which are constrained by coastal processes, the impacts of nearby extractive resources and lack of services.

(16) The character of Townsville's small communities is reflected in the small-scale, tropical architectural design elements and landscaped setting.

(17) Residential and tourist accommodation is subordinate to the conservation values on Magnetic Island. Bayside settlements at Picnic, Nelly and Horseshoe Bays and Arcadia do not expand beyond their current extent. Within these areas, a variety of housing types is provided for residents and tourists, including detached housing, low-rise multiple dwellings and accommodation buildings.

(18) Each village on Magnetic Island retains its role and sense of identity:

(a) Nelly Bay – will continue to serve as the primary service centre and gateway to the island, with tourist accommodation and centre facilities;

(b) Arcadia – will continue to serve as a predominantly residential area, with access to its own local shops, a new community hub, and some small-scale tourism accommodation;

(c) Picnic Bay – will continue to serve as a predominantly residential area, with access to its own local shops, a new community hub, and some small-scale tourism accommodation; and

(d) Horseshoe Bay – will continue to be a predominantly residential community, with some small-scale tourism accommodation and activities.

Rural residential areas

(19) Rural residential areas provide for semi-rural lifestyles in which the primary use of properties is residential, but some, generally domestic scale, rural uses occur. Activities that would significantly disrupt the amenity of these areas are not intended to occur.

(20) New rural residential development does not occur beyond those areas zoned for rural residential purposes.

(21) Rural residential development maintains the character of the area and minimises any intensification of impacts on water quality or nearby natural assets, ecological and biophysical processes, or other natural resources. Minimum lot sizes reflect the capacity of the land to assimilate the wastes produced by residents.

(22) On the edges of rural residential areas, residential uses are buffered from nearby rural land and natural assets so that the productive use of rural land and ecological and biophysical processes and values are not compromised.

(23) Rural residential areas do not offer the full range of urban services. Except in locations where sewer and water are or can be connected, new development establishes adequate on-site servicing at a standard that will not detract from neighbours' amenity, water quality or the quality of the local environment.

3.3.2.2 Land use strategies

Zoning designations closely reflect the strategic intentions regarding the extent of urban growth. Development outside these areas will not be supported.

Major greenfield areas are included in the Emerging community zone to facilitate master planning and orderly development in accordance with best practice neighbourhood planning principles for accessibility, density, land use mix, street networks and lot configuration.

Council will monitor the supply of new land for residential development to ensure at least 10 years' land supply is available and to prevent land supply placing any pressure on housing affordability.

The residential and centre zones reflect intentions for development at a range of densities. The Medium density residential and High density residential zones accommodate the city's key areas for infill development. Within these areas development is desired to capitalise on the proximity to activity centres, public transport and amenity attractors.

The Rural residential zone is used to precisely designate these areas, and the appropriate nature and intensity of development within them.

3.3.3 Element - Character and heritage

3.3.3.1 Specific outcomes

Character residential areas

(1) Townsville city contains a collection of character residential areas with different elements of importance. Common to all of these areas are:

(a) consistency in building and architectural style within a particular street or precinct of character significance; or

(b) built forms that are reflective of a period of pre-war or post-war change in Townsville.

(2) Identified character areas are protected. In these areas, contributing character buildings are retained.

(3) New development or additions and renovations to contributing character buildings within character areas are consistent with the established character in these areas, complementing traditional building elements and the scale of existing development.

Cultural heritage

(4) Development on or near places of cultural heritage significance facilitates their active use but does not detract from their heritage significance and setting, including significant views to the place.

(5) Places that have cultural heritage significance to Aboriginal or Torres Strait Islander peoples are protected. Consistent with the provisions of the *Aboriginal Cultural Heritage Act 2003*, development will take all reasonable and practicable measures to ensure Aboriginal cultural heritage is not harmed.

3.3.3.2 Land use strategies

The planning scheme establishes a Character residential zone and Cultural heritage overlay which are devised to protect character areas and heritage places.

Places of indigenous cultural heritage are acknowledged and respected by this planning scheme, but are primarily protected by other legislation.

Council recognises that the city's natural assets are likely to contain places and attributes of cultural significance to Indigenous Australians.

3.3.4 Element - Activity centres

3.3.4.1 Specific outcomes

Nature of centres

(1) A broad range of uses are encouraged at activity centres, appropriate to the identified hierarchy, to support vibrancy, community life and health and economic development and competition. Day and night-time activity is expected in Townsville's larger, higher level activity centres: CBD, Aitkenvale, Thuringowa Central, Hyde Park and future centres at Julago and Burdell. Residential development is also promoted in activity centres, in a form and density appropriate to the scale of the centre.

Editor's note—The future major centre at Burdell is planned within the North Shore emerging community area.

(2) An activity centre contains a mix of uses and is multi-functional. While the dominant building in activity centres is often a shopping centre, a shopping centre alone does not make an activity centre.

(3) The planning scheme adopts a hierarchy for activity centres in Townsville, the purpose of which is to ensure optimum access to employment, services and facilities across the city, including public transport services, to support the efficient provision of infrastructure and to optimise public investment.

(4) The hierarchy is made up of:

(a) the principal centre (CBD);

(b) major centres;

(c) district centres;

(d) local centres;

(e) neighbourhood centres; and

(f) specialised centres.

Editor's note—Townsville's hierarchy of activity centres is indicated on Strategic Framework Map SFM-002. Local and neighbourhood activity centres are numerous and are not depicted on the map. They are identified through zoning.

(5) Centres in newly developing areas expand commensurate with population growth in their primary catchments. While over the 25-year planning horizon of this planning scheme they may be expected to grow to a particular level in the hierarchy, they are not to perform at this level prematurely.

(6) Development of retail and office activities occurs within the identified activity centres and mixed use areas. These activities do not locate in an out-of-centre location, except where specifically intended in a particular zone or precinct.

(7) Showrooms and retail-based hardware stores are also located within the identified activity centres or mixed use areas. Their design and layout facilitates integration with other centre activities.

Principal centre - Townsville CBD

(8) The principal centre is the Townsville CBD. This is the largest and most important activity centre in North Queensland. It accommodates the greatest extent of administrative, civic, cultural, commercial, retail, tourism and education facilities in Townsville, providing local, city and regional functions.

(9) The principal centre (CBD) provides the greatest diversity in employment and business opportunities, is a focus for public transport and offers the highest density housing choices in the city.

(10) The principal centre (CBD) strengthens its position as the heart of Townsville by expanding its retail functions, developing an identifiable and attractive community heart and major meeting place, and increasing its variety of cultural and entertainment activities. It is also strengthened by the establishment of a public realm that is unique and is an exemplar of successful placemaking.

(11) Uses in the principal centre (CBD) include:

(a) major office developments, including offices forming part of mixed use developments;

(b) the highest order retail functions, including a department store as a signature development;

(c) convenience and boutique retailing for the CBD's workforce, residents and visitors;

(d) dining and entertainment;

(e) additional higher education or training facilities;

(f) tourist accommodation, activities and services; and

(g) in-centre, high density residential accommodation.

(12) Any additional department store in Townsville is to be located in the principal centre (CBD) and not in any other centre.

(13) Major strategic facilities such as a sports stadium, entertainment or convention centre which may be needed during the 25-year planning horizon of the planning scheme are located adjacent to the city centre. The South Townsville Railyards and Dean Street precinct is a preferred location.

Major centres - Aitkenvale, Thuringowa Central, Hyde Park, Burdell (future) and Julago (future)

(14) Major centres in Townsville support but do not undermine the role of the principal centre (CBD), offering diverse business, employment and residential opportunities. These activity centres are accessible to broad catchment areas across the city, offering higher-order shopping and commerce, entertainment, health, education and community facilities, as well as higher density housing choices. They are well serviced by public and active transport networks and increasingly offer active, pedestrian-focussed street level environments.

(15) **Aitkenvale** and **Thuringowa Central** major centres have a broad range of uses and increased vibrancy as community hubs. Integration and connectivity within the centres is improved. The centres contain an array of higher order retailing, with a broad range of commercial, community, cultural and entertainment services. Medium density housing is encouraged as an integrated component of development within the centres. Housing includes student and visitor accommodation to reinforce links with James Cook University and Townsville Hospital.

(16) **Hyde Park** major centre evolves to become a unique and high amenity centre which takes advantage of the amenity potential of adjoining lakes and open space areas. Increased diversity of activity within the centre is encouraged, including integrated medium density residential components. Retail activities are consolidated.

(17) Future major centres at **Burdell** and **Julago** accommodate a broad range of uses in an integrated, street-based format. They provide the main focal point for their respective communities. Ultimately the Burdell and Julago centres will include a diverse range of commercial and community facilities together with community meeting places and recreational facilities. Uses in the centre promote local employment and higher density residential development.

(18) The centres are well-connected to the surrounding community, maximising accessibility by walking, cycling and public transport.

(19) A new department store is not to be located within any of the existing or future major centres.

District centres - Idalia, Deeragun, Rasmussen, Annandale and Shaw (future)

Editor's note—The future district centre at Shaw is planned within the Greater Ascot emerging community area.

(20) District centres provide a mix of activities and services that cater for the weekly and fortnightly needs of surrounding communities. Generally they do not attract people from beyond the district. They contain a diversity of commercial, community and entertainment-related uses, with supermarket-based retailing. They may also include medium density housing.

(21) The **Idalia** district centre services the south-eastern suburbs, the Stuart industrial area and highway traffic. Its primary focus is in bulky goods retailing and service industries, with minor growth in traditional retailing, including supermarket shopping. This centre will become the second major bulky goods showroom development within Townsville (in addition to Domain Central), and will serve the south-eastern suburbs of Townsville.

(22) **Deeragun** district centre becomes a more consolidated centre, with improved integration and connections. More non-retail uses including commercial and medical offices, tavern or casual dining uses are anticipated. Small retail showrooms may also be accommodated. Further outward expansion of the centre or the establishment of additional supermarkets does not occur.

(23) Further development in the **Rasmussen** district centre accentuates the district role of this centre, and includes a mix of local commercial premises and community services.

(24) **Annandale** district centre serves as the main activity centre for Lavarack Barracks and remains a predominantly retail centre, with a range of supporting commercial services. Only limited expansion of this centre occurs.

(25) A new district level centre is also to be established at **Shaw** during the next 25 years. However, within the next 10 years, the centre develops only to a local centre role.

Local and neighbourhood centres

(26) Local centres are convenience-oriented centres focused on a full-line supermarket and complementary and ancillary activities servicing the needs of surrounding communities. New local centres will be established commensurate with the growth of new communities at Julago, Cosgrove and Mount Low (the latter to be located on Mt Low Parkway, directly opposite North Shore Boulevard).

(27) Neighbourhood centres are small-scale centres that provide a limited array of basic, lower order needs including convenience retail, local professional and community services. Existing centres in established suburbs are not anticipated to require significant expansion, although some minor expansion of uses may be warranted. New neighbourhood centres are anticipated in Burdell, Julago and elsewhere in newly developing areas where need can be demonstrated.

Specialised centres

(28) Specialised centres incorporate major nodes of activity with a specific and limited function. These centres are intended to support and not to undermine other activity centres within the hierarchy.

(29) The special regional business roles of Townsville Airport, Lavarack Barracks, the Port of Townsville, Domain Central, Fulham Road medical precinct, Bayswater Road medical precinct and James Cook University-Townsville Hospital precinct, are recognised. These centres do not incorporate the breadth and depth of

activities of other activity centres, but instead provide specific higher order, regional and national functions catering for a specific market or technological role and provide significant employment.

(30) The long-term operation of the **Townsville Airport** is supported for both Department of Defence purposes and to satisfy the primary air transport needs of the Townsville and North Queensland regions. Townsville Airport precinct accommodates a range of businesses with a nexus with aeronautical activities, including offices and low impact industries and research and technology-related industries. Some complementary activities which cater to the needs of businesses and workers within the centres are appropriate. However, this centre does not accommodate office or retail activities to an extent that would undermine the principal centre (CBD) or other centres.

Editor's note—Townsville Airport does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning and acknowledges the intentions of Townsville Airport's master planning document.

(31) **Lavarack Barracks** is protected for ongoing Department of Defence-related purposes, including aviation, communications, logistics, administration, training, and accommodation and recreation facilities for Department of Defence personnel.

Editor's note—Lavarack Barracks does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning.

(32) The **Port of Townsville** is protected for the benefit of the local and regional economy, and development of the port is integrated with the CBD, Palmer Street and The Strand where possible, to maximise community access to and use of waterfront areas.

Editor's note—The Port of Townsville does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning and acknowledges the intentions of Port of Townsville's master planning documents.

(33) **Domain Central precinct** does not expand to include further retail uses, other than small facilities supporting the retail showroom function (such as food and drink outlets).

(34) **Fulham Road medical precinct** will continue to be the focus of private acute medical services in the Townsville region. It accommodates medical facilities, including the hospital and medical centres catering for allied and specialist medical services. It also contains residential uses providing short-term accommodation, particularly to meet demand generated by the primary medical uses in the precinct, and aged care and retirement living and respite care.

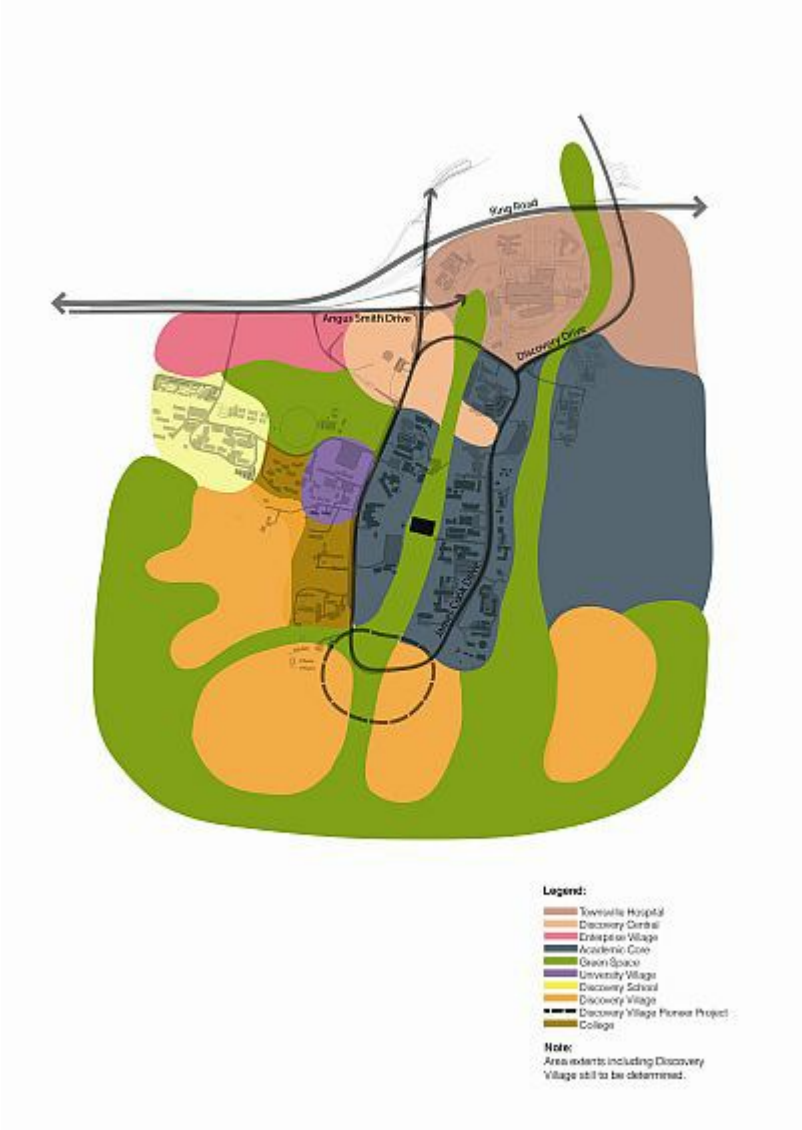
(35) **Bayswater Road medical precinct** accommodates a broad range of medical and associated services, and a mix of medical-oriented and low and medium density residential uses, in a vibrant, mixed use urban village with a strong sense of place and civic identity.

(36) The **James Cook University-Townsville Hospital precinct** evolves into a world-class knowledge community with a focus on the tropics and on sustainability. The centre becomes a mixed use environment, integrating the existing institutions and forming an integral part of Townsville, with strong links to the CBD. It becomes a leader in sustainability, minimising the use of finite resources like land, energy, water and wastewater. Development provides exemplar projects in aspects like public transport, housing, public spaces and community development, as well in its traditional academic, research and healthcare focus. It also exhibits increased self-containment with many people living and working within the centre, although its emerging resident community is well-connected to the wider city by active and public transport.

(37) The land use mix, and scale of development in the James Cook University-Townsville Hospital centre reflects the role of the centre in the city. Its focus is as a knowledge community based on the university, hospital and research and technology activities. Other land uses which benefit and enhance the knowledge community occur, including employment, residential and retail. These other uses are sufficient to facilitate high levels of self-containment on the site. They do not occur at a level that serves a wider role within the city or which may detract from the planned functions of other centres. The level of development will also need to be commensurate with the capacity of infrastructure to serve the area. Development not related to the focus of the centre, but instead designed to compete with other centres, does not occur.

Editor's note—Development of James Cook University (Douglas Campus), which is undertaken in terms of a Ministerial Designation, does not fall within the regulatory jurisdiction of the Townsville City Plan.

(38) The pattern of development is generally consistent with the strategy plan shown in Figure 3.7 – James Cook University-Townsville Hospital strategy plan.



Click here to view PDF high resolution map.

Figure 3.7 - James Cook University-Townsville Hospital centre strategy plan

Mixed use areas

(39) The city contains a number of mixed use areas and corridors, many of which arose from historic strip commercial development. These areas generally evolve to facilitate improved relationship between buildings and the street, a pedestrian-oriented streetscape and improved visual amenity along major roads.

(40) These areas contain a mix of uses including medium density housing (where compatible with the local amenity), convenience retail and small-scale offices and showrooms, community and service industry uses which do not compromise the intended role or successful functioning of centres.

Centre design

(41) The design of centres and mixed use areas in Townsville achieves:

(a) strong integration and consolidation through built form and layout;

(b) a high quality public realm, with attractive, safe and useable public spaces and streets;

(c) active uses that attract people on key pedestrian circulation streets and major frontages;

(d) buildings constructed at or close to the street on key frontages and parking areas and access ways that do not dominate major frontages and pedestrian routes;

(e) a high level of pedestrian and cyclist accessibility and accessibility by public transport;

(f) a human scale and pedestrian comfort (shelter and shade), at street level;

(g) climate responsive design, with the opportunity to adopt sustainable building designs beyond current best practice; and

(h) connectedness between green spaces and the wider network of natural assets, where practicable.

3.3.4.2 Land use strategies

The planning scheme establishes the hierarchy of centres through zoning provisions. These provisions place emphasis on ensuring centres are diverse, accessible and well-designed community hubs. Major development in the district and major centres should be supported by a centre design master plan.

Centre provisions are closely aligned with intentions for medium and higher density living options.

A detailed structure planning process will be undertaken collaboratively between council and James Cook University which may over time be integrated into the planning scheme. A 'strategic infrastructure plan' covering the whole of the centre will also be developed.

3.3.5 Element - Transport, accessibility and mobility

3.3.5.1 Specific outcomes

Transport choices

(1) The city provides choice in mode of transport. Transport systems are planned and built to conveniently and efficiently connect people with places of employment, services and leisure.

(2) The shape of the city and activity centres network establishes the basis for optimum transport outcomes for the city. The pattern supports consolidation around the principal centre (CBD) and major centres on the Ross River Road corridor, which is identified by council and the State Government as a core public transport corridor for the future.

(3) The activity centres network and designation of industrial land also support increased employment opportunities closer to where people live, reducing trip lengths and improving the efficiency and effectiveness of public transport and pedestrian and cyclist networks, and reinforcing the significance of inter-regional freight networks.

(4) The design of centres and residential areas incorporates a network of walking, cycling, public transport and vehicle routes that maximise connectivity and ease of mobility.

(5) The planning scheme places importance on the creation of attractive, climate responsive and safe streets and public spaces, and requires structure planning of centres and greenfield residential areas to ensure that the development pattern allows for high levels of accessibility.

Road and freight network

(6) National, state and regional road, rail, sea and air freight networks are protected from incompatible development and connections to the wider North and Western Queensland regions strengthened.

(7) Appropriate design and access standards are established for development on and near major transport corridors and key freight routes. Further encroachment on these corridors by sensitive land uses such as residential development is avoided and impacts are minimised where development already exists. Key routes include:

(a) the Bruce and Flinders Highways;

(b) the Ring Road;

(c) the Townsville Port Access Road;

(d) Woolcock Street;

(e) Duckworth Street-Nathan Street; and

(f) the rail lines.

(8) The planning scheme encourages co-location of freight and transport-related land uses in industrial areas with

convenient access to the principal road and rail freight network. The Townsville State Development Area will be the pre-eminent location in this regard.

(9) The defence and potential international roles for Townsville Airport will be protected from incompatible development.

3.3.5.2 Land use strategies

Better transport and accessibility outcomes for the city underpin the intentions for the development pattern and densities.

Key corridors and applicable standards for development on and near them are established by the planning scheme.

Council will work with the Queensland Government to develop high-quality public transport, cycling and walking networks, including dedicated bicycle facilities connecting major centres and catering for large volumes of cyclists. Council will also work with the Queensland Government to identify opportunities for park-and-ride facilities near designated public transport stops.

Council will support the relocation of the South Townsville rail yards to the Townsville State Development Area.

3.3.6 Element - Integrated infrastructure planning and provision

City shape

(1) Land use and development patterns support the efficient and cost-effective provision of infrastructure and community facilities.

(2) The city shape and activity centres hierarchy described in this strategic framework establish the basis for the most efficient provision of infrastructure to meet community needs over 25 years. In particular, it minimises the dilution of infrastructure investment across multiple development fronts. While upgrades will be required in the infill development areas, these costs will be less than those that would be involved in continued outward expansion of the urban area.

(3) The settlement pattern supports the co-location of community services and facilities, including in activity centres, where accessibility to communities can be maximised and multiple use of facilities can be coordinated.

(4) Major utilities and community facilities integrate sensitively with the surrounding environment through their built form and management of potential impacts.

Safety and efficiency

(5) The safe and efficient operation or use of infrastructure installations and corridors are protected.

(6) Encroachment of facilities by sensitive land uses is avoided and reasonable standards to manage impacts are established where development already exists. These facilities include:

- (a) energy-related infrastructure including electricity transmission lines, substations, gas lines and the like;
- (b) Lake Ross, Lake Paluma and other water supply areas;
- (c) water and waste water treatment plants and major distribution facilities;
- (d) solid waste treatment and disposal facilities;
- (e) transport and freight networks;
- (f) various Department of Defence landholdings and installations; and
- (g) community facilities and infrastructure.

(7) High standards of development infrastructure are established to effectively manage potential impacts on the community and the environment.

(8) Whole of lifecycle infrastructure costs are minimised.

3.3.6.2 Land use strategies

Council's Local Government infrastructure plan (Part 4 of the planning scheme) documents plans for trunk infrastructure to support the settlement pattern, and development charges are to be levied in accordance with the *Planning Act 2016*.

Council will consider strategies to encourage development within the areas identified as primary infill focus areas in recognition of the overall savings to the community that strategy will facilitate.

Council will negotiate infrastructure agreements as required with development proponents and state agencies as part of the master planning of major development areas.

3.4 Theme - Strong and connected community

Editor's note—What did the Townsville Community Plan 2011-2021 say about *Strong and connected community*?
A community that draws on the diversity, skills and expertise of our residents to build a community that has pride in its culture and lifestyle.
Seven guiding principles were also set out:

- *Strengthen community cohesion: Becoming a supportive and interconnected community that works together to make people feel comfortable and safe within their street, neighbourhood and the wider community.*
- *Value the richness of diversity: The diversity of cultures and community groups represented within Townsville are embraced so that we can all become champions of social inclusion.*
- *Develop a vibrant arts lifestyle: Embracing the richness and talent of the arts community.*
- *Nurture and value families: Providing opportunities to raise children within our unique lifestyle, and providing them with a great place to grow up.*
- *Develop a sense of safety: An environment in which the community feels safe to live, work and play.*
- *Provide active and passive sport and recreation opportunities: An environment where there is a choice of active and passive recreational activities contributes to the health and wellbeing of our city.*
- *Open, honest and accountable leadership: Inclusive engagement and communication encourages community participation in local decision-making.*

3.4.1 Strategic outcomes

(1) The character and identity of communities in urban and rural areas of Townsville evolves and strengthens through the city shape described in this strategic framework and through good urban design of places.

(2) The architectural, cultural, historic, scenic, natural, social or spiritual qualities that create places of local heritage are conserved and enhanced.

(3) Easy access is provided to community services and facilities, and to places to celebrate culture, history and identity. Public spaces and streetscapes are attractive, safe, accessible for all abilities and usable.

(4) A high-quality network of open space and recreation opportunities provides for the needs of the community, supports social interaction, enables connections to natural assets and landscape features, and reinforces the city's identity.

(5) Strong connections to the natural environment and the protection of natural assets contribute to the health and wellbeing of the community.

3.4.2 Element - Urban design

3.4.2.1 Specific outcomes

Design

(1) Design of the built environment (including buildings, streets and public spaces):

- (a) is consistent with the existing or desired character of the local area;
- (b) is oriented to the street and public places;
- (c) enhances the quality of the street;
- (d) is responsive to Townsville's climate;
- (e) creates a human scale at street level;
- (f) protects and celebrates important views, landscape features and natural assets, and places of cultural heritage significance; and

(g) makes it easy to get around, especially when walking or cycling: development is designed to integrate with its surroundings and has ample, not a minimum of, connections.

(2) Good design assists in the success of those areas that will be the focus for growth, change and economic activity.

Public realm

(3) High-quality public spaces are created that optimise opportunities for community interaction.

Prevention of crime and antisocial behaviour

(4) The design of development assists in preventing antisocial behaviour and supporting personal safety.

3.4.2.2 Land use strategies

Good urban design principles (including Crime Prevention Through Environmental Design Principles) form the basis of all planning scheme codes. At a citywide scale, they underpin the development pattern intentions.

3.4.3 Element - Open space network

3.4.3.1 Specific outcomes

Open space network

(1) Townsville has an open space network that:

(a) meets the community's recreation and sporting needs;

(b) offers a diverse range of recreation opportunities and landscape settings that encourage healthy lifestyles and physical activity;

(c) is safe and attractive;

(d) provides equitable and convenient access to sport and recreation facilities, particularly by walking and cycling;

(e) supports community groups and has the capacity to adapt to changing needs over time;

(f) is cost efficient, with a focus on co-locating sports in hubs;

(g) is designed and maintained to a high standard, and is fit for purpose;

(h) incorporates the natural landscape so that people may connect with nature in their recreation;

(i) links recreation spaces and community hubs wherever possible; and

(j) has minimal negative impacts on surrounding communities and land uses.

Types of open space

(2) The open space network provides for the following primary functions:

(a) local, district and regional recreation parks, and corridor or recreation linkages and amenity parks provide informal sport and recreation opportunities; and

(b) district, regional and specialised sports parks provide for formal sports and boast a range of training and competition infrastructure.

3.4.3.2 Land use strategies

The open space network will primarily be delivered through the Local Government infrastructure plan mechanisms. However, planning scheme requirements for reconfiguration and urban development of all types reflect the need for integrated open space and accessibility networks and a high-quality public realm.

3.4.4 Element - Strong and connected community

3.4.4.1 Specific outcomes

(1) Townsville maintains the scenic amenity values and iconic features that contribute to its character and sense of place. Development in areas of high scenic amenity is limited to minimise the potential for deterioration of the scenic values.

(2) Areas of high scenic amenity generally include elevated and vegetated areas which may also contain significant ecological and other environmental values. These include:

  (a) mountainous backdrops, including Mount Elliot, Mount Cleveland, the Pinnacles, Many Peaks Range and Hervey Range to Paluma;

  (b) significant hills and ridgelines within and framing urban areas, including Castle Hill, Mount Stuart and Mount Louisa; and

  (c) coastal headlands, foreshores and waters, including The Strand, Magnetic Island, Cape Pallarenda, Cape Cleveland, Cleveland Bay and Halifax Bay.

(3) Development is sited and designed to be sensitive to the landform, vegetation and other characteristics that contribute to scenic amenity values in all parts of the city.

(4) Non-urban land is protected to define the edges to the city, and to protect non-urban landscape values. Urban and rural residential development does not occur in rural areas.

3.4.4.2 Land use strategies

A primary strategy implemented through the planning scheme is the containment of urban growth within the designated area.

Otherwise, planning scheme requirements for reconfiguration and development of all types reflect the intention to protect areas and features of scenic importance.

3.4.5 Element - Managing the impacts of development

3.4.5.1 Specific outcomes

Protection of amenity

(1) Development mitigates the effects of new development on local character, noise and air quality, access to sunlight, breezes and privacy, and avoids commercial or through traffic in residential streets.

(2) The interface between land zoned for industry and sensitive land uses is managed to protect the health, wellbeing, amenity and safety of the community and protect industrial activities from incompatible development.

(3) The planning scheme does not protect private views, other than where proposed development is inconsistent with the described intent for a local area.

(4) Negative social impacts caused by development are avoided or minimised.

3.4.5.2 Land use strategies

Zone designations, and in some cases precincts, represent the type and scale of development intended for an area. This forms the basis for the community to establish realistic expectations about the type of amenity in an area.

3.5 Theme - Environmentally sustainable future

Editor's note—What did the Townsville Community Plan 2011-2021 say about *Environmentally sustainable future*?

Our community recognises and values our natural environment. We acknowledge the need for a more sustainable future and seek to achieve this through solutions that minimise our impact on the environment.

Three guiding principles were also set out:

- *Valuing our natural environment and urban green spaces: The Townsville community recognises, protects, retains and enhances the values and condition of our natural environment, urban green spaces, and scenic amenity.*

- *Taking responsibility for the health of our local waterways, wetlands and marine areas: The community takes appropriate actions to maintain the values and condition of our local waterways, wetlands and the marine environments.*
- *Adopting an environmentally sustainable lifestyle at home, work and at play: the community understands that our activities have an environmental impact. Individually and collectively we take responsibility for undertaking appropriate actions at home, work and play to minimise these impacts.*

3.5.1 Strategic outcomes

(1) Townsville's natural assets, including its biodiversity, habitat values and biophysical and ecological processes are protected, enhanced and restored to provide life supporting capacities for present and future generations.

(2) The maintenance of biodiversity is dependent on a variety of biophysical elements, functions and processes including an interconnected network of wildlife corridors and habitats. Habitat areas and connecting corridors are retained, and degraded links are restored to provide a continuous network of natural assets that supports the ecological and biophysical functions necessary for ensuring sustainable landscapes.

(3) The network of waterways and wetlands that contribute to terrestrial and aquatic biodiversity including fisheries, marine habitats and the Great Barrier Reef, is protected from the impacts of development to maintain high standards of water quality and aquatic ecosystem health.

(4) Water quality is protected, particularly within the city's drinking water catchments and waters identified as having high ecological value.

(5) The coastal zone is managed to protect, conserve and rehabilitate coastal resources, biological diversity and natural coastal processes.

(6) Risk to life, property and ecosystems as a result of natural hazards is minimised, and development is managed to respond to the likely impacts of climate change.

3.5.2 Element - Natural assets

3.5.2.1 Specific outcomes

(1) Areas of importance for the maintenance of habitat, biodiversity and biophysical and ecological functions are protected. Development avoids or minimises direct and indirect impacts on areas having or supporting significant environmental values, ecological functions and biophysical processes.

(2) As far as possible, natural areas are retained and integrated with the development to maintain and enhance the natural assets network.

(3) Fragmentation of native habitat is avoided to maintain biodiversity and increase ecological resilience, including resilience to climate change.

(4) Ecological corridors are maintained and where appropriate, rehabilitated and expanded, to support:

- (a) the natural movement and proliferation of native species;
- (b) ecological responses to climate change;
- (c) the maintenance of large scale migratory lifecycle processes; and
- (d) connectivity between significant habitat areas and patches of remnant vegetation.

(5) Development maintains suitable buffers to areas of significance, such as endangered and threatened ecological communities and remnant vegetation, wetlands and waterways and priority habitat to ensure the ongoing viability of the significant area and associated ecological functions and ecosystem services.

(6) Corridors and buffers are of a width which provides for:

- (a) movement of native fauna;
- (b) viable habitat areas;
- (c) minimisation of edge effects;
- (d) maintenance of the hydrological functions of the waterway or wetland;
- (e) appropriate recreational opportunities; and
- (f) any additional maintenance and bushfire setback functions to be located outside the areas required for ecological purposes.

(7) Appropriate public access to the city's natural assets is provided.

3.5.2.2 Land use strategies

The city shape and settlement pattern has been determined to avoid further expansion of urban or rural residential development beyond existing designated areas. This will avoid increasing pressures on environmentally important values.

Some areas (predominantly those in the protected estate) are included in the Environmental management and conservation zone. Other natural areas of national, state, regional and local significance are identified in overlay maps and are to be protected and managed through the Natural assets overlay code.

The Natural assets planning scheme policy no. SC6.9 assists in providing guidance to applicants regarding the range of values present across the mapped areas and how environmental assessments should be carried out.

3.5.3 Element - Integrated water cycle management and ecosystem health

3.5.3.1 Specific outcomes

Protection of waterways and wetlands

(1) Wetlands, waterways and associated riparian areas are protected from threatening processes and where practical, enhanced to ensure ecological processes and ecosystem services are fully functional.

(2) The proposed city shape and settlement pattern avoids further expansion of urban development into or nearer to important aquatic ecosystems.

(3) Development is located outside wetlands and avoids adverse effects on wetlands.

(4) Development is buffered from waterways and wetlands, with a buffer width sufficient to:

- (a) maintain ecological and habitat functions;
- (b) minimise potential edge effects; and
- (c) allow for natural hydrological (including flood-related) processes to function effectively and unimpeded.

(5) Where land is required for recreational, land management, bushfire hazard risk reduction and other appropriate purposes, these functions and land uses are located outside the areas required for ecological purposes and water quality improvement or are conducted in such a way that there are no adverse impacts on the environmental values.

Protection of water quality

(6) Intensification of development within the Lake Ross, Lake Paluma and Crystal Creek catchments is avoided.

(7) Water quality of both surface and ground waters, and the ecological and hydrological processes of catchments, are protected.

(8) New development incorporates drainage, stormwater and waste water management measures that protect ground and surface water quality and the environmental values of water.

(9) The release of acid and associated metal contaminants into the environment is avoided through appropriate standards for development involving filling or excavation, so that disturbance to acid sulfate soils is minimised and disturbed acid sulfate soils are appropriately treated.

(10) Best practice water sensitive urban design (adapted to the Dry Tropics environment) and integrated water cycle management responding to regionally specific climate and water quality characteristics, form the basis for engineering standards.

Water use efficiency

(11) Development, including landscaping, uses water efficiently as part of the total water cycle.

3.5.3.2 Land use strategies

Water resources are comprehensively protected through the Natural assets and Water resource catchment overlays, as well as through requirements under the Healthy waters and Works codes, as well as zone codes.

3.5.4 Element - Coastal protection

3.5.4.1 Specific outcomes

Conservation of coastal resources

(1) Coastal resources are conserved, and areas of high ecological significance or scenic amenity along the coast are protected.

Coastal risks

(2) Exposure of communities to coastal hazards, including erosion and storm tide inundation, is minimised, taking into account the projected effects of climate change.

(3) The settlement pattern avoids expansion of urban areas and smaller coastal settlements into environmentally significant coastal areas.

(4) In areas designated for urban development, increase in risk to people and property is avoided.

(5) Outside designated urban areas, only limited forms of development that are compatible with the risks occur within coastal hazard areas.

Public access

(6) Public access to the foreshore is maintained and managed for current and future generations.

3.5.4.2 Land use strategies

The Coastal protection overlay and underlying zoning provisions direct development so that it will be compatible with the hazard and protect coastal processes and areas of high ecological significance.

3.5.5 Element - Natural hazards (bushfire, landslide and flood)

3.5.5.1 Specific outcomes

Avoiding increase to risk

(1) New development in areas subject to bushfire, landslide or flooding hazard is compatible with the nature of the hazard.

(2) Development does not materially increase the extent or the severity of natural hazards, and the safety of people is maintained and damage to property is minimised.

(3) The settlement pattern avoids further expansion of urban and rural residential uses into hazard areas.

(4) Significant areas of Townsville are already established within the floodplains of the Ross and Bohle Rivers. Within these areas, the flood risk will be managed by avoiding intensification of development in high hazard areas and ensuring development is compatible with the hazard in other areas.

3.5.5.2 Land use strategies

Bushfire, Landslide and Flood hazard overlays and underlying zoning provisions direct development so that it will be compatible with the hazard and the desired character for the area.

3.5.6 Element - Sustainability

3.5.6.1 Specific outcomes

(1) Development is designed to sensitively respond to Townsville’s climate through its orientation, layout and design of the built environment.

(2) Development minimises demands for energy use and otherwise promotes efficient use of energy.

(3) Innovation in climate responsive and energy efficient design is encouraged.

(4) Development is located, designed and managed to avoid environmental harm or nuisance.

3.5.6.2 Land use strategies

The city shape and settlement pattern established under the planning scheme provisions underpins the growth of a more sustainable Townsville in which transportation and fossil fuel use will be better managed.

Development requirements also seek development that is climatically responsive and energy efficient at the site and built form scale. However, the planning scheme does not duplicate the jurisdiction of the *Building Act 1975* in this regard.

Planning scheme provisions also address the expected environmental performance of development generally.

3.6 Theme - Sustainable economic growth

Editor's note—What did the Townsville Community Plan 2011-2021 say about *Sustaining economic growth*?

The community recognise that it is fundamental to have a strong and balanced economic growth in order to enhance our city's way of life.

Four guiding principles were also set out:

- *Strong and diverse economy: the community recognises that sustaining a strong and diverse economy is vital for long-term prosperity.*
- *An innovative and highly skilled city: we will create new skills and business opportunities.*
- *A community that benefits from Townsville's economy: we will ensure that the benefits of economic growth are shared throughout the community.*
- *A city that sustains and prospers from its environment: the community will partner with business and industry to create a more resource efficient economy that generates new sustainable development businesses and jobs.*

3.6.1 Strategic outcomes

(1) Economic and employment growth is primarily located in Townsville's centres and industrial areas. The clustering of activities and employment in these areas facilitates improved transport networks (including public transport).

(2) Industrial land is used efficiently, a timely supply of land to meet industry needs is available, and efficient and cost-effective provision of infrastructure is facilitated.

(3) Sensitive uses are prevented from encroaching on the city's freight routes, special purpose areas, industrial areas and specialised centres, particularly Townsville Airport, Port of Townsville, the Townsville State Development Area and the Department of Defence landholdings, to ensure their ongoing efficient operation, minimise risks and avoid conflicts.

(4) Farming activities and the productive capacity of all rural land is protected.

(5) Within rural areas, new enterprises are encouraged that are associated with rural production or the natural environment, and which are not more appropriately located in urban areas.

(6) Development in and adjacent to quarries and other extractive and resource areas does not prejudice the continued and future use of the natural resources.

(7) Tourist accommodation and attractions are established in appropriate locations, and conflict between tourist activities and surrounding uses or values is minimised.

(8) Home based business is supported as an important incubator for new enterprises. However, activities are limited to ensure adverse impacts on neighbours' residential amenity do not occur.

3.6.2 Element - Industrial land

3.6.2.1 Specific outcomes

Sufficient land supply

(1) Land within designated industrial areas is used efficiently, and industries with a similar or compatible nature are co-located.

(2) The significance and potential of the Townsville State Development Area as a dry port, accommodating storage, transport and logistics activities, as well as port-related manufacturing is protected.

(3) The industrial investigation areas at Bohle Plains and Woodstock will not be developed prior to the

establishment of:

(a) a demonstrated need for the land;

(b) the inclusion of the area in council's Priority infrastructure area; and

(c) detailed structure planning which identifies, avoids and buffers significant environmental values, areas and corridors; avoids natural hazards on the site; identifies appropriate mix of industrial activity, identifies appropriate buffers, nominates site layout and circulation networks; and appropriately integrates the site with surrounding land.

(4) Interim uses in the industrial investigation areas at Bohle Plains and Woodstock do not prejudice long-term suitability for industrial use.

(5) Industrial development does not expand beyond the areas zoned for industrial purposes or identified as industry investigation areas on the strategic framework maps.

(6) In Roseneath, industrial uses with a transport and logistics focus are accommodated and are provided with adequate infrastructure, including roads, water, sewer and stormwater networks.

Protection of industry land for industry

(7) Industrial land is designed and remains available for intended industrial use and is protected from encroachment by uses that are sensitive to the impacts of industry.

(8) Industrial development is not intended to occur outside the zoned industrial areas, other than service industries and some low impact industries which may be located within activity centres or mixed use areas.

(9) Retail and commercial activities within industry zones are limited to those that directly support the industries intended for the zones, or are for outdoor sales uses. Bulky goods retailing (showrooms) and retail hardware stores are not accommodated within industry zoned land and are instead located within activity centres or mixed use areas.

(10) Subdivision requirements for industrial areas will be established to provide for a mix of lot sizes and, in particular, provision for larger lot sizes in Medium and High impact industry and Special purpose zoned areas.

Impacts of industry

(11) Industrial development is managed to protect environmental values, avoid risk to life and property and reasonably protect the amenity of surrounding areas.

(12) Alternative solutions to energy use and environmental performance are encouraged where impacts will be no worse than a conventionally designed development.

3.6.2.2 Land use strategies

Industrial areas are included in either the Low, Medium or High impact industry zone or Special purpose zone and the appropriate performance expectations for each are identified.

In addition, provisions are contained within residential zones, where relevant, to address potential reverse amenity issues from industrial areas and major infrastructure corridors. Council will work with the State Government to investigate the potential allocation of the Bohle Plains State land area to accommodate a range of industry types, including transport/freight-related activities. Industrial development of this area would desirably be contiguous with existing industry and appropriately integrate with the Townsville Ring Road.

Industrial land supply and demand will be monitored by council in order to determine when land in the investigation areas may need to be made available.

Council will work with the relevant authorities to ensure the availability of gas and telecommunications infrastructure, as well as to investigate possible alternative freight routes which minimise existing conflicts within the urban area.

3.6.3 Element - Airport, seaport and Department of Defence land

3.6.3.1 Specific outcomes

Protecting special use areas

(1) Townsville Airport, Port of Townsville and Department of Defence landholdings are recognised for their particular strategic and economic value to the community.

(2) The safety and operational efficiency of these areas is maintained. They are protected from encroachment by sensitive uses.

(3) Development in the vicinity of these areas, and the transport/freight routes which serve them, is compatible with the physical and operational characteristics of the special use areas. New development will be located and designed to minimise any potential impacts.

3.6.3.2 Land use strategies

While the planning scheme has no jurisdiction over these areas, it regulates development in the areas surrounding them to avoid conflicts and reverse amenity issues arising.

3.6.4 Element - Natural economic resources (including rural and extractive industry)

3.6.4.1 Specific outcomes

Protecting productivity

(1) The productive capacity of all rural land is optimised within its environmental constraints.

(2) Significant non-rural activities and intensive animal industries do not occur in Townsville's primary horticultural areas.

Avoiding fragmentation

(3) Further fragmentation of rural land is avoided. A lack of viability for existing farms and small holdings does not justify their further subdivision or use for non-agricultural purposes.

(4) Development complies with the nominated minimum lot size for each precinct which will generally range from 10ha for rural lifestyle precincts, to 40ha for horticultural-based precincts to 400ha for grazing-based precincts.

Diversification

(5) Opportunities for diversification of activities within the rural areas is encouraged, provided that:

- (a) the productive capacity of the land is maintained;
- (b) conflicts with existing and intended rural activities in the surrounding area are avoided;
- (c) the existing landscape and natural resource values of the land are maintained; and
- (d) the development is not more appropriately located in another zone.

(6) Industry uses that are not directly related to farming or which do not require separation from urban or rural residential areas are not appropriate in the rural zone. These should be contained within zoned industrial land. In particular, transport depots and food or meat processing industries are to be located in an industrial zone.

(7) Intensive animal industries including feedlots and cattle handling facilities (for live export) are to be directed to the broader hectare lands of the predominantly grazing precincts where potential impacts can be better managed.

Protection of extractive resources

(8) Identified areas of extractive resources and their associated haulage routes are protected from encroachment of incompatible development. Buffers are provided to separate and mitigate the impacts of extractive operations and surrounding sensitive uses.

(9) While houses may be established on existing lots within identified buffer areas and haulage routes, any development which would increase the intensity of people living, visiting or working within these areas is avoided.

(10) Quarrying and extractive industry maintains the integrity of environmental and hydrological processes beyond site boundaries and minimises impacts on such values within the site.

3.6.4.2 Land use strategies

The rural land resources are primarily managed within the planning scheme through the Rural zone.

In addition, a number of overlays also assist in protecting the range of non-urban values, including Natural assets, Extractive resources, Bushfire hazard, Landslide hazard and Coastal environment.

3.6.5 Element - Tourism

3.6.5.1 Specific outcomes

Diversity

(1) A range of tourism opportunities and experiences, particularly nature-based tourism, are encouraged, with the principal centre (CBD) and its immediate environs a focus for larger tourist facilities.

(2) Tourism within the principal centre (CBD) and its immediate environs will be anchored by the Museum of Tropical Queensland and Reef HQ Aquarium, education and research uses and accommodation facilities, with improved links to the Breakwater, Anzac Park and The Strand.

(3) Tourist accommodation and dining will also continue to be encouraged in North Ward (with a focus on The Strand and Gregory Street), the Breakwater and Palmer Street, consistent with desirable built form and urban design outcomes for those areas.

(4) Magnetic Island is a major tourism destination for Townsville and will maintain accommodation and recreation activities at a scale and form that is relative to the overall character of the island. Supporting infrastructure encouraged on the island includes service and convenience of commercial facilities, walkways, foreshore promenades, and gateway treatments at significant junctions for each village.

(5) Small-scale, low-rise tourist accommodation and support facilities are to be facilitated at Paluma, Rollingstone, Balgal Beach, Toomulla, Toolakea and Saunders Beach. Tourism-oriented development in these northern townships focuses on protecting and emphasising the natural character attributes of the local area. The relationship between tourism, the environment and the availability and capacity of local infrastructure in these northern townships is managed so that it is sustainable.

Protecting values

(6) Tourism-related development maintains or enhances Townsville's image, environmental values, ecological processes and scenic quality both within and outside of urban areas.

(7) Outside the urban area, tourism-related development occurs where directly associated with rural activities or other natural resource values. However, such uses should not give rise to conflicts which would prejudice the existing economic activity in the area or adversely affect environmental values, ecological processes values or landscape character.

3.6.5.2 Land use strategies

The relevant zones and precincts identified in the planning scheme establish appropriate performance requirements for tourism-related development in appropriate locations.

Part 4 Local government infrastructure plan

4.1 Preliminary

(1) This local government infrastructure plan has been prepared in accordance with the requirements of the *Sustainable Planning Act 2009*.

(2) The purpose of the local government infrastructure plan is to:

- (a) integrate infrastructure planning with the land use planning identified in the planning scheme;
- (b) provide transparency regarding a local government's intentions for the provision of trunk infrastructure;
- (c) enable a local government to estimate the cost of infrastructure provision to assist its long term financial planning;
- (d) ensure that trunk infrastructure is planned and provided in an efficient and orderly manner; and
- (e) provide a basis for the imposition of conditions about infrastructure on development approvals.

(3) The local government infrastructure plan:

- (a) states in Section 4.2 (planning assumptions) the assumptions about future growth and urban development including the assumptions of demand for each trunk infrastructure network;
- (b) identifies in Section 4.3 (priority infrastructure area) the prioritised area to accommodate urban growth up to 2026;
- (c) states in Section 4.4 (desired standards of service) for each trunk infrastructure network the desired standard of performance;
- (d) identifies in Section 4.5 (plans for trunk infrastructure) the existing and future trunk infrastructure for the following networks:
  - (i) water supply;
  - (ii) sewerage;
  - (iii) roads;
  - (iv) footpaths and cycleways; and
  - (v) parks and land for community facilities.
- (e) provides a list of supporting documents that assist in the interpretation of the local government infrastructure plan in the Editor's note – Extrinsic material at the end of Section 4.5.2.

4.2 Planning assumptions

(1) The planning assumptions state the assumptions about:

(a) population and employment growth; and

(b) the type, scale, location and timing of development including the demand for each trunk infrastructure network.

(2) The planning assumptions together with the desired standards of service form a basis for the planning of the trunk infrastructure networks and the determination of the priority infrastructure area.

(3) The planning assumptions have been prepared for:

(a) the base date 2011 and the following projection years to accord with future Australian Bureau of Statistics census years:

(i) mid 2016;

(ii) mid 2021;

(iii) mid 2026;

(iv) mid 2031; and

(v) ultimate

(b) the LGIP development types in column 2 that include the uses in column 3 of Table 4.2.1.

(c) the projection areas identified on Growth Model Zone Maps 1 to 5 in the extrinsic material (Local Government Infrastructure Plan - planning assumptions & PIA). For reporting purposes, the projections are summarised by the reporting areas identified in Schedule 3 - Local government infrastructure plan mapping and tables, SC3.3.1 - Reporting areas map.

Table 4.2.1-Relationship between LGIP development categories, development types and uses

Column 1 **LGIP development category**	**Column 2** **LGIP development type**	**Column 3** **Uses**
Residential development	Single Dwelling (urban)	Dwelling house (urban)
	Single Dwelling (rural residential)	Dwelling house (rural residential)
	Single Dwelling (rural)	Dwelling house (rural)
	Multiple Dwelling	Dual occupancy Multiple dwelling
	Other Dwelling	Caretaker's accommodation Community residence Dwelling unit Relocatable home park Residential care facility Retirement facility
Non-residential development	Retail	Adult store Agricultural supplies store Bar Bulk landscape supplies Food and drink outlet Function facility Garden centre Hardware and trade supplies Market Outdoor sales Roadside stall Service station Shop Shopping centre Showroom Wholesale nursery

Column 1 LGIP development category	Column 2 LGIP development type	Column 3 Uses
	Services	Animal keeping Brothel Car wash Cemetery Childcare centre Club Community care centre Community use Crematorium Detention facility Educational establishment Environmental facility Funeral parlour Health care services Home based business Hospital Hotel Indoor sport and recreation Major sport, recreation and entertainment facility Motor sport facility Nature-based tourism Nightclub entertainment facility Non-resident workforce accommodation Outdoor sport and recreation Outstation Park Place of worship Resort complex Rooming accommodation Rural workers accommodation Service industry Short-term accommodation Theatre Tourist attraction Tourist park
	Professional	Emergency services Office Sales office Veterinary services
	Industry	Air services High impact industry Landing Low impact industry Marine industry Medium impact industry Parking station Port services Research and technology industry Rural industry Special industry Telecommunications facility Transport depot Warehouse Winery

Column 1 LGIP development category	Column 2 LGIP development type	Column 3 Uses
	Other	Animal husbandry Aquaculture Cropping Extractive industry Intensive animal husbandry Intensive horticulture Major electricity infrastructure Permanent plantation Renewable energy facility Substation Utility installation

(4) Details of the methodology used to prepare the planning assumptions are stated in the extrinsic material.

4.2.1 Population and employment growth

(1) A summary of the assumptions about population and employment growth for the planning scheme area is stated in Table 4.2.1.1-Population and employment assumptions summary.

Table 4.2.1.1-Population and employment assumptions summary

Column 1 Description	Column 2 Assumptions					
	2011	2016	2021	2026	2031	Ultimate
Population	180,114	197,830	212,488	228,049	243,892	404,326
Employment	90,057	98,915	104,817	112,259	119,531	418,035

(2) Detailed assumptions about growth for each projection area and LGIP development type category are identified in the following tables in Schedule 3 Local government infrastructure plan mapping and tables:

(a) Table SC3.1.1 - Existing and projected population, and;

(b) Table SC3.1.2 - Existing and projected employment;

Editor's note—More detailed projections by growth model zone areas are available in the extrinsic material.

4.2.2 Development

(1) The developable area is identified in Schedule 3-Local government infrastructure plan mapping and tables, SC3.3.2 - Developable area map.

(2) The planned density for future development is stated in Table 4.2.2.1 to Table 4.2.2.5.

Editor's note—Locations where infill and broad-hectare densities apply are identified respectively as 'less than threshold' and 'greater than threshold' areas that are mapped in Appendix C and Appendix D of *Local government infrastructure plan - planning assumptions & PIA . Townsville City Council.* (extrinsic material). The densities and other key assumptions in this local government infrastructure plan include:

- Assumed population, housing and employment densities (infill) (Table 4.2.2.1);
- Assumed population, housing and employment densities (broad-hectare) (Table 4.2.2.2);
- Assumed population, housing and employment densities (heritage)(Table 4.2.2.3);
- Assumed population, housing and employment densities (special cases) as shown in Figure 4.2.2.1 (Table 4.2.2.4); and
- Delayed start dates for growth associated with preliminary approvals (Table 4.2.2.5).

(3) A summary of the assumptions about future residential and non-residential development for the planning scheme area is stated in Table 4.2.2.6 - Residential dwelling and non-residential floor space assumption summary.

(4) A summary of the assumptions about future educational enrolments for the planning scheme area is stated in Table 4.2.2.7 - Education assumptions summary.

Table 4.2.2.1-Assumed population, housing and employment densities (infill)

Zone	Precinct	Ultimate density (per net developable hectare)						
		Single dwelling (no.)	Multiple or other dwelling (no.)	Retail(m2)	Services (m2)	Profess. (m2)	Industry (m2)	Other (m2)
CF	All	-	-	-	-	-	-	-
CR	All	16.7	-	-	-	-	-	-
DC	All	-	-	2,970	765	765	-	-
EC	MCF2	-	-	2,310	595	595	-	-
EC	MCNS	-	-	5,280	1,360	1,360	-	-
EC	Other	16.6	4.9	20	80	-	-	-
HDR	PS	-	590.6	9,936	-	-	-	-
HDR	Other	-	80.0	656	83	459	-	-
HII	All	-	-	3	65	65	6,367	-
LC	All	-	-	2,970	765	765	-	-
LDR	MCF1*	-	-	2,310	595	595	-	-
LDR	MHF1*	-	-	-	3,180	2,120	-	-
LDR	RRRC*	18.8	2	10	40	-	-	-
LDR	ST*	10.0	-	-	-	-	-	-
LDR	Other	18.9	2.1	5	20	-	-	-
LII	All	-	-	1,120	319	286	3,646	230
MC	ACC	-	36.0	4,224	1,088	1,088	-	-
MC	ACF	-	-	3,300	850	850	-	-
MC	AMC	-	18.0	4,752	1,224	1,224	-	-
MC	HPMC(MCC)	-	-	5,280	1,360	1,360	-	-
MC	HPMC(Other)	-	-	5,280	1,360	1,360	-	-
MC	MCF3	-	-	2,310	595	595	-	-
MC	TCMC(TD)	-	21.9	3,373	869	869	-	-
MC	TCMC(TCS)	-	21.9	3,373	869	869	-	-
MC	Other	-	18.0	4,752	1,224	1,224	-	-
MDR	AV	-	137.9	3,901	1,005	1,005	-	-
MDR	AMD	0.1	221.2	5	21	-	-	-
MDR	HPMD	-	222.3	17	4	4	-	-
MDR	PB	18.9	2.1	5	20	-	-	-
MDR	NBT	-	42.0	2,100	1,050	1,050	-	-
MDR	NWV	11.0	64.4	7	28	-	-	-
MDR	S	10.6	61.8	35	140	-	-	-
MDR	Other	11.0	97.8	5	21	-	-	-
MII	All	-	-	601	223	124	5,121	130
MU	AC	-	42.0	2,100	1,050	1,050	-	-
MU	BRM	-	-	-	3,180	2,120	-	-
MU	CTR	-	24.3	2,435	2,435	-	-	-
MU	KT	-	-	1,300	1,950	1,950	1,300	-
MU	KR	11.0	97.8	5	21	-	-	-
MU	NBG	-	42.0	2,100	1,050	1,050	-	-
MU	CBDG	-	21.9	1,789	1,661	1,661	-	-
MU	STRD	-	341.0	9,900	-	-	-	-
MU	WS	11.0	64.5	5	21	-	-	-
MU	Other	-	21.9	1,789	1,661	1,661	-	-
NC	All	-	-	2,310	595	595	-	-
OS	R	-	-	1,300	1,950	1,950	1,300	-
OS	Other	-	-	-	-	-	-	-
PC	CA	-	-	3,900	30,550	30,550	-	-

Zone	Precinct	Ultimate density (per net developable hectare)						
		Single dwelling (no.)	Multiple or other dwelling (no.)	Retail(m2)	Services (m2)	Profess. (m2)	Industry (m2)	Other (m2)
PC	FSR	-	357.0	9,686	25,809	25,809	-	-
PC	Other	-	399.0	3,857	25,622	25,622	-	-
RR	RRRD	0.025	-	-	-	-	-	-
RR	Other	1.6	-	-	-	-	-	-
RUR	H	0.025	-	-	-	-	-	-
RUR	C	0.003	-	-	-	-	-	-
RUR	J	0.1	-	-	-	-	-	-
RUR	RRRD	0.003	-	-	-	-	-	-
RUR	Other	0.003	-	-	-	-	-	-
SC	Other	-	-	-	-	-	-	-
SC	BRM	-	-	-	3,180	2,120	-	-
SC	D	-	-	3,500	-	-	-	-
SC	FRM	-	34	670	2,680	-	-	-
SC	MH	-	-	-	7,200	4,800	-	-
SC	MHF2	-	-	-	3,180	2,120	-	-
SP	TSDA (B, EC, ECO)	-	-	-	-	-	-	-
SP	TSDA (HIIP)	-	-	340	126	84	2,877	74
SP	TSDA (LMI)	-	-	1,120	319	286	-	230
SP	TSDA (Other)	-	-	601	223	124	-	130
SR	BBGC	-	-	20	5	-	-	-
SR	Other	-	-	-	-	-	-	-

Table 4.2.2.2-Assumed population, housing and employment densities (broad-hectare)

Zone	Precinct	Ultimate density (per net developable hectare)						
		Single dwellings (no.)	Multiple or other dwelling (no.)	Retail (m2)	Services (m2)	Profess. (m2)	Industry (m2)	Other (m2)
CF	All	-	-	-	-	-	-	-
CR	All	11.3	-	-	-	-	-	-
DC	All	-	-	2,970	765	765	-	-
EC	MCF2	-	-	1,485	383	383	-	-
EC	MCNS	-	-	3,432	884	884	-	-
EC	Other	10.8	3.2	13	52	-	-	-
HDR	PS	-	590.6	9,936	-	-	-	-
HDR	Other	-	51.9	425	54	298	-	-
HII	All	-	-	1	16	16	1,592	-
LC	All	-	-	2,970	765	765	-	-
LDR	MCF1*	-	-	1,485	383	383	-	-
LDR	MHF1*	-	-	-	3,180	2,120	-	-
LDR	RRRC*	12.2	1.3	7	26	-	-	-
LDR	ST*	6.5	-	-	-	-	-	-
LDR	Other	12.3	1.3	3	13	-	-	-
LII	All	-	-	720	205	184	2,344	148
MC	ACC	-	23.4	2,746	707	707	-	-
MC	ACF	-	-	2,145	553	553	-	-
MC	AMC	-	11.7	3,089	796	796	-	-
MC	HPMC(1)	-	-	4,290	1,105	1,105	-	-
MC	HPMC(2)	-	-	3,432	884	884	-	-
MC	MCF3	-	-	1,485	383	383	-	-
MC	TCMC(TD)	-	14.2	2,192	565	565	-	-

Zone	Precinct	Ultimate density (per net developable hectare)						
		Single dwellings (no.)	Multiple or other dwelling (no.)	Retail (m2)	Services (m2)	Profess. (m2)	Industry (m2)	Other (m2)
MC	TCMC(TCS)	-	14.2	2,192	565	565	-	-
MC	Other	-	11.7	3,089	796	796	-	-
MDR	AV	-	89.6	2,535	653	653	-	-
MDR	AMD	0.1	144.2	3	14	-	-	-
MDR	HPMD	-	144.9	11	3	3	-	-
MDR	PB	12.3	1.3	3	13	-	-	-
MDR	NBT	-	27.3	1,365	683	683	-	-
MDR	NWV	7.2	41.8	5	18	-	-	-
MDR	S	6.9	40.1	23	91	-	-	-
MDR	Other	7.2	63.5	3	14	-	-	-
MII	All	-	-	388	144	80	3,304	84
MU	AC	-	27.5	1,375	688	688	-	-
MU	BRM	-	-	-	3,180	2,120	-	-
MU	CTR	-	15.8	1,584	1,584	-	-	-
MU	KT	-	-	846	1,269	1,269	846	-
MU	KR	7.2	63.5	3	14	-	-	-
MU	NBG	-	27.3	1,365	683	683	-	-
MU	CBDG	-	14.3	1,164	1,081	1,081	-	-
MU	STRD	-	341.0	9,900	-	-	-	-
MU	WS	7.2	41.9	3	14	-	-	-
MU	Other	-	14.3	1,164	1,081	1,081	-	-
NC	All	-	-	2,310	595	595	-	-
OS	R	-	-	845	1,268	1,268	845	-
OS	Other	-	-	-	-	-	-	-
PC	CA	-	-	3,900	30,550	30,550	-	-
PC	FSR	-	357.0	9,686	25,809	25,809	-	-
PC	Other	-	399.0	3,857	25,622	25,622	-	-
RR	RRRD	0.021	-	-	-	-	-	-
RR	Other	1.3	-	-	-	-	-	-
RUR	H	0.021	-	-	-	-	-	-
RUR	C	0.002	-	-	-	-	-	-
RUR	J	0.085	-	-	-	-	-	-
RUR	RRRD	0.002	-	-	-	-	-	-
RUR	Other	0.002	-	-	-	-	-	-
SC	Other	-	-	-	-	-	-	-
SC	BRM	-	-	-	3,180	2,120	-	-
SC	D	-	-	3,500	-	-	-	-
SC	FRM	-	21.8	435	1,740	-	-	-
SC	MH	-	-	-	7,200	4,800	-	-
SC	MHF2	-	-	-	3,180	2,120	-	-
SP	TSDA (B, EC, ECO)	-	-	-	-	-	-	-
SP	TSDA (HIIP)	-	-	186	69	46	1,578	40
SP	TSDA (LMI)	-	-	720	205	184	-	148
SP	TSDA (Other)	-	-	388	144	80	-	84
SR	BBGC	5.0	-	13	3	-	-	-
SR	Other	-	-	-	-	-	-	-

Table 4.2.2.3-Assumed population, housing and employment exceptions (heritage)

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
24	Lot 1 on RP706700	269	0	0	0	0	0	0	1	0	0	vacant
25	Lot 1 on RP732245	255	0	0	0	0	0	32	66	62	0	hall
26	Lot 7 on RP703414	280	2.8	0	0	0	0	0	0	0	0	estimated
27	Lot 6 on T118301	221	2.8	0	0	0	0	0	0	0	0	USH
28	Lot 50 on T118105	267	2.8	0	0	0	0	0	0	0	0	USH
29	Lot 169 on T118105	269	2.8	0	0	0	0	0	0	0	0	USH
30	Lot 19 on RP701558	256	0	0	0	0	0	24	49	47	0	USH
31	Lot 1 on RP701861	460	0	0	0	0	0	3	7	6	0	estimated
32	Lot 18 on RP701558	256	0	0	0	0	0	24	50	47	0	estimated
33	Lot 204 on T118101	258	0	0	0	0	0	0	1	0	0	estimated
34	Lot 47 on T118117	258	0	0	0	0	0	0	1	0	0	Church
35	Lot 446 on CP886001	472	0	0	0	0	0	0	10	0	0	Church
36	Lot 42 on RP703374	268	0	0	0	0	0	14	29	27	0	estimated
37	Lot 202 on T118101	258	0	0	0	0	0	0	1	0	0	estimated
38	Lot 2 on RP860274	272	0	0	0	0	0	54	111	105	0	Church
39	Lot 41 on RP703374	268	0	0	0	0	0	14	29	27	0	estimated
40	Lot 203 on T118101	258	0	0	0	0	0	0	1	0	0	estimated
41	Lot 19 on RP745707	257	2.8	0	0	0	0	0	0	0	0	Church
42	Lot 32 on RP729858	233	2.8	0	0	0	0	0	0	0	0	USH
43	Lot 2 on RP707346	224	0	0	0	0	0	20	41	38	0	USH
44	Lot 263 on T1181	224	0	0	0	0	0	20	42	39	0	estimated
45	Lot 1 on RP701770	224	0	0	0	0	0	9	18	17	0	estimated
46	Lot 258 on T1181	224	0	0	0	0	0	20	42	39	0	estimated
47	Lot 3 on SP148258	224	0	0	0	0	0	25	53	50	0	estimated
48	Lot 1 on SP148258	224	0	0	0	0	0	40	82	78	0	estimated
49	Lot 2 on RP709172	226	2.8	0	0	0	0	0	0	0	0	estimated
50	Lot 52 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
51	Lot 65 on T11884	226	2.8	0	0	0	0	0	0	0	0	vacant
52	Lot 160 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
53	Lot 68 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
54	Lot 2 on RP702016	224	0	0	0	0	0	29	60	57	0	USH
55	Lot 32 on T11884	226	0	7.2	0	0	0	0	0	0	0	estimated
56	Lot 2 on RP733821	224	2.8	0	0	0	0	0	0	0	0	4 units

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
57	Lot 1 on RP722451	216	2.8	0	0	0	0	0	0	0	0	USH
58	Lot 2 on RP701633	216	2.8	0	0	0	0	0	0	0	0	USH
59	Lot 1 on RP702042	216	2.8	0	0	0	0	0	0	0	0	USH
60	Lot 2 on RP840903	216	0	0	0	0	0	0	1	0	0	USH
61	Lot 262 on T1181	224	0	0	0	0	0	20	41	38	0	Church
62	Lot 83 on T11884	227	2.8	0	0	0	0	0	0	0	0	estimated
63	Lot 137 on T11884	226	2.8	0	0	0	0	0	0	0	0	Vacant
64	Lot 14 on T118194	225	2.8	0	0	0	0	0	0	0	0	vacant
65	Lot 51 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
66	Lot 70 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
67	Lot 153 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
68	Lot 48 on T1187	224	2.8	0	0	0	0	0	0	0	0	USH
69	Lot 117 on RP703355	272	2.8	0	0	0	0	0	0	0	0	USH
70	Lot 118 on RP703355	272	2.8	0	0	0	0	0	0	0	0	USH
71	Lot 23 on RP703389	268	2.8	0	0	0	0	0	0	0	0	USH
72	Lot 2 on RP703361	272	2.8	0	0	0	0	0	0	0	0	USH
73	Lot 52 on RP706831	209	0	7.2	0	0	0	0	0	0	0	USH
74	Lot 176 on T11884	226	2.8	0	0	0	0	0	0	0	0	4 units
75	Lot 1 on RP708992	216	2.8	7.2	0	0	0	0	0	0	0	USH
76	Lot 4 on RP701633	216	2.8	0	0	0	0	0	0	0	0	4 units
77	Lot 1 on RP702085	216	2.8	0	0	0	0	0	0	0	0	USH
78	Lot 3 on RP702042	216	2.8	0	0	0	0	0	0	0	0	vacant
79	Lot 74 on T11813	216	0	0	0	0	0	0	1	0	0	KSQ Exception
80	Lot 1 on RP714466	212	2.8	0	0	0	0	0	0	0	0	Church
81	Lot 29 on RP701601	255	2.8	0	0	0	0	0	0	0	0	USH
82	Lot 16 on RP706831	209	2.8	0	0	0	0	0	2.8	0	0	1 USH
83	Lot 1 on RP716224	228	2.8	0	0	0	0	0	0	0	0	Boarding House
84	Lot 105 on T1186	222	2.8	0	0	0	0	0	0	0	0	USH
85	Lot 276 on T11868	265	0	0	0	0	0	0	1	0	0	USH
86	Lot 275 on T11868	265	0	0	0	0	0	0	1	0	0	Church
87	Lot 112 on SP130012	270	0	0	0	0	0	54	0	0	0	Church
88	Lot 48 on RP701649	254	2.8	0	0	0	0	0	0	0	0	Auction house
89	Lot 1 on RP718874	460	0	0	0	0	0	0	1	0	0	USH
90	Lot 15 on RP701784	222	2.8	0	0	0	0	0	0	0	0	Hall

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
91	Lot 169 on EP2263	255	2.8	0	0	0	0	0	2.8	0	0	USH
92	Lot 51 on RP701649	254	2.8	0	0	0	0	0	0	0	0	vacant
93	Lot 52 on RP701649	254	2.8	0	0	0	0	0	0	0	0	USH
94	Lot 102 on T11887	265	0	0	0	0	0	20	41	39	0	vacant
95	Lot 1 on RP727464	330	2.8	0	0	0	0	0	0	0	0	estimated
96	Lot 25 on RP703382	274	2.8	0	0	0	0	0	0	0	0	USH
97	Lot 4 on RP716211	474	2.8	0	0	0	0	0	0	0	0	USH
98	Lot 291 on RP703355	275	0	0	0	0	0	0	1	0	0	USH
99	Lot 292 on RP703355	275	0	0	0	0	0	0	1	0	0	Church
100	Lot 42 on RP703389	268	2.8	0	0	0	0	0	0	0	0	Church
101	Lot 172 on RP703399	279	2.8	0	0	0	0	0	0	0	0	USH
102	Lot 143 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
103	Lot 296 on RP703355	275	0	0	0	0	0	0	1	0	0	USH
104	Lot 289 on RP703355	275	0	0	0	0	0	0	1	0	0	Church
105	Lot 290 on RP703355	275	0	0	0	0	0	0	1	0	0	Church
106	Lot 30 on RP703409	287	2.8	0	0	0	0	0	0	0	0	Church
107	Lot 183 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
108	Lot 72 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
109	Lot 182 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
110	Lot 149 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
111	Lot 165 on SP116238	278	2.8	0	0	0	0	0	0	0	0	USH
112	Lot 31 on RP703409	287	2.8	0	0	0	0	0	0	0	0	USH
113	Lot 148 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
114	Lot 150 on RP703359	278	2.8	0	0	0	0	0	0	0	0	USH
115	Lot 4 on SP119505	370	2.8	0	0	0	0	0	0	0	0	USH
116	Lot 18 on RP701633	216	2.8	0	0	0	0	0	0	0	0	USH
117	Lot 2 on RP701662	217	0	0	0	0	0	13	28	26	0	FSE Exception
118	Lot 2 on RP701648	217	0	0	0	0	0	0	53	50	0	estimated
119	Lot 3 on SP123456	213	0	0	0	0	0	0	1	0	0	FSE Exception
120	Lot 1 on RP701648	217	0	0	0	0	0	1	1	0	0	Council Office
121	Lot 1 on RP701696	218	0	0	0	0	0	0	417	0	0	vacant
122	Lot 12 on T11840	216	2.8	0	0	0	0	0	0	0	0	KSQ Exception
123	Lot 2 on RP707340	217	0	0	0	0	0	10	20	19	0	USH
124	Lot 16 on RP707412	217	0	0	0	0	0	20	41	39	0	estimated

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
125	Lot 3 on RP710800	287	0	0	0	0	0	0	1	0	0	vacant
126	Lot 1 on RP701816	216	0	7.2	0	0	0	0	0	0	0	Hall
127	Lot 709 on SP135285	263	0	0	0	0	0	0	0	2	0	FSE Exception
128	Lot 24 on RP701633	216	2.8	0	0	0	0	0	0	0	0	vacant
129	Lot 72 on T11813	216	0	0	0	0	0	0	1	0	0	USH
130	Lot 1 on RP710504	225	2.8	0	0	0	0	0	0	0	0	Church
131	Lot 71 on T11813	216	0	0	0	0	0	0	1	0	0	USH
132	Lot 1 on RP701912	225	2.8	0	0	0	0	0	0	0	0	vacant
133	Lot 2 on RP701817	216	2.8	0	0	0	0	0	0	0	0	KSQ Exception
134	Lot 43 on RP703476	285	0	0	0	0	0	0	1	0	0	USH
135	Lot 6 on RP719055	317	2.8	0	0	0	0	0	0	0	0	Church
136	Lot 171 on T1181	217	0	0	0	0	0	20	31	29	0	FSE exception
137	Lot 171 on RP703537	332	2.8	0	0	0	0	0	0	0	0	estimated
138	Lot 2 on RP701659	217	0	0	0	0	0	5	12	11	0	USH
139	Lot 5 on T118604	218	0	0	0	0	0	0	100	0	0	estimated
140	Lot 20 on RP707272	217	0	0	0	0	0	10	16	15	0	estimated
141	Lot 4 on RP701778	252	2.8	0	0	0	0	0	0	0	0	estimated
142	Lot 2 on RP707272	217	0	0	0	0	0	9	14	14	0	USH
143	Lot 5 on RP701603	255	2.8	0	0	0	0	0	0	0	0	estimated
144	Lot 2 on RP725278	252	2.8	0	0	0	0	0	0	0	0	USH
145	Lot 37 on T11868	270	0	0	0	0	0	17	36	34	0	USH
146	Lot 3 on RP701778	252	2.8	0	0	0	0	0	0	0	0	estimated
147	Lot 11 on RP903759	218	0	0	0	0	0	20	41	39	0	USH
148	Lot 163 on T1181	217	0	0	0	0	0	20	31	29	0	estimated
149	Lot 2 on RP709895	217	0	1.8	0	0	0	6	0	0	0	estimated
150	Lot 2 on RP701721	217	0	0	0	0	0	10	15	14	0	1 Unit 1 shop
151	Lot 1 on RP701930	270	0	0	0	0	0	15	0	0	0	estimated
152	Lot 31 on T11860	217	0	0	0	0	0	10	15	14	0	Vacant
153	Lot 49 on RP703409	287	2.8	0	0	0	0	0	0	0	0	estimated
154	Lot 52 on RP703409	287	2.8	0	0	0	0	0	2.8	0	0	boarding house
155	Lot 1 on RP701721	217	0	0	0	0	0	10	15	14	0	boarding house
156	Lot CP on SP141326	219	0	10.8	0	0	0	0	0	0	0	Vacant
157	Lot 48 on RP703409	287	2.8	0	0	0	0	0	0	0	0	6 units
158	Lot 1 on RP712215	219	0	0	0	0	0	10	20	19	0	USH

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
159	Lot 2 on RP743712	321	2.8	0	0	0	0	0	0	0	0	School
160	Lot 6 on RP703442	291	2.8	0	0	0	0	0	0	0	0	USH
161	Lot 1 on RP708141	219	0	0	0	0	0	14	29	27	0	School
162	Lot 706 on SP112195	258	0	0	0	0	0	80	123	116	0	School
163	Lot 2 on RP709750	254	0	0	0	0	0	0	1	0	0	estimated
164	Lot 1 on RP714572	317	2.8	0	0	0	0	0	0	0	0	Church
165	Lot 2 on RP701742	219	0	0	0	0	0	3	7	6	0	USH
166	Lot 3 on RP709750	254	0	0	0	0	0	0	1	0	0	School
167	Lot 3 on RP712293	232	2.8	0	0	0	0	0	0	0	0	Church
168	Lot 169 on RP703537	332	2.8	0	0	0	0	0	0	0	0	USH
169	Lot 133 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
170	Lot 66 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
171	Lot 3 on RP701633	216	2.8	0	0	0	0	0	0	0	0	USH
172	Lot 2 on RP701632	216	2.8	0	0	0	0	0	0	0	0	USH
173	Lot 42 on RP703476	285	0	0	0	0	0	0	1	0	0	KSQ Exception
174	Lot 21 on T118288	220	2.8	0	0	0	0	0	0	0	0	Church
175	Lot 21 on T118638	265	0	0	0	0	0	0	0	0	63	Vacant
176	Lot 2 on RP748152	493	0	0	0	0	0	0	5	0	0	Transport Terminal
177	Lot 1 on RP865807	460	0	0	0	0	0	8	0	0	0	Racecourse
178	Lot 2 on RP701653	217	0	0	0	0	0	6	12	12	0	School
179	Lot 277 on T11868	265	0	0	0	0	0	0	1	0	0	School
180	Lot 3 on RP701665	217	0	0	0	0	0	8	18	17	0	FSE exception
181	Lot 170 on RP703537	332	2.8	0	0	0	0	0	0	0	0	Vacant
182	Lot 43 on RP703374	268	0	0	0	0	0	14	29	27	0	USH
183	Lot 2 on RP709434	256	0	0	0	0	0	0	1	0	0	estimated
184	Lot 3 on RP745504	230	2.8	0	0	0	0	0	0	0	0	Church
185	Lot 152 on T11884	226	0	3.6	0	0	0	0	0	0	0	USH
186	Lot 85 on T11884	227	2.8	0	0	0	0	0	0	0	0	2 Units
187	Lot 86 on T11884	227	2.8	0	0	0	0	0	0	0	0	USH
188	Lot 138 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
189	Lot 43 on RP703389	268	2.8	0	0	0	0	0	0	0	0	USH
190	Lot 4 on RP713165	224	0	0	0	0	0	17	35	33	0	USH
191	Lot 247 on EP2301	224	0	0	0	0	0	0	5	0	0	estimated
192	Lot 69 on T11884	226	2.8	0	0	0	0	0	0	0	0	Toobrook Pool

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
193	Lot 3 on RP703437	291	2.8	0	0	0	0	0	0	0	0	USH
194	Lot 7 on RP724203	293	2.8	0	0	0	0	0	0	0	0	boarding house
196	Lot 21 on RP906488	225	2.8	0	0	0	0	0	0	0	0	1 RSH
197	Lot 1 on RP739248	225	2.8	0	0	0	0	0	0	0	0	USH
198	Lot 71 on T11867	225	2.8	0	0	0	0	0	0	0	0	USH
199	Lot 1 on SP156441	216	2.8	0	0	0	0	0	0	0	0	KSQ Exception
200	Lot 2 on RP701818	216	0	5.4	0	0	0	0	0	0	0	USH
201	Lot 3 on RP701927	230	2.8	0	0	0	0	0	0	0	0	KSQ Exception
202	Lot 6 on T118212	217	0	0	0	0	0	16	33	31	0	FSE Exception
203	Lot 48 on T118117	258	0	0	0	0	0	0	1	0	0	FSE exception
204	Lot 46 on T118117	258	0	0	0	0	0	0	1	0	0	Church
205	Lot 1 on RP701632	216	2.8	0	0	0	0	0	0	0	0	Church
206	Lot 73 on T11813	216	0	0	0	0	0	0	1	0	0	USH
207	Lot 1 on RP719858	225	2.8	0	0	0	0	0	0	0	0	Church
208	Lot 2 on RP715005	268	0	0	0	0	0	1	0	0	0	FSE exception
209	Lot 1 on RP735183	217	0	0	0	0	0	35	73	69	0	shop
210	Lot 1 on RP708807	226	2.8	0	0	0	0	0	0	0	0	Vacant
211	Lot 53 on T11884	226	2.8	0	0	0	0	0	0	0	0	USH
212	Lot 2 on RP707023	225	0	5.4	0	0	0	0	0	0	0	USH
213	Lot 15 on T11840	216	2.8	0	0	0	0	0	0	0	0	3 units
214	Lot 9 on RP701633	216	2.8	0	0	0	0	0	0	0	0	included in GM
215	Lot 1 on RP717329	225	2.8	0	0	0	0	0	0	0	0	USH
216	Lot 2 on RP702042	216	2.8	0	0	0	0	0	0	0	0	1 USH
217	Lot 1 on RP701812	216	2.8	0	0	0	0	0	0	0	0	vacant
218	Lot 13 on T11840	216	2.8	0	0	0	0	0	0	0	0	USH
219	Lot 3 on SP172355	209	0	0	0	0	0	0	10	0	0	USH
220	Lot 1 on SP172355	209	0	0	0	0	0	0	10	0	0	Hotel
221	Lot 160 on EP708	209	2.8	0	0	0	0	0	0	0	0	Hotel
222	Lot 2 on SP172355	209	0	0	0	0	0	0	10	0	0	1 USH
223	Lot 158 on T118105	269	2.8	0	0	0	0	0	0	0	0	Hotel
224	Lot 99 on T118105	267	2.8	0	0	0	0	0	0	0	0	USH
225	Lot 2 on RP745103	267	2.8	0	0	0	0	0	0	0	0	USH
226	Lot 320 on T11823	214	0	0	0	0	0	20	41	39	0	USH
227	Lot 4 on RP701770	224	0	0	0	0	0	13	27	25	0	estimated

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
228	Lot 203 on T11823	460	2.8	0	0	0	0	0	0	0	0	estimated
229	Lot 2 on RP701770	224	0	0	0	0	0	9	19	18	0	USH
230	Lot 3 on RP701770	224	0	0	0	0	0	8	16	15	0	estimated
231	Lot 1 on RP748513	234	0	0	0	0	0	0	0	0	15	estimated
232	Lot 44 on RP703476	285	0	0	0	0	0	0	1	0	0	Furniture Manufacturer
233	Lot 3 on RP701851	460	2.8	0	0	0	0	0	0	0	0	Church
234	Lot 1 on RP712482	267	0	5.4	0	0	0	0	0	0	0	USH
235	Lot 32 on RP703409	287	2.8	0	0	0	0	0	0	0	0	3 units
236	Lot 51 on SP126582	278	0	0	0	0	0	3	0	0	0	School
237	Lot 28 on T118117	258	2.8	0	0	0	0	0	0	0	0	Shop
238	Lot 1 on RP715489	209	0	7.2	0	0	0	0	0	0	0	vacant
239	Lot 2 on T118125	226	2.8	0	0	0	0	0	0	0	0	4 units
240	Lot 75 on T118105	267	0	0	0	0	0	0	1	0	0	USH
241	Lot 87 on T118105	267	0	0	0	0	0	0	1	0	0	Church
242	Lot 72 on T118105	267	0	0	0	0	0	0	1	0	0	Church
243	Lot 88 on T118105	267	0	0	0	0	0	0	1	0	0	Church
244	Lot 71 on T118105	267	0	0	0	0	0	0	1	0	0	Church
245	Lot 74 on T118105	267	0	0	0	0	0	0	1	0	0	Church
246	Lot 73 on T118105	267	0	0	0	0	0	0	1	0	0	Church
247	Lot 89 on T118105	267	0	0	0	0	0	0	1	0	0	Church
248	Lot 90 on T118105	267	0	0	0	0	0	0	1	0	0	Church
249	Lot 37 on T11813	224	0	0	0	0	0	20	41	39	0	vacant
250	Lot 18 on T11840	216	0	9	0	0	0	0	0	0	0	estimated
251	Lot 55 on T11813	216	2.8	0	0	0	0	0	0	0	0	5 units
252	Lot 1 on RP701662	217	0	0	0	0	0	6	13	13	0	FSE exception
253	Lot 2 on RP725371	459	0	0	0	2.8	0	0	0	0	0	estimated
254	Lot 156 on T118192	249	0	0	0	0	0	0	1	0	0	School
255	Lot 157 on T118192	249	0	0	0	0	0	0	1	0	0	Church
256	Lot 202 on CP895209	211	2.8	0	0	0	0	0	0	0	0	Church
257	Lot 43 on T11868	270	0	0	0	0	0	20	41	39	0	School
258	Lot 35 on T11868	270	0	0	0	0	0	20	41	39	0	estimated
259	Lot 1 on RP701722	254	2.8	0	0	0	0	0	0	0	0	Vacant
260	Lot 219 on T1181	218	0	0	0	0	0	20	41	39	0	USH
261	Lot 2 on RP701959	265	2.8	0	0	0	0	0	0	0	0	estimated

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
262	Lot 23 on RP745734	219	0	0	0	0	0	10	20	19	0	Vacant
263	Lot 6 on RP745498	254	2.8	0	0	0	0	0	0	0	0	School
264	Lot 219 on T1186	228	2.8	0	0	0	0	0	0	0	0	USH
265	Lot 36 on T11868	270	0	0	0	0	0	7	0	0	0	USH
266	Lot 1 on RP709895	217	0	1.8	0	0	0	6	0	0	0	restaurant
267	Lot 33 on T11860	217	0	0	0	0	0	10	20	19	0	1 Unit 1 shop
268	Lot 170 on EP2263	255	2.8	0	0	0	0	0	2.8	0	0	estimated
269	Lot 105 on RP703355	272	2.8	0	0	0	0	0	0	0	0	Boarding House
270	Lot 1 on RP738946	179	0	3.6	0	0	0	0	0	0	0	USH
271	Lot 401 on P8363	100	2.8	0	0	0	0	0	0	0	0	2 Units
272	Lot 633 on EP1908	243	0	0	0	0	0	0	0	200	0	1 USH
273	Lot 254 on T11869	252	2.8	0	0	0	0	0	0	0	0	office
274	Lot 4 on SP120464	267	2.8	0	0	0	0	0	0	0	0	USH
275	Lot 63 on RP748781	209	0	0	0	0	0	0	6	0	0	USH
276	Lot 1 on RP739077	460	0	0	0	0	0	86	0	0	0	Alma Den
277	Lot 304 on T11823	460	0	0	0	0	0	0	1	0	0	estimated
278	Lot 319 on T11823	214	0	0	0	0	0	0	1	0	0	Church
279	Lot 1 on SP188739	260	2.8	0	0	0	0	0	0	0	0	Prison
280	Lot 1 on SP229803	214	0	0	0	0	0	49	75	71	0	USH
281	Lot 1 on RP726632	459	0	0	0	2.8	0	0	0	0	0	KSQ Exception
281	Lot 1 on RP726632	459	0	0	0	2.8	0	0	0	0	0	KSQ Exception
282	Lot 294 on RP703355	275	0	0	0	0	0	0	1	0	0	vacant
283	Lot 295 on RP703355	275	0	0	0	0	0	0	1	0	0	Church
284	Lot 4 on CWL812290	100	0	0	0	0	0	0	1	0	0	Church
285	Lot 123 on RP703476	285	2.8	0	0	0	0	0	0	0	0	Church
286	Lot 122 on RP703476	285	2.8	0	0	0	0	0	0	0	0	USH
287	Lot 14 on T11834	460	2.8	0	0	0	0	0	0	0	0	USH
288	Lot 293 on RP703355	275	0	0	0	0	0	0	1	0	0	USH
289	Lot 15 on T11834	460	2.8	0	0	0	0	0	0	0	0	Vacant
290	Lot 3 on RP882869	129	0	0	0	0	0	0	1	0	0	USH
291	Lot 4 on RP736178	123	0	0	2.8	0	0	0	0	0	0	Church
292	Lot 4 on RP736178	123	0	0	2.8	0	0	0	0	0	0	USH
293	Lot 203 on P8363	100	2.8	0	0	0	0	0	0	0	0	Vacant
294	Lot 89 on CWL1621	100	0	0	0	0	0	0	5	0	0	USH

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
295	Lot 308 on P8363	100	2.8	0	0	0	0	0	0	0	0	School (Paluma)
296	Lot 2 on RP716527	217	0	0	0	0	0	14	29	27	0	Masonic Lodge
297	Lot 44 on T118114	231	2.8	0	0	0	0	0	0	0	0	estimated
298	Lot 43 on T118114	231	2.8	0	0	0	0	0	0	0	0	USH
299	Lot 491 on E12463	393	0	0	0	0	0	0	1	0	0	Vacant
300	Lot 3 on RP721229	230	2.8	0	0	0	0	0	0	0	0	Church
301	Lot 2 on RP882869	129	0	0	0	0	0	0	1	0	0	vacant
302	Lot CP on SP175565	462	2.8	0	0	0	0	0	0	0	0	FSE exception
303	Lot 2 on RP709839	462	2.8	0	0	0	0	0	0	0	0	FSE exception
304	Lot 323 on T118105	270	0	0	0	0	0	20	41	39	0	FSE exception
305	Lot 181 on T1181	219	0	0	0	0	0	20	41	39	0	School
306	Lot 16 on P83615	100	2.8	0	0	0	0	0	0	0	0	water tank vacant
307	Lot 6 on P8366	100	2.8	0	0	0	0	0	0	0	0	1 USH
308	Lot 1 on P8363	100	2.8	0	0	0	0	0	0	0	0	USH
309	Lot 41 on T11884	226	2.8	0	0	0	0	0	0	0	0	Old school Horseshoe Bay Vacant
310	Lot 132 on T11888	234	2.8	0	0	0	0	0	0	0	0	vacant
311	Lot 2 on RP718721	217	0	0	0	0	0	0	23	22	0	USH
312	Lot 1 on RP701927	230	2.8	0	0	0	0	0	0	0	0	vacant
313	Lot 182 on T1181	219	0	0	0	0	0	20	41	39	0	USH
314	Lot 6 on P8368	100	2.8	0	0	0	0	0	0	0	0	estimated
315	Lot 2 on RP717551	283	2.8	0	0	0	0	0	0	0	0	USH
316	Lot 3 on RP701722	254	2.8	0	0	0	0	0	0	0	0	USH
317	Lot 2 on SP123456	213	0	0	0	0	0	0	1	0	0	USH
318	Lot 33 on RP703409	287	2.8	0	0	0	0	0	0	0	0	Church
319	Lot 2 on RP701722	254	2.8	0	0	0	0	0	0	0	0	USH
320	Lot 6 on RP706869	223	0	7.2	0	0	0	0	0	0	0	USH
321	Lot 47 on RP701649	254	2.8	0	0	0	0	0	0	0	0	4 units
322	Lot 2 on RP710003	224	0	0	0	0	0	0	1	0	0	USH
323	Lot 2 on RP701606	255	2.8	0	0	0	0	0	0	0	0	Church
324	Lot 1 on RP743522	178	2.8	0	0	0	0	0	0	0	0	Vacant
325	Lot 102 on B9031	107	2.8	0	0	0	0	0	0	0	0	USH
326	Lot 2 on SP212760	217	0	0	0	0	0	11	23	21	0	USH
327	Lot 9 on T118290	258	0	0	0	0	0	16	24	23	0	Vacant
328	Lot 1 on RP723447	466	0	0	0	0	0	0	0	0	4	estimated
329	Lot 1 on SP239094	100	2.8	0	0	0	0	0	0	0	0	Sewerage Treatment Plant Mt St John)

ID	Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				Comment
			Single (Urban)	Multiple	Rural Residential	Rural	Other	Retail	Service	Professional	Industrial	
330	Lot 1 on RP716539	225	2.8	0	0	0	0	0	0	0	0	USH
331	Lot 5 on RP711405	284	2.8	0	0	0	0	0	0	0	0	FSR and HSR exceptions
332	Lot 716 on T118501	217	0	0	0	0	0	0	306	0	0	Vacant
333	Lot 453 on EP1600	217	0	0	0	0	0	0	1	0	0	Courthouse
334	Lot CP on SP222359	217	0	0	0	0	0	36	75	71	0	Vacant
335	Lot 224 on RP713516	252	0	0	0	0	0	0	30	0	0	vacant
336	Lot 16 on SP236486	225	2.8	0	0	0	0	0	0	0	0	Green Street SES

Table 4.2.2.4-Assumed population, housing and employment exceptions (special cases)

Description	GMZ	Ultimate population by dwelling					Ultimate employment by category				
		Single (Urban)	Multiple	Rural Res.	Rural	Other	Retail	Service	Professional	Industrial	Other
Breakwater	215	73	2,129	0	0	3	134	1,800	79	0	17
Breakwater	461	46	434	0	0	117	6	10	8	2	4
North Ward Hospital site	225	0	365	0	0	0	115	135	103	0	3
JCU Discovery Rise	385	4,424	1,267	0	0	838	70	2,383	106	0	3
Hospital	510	14	0	0	0	0	0	700	47	5	0
Hospital	511	6	4	0	0	36	26	4,720	77	16	0
Port	261	0	0	0	0	0	0	0	0	500	0
Port	262	0	0	0	0	0	0	0	0	0	0
Port	264	0	0	0	0	0	0	0	0	500	0
Port	266	0	0	0	0	0	0	0	0	360	0
QNI	194	0	0	0	0	0	13	3	300	1,497	5
Defence land RAAF	247	0	0	0	0	100	0	0	0	0	800
Defence Lavarack	375	70	4	0	0	2000	22	147	5,200	56	143
Airport	246	0	0	0	0	0	118	208	693	500	30
Rocky Springs	457	30,992	0	0	0	0	2,132	3,117	998	1,159	533
Rocky Springs	206	1,812	0	0	0	0	99	190	179	0	18
Flinders Street East	462	0	0	0	0	0	400	620	590	0	0
Honeycombes' Development	214	0	1080	0	0	0	132	163	154	0	9
Historic Rail Station	219	0	0	0	0	0	0	121	115	0	0
Kings Street Quarter	462	0	1161	0	0	0	936	2522	2382	0	9
Dean Park Car Park	270	0	0	0	0	0	27	196	11	108	18
South Townsville Rail Yards	277	0	0	0	0	0	116	823	46	452	75

Click here to view PDF high resolution map - Special Exceptions

Figure 4.2.2.1 - Location of areas 'exception' to the land use zones and precinct assumptions

Table 4.2.2.5-Delayed start date for growth associated with preliminary approvals

Application	Development	Description	GMZ	Start Date
MI10/0055	Cosgrove	Master planned community (2,300 residential lots, etc)	238	2013
MI08/0067	Owens & Turner	Master planned community (3,600 residential lots, etc)	444, 445	2019
M85/07	Harris, Hogarth & Goffage	+350 residental lots	117	2016
MI08/0069	Owens & Turner	Commercial & retail uses	452	2017
MI07/0092	Rocky Springs	Master planned community (12,500 residential lots, etc)	206, 457	2017

Table 4.2.2.6-Residential dwelling and non-residential floor space assumption summary

Column 1 Description		Column 2 - Assumptions					
		2011	2016	2021	2026	2031	Ultimate
Housing	Single	54,888	61,077	66,506	72,323	78,272	111,270
	Multiple dwelling	13,953	15,453	16,660	18,011	19,378	48,402
	Other	1,457	1,725	2,037	2,300	2,528	3,137
	Total	70,297	78,255	85,203	92,634	100,178	162,809
Non-residential floor space (m2 GFA)	Retail	461,763	507,181	527,337	566,167	602,706	2,821,490
	Services	540,616	593,790	628,740	673,697	717,086	2,184,806
	Professional	394,972	433,821	460,149	492,564	524,608	1,591,110
	Industrial	1,840,690	2,021,739	2,171,477	2,324,357	2,471,865	8,872,650
	Other	53,358	58,606	61,486	65,979	70,384	438,460
	Total	3,291,397	3,615,138	3,849,188	4,122,764	4,386,648	15,908,516

Table 4.2.2.7-Education assumptions summary

Column 1 Description		Column 2 - Assumptions					
		2011	2016	2021	2026	2031	Ultimate
Education enrolments	Pre-primary	18,712	19,792	20,473	21,140	21,759	23,752
	Secondary	12,892	13,636	14,104	14,591	15,062	16,500
	Tertiary	13,775	15,137	16,208	17,317	18,411	19,213
	Total	45,379	48,565	50,785	53,048	55,232	59,464

Editor's note—Student enrolments are also a critical aspect of infrastructure planning, so their assumptions and projections have been made in addition, and supplementary to, the statutory requirements of the LGIP.

(5) Detailed assumptions about future development for each projection area and LGIP development type are identified in the following tables in Schedule 3 - Local government infrastructure plan mapping and tables:

(a) Table SC3.1.3 - Existing and projected residential dwellings;

(b) Table SC3.1.4 - Existing and projected non-residential floor space; and

(c) Table SC3.1.5 - Existing and projected education enrolments.

Editor's note—More detailed projections by growth model zone areas are available in the extrinsic material. Projections are based on the Townsville Growth Model (18.5.2016), moderated to provide for an earlier start for Rocky Springs, and a later start for Mt Low Developments.

4.2.3 Infrastructure demand

(1) The demand generation rate for a trunk infrastructure network is stated in Column 4 of Table SC3.1.6a and Table SC3.1.6b, Schedule 3, Local government infrastructure plan mapping and tables.

These rates are for land which is, respectively, less than or greater than thresholds of size that represent infill or broad-hectare development that correlate with the development assumptions in section 4.2.2.

(2) The service catchments are identified in Schedule 3 Local government infrastructure plan mapping and tables, SC3.3.3 – Service area maps. They are also shown in finer detail in the plans for trunk infrastructure[1].

(3) A summary of the projected infrastructure demand for each service catchment is stated in Table 4.2.3.1 to Table 4.2.3.5.

[1] This is different to the LGIP template. Reference to the service catchment maps are made here rather than from the tables.

Table 4.2.3.1 - Water supply demand summary

Service area	Water supply demand (EP)					
	2011	2016	2021	2026	2031	Ultimate
Central, urban	187,710	209,269	225,917	244,467	265,694	467,262
Central, non-urban	19,337	20,751	23,172	24,696	25,754	32,712
Cungulla	395	419	442	464	497	881
Magnetic Island, urban	2,666	2,868	3,015	3,193	3,416	9,358
Magnetic Island, non-urban	111	116	121	127	134	224
Paluma	134	134	134	134	134	156
Total	210,354	233,558	252,800	273,080	295,630	510,591

Table 4.2.3.2 - Sewerage demand summary

Service area	Sewerage demand (EP)					
	2011	2016	2021	2026	2031	Ultimate
Central, urban	198,157	220,564	237,732	256,957	278,830	496,803
Central, non-urban	741	1,049	1,233	1,438	1,621	4,222
Magnetic Island, urban	2,737	2,940	3,086	3,265	3,489	9,656
Magnetic Island, non-urban	-	-	-	-	-	-
Toomulla	158	165	170	176	184	308
Total	201,793	224,718	242,221	261,835	284,124	510,989

Table 4.2.3.3 - Roads demand summary

Service area	Roads demand (Trip ends/d)					
	2011	2016	2021	2026	2031	Ultimate
Central, urban	1,048,626	1,158,434	1,238,356	1,331,976	1,431,161	3,696,195
Central, non-urban	41,936	47,904	56,563	64,895	66,317	130,445
Magnetic Island, urban	12,314	12,860	13,250	13,732	14,333	46,047
Magnetic Island, non-urban	427	447	465	488	514	843
Rural	49,812	52,685	55,071	57,760	60,701	216,995
Total	1,153,114	1,272,328	1,363,705	1,468,852	1,573,025	4,090,524

Table 4.2.3.4 - Pathways demand summary

Service area	Pathways demand (Trip ends/d)					
	2011	2016	2021	2026	2031	Ultimate
Urban	47,012	51,581	55,011	58,693	62,754	93,483
Non-urban	-	-	-	-	-	-
Total	47,012	51,581	55,011	58,693	62,754	93,483

Table 4.2.3.5 - Parks and land for community facilities demand summary

Service area	Parks etc demand (ERP)					
	2011	2016	2021	2026	2031	Ultimate
Urban	157,017	173,427	185,631	198,840	214,763	359,605
Non-urban	23,097	24,403	26,857	29,209	29,130	44,741
Total	180,114	197,830	212,488	228,049	243,892	404,346

4.3 Priority infrastructure area

(1) The priority infrastructure area identifies the area prioritised for the provision of trunk infrastructure to service the existing and assumed future urban development up to 2026.

(2) The priority infrastructure area is identified in Schedule 3 - Local government infrastructure plan mapping and tables, SC3.3.4 - Priority infrastructure area map.

4.4 Desired standards of service

(1) This section states the key standards of performance for a trunk infrastructure network.

(2) Details of the standard of service for a trunk infrastructure networks are identified in the extrinsic material.

4.4.1 Water supply

The water supply desired standards of service is to:

(1) Ensure drinking water complies with the National Health and Medical Research Council (NHMRC) Australian drinking water guidelines for colour, turbidity and microbiology.

(2) Collect, store, treat and convey potable water from source to consumers in accordance with the *Water Act 2000*.

(3) Minimise non-revenue water loss.

(4) Design the water supply network in accordance with council's adopted standards identified in the planning scheme to provide:

  (a) average day consumption (AD) – 600 l/EP/day;

  (b) minimum and maximum supply pressure of 220 kPa and 800 kPa at each property boundary; and

  (c) fire flow for residential (15 l/s for 2 hours), industrial and commercial (30 l/s for 4 hours) development.

(5) Ensure water systems meet the requirements of the *Water Supply (Safety and Reliability) Act 2008*.

4.4.2 Sewerage

The sewerage desired standards of service is to:

(1) Provide a reliable network that collects, stores, transports, treats and releases sewerage from premises.

(2) Design the sewerage network in accordance with:

  (a) council's adopted standards identified in the planning scheme;

  (b) Water Services Association of Australia (WSAA) guidelines;

  (c) the *Water Act 2000*;

  (d) the requirements of the *Water Supply (Safety and Reliability) Act 2008*;

  (e) all Environment Protection (EPA) legislation, regulations and licence conditions; and

  (f) key design parameters identified in Table 4.4.2.1.

Table 4.4.2.1 - Key design parameters for the sewerage network

Infrastructure item	Design parameters
All (network)	average dry weather flow (ADWF) - 230 l/EP/day peak wet weather flow (PWWF) - 5 x ADWF or C1 x ADWF (whichever is larger). C1 = $15x(EP)^{-0.1587}$
Pump stations	emergency storage of 6 hrs @ ADWF in pump stations and contributing gravity sewer catchments. installed large pump capacity - PWWF installed small pump capacity - 2 x ADWF
Gravity sewers	air space of at least 30% of pipe diameter at design flow slope to achieve self-cleansing velocity
Rising mains	minimum velocity for small pump: 0.5 m/s minimum velocity for large pump: 0.75 m/s maximum velocity: 2.5 m/s
Sewerage treatment/release	existing and future DEHP licence conditions, Recycled Water Management Plan requirements, EPBC requirements, biosolids guidelines and other relevant state and federal government guidelines and legislation.

The above table provides a summary of a few of the key design parameters for the sewage network. Reference should be made to the full council planning and design standards in the relevant planning scheme code and policy along with

other nominated standards, guidelines and legalisation for the planning and design of sewerage networks.

4.4.3 Roads

The roads desired standards of service is to:

(1) Provide a functional, safe and efficient road hierarchy that supports settlement patterns, commercial and economic activities, and freight movement.

(2) Design the road network to comply with the following:

(a) adopted standards identified in the planning scheme, and where deficient: the Department of Transport and Main Roads' Interim Guide to Road Planning and Design or the AUSTROADS guides;

(b) maximum road volume to capacity ratios (Table 4.4.3.1); and

(c) maximum degree of saturation for intersections (Table 4.4.3.2).

Table 4.4.3.1 - Maximum volume to capacity ratios for the road network

Infrastructure item	Maximum volume to capacity ratio by land use	
	Residential	Non-residential
Arterial	0.75	0.75
Sub-arterial	0.75	0.75
Major collector	0.75	0.75
Arterial (state-controlled)	0.75	0.75

Table 4.4.3.2 - Maximum degree of saturation for road intersections

Road network item	Maximum degree of saturation
Traffic signals	0.8
Roundabout	0.8
Priority controlled	0.8
Traffic signals (state-controlled)	0.8

4.4.4 Footpaths and cycleways network

The footpaths and cycleways desired standards of service is to:

(1) Provide a safe, attractive and convenient network that links residential areas to major activity nodes and public transport interchanges, thereby encouraging walking and cycling as acceptable travel alternatives; and

(2) Comply with council's adopted standards identified in the planning scheme, and Table 4.4.4.1.

Table 4.4.4.1 - Key footpath and cycleway design characteristics

Characteristic	Description
Coherence	Continuity of routes, consistent quality of routes and facilities, easy to follow, freedom of choice of routes.
Directness	Efficient operating speed, minimal delay times on commuting routes, avoid detour effects.
Safety	Minimal risk of accidents, conflict with motorised traffic or exposure to unsafe infrastructure.
Attractiveness	Lighting, personal safety, aesthetics, integration with surrounding area, access to different activities.
Comfort	Smooth, skid resistant surfaces, gentle gradients, minimal obstructions, minimal need to stop, minimal complicated movements, protection from adverse weather, journey facilities (e.g. seats, shade, drinking fountains).

4.4.5 Public parks and land for community facilities network

The parks and land for community facilities DSS is to:

(1) Provide an accessible network of parks, open space, and opportunities for co-located community facilities that meets the needs of residents and visitors in accordance with the rate of provision identified in Table 4.4.5.1 and accessibility standards outlined in Table 4.4.5.2.

(2) Ensure land for public parks and community facilities has:

(a) minimum land size as identified in Table 4.4.5.3;

(b) configuration, slope, and acceptable level of flood immunity in accordance with adopted standards identified in Table 4.4.5.3; and

(c) embellish public parks to complement the type and purpose of the public park as identified in Table 4.4.5.4.

Table 4.4.5.1 - Park provision

Infrastructure	Rate of provision (m^2/ERP)	
	District	Regional
Recreation parks	4	6
Sports parks	12	5

Table 4.4.5.2 - Park access

Infrastructure	Accessibility standard (km)	
	District	Regional
Recreation parks	2	25
Sports parks	5	10

Table 4.4.5.3 - Land characteristics

Infrastructure	Recreation parks		Sports parks	
	District	Regional	District	Regional
Minimum usable size (ha)	2	6	3	10
Average (desired) size (ha)	4	13	6	18
Shape of land	Preferred square or rectangular aspect ratio no greater than 2:1		To maximise area available for playing fields, a square or rectangle is most efficient	
Minimum desired flood immunity	20% of total area to be above Q50, 10% to be above Q100	50% of total area to be above Q50, 20% to be above Q100	Free of hazards. Fields and courts above Q50. Built facilities above Q100	
Maximum desired grade	Average grade of 1:14 for 50% of site		1:80 for all playing surfaces. Laser levelling to a maximum gradient of 1:100	
Road frontage and visibility	50% of park perimeter to have direct road frontage, preferably on a collector road		Approximately 25-50% of the park perimeter to have direct road frontage	

Table 4.4.5.4 - Standard facilities/embellishments for trunk public parks

Embellishment type	Recreation parks		Sport parks	
	District	Regional	District	Regional
Playground	✓	✓		
Half-basketball court	✓	✓		
Re-bound wall	✓	✓		
Skate facility	✓	✓		
Exercise equipment	✓	✓		
Fencing – bollards or log and rail to prohibit car access	✓	✓	✓	✓
Shade trees clustered near activity areas	✓	✓	✓	✓
Turf	✓	✓	✓	✓
Landscaped garden beds	✓	✓	✓	✓
Irrigation	✓	✓	✓	✓
Lighting	✓	✓	✓	✓
Internal pathways and paving	✓	✓	✓	✓
Bicycle racks	✓	✓	✓	✓
Signage	✓	✓	✓	✓
Shade structures	✓	✓	✓	✓
Tap/bubbler	✓	✓	✓	✓
Bench seating	✓	✓	✓	✓
Electric barbeque	✓	✓		
Picnic shelters	✓	✓	✓	✓
Bins	✓	✓	✓	✓
Dog off-leash areas	✓	✓		
Toilets	✓	✓	✓	✓
Internal roads and car parking		✓	✓	✓
Clubhouse			✓	✓
Spectator facilities			✓	✓
Sports fields			✓	✓
Sports courts			✓	✓

4.5 Plans for trunk infrastructure

(1) The plans for trunk infrastructure identify the trunk infrastructure networks intended to service the existing and assumed future urban development at the desired standard of service up to 2031.

4.5.1 Plans for trunk infrastructure maps

(1) The existing and future trunk infrastructure networks are shown on the following maps in Schedule 3-Local government infrastructure plan mapping and tables:

(a) SC3.3.5 - Plans for trunk water supply infrastructure;

(b) SC3.3.6 - Plans for trunk sewerage infrastructure;

(c) SC3.3.7 - Plans for trunk roads infrastructure;

(d) SC3.3.8 - Plan for trunk footpaths and cycleways infrastructure;

(e) SC3.3.9 - Plan for trunk parks and land for community facilities infrastructure.

(2) The State infrastructure forming part of transport trunk infrastructure network has been identified using information provided by the relevant State infrastructure supplier.

4.5.2 Schedules of works

(1) Details of the existing and future trunk infrastructure networks are identified in the electronic Excel schedule of works model which can be viewed on council's website (Click here).

(2) The future trunk infrastructure is identified in the following tables in Schedule 3-Local government infrastructure plan mapping and tables:

(a) for the water supply network, Table SC3.3.5.1

(b) for the sewerage network, Table SC3.3.6.1

(c) for the road network, Table SC3.3.7.1

(d) for the footpath and cycleway network, Table SC3.3.8.1

(e) for the parks and land for community facilities network, Table SC3.3.9.1

Editor's note—Extrinsic material

The below table identifies the documents that assist in the interpretation of the local government infrastructure plan and are extrinsic material under the *Statutory Instruments Act 1992*.

List of extrinsic material

Column 1 **Title of document**	**Column 2** **Date**	**Column 3** **Author**
Local government infrastructure plan – planning assumptions & PIA. Townsville City Council.	11.4.17	D. Irwin
Local government infrastructure plan – DSS, definitions and demand. Townsville City Council.	11.4.17	D. Irwin
Local government infrastructure plan – PFTI. Townsville City Council.	11.4.17	D. Irwin
Local government infrastructure plan – alignment with the long term financial plan. Townsville City Council.	11.4.17	D. Irwin
Local government infrastructure plan – SOW model user manual. Townsville City Council.	11.4.17	D. Irwin
LGIP projections and densities. EXCEL spreadsheet. Townsville City Council	11.4.17	D. Irwin
PIP water infrastructure planning summary of water supply strategies. DPM Water Pty Ltd report for Townsville City Council. (37386545)	2013	DPM Water Pty Ltd
PIP sewer infrastructure planning summary of sewer strategies. DPM Water Pty Ltd report for Townsville City Council (37386503)	Jan 2013	DPM Water Pty Ltd
Townsville City Council road network planning report . Townsville City Council (78587969).	Nov 2014	B. Bailey

Townsville City Council report for footpath and cycleway network for priority infrastructure plans. Townsville City Council (37384255).	Jan 2013	B. Bailey
Townsville City Council parks planning report (94191754)	14.3.17	D. Irwin

4.6 Definitions

This local government infrastructure plan has been prepared as part of a planning scheme compliant with the Queensland Planning Provisions version 3.0, 17 February 2013. As such, terms defined elsewhere in the planning scheme are applicable here. In addition, the following terms also apply.

Table 4.6.1 - Zoning code abbreviations

Note – these are not a complete list, but are relevant to the tables elsewhere in this local government infrastructure plan and relate to zones described in the planning scheme.

Abbreviation	Zoning
CF	Community Facilities
CR	Character Residential
DC	District Centre
EC	Emerging Communities
HDR	High Density Residential
HII	High Impact Industry
LC	Local Centre
LDR	Low Density Residential
LII	Low Impact Industry
MC	Major Centre
MDR	Medium Density Residential
MII	Medium Impact Industry
MU	Mixed Use
NC	Neighbourhood Centre
OS	Open Space
PC	Principal Centre
RR	Rural Residential
RUR	Rural
SC	Specialised Centre
SR	Sport and Recreation

Table 4.6.2 - Precinct code abbreviations

Note - these are not a complete list, but are relevant to the tables elsewhere in this local government infrastructure plan and relate to precincts described in the planning scheme, or growth model precincts identified in the extrinsic material.

Abbreviation	Precinct
AC	Arcadia Central
ACC	Aitkenvale Centre Core
ACF	Aitkenvale Centre Frame
AMC	Aitkenvale Major Centre
AMD	Aitkenvale Medium Density
AV	Aitkenvale Village
BBCG	Balgal Beach Golf Course
BRM	Bayswater Road Medical - Mixed use precinct
C	Cungulla
CA	Civic Administration
CBDG	Sturt Street Gateway
CTR	Charters Towers Road Business - Mixed Use precinct
D	Domain Central (growth model precinct)
FRM	Fulham Road Medical (growth model precinct)
FSR	Flinders Street Retail
H	Horticulture
HPMC	Hyde Park Major Centre

Abbreviation	Precinct
HPMD	Hyde Park Medium Density
J	Jensen
KR	Kings Road
KT	Kirwan Traders
MCF1	Major Centre Fringe 1 (growth model precinct)
MCF2	Major Center Fringe 2 (growth model precinct)
MCF3	Major Center Fringe 3 (growth model precinct)
MCNS	Major Center North Shore (growth model precinct)
MH	Mater Hospital (growth model precinct)
MHF1	Mater Hospital Frame 1 (growth model precinct)
MHF2	Mater Hospital Frame 2 (growth model precinct)
NBG	Nelly Bay Gateway
NBT	Nelly Bay Tourist
NWV	North Ward Villages
PB	Picnic Bay
PS	Palmer Street
R	Riverway
RRRC	Ross River Road Corridor (growth model precinct)
RRRD	Rural Residential Ross Dam (growth model precinct)
S	The Strand
STRD	South Townsville Rail yards and Dean Park
TCMC	Thuringowa Central Major Centre
TSDA	Townsville State Development Area (model precinct)
WS	Wotton Street

Table 4.6.3 - Sub-precinct code abbreviations

Note - these are not a complete list, but are relevant to the tables elsewhere in this local government infrastructure plan and relate to sub-precincts described in the planning scheme, or growth model precincts identified in the extrinsic material.

Abbreviation	Sub-precinct
BP	Buffer (TSDA) – (growth model precinct)
ECP	Environmental Conservation (TSDA) – (growth model precinct)
ECOP	Ecological Corridor & Offsets (TSDA) – (growth model precinct)
HIIP	High Impact Industry (TSDA) – (growth model precinct)
LMI	Low Medium Impact Industry (TSDA) – (growth model precinct)
TCS	Thuringowa Centre Support
TD	Thuringowa Drive

Part 5 Tables of assessment

5.1 Preliminary

The tables in this part identify the category of development, and the category of assessment and assessment benchmarks for assessable development in the planning scheme area.

5.2 Reading the tables

The tables identify the following:

(1) The category of development:

- (a) prohibited;
- (b) accepted, including accepted with requirements; and
- (c) assessable development: that requires code or impact assessment

(2) The category of assessment - code or impact - for assessable development in:

- (a) a zone and, where used, a precinct or sub-precinct of a zone;
- (b) an overlay where used.

(3) the assessment benchmarks for assessable development and requirements for accepted development, including:

- (a) whether a zone code or specific provisions in the zone code apply (shown in the 'assessment benchmarks for assessable development and requirements for accepted development' column);
- (b) if there is an overlay:
  - (i) whether an overlay code applies (shown in Table 5.9.1); or
  - (ii) whether the assessment benchmarks as shown on the overlay map (noted in the 'assessment benchmarks for assessable development and requirements for accepted development' column) applies;
- (c) any other applicable code(s) (shown in the 'assessment benchmarks for assessable development and requirements for accepted development' column).
- (d) any requirements for accepted development which will need to be met in order for the development to remain accepted.

(4) any variation to the category of assessment (shown as an 'if' in the 'Categories of development and assessment' column) that applies to the development.

Note—Development will only be taken to be prohibited development under the planning scheme if it is identified as prohibited development in schedule 10 of the Regulation.

Editor's note—Examples of matters that can vary the categories of development and assessment are gross floor area, height, numbers of people or precinct provisions.

5.3 Categories of development and assessment

5.3.1 Process for determining the category of development and the category of assessment for assessable development

The process for determining a category of development and category of assessment is:

(1) for a material change of use, establish the use by reference to the use definitions in Schedule 1;

(2) for all development, identify the following:

(a) the zone or zone precinct that applies to the premises, by reference to the zone map in Schedule 2;

Editor's note—Local plans are not used in this planning scheme.

(b) if an overlay applies to the premises, by reference to the overlay map in Schedule 2;

(3) determine if the development is accepted development under schedule 6 of the Regulation.

Editor's note—Schedule 6 of the Regulation prescribes development that a planning scheme can not state is assessable development where the matters identified in the schedule are met.

(4) if the development is not regulated by the Regulation, determine the initial level of assessment by reference to the tables in:

- section 5.5 Categories of development and assessment -Material change of use,
- section 5.6 Categories of development and assessment -Reconfiguring a lot,
- section 5.7 Categories of development and assessment -Building work,
- section 5.8 Categories of development and assessment -Operational work;

(5) a precinct of a zone may change the categories of development and assessment and this will be shown in the 'categories of development and assessment' column of each of the tables in sections 5.5, 5.6, 5.7, and 5.8;

(6) if an overlay applies, refer to section 5.9 Categories of development and assessment-Overlays, to determine if the overlay further changes the category of development or assessment;

5.3.2 Determining the category of development and categories of assessment

(1) A material change of use is assessable development:

(a) unless the tables in section 5.5 Categories of development and assessment state otherwise;

(b) if a use is not listed or defined in the tables in section 5.5 Categories of development and assessment;

(c) unless otherwise prescribed within the Act or the Regulation.

(2) Reconfiguring a lot is assessable development requiring code assessment unless the tables in section 5.6 Categories of development and assessment state otherwise or unless otherwise prescribed within the Act or the Regulation.

(3) Building work and operational work are accepted development, unless the tables in sections 5.7 and 5.8 Categories of development and assessment state otherwise or unless otherwise prescribed within the Act or the Regulation.

(4) Where an aspect of development is proposed on premises included in more than one zone or overlay, category of development and assessment for that aspect is the highest category for each aspect of the development under each of the applicable zones or overlays.

(5) Where development is proposed on premises partly affected by an overlay, the category of development for assessment for the overlay only relates to the part of the premises affected by the overlay.

(6) For the purposes of Schedule 6, Part 2 Material change of use section (2)(2)(d)(i) or (ii) of the Regulation, an overlay does not apply to the premises if the development meets the acceptable outcomes that form the requirements for accepted development in the relevant overlay code.

(7) If development is identified as having a different category of development or category of assessment under a zone than under an overlay, the highest category of development or assessment applies as follows:

(a) accepted development subject to requirements prevails over accepted development;

(b) code assessment prevails over accepted development where subject to requirements and accepted

development;

(c) impact assessment prevails over code assessment, accepted development where subject to requirements and accepted development.

(8) Provisions of Part 10 may override any of the above.

(9) The category of development prescribed under schedule 6 of the Regulation overrides all other categories of development or assessment for that development under the planning scheme to the extent of any inconsistency.

(10) Despite all of the above, if development is listed as prohibited development under schedule 10 of the Regulation, a development application cannot be made.

Editor's note - Schedule 7 of the Regulation also identifies development that the state categorises as accepted development. Some development in the schedule may still be made assessable under the planning scheme.

Note—Development is to be taken to be prohibited development under the planning scheme only if it is identified in schedule 10 of the Regulations.

5.3.3 Determining the requirements for accepted development and assessment benchmarks and other matters for assessable development

(1) Accepted development does not require a development approval and is not subject to assessment benchmarks. However, certain requirements or variations may apply to some types of development for it to be accepted development. Where nominated in the categories of development and assessment, accepted development (where stated as 'accepted development subject to requirements') must comply with the requirements contained in the identified assessment benchmark(s) as identified in the 'assessment benchmarks for assessable development and requirements for accepted development' column.

(2) Accepted development that does not comply with one or more of the requirements of an identified assessment benchmark, becomes code assessable development unless otherwise specified in the Categories or development and assessment column.

(3) The following rules apply in determining assessment benchmarks for each category of development and assessment.

Development subject to code assessment:

(a) is to be assessed against all the assessment benchmark(s) identified in the assessment benchmarks for assessable development and requirements for accepted development column;

(b) that occurs as a result of development becoming subject to code assessment pursuant to sub-section 5.3.3(2), must:

(i) be assessed against the assessment benchmark(s) for the development application, limited to the subject matter of the accepted development assessment benchmark(s) acceptable outcomes that were not complied with or were not capable of being complied with under sub-section 5.3.3(2);

(ii) comply with all required acceptable outcomes of the assessment benchmarks identified in sub-section 5.3.3(1), other than those mentioned in sub-section 5.3.3(2);

(c) that complies with:

(i) the purpose and overall outcomes of the code complies with the code;

(ii) the performance or acceptable outcomes complies with the purpose and overall outcomes of the code;

(d) must be assessed against any assessment benchmarks for the development identified in section 30 of the Regulation.

Development subject to Impact assessment:

(a) is to be assessed against the identified assessment benchmarks in the assessment benchmarks column (where relevant);

(b) assessment is to have regard to the whole of the planning scheme, to the extent relevant; and

(c) is to be be assessed against any assessment benchmarks for the development identified in section 30

of the Regulation.

Note—The first row of each of the assessment benchmarks is to be checked to confirm if there are assessment benchmarks that commonly apply to general scenarios in the zone or overlay.

Editor's note— Section 31 of the Regulation identifies the matters that impact assessment must have regard to.

5.4 Regulated categories of development and categories of assessment prescribed by the Regulation

Editor's note— The following schedules of the Regulation are relevant to the Townsville Planning Scheme:

- Schedule 6, Part 2, 6 of the Regulation, Material change of use for community residence
- Schedule 13 of the Regulation, Requirements for cropping involving forestry for wood production
- Schedule 12 of the Regulation, Particular reconfiguring a lot requiring code assessment

And other parts of the Regulation may also be relevant.

5.5 Categories of development and assessment - Material change of use

The following tables identify the categories of development and assessment and the corresponding assessment benchmarks for assessable development and accepted development for development in a zone for making a material change of use.

Table 5.5.1 - Low density residential zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Dwelling house Dwelling unit **Editor's note—**This category of development and assessment may be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1. Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Dual occupancy **Editor's note—**This category of development and assessment may be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1.	**Accepted development**	
	If not in the Stables precinct	No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Accepted development subject to requirements	
	If located in the Stables precinct and associated with a stables use on the same site.	Low density residential zone code Works code

Caretaker's accommodation	**Assessable development - Code-assessment**	
	If: (a) not Accepted development subject to requirements; and (b) in the Stables precinct.	Low density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Sales office	**Accepted development subject to requirements**	
		Low density residential zone code
Animal keeping **Editor's note—**Council's local laws also establish requirements regarding the keeping of animals.	**Accepted development subject to requirements**	
	If a stable and in the Stables precinct	Low density residential zone code
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	Low density residential zone code
Emergency services	**Assessable development - Code assessment**	
		Low density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.2 - Medium density residential zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Dual occupancy Dwelling house Dwelling unit **Editor's note—**This category of development and assessment may be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1. Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Sales office	**Accepted development subject to requirements**	
		Medium density residential zone code
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	Medium density residential zone code
Community use Food and drink outlet	**Assessable development - Code assessment**	
	If: (a) in the Picnic Bay precinct, Nelly Bay tourist precinct, North Ward villages precinct, Hyde Park medium density precinct, The Strand precinct or the Aitkenvale village precinct; and (b) the use is located on the ground floor.	Medium density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	

Health care services Office Service industry Shop	If: (a) in the Picnic Bay precinct, Nelly Bay tourist precinct, North Ward villages precinct, Hyde Park medium density precinct or the Aitkenvale village precinct; (b) the gross floor area does not exceed 250m²; (c) the use is located on the ground floor; and (d) fronting Gregory Street where in the North Ward villages precinct. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Medium density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Multiple dwelling Residential care facility Retirement facility Rooming accommodation Short-term accommodation	**Assessable development - Code assessment**	
	If building height does not exceed the number of storeys applicable in Table 5.5.3	Medium density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Community care centre Emergency services	**Assessable development - Code assessment**	
		Medium density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the caterories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Thuringowa South precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Thuringowa South precinct	5 storeys where on a site fronting Riverway Drive 3 storeys otherwise

Thuringowa East precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Thuringowa East precinct	3 storeys where on a site fronting Jenkins Street or Garner Road 5 storeys otherwise

Rossiter Park precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Rossiter Park precinct	6 storeys

Aitkenvale medium density precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Aitkenvale medium density precinct	5 storeys

Aitkenvale village precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Aitkenvale village precinct	5 storeys

Hyde Park medium density precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Hyde Park medium density precinct	5 storeys

Kings Road medium density precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Kings Road medium density precinct	5 storeys

The Strand precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
The Strand precinct	5 storeys

North Ward Gateway precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
North Ward gateway precinct	8 storeys

North Ward villages precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
North Ward villages precinct	8 storeys

North Ward medium density precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
North Ward medium density precinct	5 storeys

Magnetic Island medium density precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Magnetic Island medium density precinct	2 storeys

Picnic Bay precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Picnic Bay precinct	2 storeys

Nelly Bay tourist precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Nelly Bay tourist precinct	4 storeys

Wills Street precinct

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Wills Street precinct	4 storeys

Where not in a precinct or in a precinct not listed above

Table 5.5.3-Assessable development - Code assessment building height thresholds for the Medium density residential zone

Location	Number of storeys
Where not in a precinct or in a precinct not listed in Table 5.5.3	3 storeys

Table 5.5.4 - High density residential zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Dual occupancy Dwelling house Dwelling unit **Editor's note—**This category of development and assessment may be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1. Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Sales office	**Accepted development subject to requirements**	
		High density residential zone code
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	High density residential zone code
Educational establishment	**Accepted development subject to requirements**	
	If: (a) in the Flinders Street West precinct; (b) within an existing building; and (c) not involving more than minor building work.	High density residential zone code Works code
	Assessable development - Code assessment	
	Otherwise	High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code

Child care centre Community use Health care services Office Service industry Shop	**Assessable development - Code assessment**	
	If: (a) the gross floor area does not exceed 250m²; and (b) the use is located on the ground floor. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar	**Assessable development - Code assessment**	
	If the use is located on the ground or the first floor levels.	High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Assessable development - Code assessment**	
	If: (a) the use is located on the ground or the first floor levels; and (b) the use does not involve a drive through facility.	High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Multiple dwelling Residential care facility Resort complex Retirement facility Rooming accommodation Short-term accommodation	**Assessable development - Code assessment**	
	If building height does not exceed 12 storeys	High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Community care centre Emergency services Function facility Market	**Assessable development - Code assessment**	
		High density residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.5 - Rural residential zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Dwelling house **Editor's note–**This category of development and assessment may be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1. Landing **Editor's note–**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Cropping	**Accepted development**	
	If the area of cropping does not exceed 100m²	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Rural residential zone code
Roadside stall Sales office	**Accepted development subject to requirements**	
		Rural residential zone code
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	Rural residential zone code
Animal keeping **Editor's note–**Council's local laws also establish requirements regarding the keeping of animals.	**Accepted development subject to requirements**	
	If not a cattery or kennel	Rural residential zone code
	Assessable development - Code assessment	

Emergency services		Rural residential zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.6 - Character residential zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Editor's note-Building in the Character residential zone may be made assessable under the table of assessment for building work. Refer to Table 5.7.1. Dual occupancy Dwelling house **Editor's note—**This category of development and assessment may also be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1. Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	Character residential zone code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.7 - Neighbourhood centre zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Caretaker's accommodation Child care centre Community care centre Community use Dwelling unit Emergency services	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Neighbourhood centre zone code Works code
	Assessable development - Code assessment	
	Otherwise	Neighbourhood centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Accepted development subject to requirements**	
	If: (a) in an existing building and not involving more than minor building work; and (b) where not involving a drive through facility.	Neighbourhood centre zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 500m^2; and (c) where not involving a drive through facility **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Neighbourhood centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	

Health care services Office Sales office Service industry Shop Shopping centre Veterinary services	If in an existing building and not involving more than minor building work	Neighbourhood centre zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 500m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Neighbourhood centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Club Educational establishment Indoor sport and recreation	**Assessable development - Code assessment**	
	If the gross floor area does not exceed 500m^2 **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Neighbourhood centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Community residence Market Multiple dwelling Rooming accommodation Short-term accommodation	**Assessable development - Code assessment**	
		Neighbourhood centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use		The planning scheme

Editor's note-The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.8 - Local centre zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Caretaker's accommodation Child care centre Community care centre Community residence Community use Dwelling unit Emergency services Multiple dwelling Place of worship Rooming accommodation Sales office Short-term accommodation	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Local centre zone code Works code
	Assessable development - Code assessment	
	Otherwise	Local centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Adult store Health care services Office Market Shop Shopping centre Service industry Veterinary services	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Local centre zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 1000m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Local centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	
	If: (a) in an existing building and not involving more than minor building work; and (b) where not involving a drive through facility.	Local centre zone code Works code
	Assessable development - Code assessment	

Food and drink outlet	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 1000m^2; and (c) where not involving a drive through facility. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Local centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Club Educational establishment Indoor sport and recreation	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Local centre zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) gross floor area does not exceed 500m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Local centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar Function facility Hotel	**Assessable development - Code assessment**	
	If in the North Ward local centre precinct	Local centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.9 - District centre zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	District centre zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar Car wash Caretaker's accommodation Child care centre Community care centre Community residence Community use Club Dwelling unit Educational establishment Emergency services Health care services Hotel Function facility Funeral parlour Indoor sport and recreation Market Multiple dwelling Place of worship Retirement facility Rooming accommodation Sales office Service station Short-term accommodation Veterinary services	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	District centre zone code Works code
	Assessable development - Code assessment	
	Otherwise	District centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	

	If in an existing building and not involving more than minor building work	District centre zone code Works code
	Assessable development - Code assessment	
Adult store Food and drink outlet Office Shop Shopping centre Service industry	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 4,200m2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	District centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	
	If in an existing building and not involving more than minor building work	District centre zone code Works code
	Assessable development - Code assessment	
Garden centre Hardware and trade supplies Showroom	If not not accepted development subject to requirements and: (a) in the Idalia district centre precinct; or (b) not in the Idalia district centre precinct and the gross floor area does not exceed 3,500m2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	District centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	
Parking station		District centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.10 - Major centre zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Major centre zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar Car wash	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Major centre zone code Works code
	Assessable development - Code assessment	

Caretaker's accommodation Child care centre Community care centre Community residence Community use Club Dwelling unit Educational establishment Emergency services Health care services Hotel Function facility Indoor sport and recreation Market Multiple dwelling Place of worship Retirement facility Rooming accommodation Sales office Service station Short-term accommodation Theatre Veterinary services	Otherwise	Major centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Adult store Food and drink outlet Office Showroom Service industry	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Major centre zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 6,000m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Major centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	
	If: (a) in an existing building and not involving more than minor building work; and (b) not in the Thuringowa centre support sub-precinct.	Major centre zone code Works code

Shop Shopping centre	**Assessable development - Code assessment**	
	If: (a) not accepted development subject to requirements; (b) not in the Thuringowa centre support sub-precinct; and (c) the gross floor area does not exceed 6,000m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Major centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Parking station	**Assessable development - Code assessment**	
		Major centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.11 - Principal centre (CBD) zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Principal centre (CBD) zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Adult store Bar Caretaker's accommodation Child care centre Community care centre	**Accepted development subject to requirements**	
	If in an existing building and not involving more than minor building work	Works code
	Assessable development - Code assessment	

Community residence Community use Club Dwelling unit Educational establishment Emergency services Food and drink outlet Function facility Health care services Hotel Indoor sport and recreation Market Office Place of worship Rooming accommodation Sales office Shop Shopping centre Showroom Service industry Service station Theatre Veterinary services	If not accepted development subject to requirements and: (a) not in the Civic and administration precinct; or (b) in the Civic and administration precinct and the proposed building height is 8 storeys or less.	Principal centre (CBD) zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Multiple dwelling Retirement facility Short-term accommodation	**Accepted development subject to requirements**	
	If: (a) not located at ground floor level; and (b) within an existing building and not involving more than minor building work.	Principal centre (CBD) zone code Works code
	Assessable development - Code assessment	
	If not located at ground floor level and: (a) not in the Civic and administration precinct; or (b) in the Civic and administration precinct and the building height is 8 storeys or less.	Principal centre (CBD) zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Nightclub entertainment facility	**Accepted development subject to requirements**	
	If: (a) in the Flinders Street East precinct; and (b) within an existing building and not involving more than minor building work.	Works code
	Assessable development - Code assessment	
	Otherwise	Principal centre (CBD) zone code Healthy waters code Landscape code Transport impact, access and parking code Works code

Assessable development - Impact assessment	
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.	The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.12 - Specialised centre zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note–**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	If: (a) not accepted; and (b) not in the James Cook University-Townsville Hospital precinct, Fulham Road medical precinct or Bayswater Road medical precinct.	Specialised centre zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Caretaker's accommodation Child care centre Community care centre Community use Dwelling unit Emergency services Indoor sport and recreation Sales office	**Accepted development subject to requirements**	
	If within an existing building and not involving more than minor building work	Works code
	Assessable development - Code assessment	
	Otherwise	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Community residence	**Assessable development - Code assessment**	
	If in the Bayswater Road medical precinct or the Fulham Road medical precinct	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	

Bar Club Food and drink outlet Market Service industry	If: (a) not in the James Cook University-Townsville Hospital precinct and the gross floor area does not exceed 250m^2; or (b) if in the James Cook University-Townsville Hospital precinct and the gross floor area does not exceed 1,000m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Shop Shopping centre	**Assessable development - Code assessment**	
	If in the James Cook University - Townsville Hospital precinct and the gross floor area does not exceed 1,000m² **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing centre and the additional gross floor area forming part of the development application.	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Educational establishment Health care services Multiple dwelling Place of worship Research and technology industry Residential care facility Retirement facility Rooming accommodation Short-term accommodation	**Assessable development - Code assessment**	
	If in the James Cook University-Townsville Hospital precinct, Bayswater Road medical precinct or Fulham Road medical precinct	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Outdoor sport and recreation	**Assessable development - Code assessment**	
	If in the James Cook University-Townsville Hospital precinct	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Garden centre Hardware and trade supplies Showroom	**Assessable development - Code assessment**	
	If in the Domain Central precinct	Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	

Parking station		Specialised centre zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the level of assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Editor's note—Development of James Cook University (Douglas Campus), which is undertaken in terms of a Ministerial Designation, does not fall within the regulatory jurisdiction of the Townsville City Plan.

Table 5.5.13 - Mixed use zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Home based business Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Bar Caretaker's accommodation Child care centre Club Community care centre Community use Dwelling unit Educational establishment Emergency services Food and drink outlet Funeral parlour Health care services Indoor sport and recreation Low impact industry Market Place of worship Sales office Service industry Veterinary services	**Accepted development subject to requirements**	
	If within an existing building and not involving more than minor building work	Mixed use zone code Works code
	Assessable development - Code assessment	
	Otherwise	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Function facility	**Accepted development subject to requirements**	
	If: (a) in the Magnetic Island villages precinct, Nelly Bay gateway precinct, Arcadia Central precinct, South Townsville Railyards and Dean Park precinct, King Street quarter precinct or Breakwater precinct; and (b) in an existing building and not involving more than minor building work.	Mixed use zone code Works code
	Assessable development - Code assessment	

	If: (a) not accepted development subject to requirements; and (b) located in the Magnetic Island villages precinct, Nelly Bay gateway precinct, Arcadia Central precinct, South Townsville Railywards and Dean Park precinct, King Street quarter precinct or Breakwater precinct.	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Community residence Multiple dwelling Retirement facility Rooming accommodation Short-term accommodation	**Accepted development subject to requirements**	
	If: (a) not in the Charters Towers Road business precinct, CBD gateway precinct or Wotton Street precinct; and (b) within an existing building and not involving more than minor building work.	Mixed use zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) not in the Charters Towers Road business precinct, CBD gateway precinct or Wotton Street precinct.	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Adult store Office Shop Shopping centre	**Accepted development subject to requirements**	
	If: (a) within an existing building and not involving more than minor building work; and (b) the gross floor area does not exceed 500m^2.	Mixed use zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; and (b) the gross floor area does not exceed 1,000m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	

Hardware and trade supplies Showroom	If: (a) not in the Breakwater precinct; (b) within an existing building and not involving more than minor building work; and (c) the gross floor area does not exceed 500m^2.	Mixed use zone code Works code
	Assessable development - Code assessment	
	If: (a) not accepted development subject to requirements; (b) not in the Breakwater precinct; and (c) the gross floor area does not exceed 1,500m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Car wash Garden centre Outdoor sales Parking station Service station	**Assessable development - Code assessment**	
	If not in the Breakwater precinct	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Major sport recreation and entertainment facility Outdoor sport and recreation	**Assessable development - Code assessment**	
	If in the South Townsville Railyards and Dean Park precinct	Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Hotel	**Assessable development - Code assessment**	
		Mixed use zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.14 - Sport and recreation zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Dwelling house Dual occupancy **Editor's note—**This category of development and assessment may also be altered by the Water resource catchment, Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1.	**Accepted development**	
	If in the Balgal Beach golf course precinct	No assessment benchmarks apply
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Sport and recreation zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Caretaker's accommodation	**Accepted development subject to requirements**	
		Sport and recreation zone code Works code
Community use Outdoor sport and recreation	**Accepted development subject to requirements**	
	If provided by a public sector entity	Sport and recreation zone code Works code
	Assessable development - Code assessment	
	Otherwise	Sport and recreation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development subject to requirements	
	If provided by a public sector entity	Sport and recreation zone code Works code
	Assessable development - Code assessment	

Major sport, recreation and entertainment facility	If: (a) not accepted development subject to requirements; and (b) for a racecourse (horses) or ancillary activities in the Cluden precinct.	Sport and recreation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar Club Shop	**Assessable development - Code assessment**	
	If the gross floor area does not exceed 250m² **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Sport and recreation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Assessable development - Code assessment**	
	If: (a) the gross floor area does not exceed 250m²; and (b) where not involving a drive through facility. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Sport and recreation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Child care centre Community care centre Educational establishment Emergency services Function facility Health care services Indoor sport and recreation Market	**Assessable development - Code assessment**	
		Sport and recreation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.15 - Open space zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Community use Outdoor sport and recreation	**Accepted development subject to requirements**	
	If provided by a public sector entity	Open space zone code Works code
	Assessable development - Code assessment	
	Otherwise	Open space zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Club Food and drink outlet	**Assessable development - Code assessment**	
	If: (a) in the Riverway precinct; or (b) not in the Riverway precinct, and the gross floor area does not exceed 150m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Open space zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Shop	**Assessable development - Code assessment**	
	If in the Riverway precinct	Open space zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	

Community care centre Market		Open space zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.16 - Community facilities zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
Caretaker's accommodation Community care centre Community residence Community use Emergency services	**Accepted development subject to requirements**	
		Community facilities zone code Works code
Child care centre Educational establishment Health care services Indoor sport and recreation Market Outdoor sport and recreation Place of worship Retirement facility Residential care facility Rooming accommodation	**Assessable development - Code assessment**	
		Community facilities zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bar Club Shop	**Assessable development - Code assessment**	
	If the gross floor area does not exceed 250m² **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Community facilities zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Assessable development - Code assessment**	
	If: (a) the gross floor area does not exceed 250m²; and (b) where not involving a drive through facility. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Community facilities zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Accepted development	
	If provided by a public sector entity	No assessment benchmarks apply

Cemetery Crematorium Funeral parlour	**Assessable development - Code assessment**	
	Otherwise	Community facilities zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.17 - Environmental management and conservation zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Dwelling house	**Assessable development - Code assessment**	
		Environmental management and conservation zone code Works code
Telecommunications facility	**Assessable development - Code assessment**	
		Environmental management and conservation zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Outdoor sport and recreation	**Assessable development - Code assessment**	
		Environmental management and conservation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Caretaker's accommodation Club Community care centre Community use Educational establishment Food and drink outlet Shop	**Assessable development - Code assessment**	
	If gross floor area does not exceed 100m^2 **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Environmental management and conservation zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.18 - Low impact industry zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park Sales office	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Low impact industry zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Agricultural supplies store Caretaker's accommodation Emergency services Low impact industry Service industry Warehouse	**Accepted development subject to requirements**	
	If not in the Nelly Bay low impact industry precinct	Low impact industry zone code Works code
	Assessable development - Code assessment	
	If in the Nelly Bay low impact industry precinct	Low impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Accepted development subject to requirements**	
	If: (a) not in the Nelly Bay low impact industry precinct; and (b) the gross floor area does not exceed 150m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Low impact industry zone code Works code
	Assessable development - Code assessment	

	If: (a) in the Nelly Bay low impact industry precinct; and (b) the gross floor area does not exceed 150m². **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Low impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Bulk landscape supplies Car wash Garden centre Indoor sport and recreation Outdoor sales Research and technology industry Service station	**Assessable development - Code assessment**	
		Low impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Hardware and trade supplies	**Assessable development - Code assessment**	
	If involving an area for display and sales to the general public of not more than 35% of the gross floor area	Low impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in the table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.19 - Medium impact industry zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park Sales office	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Telecommunications facilities and utilities code Medium impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Accepted development subject to requirements	
	Otherwise	Medium impact industry zone code Telecommunications facilities and utilities code Works code
Caretaker's accommodation Emergency services Low impact industry Medium impact industry Research and technology industry	**Accepted development subject to requirements**	
	If not in the Roseneath medium impact industry precinct	Medium impact industry zone code Works code
	Assessable development - Code assessment	
	If in the Roseneath medium impact industry precinct	Medium impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Agricultural supplies store Warehouse	**Accepted development subject to requirements**	
	If not in the Roseneath medium impact industry precinct	Medium impact industry zone code Works code
	Assessable development - Code assessment	
	Otherwise	Medium impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code

Brothel Bulk landscape supplies Car wash Indoor sport and recreation Outdoor sales Parking station Service industry Service station Transport depot	**Assessable development - Code assessment**	
		Medium impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Food and drink outlet	**Accepted development subject to requirements**	
	If gross floor area does not exceed 150m^2 **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Medium impact industry zone code Works code
Hardware and trade supplies	**Assessable development - Code assessment**	
	If involving an area for display and sales to the general public of not more than 20% of the gross floor area	Medium impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.20 - High impact industry zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park Sales office	**Accepted development**	
		No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Telecommunications facilities and utilities code High impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Accepted development subject to requirements	
	Otherwise	High impact industry zone code Telecommunications facilities and utilities code Works code
Caretaker's accommodation Emergency services Medium impact industry Research and technology industry Warehouse	**Accepted development subject to requirements**	
		High impact industry zone code Works code
Food and drink outlet	**Accepted development subject to requirements**	
	If the gross floor area does not exceed 150m^2 **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	High impact industry zone code Works code
Extractive industry High impact industry Parking station Service station Transport depot	**Assessable development - Code assessment**	
		High impact industry zone code Healthy waters code Landscape code Transport impact, access and parking code Works code

Assessable development - Impact assessment	
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.	The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.21 - Rural zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Animal husbandry **Editor's note—**Council's local laws also establish requirements regarding the keeping of animals. Emergency services Landing **Editor's note—**Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Intensive horticulture	**Accepted development**	
	If not a mushroom farm	No assessment benchmarks apply
Animal keeping **Editor's note—**Council's local laws also establish requirements regarding the keeping of animals.	**Accepted development**	
	If not a cattery or kennel	No assessment benchmarks apply
	Assessable development - Code assessment	
	If a cattery or kennel in the Mixed farming precinct or Grazing precinct	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Cropping	**Accepted development**	
	If other than forestry for wood production	No assessment benchmarks apply
Community use Cemetery Crematorium	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
	Assessable development - Code Assessment	
	Otherwise	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
	Accepted development	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	

Telecommunications facility	Otherwise	Rural zone code Telecommunications facilities and utilities code Healthy waters code Landscape code Transport impact, access and parking code Works code
Permanent plantation	**Accepted development**	
	If in the Mixed farming precinct or Grazing precinct and located outside of strategic cropping land or potential strategic cropping land	No assessment benchmarks apply
Caretaker's accommodation Community residence Dwelling house	**Accepted development subject to requirements**	
	If it will not result in more than two dwellings of any kind on a lot	Rural zone code
Rural workers accommodation	**Accepted development subject to requirements**	
	If accommodating no more than 15 workers	Rural zone code
	Assessable development - Code assessment	
	Otherwise	Rural zone code
Home based business Roadside stall	**Accepted development subject to requirements**	
		Rural zone code
Rural industry	**Accepted development subject to requirements**	
	If storing and packaging products produced on the site	Rural zone code
	Assessable development - Code assessment	
	Otherwise	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Extractive industry	**Assessable development - Code assessment**	
	If in an extractive resource area shown on overlay map OM-05	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Wholesale nursery	**Assessable development - Code assessment**	
		Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	

Outdoor sport and recreation	If: (a) in the Mixed farming precinct or Grazing precinct; (b) there is no outdoor lighting; and (c) the gross floor area of any buildings does not exceed 150m^2. **Editor's note—**The gross floor area threshold is calculated for a new use or an extension to an existing use. It is not the cumulative total of the existing use and the additional gross floor area forming part of the development application.	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Code assessment	
Aquaculture Bulk landscape supplies	If in the Mixed farming precinct or Grazing precinct	Rural zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.22 - Emerging community zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Animal husbandry **Editor's note—**Council's local laws also establish requirements regarding the keeping of animals. Cropping Landing **Editor's note—**This Landings are separately regulated under the Prescribed Tidal Works Code. Park	**Accepted development**	
		No assessment benchmarks apply
Community residence Dwelling house Dual occupancy **Editor's note—**This category of development and assessment may be altered by the Flood hazard, Coastal environment and Landslide hazard overlays. Refer to Table 5.9.1.	**Accepted development**	
	If it will not result in more than two dwellings of any kind on a lot	No assessment benchmarks apply
Major electricity infrastructure Substation Utility installation	**Accepted development**	
	If provided by a public sector entity	No assessment benchmarks apply
Telecommunications facility	**Accepted development**	
	If aerial cabling for broadband purposes	No assessment benchmarks apply
	Assessable development - Code assessment	
	Otherwise	Emerging community zone code Healthy waters code Landscape code Telecommunications facilities and utilities code Transport impact, access and parking code Works code
Sales office	**Accepted development subject to requirements**	
		Emerging community zone code
Home based business	**Accepted development subject to requirements**	
	If: (a) the gross floor area does not exceed 60m²; and (b) the use is contained within an existing domestic outbuilding or dwelling.	Emerging community zone code
	Assessable development - Code assessment	

Emergency services		Emerging community zone code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Impact assessment		
Any other use not listed in this table. Any use listed in this table and not meeting the description listed in the categories of development and assessment column. Any other undefined use.		The planning scheme

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.5.23 - Special purpose zone

Use	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Development in the Townsville State Development Area is administered by the Coordinator-General through its adopted development scheme. In this area, only development applications for reconfiguration of a lot and operational works will be assessed by Townsville City Council.		No assessment benchmarks apply

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

5.6 Categories of development and assessment - Reconfiguring a lot

The following table identifies the categories of development and assessment and corresponding assessment benchmarks for assessable development and requirements for accepted development for reconfiguring a lot.

Table 5.6.1-Reconfiguring a lot

Editor's note—Refer also to Table 5.4.2 for Regulated categories of development and assessment: Reconfiguring a lot and to Schedule 6 of the Regulation for Reconfiguring a lot which is accepted.

Emerging community

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Emerging community zone	**Assessable development - Code assessment**	
	If the size of each lot created is equal to or greater than 10ha	Emerging community zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Impact assessment	
	Otherwise	The planning scheme including: Emerging community zone code Reconfiguring a lot code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Character residential

Table 5.6.1-Reconfiguring a lot (Part)

<table>
<tr><th>Zone</th><th>Categories of development and assessment</th><th>Assessment benchmarks for assessable development and requirements for accepted development</th></tr>
<tr><td rowspan="4">Character residential zone</td><td colspan="2">Assessable development - Code assessment</td></tr>
<tr><td>If:
(a) not in the Inter-war to 1950s asymmetrical gable precinct, the Interwar gables and Queensland bungalows precinct,or the Queenslanders precinct; or
(b) in the Inter-war to 1950s asymmetrical gable precinct or the Interwar gables and Queensland bungalows precinct or the Queenslanders precinct and the size of each lot created is equal to or greater than 500m2.</td><td>Character residential zone code
Reconfiguring a lot code
Healthy waters code
Landscape code
Transport impact, access and parking code
Works code</td></tr>
<tr><td colspan="2">Assessable development - Impact assessment</td></tr>
<tr><td>Otherwise</td><td>The planning scheme including:
Character residential zone code
Reconfiguring a lot code</td></tr>
<tr><td colspan="3">Assessable development - Code assessment</td></tr>
<tr><td colspan="3">Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation.
Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.</td></tr>
</table>

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Rural residential

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Rural residential zone	**Assessable development - Code assessment**	
	If the size of each lot created is equal to or greater than: (a) 4ha (if on land to which a Water resource catchment overlay applies); or (b) 4,000m^2 otherwise.	Rural residential zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
	Assessable development - Impact assessment	
	Otherwise	The planning scheme including: Rural residential zone code Reconfiguring a lot code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Low density residential

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Low density residential zone	**Assessable development - Code assessment**	
	All	Low density residential zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Medium density residential

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Medium density residential zone	**Assessable development - Code assessment**	
	All	Medium density residential zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

High density residential

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
High density residential zone	**Assessable development - Code assessment**	
	All	High density residential zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation.. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Neighbourhood centre

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Neighbourhood centre zone	**Assessable development - Code assessment**	
	All	Neighbourhood centre zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Local centre

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Local centre zone	**Assessable development - Code assessment**	
	All	Local centre zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

District centre

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
District centre zone	**Assessable development - Code assessment**	
	All	District centre zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Major centre

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Major centre zone	**Assessable development - Code assessment**	
	All	Major centre zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Principal centre (CBD)

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Principal centre (CBD) zone	**Assessable development - Code assessment**	
	All	Principal centre (CBD) zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Specialised centre

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Specialised centre zone	**Assessable development - Code assessment**	
	All	Specialised centre zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Mixed use

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Mixed use zone	**Assessable development - Code assessment**	
	All	Mixed use zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Community facilities

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Community facilities zone	**Assessable development - Code assessment**	
	All	Community facilities zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Low impact industry

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Low impact industry zone	**Assessable development - Code assessment**	
	All	Low impact industry zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed the Regulation.

Medium impact industry

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Medium impact industry zone	**Assessable development - Code assessment**	
	All	Medium impact industry zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

High impact industry

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
High impact industry zone	**Assessable development - Code assessment**	
	All	High impact industry zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Special purpose

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Special purpose zone	**Assessable development - Code assessment**	
	All	Special purpose zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Open space

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Open space zone	**Assessable development - Code assessment**	
	All	Open space zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Sport and recreation

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Sport and recreation zone	**Assessable development - Code assessment**	
	All	Sport and recreation zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Environmental management and conservation

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Environmental management and conservation zone	**Assessable development - Code assessment**	
	All	Environmental management and conservation zone code Reconfiguring a lot code Healthy waters code Landscape code Transport impact, access and parking code Works code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Rural

Table 5.6.1-Reconfiguring a lot (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Rural zone	**Assessable development - Code assessment**	
	If the size of each lot created is equal to or greater than: (a) in the Horticulture precinct: 40ha; or (b) in the Mixed farming precinct: (i) 400ha if on land to which a Water resource catchment overlay applies; or (ii) 40ha otherwise; or (c) in the Grazing precinct: 400ha; or (d) in the Jensen precinct: 10ha; or (e) in the Cungulla precinct: 10ha.	Rural zone code Reconfiguring a lot code Healthy waters code Transport impact, access and parking code Works code
	Assessable development - Impact assessment	
	Otherwise	The planning scheme including: Rural zone code Reconfiguring a lot code
Assessable development - Code assessment		
Any other reconfiguring a lot not listed in this table, unless otherwise prescribed in the Regulation. Any reconfiguring a lot listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

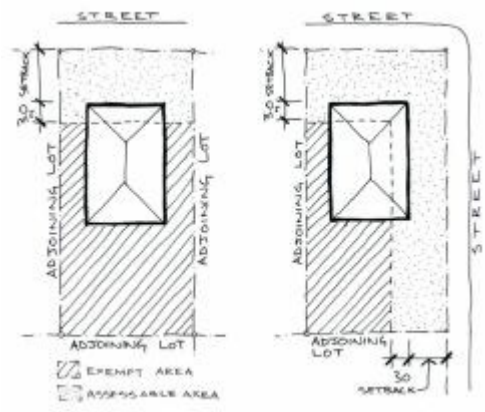
5.7 Categories of development and assessment - Building work

The following table identifies the categories of development and assessment and the assessment benchmarks for assessable development and requirements for accepted development for building work regulated under the planning scheme.

Table 5.7.1 - Building work

Editor's note—The planning scheme also regulates building work through the categories of development and assessment for overlays.
Editor's note—Contributing character buildings and non-contributing properties are identified in Character residential planning scheme policy SC6.2.

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Character residential zone	**Assessable development - Code assessment**	
	If: (a) involving partial demolition, external alteration, extension (including minor building work and the construction of a class 10a building (as defined by the Building Code of Australia)), to a contributing character building where all or part of the work is in front of or within a depth of 3m from the facade facing any street; or (b) raising or lowering a contributing character building by more than 1m; or (c) relocating a contributing character building within the same site; or (d) involving construction of a class 10a building (as defined by the Building Code of Australia) on the site of a non-contributing property, where all or part of the work is in front of, or within a depth of 3m from the main building façade facing any street; or (e) construction of any new class 1a or class 2 building (as defined by the Building Code of Australia) on either a contributing or non-contributing character site, unless on a rear lot.	Character residential zone code



Assessable development - Impact assessment	
If involving relocation off the site or the total demolition of a contributing character building	The planning scheme including: Character residential zone code Reconfiguring a lot code
Accepted development	
Replacement or refurbishment of stairs on a contributing character building. Raising or lowering a contributing character building by 1m or less. Any other building work not listed in this table. Any building work listed in this table and not meeting the description listed in the categories of development and assessment column.	

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

5.8 Categories of development and assessment - Operational work

The following tables identify the categories of development and assessment and corresponding assessment benchmarks for assessable development and requirements for accepted development for operational work.

Table 5.8.1 - Operational work

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
All zones	**Assessable development - Code assessment**	
	If operational works (other than filling or excavation) for the reconfiguration of a lot	Healthy waters code Landscape code Reconfiguration of a lot code Transport impact, access and parking code Works code
	If operational works (other than filling or excavation) for a material change of use	Healthy waters code Landscape code Transport impact, access and parking code Works code
	If filling and excavation: (a) within 1.5m of a lot boundary and exceeding a depth of 300mm; or (b) involving: (i) a depth exceeding 1m; or (ii) a volume of 100m³ or more.	Healthy waters code Works code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.8.2-Operational work being placing an advertising device on premises

Editor's note—Council's local laws also establish requirements regarding the placement of advertising devices on a premises.

Editor's note—Advertising devices in unallocated State land, reserve or road may require a permit to occupy under the *Land Act 1994*.

Editor's note—Advertising device within or adjacent to a State-controlled road corridor may require approval by the Department of Transport and Main Roads.

Note—Advertising devices required to meet statutory purposes are exempt.

Editor's note—Refer to Table 9.4.1.3(b) - Types of advertising devices in section 9.4.1 Advertising devices code for descriptions of the various types of advertising devices.

Neighbourhood centre zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
	Accepted development	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	

Neighbourhood centre zone	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Local centre zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Local centre zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Exempt development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

District centre zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
District centre zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Exempt development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Major centre zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Major centre zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		

Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Principal centre (CBD) zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
	Exempt	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) if in the Flinders Street East precinct: (i) a commercial flag; or (ii) a footway sign; or (iii) a street furniture sign; or (c) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	

Principal centre (CBD) zone	If: (a) in the Flinders Street East precinct; (i) an awning fascia sign; or (ii) a blind/canopy sign; or (iii) a hamper sign; or (iv) a stallboard sign; or (v) an under-awning sign; or (vi) a wall sign; or (vii) a window sign; or (b) otherwise: (i) an above-awning sign; or (ii) an animated sign; or (iii) an awning fascia sign; or (iv) a banner sign; or (v) a bunting; or (vi) a fence sign; or (vii) a ground sign; or (viii) an inflatable sign; or (ix) a panel sign; or (x) a pole sign; or (xi) a projecting sign; or (xii) a pylon sign; or (xiii) a roof sign; or (xiv) an under-awning sign; or (xv) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Exempt development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Specialised centre zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Specialised centre zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Exempt development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Mixed use zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Mixed use zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) a street furniture sign; or (vii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an animated sign; or (c) an awning fascia sign; or (d) a banner sign; or (e) a bunting; or (f) a fence sign; or (g) a ground sign; or (h) an inflatable sign; or (i) a panel sign; or (j) a pole sign; or (k) a projecting sign; or (l) a pylon sign; or (m) a roof sign; or (n) an under-awning sign; or (o) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Community facilities zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Community facilities zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a footway sign; or (c) a street furniture sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an awning fascia sign; or (c) a banner sign; or (d) a blind/canopy sign; or (e) a bunting; or (f) a commercial flag; or (g) a fence sign; or (h) a ground sign; or (i) a hamper sign; or (j) a panel sign; or (k) a projecting sign; or (l) a stallboard sign; or (m) an under-awning sign; or (n) a wall sign; or (o) a window sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Environmental management and conservation zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Environmental management and conservation zone	**Assessable development - Code assessment**	
	All advertising devices listed in Table 9.3.1.3(b)	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Low impact industry zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

<table>
<tr><th>Zone</th><th>Categories of development and assessment</th><th>Assessment benchmarks for assessable development and requirements for accepted development</th></tr>
<tr><td rowspan="6">Low impact industry zone</td><td colspan="2">Accepted development</td></tr>
<tr><td>If:
(a) any advertising device located internally within a building and not generally visible from outside; or
(b) otherwise:
(i) an above-awning sign; or
(ii) an awning fascia sign; or
(iii) a banner sign; or
(iv) a blind/canopy sign; or
(v) a bunting; or
(vi) a commercial flag; or
(vii) a footway sign; or
(viii) a fence sign; or
(ix) a ground sign; or
(x) a hamper sign; or
(xi) a panel sign; or
(xii) a projecting sign; or
(xiii) a stallboard sign; or
(xiv) a street furniture sign; or
(xv) an under-awning sign; or
(xvi) a wall sign; or
(xvii) a window sign.</td><td></td></tr>
<tr><td colspan="2">Accepted development subject to requirements</td></tr>
<tr><td>If:
(a) an animated sign; or
(b) an inflatable sign; or
(c) a pole sign; or
(d) a pylon sign; or
(e) a roof sign.</td><td>Advertising devices code</td></tr>
<tr><td colspan="2">Assessable development - Code assessment</td></tr>
<tr><td>If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).</td><td>Advertising devices code</td></tr>
<tr><td colspan="3">Accepted development</td></tr>
<tr><td colspan="3">Any other operational work not listed in this table.
Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.</td></tr>
</table>

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Medium impact industry zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Medium impact industry zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) an above-awning sign; or (ii) an awning fascia sign; or (iii) a banner sign; or (iv) a blind/canopy sign; or (v) a bunting; or (vi) a commercial flag; or (vii) a footway sign; or (viii) a fence sign; or (ix) a ground sign; or (x) a hamper sign; or (xi) a panel sign; or (xii) a projecting sign; or (xiii) a stallboard sign; or (xiv) a street furniture sign; or (xv) an under-awning sign; or (xvi) a wall sign; or (xvii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an animated sign; or (b) an inflatable sign; or (c) a pole sign; or (d) a pylon sign; or (e) a roof sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
High impact industry zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) an above-awning sign; or (ii) an awning fascia sign; or (iii) a banner sign; or (iv) a blind/canopy sign; or (v) a bunting; or (vi) a commercial flag; or (vii) a footway sign; or (viii) a fence sign; or (ix) a ground sign; or (x) a hamper sign; or (xi) a panel sign; or (xii) a projecting sign; or (xiii) a stallboard sign; or (xiv) a street furniture sign; or (xv) an under-awning sign; or (xvi) a wall sign; or (xvii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an animated sign; or (b) an inflatable sign; or (c) a pole sign; or (d) a pylon sign; or (e) a roof sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Special purpose zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) otherwise: (i) an above-awning sign; or (ii) an awning fascia sign; or (iii) a banner sign; or (iv) a blind/canopy sign; or (v) a bunting; or (vi) a commercial flag; or (vii) a footway sign; or (viii) a fence sign; or (ix) a ground sign; or (x) a hamper sign; or (xi) a panel sign; or (xii) a projecting sign; or (xiii) a stallboard sign; or (xiv) a street furniture sign; or (xv) an under-awning sign; or (xvi) a wall sign; or (xvii) a window sign.	
	Accepted development subject to requirements	
	If: (a) an animated sign; or (b) an inflatable sign; or (c) a pole sign; or (d) a pylon sign; or (e) a roof sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Open space zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a footway sign; or (c) a street furniture sign.	
	Accepted development subject to requirements	
	If: (a) a blind/canopy sign; or (b) a commercial flag; or (c) a hamper sign; or (d) a stallboard sign; or (e) an under-awning sign; or (f) a window sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Low density residential zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

<table>
<tr><th>Zone</th><th>Categories of development and assessment</th><th>Assessment benchmarks for assessable development and requirements for accepted development</th></tr>
<tr><td rowspan="6">Low density residential zone</td><td colspan="2">Accepted development</td></tr>
<tr><td>If:
(a) any advertising device located internally within a building and not generally visible from outside; or
(b) a street furniture sign.</td><td></td></tr>
<tr><td colspan="2">Accepted development subject to requirements</td></tr>
<tr><td>If a fence sign or a wall sign for a Home based business</td><td>Advertising devices code</td></tr>
<tr><td colspan="2">Assessable development - Code assessment</td></tr>
<tr><td>If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).</td><td>Advertising devices code</td></tr>
<tr><td colspan="3">Accepted development</td></tr>
<tr><td colspan="3">Any other operational work not listed in this table.
Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.</td></tr>
</table>

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Medium density residential zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Medium density residential zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a street furniture sign.	
	Accepted development subject to requirements	
	If: (a) a fence sign or a wall sign for a Home based business; or (b) in the Picnic Bay precinct, Nelly Bay tourist precinct, North Ward villages, Hyde Park medium density residential precinct or The Strand precinct; and (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a footway sign; or (iv) a hamper sign; or (v) a stallboard sign; or (vi) an under-awning sign; or (vii) a window sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

High density residential zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
High density residential zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a blind/canopy sign; or (c) a commercial flag; or (d) a footway sign; or (e) a hamper sign; or (f) a stallboard sign; or (g) a street furniture sign; or (h) a window sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an awning fascia sign; or (c) a banner sign; or (d) a fence sign; or (e) a ground sign; or (f) a panel sign; or (g) a projecting sign; or (h) a roof sign; or (i) an under-awning sign; or (j) a wall sign.	Advertising devices code
	Accepted development subject to requirements	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in the table and not complying with the criteria in the level of assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Character residential zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Character residential zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a street furniture sign.	
	Accepted development subject to requirements	
	If a fence sign or a wall sign for a home based business	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Rural residential zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Rural residential zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a street furniture sign.	
	Accepted development subject to requirements	
	If a fence sign or a wall sign for a home based business	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Emerging community zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Emerging community zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a street furniture sign.	
	Accepted development subject to requirements	
	If a fence sign or a wall sign for a Home based business	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Rural zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Rural zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) a street furniture sign.	
	Accepted development subject to requirements	
	(a) If for a business activity, roadside stall or winery and: (i) an above-awning sign; or (ii) an awning fascia sign; or (iii) a banner sign; or (iv) a bunting; or (v) a commercial flag; or (vi) a fence sign; or (vii) a footway sign; or (viii) a ground sign; or (ix) a panel sign; or (x) a projecting sign; or (xi) a wall sign ; or (b) a roof sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		
Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.		

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

Sport and recreation zone

Table 5.8.2—Operational work being placing an advertising device on premises (Part)

Zone	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Sport and recreation zone	**Accepted development**	
	If: (a) any advertising device located internally within a building and not generally visible from outside; or (b) any advertising device for a major sport, recreation and entertainment facility comprising a sports stadium or motor sport facility; or (c) for a club, food and drink outlet, functions facility, indoor sport and recreation, outdoor sport and recreation, bar or shop, and: (i) a blind/canopy sign; or (ii) a commercial flag; or (iii) a hamper sign; or (iv) a stallboard sign; or (v) an under-awning sign; or (vi) a window sign; or (d) otherwise: (i) a street furniture sign; or (ii) footway sign.	
	Accepted development subject to requirements	
	If: (a) an above-awning sign; or (b) an awning fascia sign; or (c) a banner sign; or (d) a bunting; or (e) a fence sign; or (f) a ground sign; or (g) a panel sign; or (h) a projecting sign; or (i) a wall sign.	Advertising devices code
	Assessable development - Code assessment	
	If not made accepted development subject to requirements, any advertising device listed in Table 9.3.1.3(b).	Advertising devices code
Accepted development		

Any other operational work not listed in this table. Any operational work listed in this table and not meeting the description listed in the categories of development and assessment column.

Editor's note—The above categories of development and assessment apply unless otherwise prescribed in the Regulation.

5.9 Categories of development and assessment—Overlays

The following table identifies where an overlay changes the categories of development and assessment from that stated in a zone and the relevant assessment benchmarks.

Airport environs overlay

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Airport environs overlay		
Any material change of use, reconfiguring a lot or operational work within: (a) the airport's operational airspace shown on overlay Map OM-01.1; or (b) the lighting area buffer zones shown on overlay Map OM-01.5; or (c) aviation facilities' buffers areas shown on overlay Map OM-01.3.	No change to the category of development and assessment	Airport environs overlay code where the development is accepted development subject to requirements or assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is applicable to accepted development subject to requirements development.
Any material change of use: (a) within 13km of an airport runway shown on overlay Map OM-01.2; or (b) within a public safety area shown on overlay Map OM-01.2.	No change to the category of development and assessment	Airport environs overlay code where the development is accepted development subject to requirements or assessable development under the categories of development and assessment for the relevant zone.
Any material change of use above the 20 ANEF contour shown on overlay Map OM-01.4 for: (a) Dwelling house; or (b) Dual occupancy.	Accepted development subject to requirements.	Airport environs overlay code
Any other material change of use above the 20 ANEF contour shown on overlay Map OM-01.4.	No change to the category of development and assessment	Airport environs overlay code where the development is accepted development subject to requirements or assessable development under the categories of development and assessment for the relevant zone.

Bushfire hazard overlay (high hazard area)

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Bushfire hazard overlay (high hazard area)		
Material change of use for: (a) Child care centre; or (b) Detention facility; or (c) Educational establishment; or (d) Emergency services; or (e) Hospital; or (f) Industry activities involving manufacture or storage of hazardous materials in bulk; or (g) Multiple dwelling; or (h) Residential care facility; or (i) Retirement facility; or (j) Relocatable home park; or (k) Rooming accommodation; or (l) Shopping centre; or (m) Short-term accommodation; or (n) Telecommunications facility; or (o) Tourist park; or (p) Tourist attraction; or (q) Transport depot; or (r) Utility installation.	Assessable development - impact assessable	Bushfire hazard overlay code
Any other material change of use	No change to the category of development and assessment	Bushfire hazard overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.
Reconfiguration of a lot	No change to the category of development and assessment	Bushfire hazard overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.

Bushfire hazard overlay (medium hazard area)

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Bushfire hazard overlay (medium hazard area)		
Any material change of use	No change to the category of development and assessment	Bushfire hazard overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.
Reconfiguration of a lot	No change to the category of development and assessment	Bushfire hazard overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.

Coastal environment overlay

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Coastal environment overlay		
Material change of use for: (a) Dwelling house; or (b) Community residence.	Accepted development subject to requirements.	Coastal environment overlay code
Material change of use for a Dual occupancy	Assessable development - code assessment	Coastal environment overlay code
Building work involving the lowering of floor levels or enclosure of a ground floor storey on an existing: (a) Dwelling house; or (b) Dual occupancy; or (c) Community residence.	Accepted development subject to requirements.	Coastal environment overlay code
Any other material change of use	No change to the category of development and assessment	Coastal environment overlay code where the development is assessable development under the categories of development and assessment for the relevant zone.
Reconfiguration of a lot	No change to the category of development and assessment	Coastal environment overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.
Operational work	No change to the category of development and assessment	Coastal environment overlay code where the development is assessable development under the categories of development and assessment for operational work.

Cultural heritage overlay

On a heritage place

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Cultural heritage overlay		
On a heritage place		
Building work where an 'Exemption Certificate' has been issued for work under Section 75 of the *Queensland Heritage Act 1992*	Accepted development	No assessment benchmarks applicable
Material change of use	No change to the category of development and assessment	Cultural heritage overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.
Building work, where involving the total demolition or relocation of a heritage place	Assessable development - impact assessment	Cultural heritage overlay code
Building work, including minor building work, where involving: (a) alterations to a heritage place, including alterations to the interior of buildings; or (b) extensions to a heritage place; or (c) erecting a new or separate building on a heritage place site; or (d) the partial demolition of a heritage place	Assessable development - code assessment	Cultural heritage overlay code
Operational work where involving a change to landscaping, fencing or natural features of land referred to in the citation for a heritage place listed in SC6.3 Cultural heritage planning scheme policy	Assessable development - code assessment	Cultural heritage overlay code
Reconfiguration of a lot	No change to the category of development and assessment	Cultural heritage overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.

Cultural heritage overlay

Adjoining a heritage place

Table 5.9.1 - Assessment criteria for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Cultural heritage overlay		
Adjoining a heritage place		
Material change of use	No change to the category of development and assessment	Cultural heritage overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.
Reconfiguration of a lot	No change to the category of development and assessment	Cultural heritage overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.

Natural assets overlay

Table 5.9.1 - Assessment benchmark for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Natural assets overlay		
Material change of use	No change to the category of development and assessment	Natural assets overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements.
Reconfiguration of a lot	No change to the category of development and assessment	Natural assets overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.
Operational work being clearing of vegetation	Assessable development - code assessment if: (a) within an urban area; (b) not associated with an assessable development material change of use or reconfiguration of a lot; and (c) in the very high importance area shown on the overlay map OM-08. **Editor's note—** Urban area has the same meaning as in the Regulations.	Natural assets overlay code

Any other operational work	No change to the category of development and assessment	Natural assets overlay code where the development is assessable development under the categories of development and assessment for operational work. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.

Extractive resources overlay

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Extractive resources overlay		
Material change of use	No change to the category of development and assessment	Extractive resources overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements.
Reconfiguration of a lot	No change to the category of development and assessment	Extractive resources overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.

Flood hazard overlay (high and medium hazard areas)

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Flood hazard overlay (high and medium hazard areas) **Note—**to avoid any doubt, the term medium hazard area includes areas shown on the overlay maps as medium hazard — further investigation areas.		
Material change of use for a telecommunications facility	Assessable development - code assessment	Flood hazard overlay code
Material change of use for: (a) Dwelling house; or (b) Dual occupancy; or (c) Community residence.	Accepted development subject to requirements	Flood hazard overlay code
Material change of use for: (a) Emergency services; or (b) Hospital; or (c) Special industry; or (d) High impact industry; or (e) Residential care facility; or (f) Retirement facility; or (g) Major electricity infrastructure; or (h) Air services.	Assessable development - code assessment	Flood hazard overlay code

Building work involving the lowering of floor levels or enclosure of a ground floor storey on an existing: (a) Dwelling house; or (b) Dual occupancy; or (c) Community residence.	Accepted development subject to requirements	Flood hazard overlay code
Any other material change of use	No change to the category of development and assessment	Flood hazard overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note—**This overlay code is applicable to accepted development subject to requirements identified in the categories of development and assessment for the relevant zone.
Reconfiguration of a lot	No change to the category of development and assessment	Flood hazard overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.
Operational Works involving filling or excavation of more than $10m^3$ of material	Code assessment	Flood hazard overlay code
Any other operational works	No change to the category of development and assessment	Flood hazard overlay code where the development is assessable development under the categories of development and assessment for operational works.

Flood hazard overlay (low hazard area)

Table 5.9.1 - Assessment benchmarks for overlays

Development	**Categories of development and assessment**	**Assessment benchmarks for assessable development and requirements for accepted development**
Flood hazard overlay (low hazard area)		
Material change of use for: (a) Emergency services; or (b) Hospital; or (c) Special industry; or (d) High impact industry; or (e) Residential care facility; or (f) Retirement facility; or (g) Major electricity infrastructure; or (h) Air services.	Assessable development - code assessment	Flood hazard overlay code

Landslide hazard overlay (high and potential debris flow hazard areas or slope angle greater than 23 degrees)

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landslide hazard overlay (high and potential debris flow hazard areas or slope angle greater than 23 degrees)		
Material change of use for: (a) Dwelling house; or (b) Dual occupancy.	Assessable development - code assessment	Landslide hazard overlay code
Any other material change of use	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable development under the categories of development and assessment for the relevant zone. **Editor's note-**This overlay code is not applicable to accepted development subject to requirements.
Reconfiguration of a lot	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable development under the categories of development and assessment for the reconfiguration of a lot.
Operational work	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable under the table of assessment for operational work. **Editor's note-**This overlay code is not applicable to Accepted development subject to requirements development.

Landslide hazard overlay (very low, low and medium hazard areas)

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Landslide hazard overlay (very low, low and medium hazard areas)		
Material change of use	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable under the table of assessment for the relevant zone **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.
Reconfiguration of a lot	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable under the table of assessment for reconfiguration of a lot
Operational work	No change to the category of development and assessment	Landslide hazard overlay code where the development is assessable under the table of assessment for operational work **Editor's note—**This overlay code is not applicable to accepted development subject to requirements development.

Water resource catchment overlay

Table 5.9.1 - Assessment benchmarks for overlays

Development	Categories of development and assessment	Assessment benchmarks for assessable development and requirements for accepted development
Water resource catchment overlay		
Material change of use for a Dwelling house	Accepted development subject to requirements	Water resource catchment overlay code
Any other material change of use	No change to the category of development and assessment	Water resource catchment overlay code **Editor's note—**This overlay code is applicable to accepted development subject to requirements.
Reconfiguration of a lot	No change to the category of development and assessment	Water resource catchment overlay code where the development is assessable development under the categories of development and assessment for reconfiguration of a lot.
Operational works	No change to the category of development and assessment	Water resource catchment overlay code where the development is assessable development under the categories of development and assessment for operational works. **Editor's note—**This overlay code is not applicable to accepted development subject to requirements operational work.

Note—Some overlays may only be included for information purposes. This should not change the category of development and assessment or assessment benchmarks in the planning scheme.

Editor's note—The Transport noise corridor overlay is contained in the planning scheme for information purposes only. The Transport noise corridor overlay identifies land affected by transport noise in accordance with Chapter 8B of the *Building Act 1975*. In these areas, building work will be assessable against the Queensland Development Code Part 4.4 — Buildings in a Transport Noise Corridor.

Part 6 Zones

6.1 Preliminary

(1) Zones organise the planning scheme area in a way that facilitates the location of preferred or acceptable land uses.

(2) Zones are mapped and included in Schedule 2.

(3) The categories of development and assessment for development in a zone are in Part 5.

(4) Assessment benchmarks for zones are contained in a zone code.

(5) A precinct may be identified for part of a zone.

(6) Precinct provisions are contained in the zone code.

(7) Each zone code identifies the following:

- (a) the purpose of the code;
- (b) the overall outcomes that achieve the purpose of the code;
- (c) the performance outcomes that achieve the overall outcomes and the purpose of the code;
- (d) the acceptable outcomes that achieve the performance and overall outcomes and the purpose of the code; and
- (e) the performance and acceptable outcomes for the precinct.

(8) The following are the zone codes for the planning scheme:

- (a) Residential zones category:
  - (i) Low density residential zone code;
  - (ii) Medium density residential zone code;
  - (iii) High density residential zone code;
  - (iv) Rural residential zone code;
  - (v) Character residential zone code;
- (b) Centres zones category:
  - (i) Neighbourhood centre zone code;
  - (ii) Local centre zone code;
  - (iii) District centre zone code;
  - (iv) Major centre zone code;
  - (v) Principal centre (CBD) zone code;
  - (vi) Specialised centre zone code;
  - (vii) Mixed use zone code;
- (c) Community facilities and open space zones category:
  - (i) Sport and recreation zone code;
  - (ii) Open space zone code;
  - (iii) Community facilities zone code;
  - (iv) Environmental management and conservation zone code;
- (d) Industry zones category:
  - (i) Low impact industry zone code;
  - (ii) Medium impact industry zone code;
  - (iii) High impact industry zone code;
- (e) Rural zones category:
  - (i) Rural zone code;
- (f) Other zones category:

(i) Emerging community zone code;

(ii) Special purpose zone code.

6.2 Residential zones category

6.2.1 Low density residential zone code

6.2.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.1.2 Purpose

(1) The purpose of the Low density residential zone code is to provide for predominately dwelling houses.

(2) The particular purpose of the code is to:

- (a) primarily accommodate dwelling houses and dual occupancy dwellings;
- (b) provide for housing choice and affordability by allowing for a range of lot sizes;
- (c) maintain the low-rise and lower density character of Townsville's suburbs;
- (d) maintain a high level of residential amenity; and
- (e) achieve accessible, well-serviced and well-designed communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) built form is of a house compatible scale and consistent with the local streetscape character;
- (b) reconfiguration facilitates a range of lot sizes to accommodate dwelling houses and dual occupancy dwellings, typically on lots 400m^2 or greater (unless otherwise intended in a precinct);
- (c) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (d) residential development is protected from the impacts of any nearby industrial activities, transport corridors, infrastructure, installations and major facilities such as the port, airport and Department of Defence landholdings;
- (e) the design of development promotes accessibility by walking, cycling and public transport;
- (f) the design of development is responsive to the city's climate and promotes sustainable practices including energy efficiency and water conservation;
- (g) low-rise multiple dwellings, residential care or retirement facilities may be acceptable within this zone where provided in locations that are within a convenient walkable distance to centres, public transport and community activities, and where of a scale that is consistent with the local character;
- (h) non-residential uses only occur within the zone where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centre zones;
- (i) development minimises impacts on remaining areas of ecological significance within the zone; and
- (j) the natural bushland setting and village character of the northern beaches and Magnetic Island townships are maintained. Tourism accommodation in these communities is of a house compatible scale.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Ross River Road corridor precinct:

(a) existing non-residential uses continue operation without significantly expanding;

(b) no additional non-residential development is established within the precinct to avoid the continuation of strip commercial development; and

(c) redevelopment of sites within this precinct may occur for the purposes of low-rise multiple dwellings, residential care or retirement facilities.

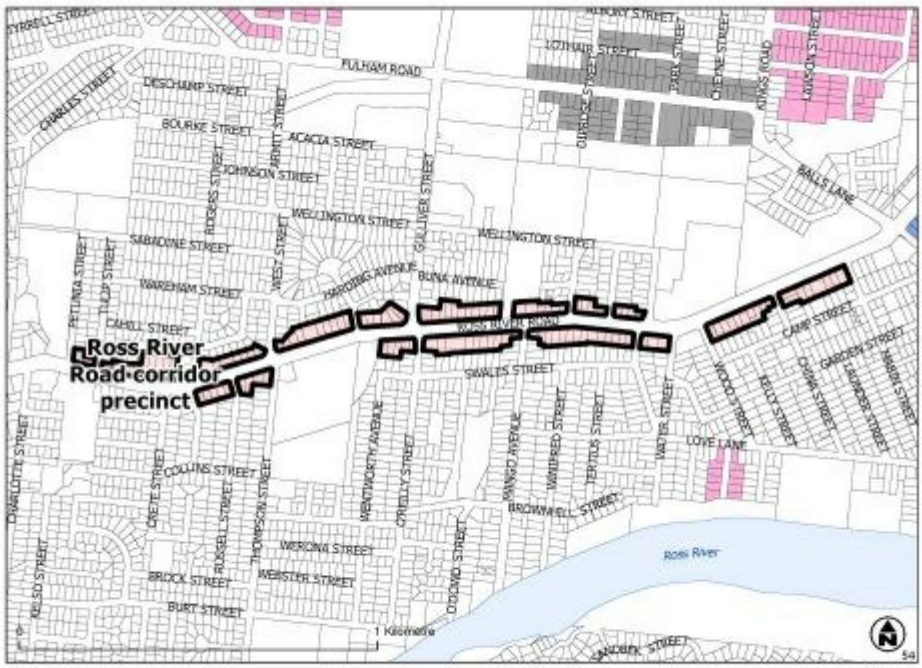


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Figure 6.1 Ross River Road corridor precinct

Stables precinct:

(a) stables are established in a manner that minimises impacts on residential amenity; and

(b) residential uses in the precinct do not intensify.

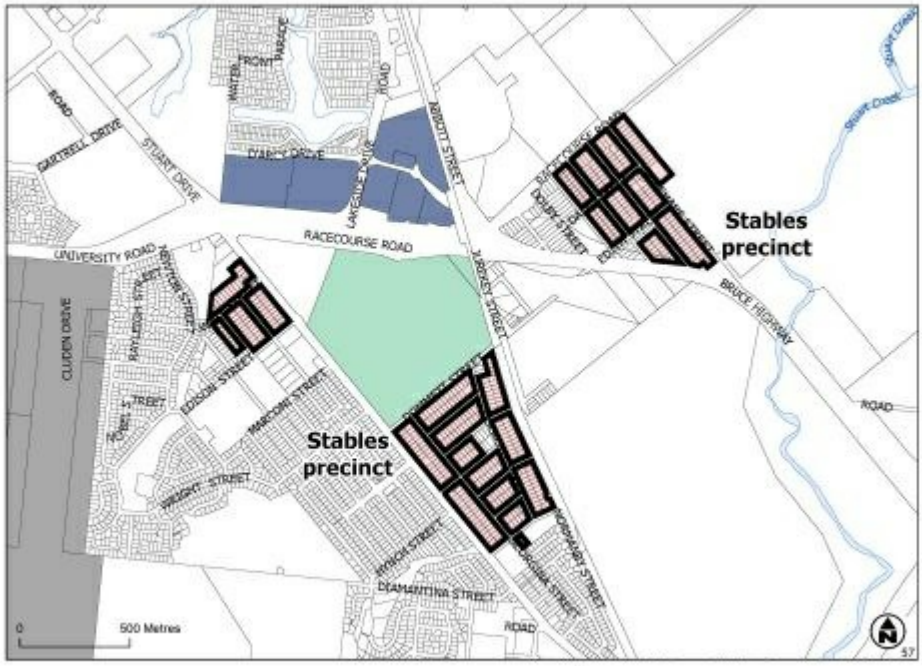

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Figure 6.2 Stables precinct

Marlow Street precinct:

(a) residential development occurs primarily in the form of dwelling houses on large lots with a limited site cover;

(b) lots are not smaller than 750m^2 and the minimum average lot size across the whole of the precinct is not less than 1,700m^2;

(c) development facilities viable wildlife corridors through the precinct; and

(d) built form and infrastructure is sub-ordinate to the vegetation and the natural landform.

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Figure 6.3 — Marlow Street precinct

6.2.1.3 Assessment benchmarks

Table 6.2.1.3 Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation, does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**a heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home based business on the site. **Editor's note—**home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

PO2 Commercial vehicle parking: (a) has a direct nexus with a home based business carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO2.1** Not more than one commercial vehicle is parked on the site.
	AO2.2 While on-site, vehicles: (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.
	AO2.3 Any commercial vehicle does not exceed 4.5 tonnes gross vehicle mass and is housed behind the building line.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For accepted development subject to requirements and assessable development	
Sales office	
PO3 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO3** Development of the sales office is in place for no more than two years.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for accepted development subject to requirements and assessable development in precincts **Note—**Townsville City Council has an animal keeping local law that also sets out requirements for stables. These must also be complied with.	
For accepted development subject to requirements and assessable development	
Stables precinct	
PO4 Only dwelling houses or caretaker's accommodation are established in the precinct.	**AO4** The development does not involve a dual occupancy, rooming accommodation, multiple dwelling, retirement facility, residential care facility, short-term accommodation or tourist park.
PO5 Reconfiguration does not result in additional lots being created.	**AO5** Lot size is no less than 1,000m^2.
PO6 The site is of a size to accommodate stables and associated service areas and allows for setback of stables from adjacent houses.	**AO6** Where stables are proposed, the site has a minimum area of 1,000m^2.
PO7 Stables are established where provision is made for a manager living on-site.	**AO7** Stables are established on the same site as a dwelling house or caretaker's accommodation.
PO8 Residential uses in the precinct do not intensify.	**AO8** Not more than one dwelling house or caretaker's accommodation unit is established on each lot.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO9 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO10 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.
PO11 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO12 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General	
PO13 Development minimises impacts on remaining areas of ecological significance within the zone.	No acceptable outcome is nominated.
PO14 On elevated or steeply sloping sites: (a) development is sympathetic to the natural landform through the use of terraced or split level building forms; (b) the understoreys of buildings are screened to maintain the quality of views from public vantage points below; and (c) buildings avoid highly reflective finishes.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO15 Parking facilities are located to be concealed from public view to ensure an attractive streetscape.	**AO15** Vehicle parking structures are located: (a) behind the building setback; or (b) behind the building; or (c) at basement level. Figure 6.4 – Concealment of parking structure illustrates.

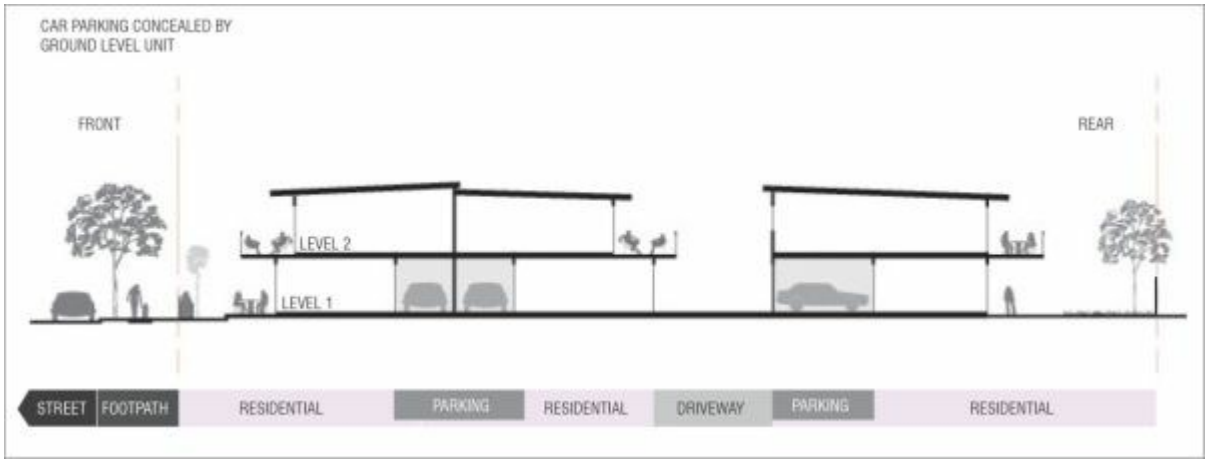

Figure 6.4 Concealment of parking structure

PO16 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development — where a non-residential or tourist accommodation use	
PO17 Non-residential uses are established only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO18 Tourist accommodation occurs only within the townships of Paluma, Balgal Beach, Toomulla, Toolakea and Saunders Beach and the Magnetic Island townships, and is compatible with the village character of these communities.	No acceptable outcome is nominated.
PO19 Development is of a house compatible scale.	**AO19.1** The use does not involve any building work or only minor building work. OR
	AO19.2 Where a new building is proposed: (a) buildings and other structures do not exceed 8.5m or 2 storeys, whichever is the lesser; (b) the building does not exceed 250m^2 in gross floor area; (c) site cover does not exceed 60%; and (d) the maximum length of any wall is 12m.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility or retirement facility development	
Location	
PO20 Multiple dwelling, residential care facility or retirement facility development occur only in locations where: (a) they can be designed to be compatible with local character and low density scale of development; (b) having convenient walkable access to the city's network of centres; (c) having convenient walkable access to public transport; and (d) having convenient walkable access to recreational facilities.	**AO20** The premises: (a) is located within 400m of a centre zone or public transport stop on a major road; (b) has a minimum site area of 1,000m² and 20m frontage where for a multiple dwelling; (c) has a minimum site area of 3,000m² and 20m frontage where for a residential care facility or retirement facility; and (d) is located within 400m of a park.
PO21 Buildings are low-rise and of a house compatible scale.	**AO21** Building design achieves: (a) a site cover that does not exceed 65% of site area; (b) a building height that does not exceed 2 storeys and 8.5m if it is within 10m of a site boundary, and 3 storeys if it is 10m or more from a site boundary; and (c) the maximum length of any wall is 12m.
PO22 Building setbacks and landscaping: (a) create an attractive, consistent and cohesive streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; and (c) do not prejudice the development or amenity of adjoining sites.	**AO22.1** Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 3m. Figure 6.5 – Appropriate front setbacks illustrates.
	AO22.2 A landscape area with a minimum dimension of 1m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access only). Figure 6.6 – Appropriate front and rear setbacks illustrates.
	AO22.3 The side boundary setback is a minimum of: (a) 1.5m for a wall up to 4.5m high; (b) 2m for a wall up to 7.5m high; and (c) 2.5m for any part of a wall over 7.5m high. **Editor's note—**Development should also comply with the requirements of AO21 (b), such that any part of the building that is 3 storeys is 10m or more from a site boundary.
	AO22.4 The rear boundary setback is a minimum of 6m. Figure 6.6 - Appropriate front and rear setbacks illustrates.

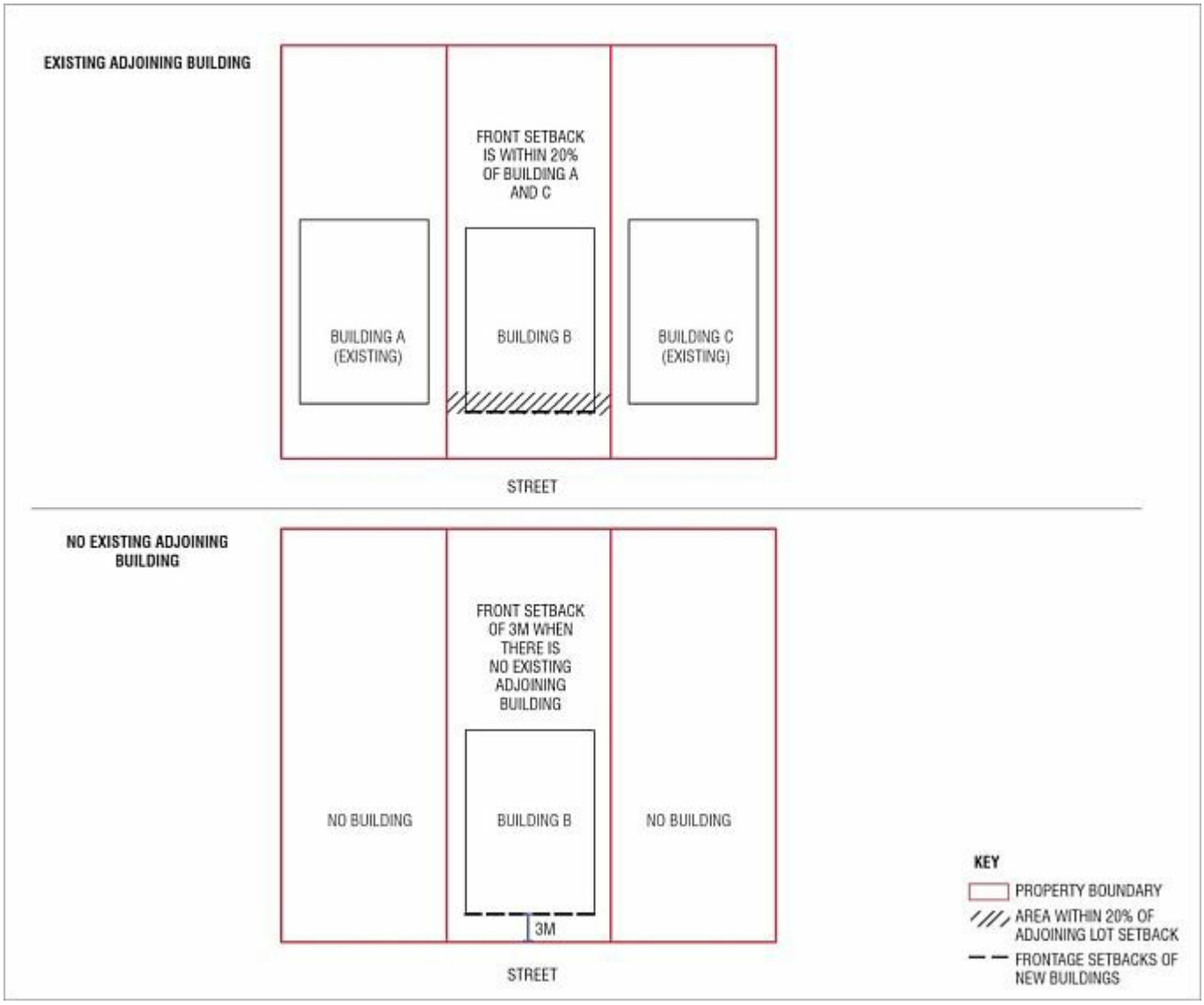

Figure 6.5 Appropriate front setbacks

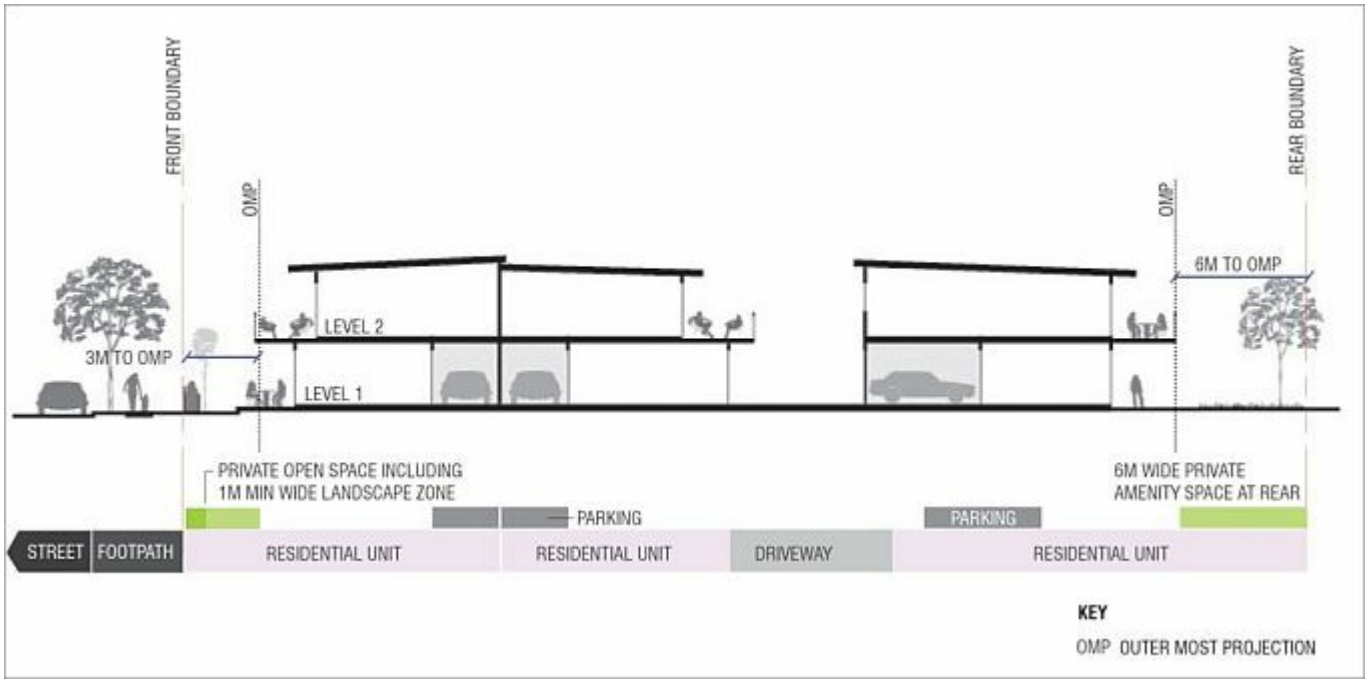

Figure 6.6 Appropriate front and rear setbacks

PO23 Built to boundary walls do not impact on the amenity or privacy of adjoining premises.	**AO23** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within the front or rear setback; (c) are not located within 1.5m of a habitable room or house on an adjoining lot; (d) have a maximum height of 3m; and (e) have a maximum length of 9m.
PO24 Buildings are designed to achieve good solar access by: (a) minimising the extent of shadows on usable private open space or public spaces; and (b) providing adequate sunlight to habitable rooms.	No acceptable outcome is nominated.
PO25 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings, including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages; (f) elements which assist in wayfinding and legibility; and (g) elements which relate to the context including surrounding buildings, parks, streets and open spaces. Figure 6.7 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.
PO26 Roof form assists in reducing the appearance of building bulk by: (a) articulating individual dwellings; and (b) incorporating variety in design through use of roof pitch, height, gables and skillions. Figure 6.7 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.

Figure 6.7 Building design elements

PO27 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO27.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other public spaces. Figure 6.8 – Design for casual surveillance illustrates.
	AO27.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

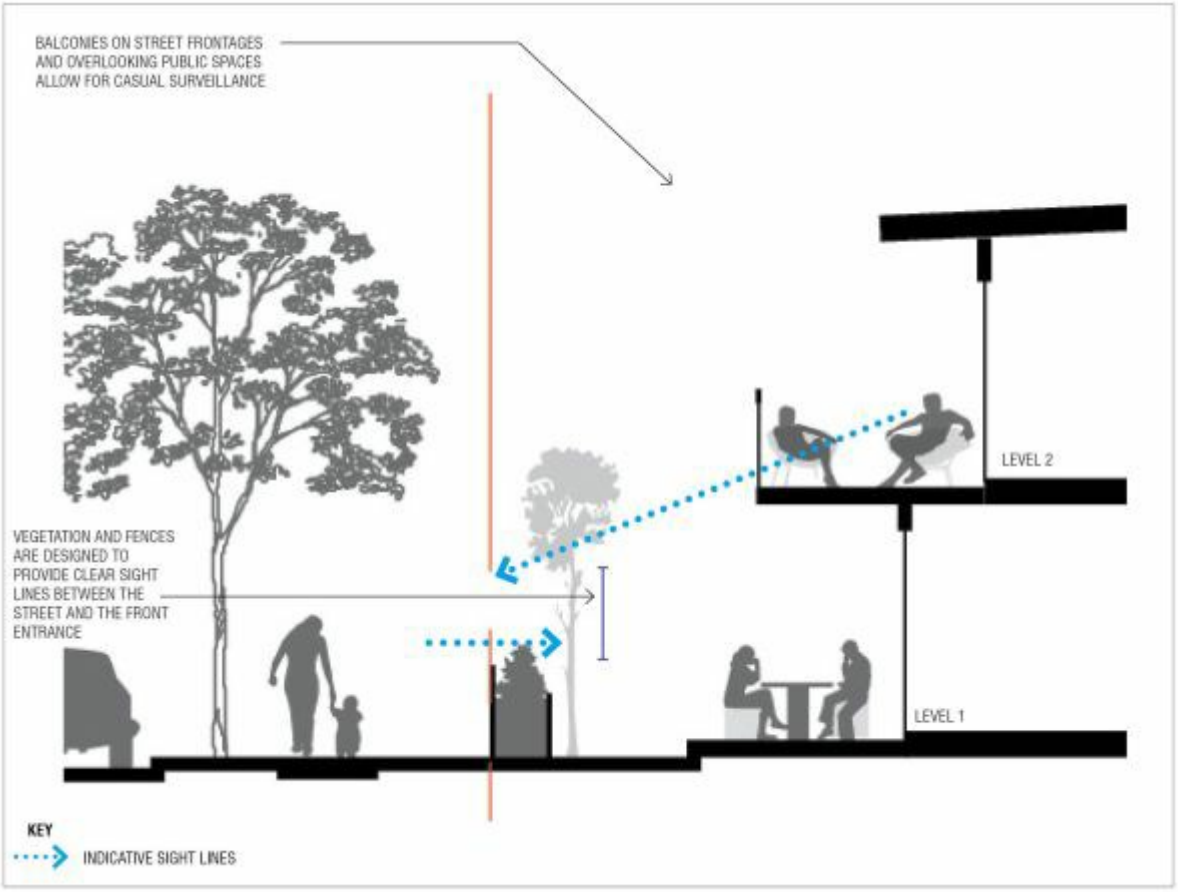

Figure 6.8 Design for casual surveillance

PO28 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO28.1** For a ground floor dwelling (where a multiple dwelling), ground floor private open space is provided with: (a) a minimum area of 35m²; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air-conditioning units.
	AO28.2 For a dwelling above ground storey, private open space is provided as a balcony with: (a) a minimum area of 9m² for a 1 bedroom unit or 16m² for a 2 or more bedroom unit; (b) a minimum dimension of 3m; and (c) clear of any utilities such as air conditioning units or drying space.
	AO28.3 Where clothes drying areas are provided on private balconies they are screened from public view and do not take up more than 10% of the balcony area.
	AO28.4 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings. Where screening is used, it is at least 50% translucent.
PO29 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO30 Communal open space provides facilities including seating, landscaping and shade. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.
PO31 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Ross River Road corridor precinct	
PO32 No new non-residential development is established within the precinct.	No acceptable outcome is nominated.
PO33 Expansion of existing non-residential development is minor in nature and does not significantly increase the intensity of non-residential activity.	**AO33** New gross floor area is only added through internal building work to an existing building.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Marlow Street precinct	
PO34 Reconfiguration creates large residential lots which support the protection of environmental values.	**AO34** Lots are not smaller than 750m^2 and the minimum average lot size across the whole of the precinct is not less than 1,700m^2.
PO35 Residential development occurs primarily in the form of dwelling houses on large lots with a limited site cover.	No acceptable outcome is nominated.
PO36 Built form and infrastructure is subordinate to vegetation and the natural landform.	No acceptable outcome is nominated.

6.2.2 Medium density residential zone code

6.2.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.2.2 Purpose

(1) The purpose of the Medium density residential zone code is to provide for a range and mix of dwelling types including dwelling houses and multiple dwellings.

(2) The particular purpose of the code is to:

- (a) provide opportunities for medium density living close to centres and other community nodes in a generally low to medium-rise built form;
- (b) maintain a high level of residential amenity; and
- (c) achieve accessible, well-serviced and well-designed communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) residential development consists primarily of low-rise (up to 3 storeys in building height) apartments or town house style dwellings, together with a mix of lot sizes or duplex housing types. Taller, more intensive built form will generally be limited to key infill locations near the city's major centres, as specifically intended in particular precincts;
- (b) built form creates an attractive and pedestrian oriented streetscape which integrates with nearby centres, public transport and community activities;
- (c) reconfiguration creates lots which facilitate the location of dwellings which address the street and allow for climate-responsive building orientation;
- (d) residential uses may also include residential care facilities, retirement facilities, rooming accommodation and short-term accommodation;
- (e) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (f) residential development is protected from the impacts of nearby centres, industrial activities, transport corridors and infrastructure installations and major facilities such as the port, airport and Department of Defence landholdings;
- (g) the design of development promotes accessibility by walking, cycling and public transport;
- (h) the design of development is responsive to the city's climate by taking into account prevailing breezes, slope and solar orientation, provision of awnings and promotes sustainable practices including energy efficiency and water conservation; and
- (i) non-residential uses only occur where they are specifically intended in particular precincts or where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centres.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Thuringowa South precinct:

(a) medium density housing reinforces the role and vibrancy of Thuringowa Central major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) development facilitates improved accessibility to the major centre for pedestrians and cyclists and promotes access to public transport facilities;

(c) a new east-west road link is created through the precinct providing an alternative route to High Range Drive;

(d) built form creates a medium-rise environment (up to 5 storeys in building height) along Riverway Drive;

(e) otherwise, built form within the precinct is generally low-rise (up to 3 storeys in building height); and

(f) Riverway Drive becomes a tropical boulevard providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

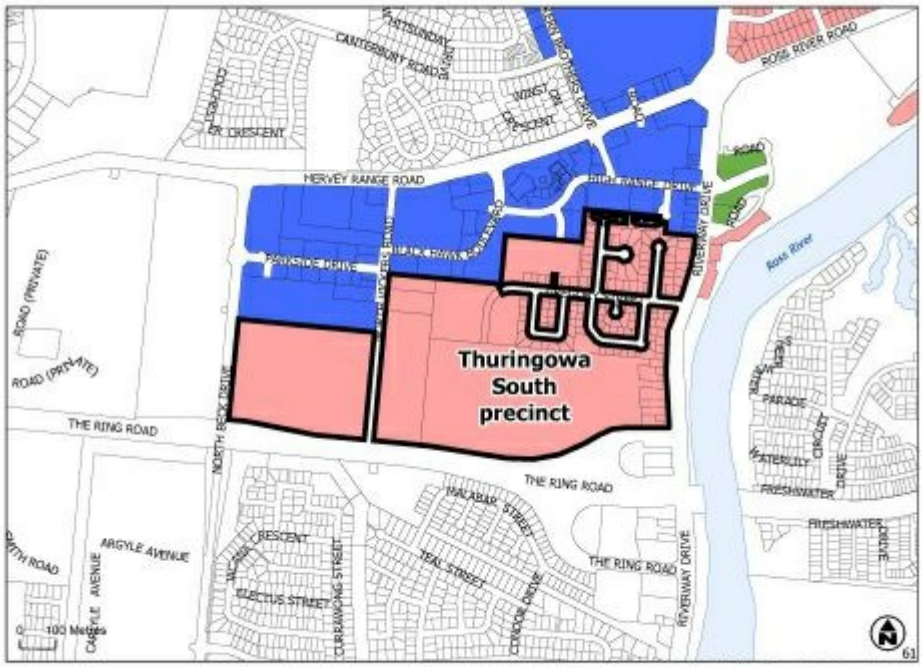

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Figure 6.9 Thuringowa South precinct

Thuringowa East precinct:

(a) medium density housing reinforces the role and vibrancy of Thuringowa Central major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) along Thuringowa Drive and Ross River Road and transitions down to surrounding low-rise residential areas;

(c) development facilitates improved accessibility to the major centre for pedestrians and cyclists, provides for safer and shadier pedestrian routes and road crossings and promotes access to public transport facilities;

(d) Thuringowa Drive, Riverway Drive and Ross River Road become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and reduction in vehicular access points and screening of parking areas; and

(e) existing non-residential uses do not significantly expand and no additional non-residential development is established within the precinct.

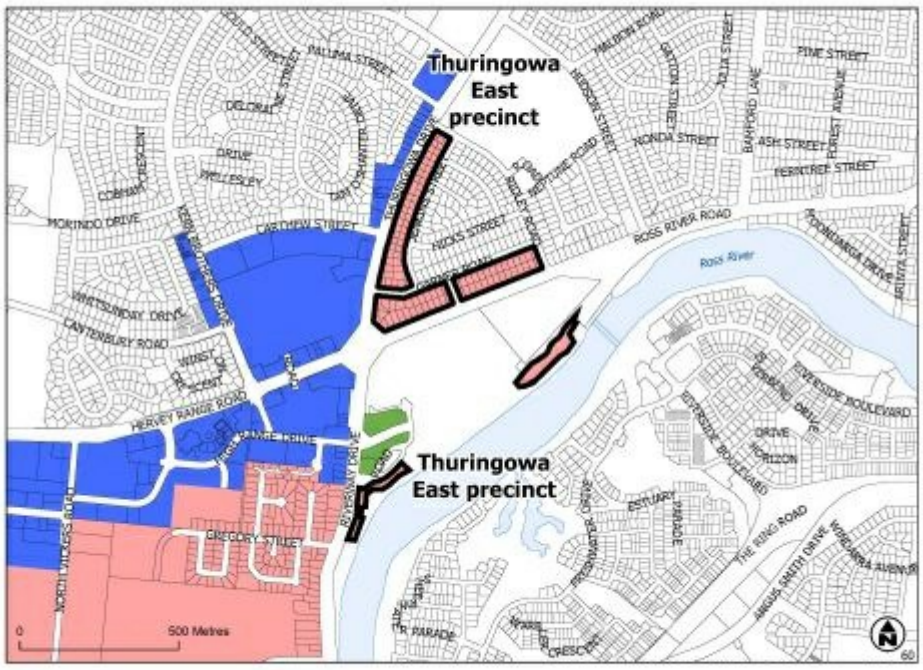

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Figure 6.10 Thuringowa East precinct

Rossiter Park precinct:

(a) the precinct redevelops into a medium density residential community, through amalgamation of existing lots into larger sites that provide the opportunity for better designed medium density residential development;

(b) built form creates a medium-rise environment (up to 6 storeys in building height) fronting Rossiter Park and transitions down (up to 3 storeys in building height) to surrounding low-rise residential areas;

(c) development creates a strong orientation to the street and to Rossiter Park; and

(d) the redevelopment of this precinct aligns new streets with the existing street grid alignment to the north to integrate the emerging precinct into the surrounding Aitkenvale locality and re-establishes direct travel connections between the Aitkenvale major centre and Ross River and its parkland via Elizabeth Street.

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Figure 6.11 Rossiter Park precinct

Aitkenvale medium density precinct:

(a) medium density housing reinforces the role and vibrancy of the Aitkenvale major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) throughout the precinct; and

(c) new development facilitates improved accessibility for pedestrians and cyclists, provides for safer and shadier pedestrian routes and road crossings and promotes access to public transport facilities.

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Figure 6.12 Aitkenvale medium density precinct

Aitkenvale village precinct:

(a) non-residential uses occur in this precinct but are limited to small-scale retail, dining and entertainment activities accommodated on the ground floor of a residential development, and having direct frontage to Patrick Street or Elizabeth Street;

(b) built form creates a medium-rise environment (up to 5 storeys in building height);

(c) Patrick Street and Elizabeth Street are activated by small-scale shop fronts and kerbside activities at the ground storey with awnings providing protection from the elements;

(d) non-residential activities within the precinct do not impact on the role and function of the Aitkenvale major centre;

(e) large format retail and showroom uses do not establish within this precinct;

(f) development creates a safe environment, balancing vibrant street activity and the protection of visual amenity;

(g) linkages between the Aitkenvale centre and centre core sub-precinct, the Aitkenvale centre frame precinct and the Aitkenvale medium density precinct are improved through the strengthening of primary pedestrian linkages along Elizabeth Street and Patrick Street;

(h) streetscaping along Elizabeth Street and Patrick Street frontages occurs to improve the interface between the site and the street whilst also improving the pedestrian environment and experience; and

(i) Elizabeth Street is the focus for the creation of an active main street environment.

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Figure 6.13 Aitkenvale village precinct

Hyde Park medium density precinct:

(a) land adjoining the open space corridor through Hyde Park provides for the emergence of a new residential community which complements the Hyde Park major centre;

(b) development provides for the improvement of access to the adjoining open space corridor for recreational use, whilst preserving its drainage function;

(c) a mix of housing types is provided within the precinct in generally low to medium-rise built form (up to 5 storeys in building height) which is oriented to the open space and assists in activating this interface;

(d) provision of a new road off Woolcock Street defines the precinct from adjoining commercial activities and connects it to the existing local street network via Dillane Street;

(e) the precinct connects with Virgil Street and development facilitates this becoming the major east-west pedestrian thoroughfare through the locality;

(f) non-residential uses may be established in the precinct where fronting Woolcock Street. Non-residential uses are generally small-scale and accommodated on the ground storey of a residential development; and

(g) non-residential activities within the precinct do not impact on the role and function of the Hyde Park major centre.

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Figure 6.14 Hyde Park medium density precinct

Kings Road medium density precinct:

(a) development creates a medium-rise built form (up to 5 storeys in building height), with variation in built form to create visual interest across the precinct;

(b) the interface with the showgrounds is enhanced; and

(c) impacts on residential amenity from the rail corridor are minimised.

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Figure 6.15 Kings Road medium density precinct

The Strand precinct:

(a) this precinct enhances its role as Townsville's pre-eminent residential and tourist destination built on the amenity offered by The Strand parklands;

(b) The Strand forms the central focus of activity and concentration of medium density accommodation for tourists and residents;

(c) development creates a safe environment balancing vibrant street activity and the protection of residential amenity;

(d) The Strand plays a secondary role to nearby centres in accommodating non-residential uses. Non-residential uses are generally limited to small-scale cafes and restaurants accommodated on the ground storey of a residential development, to activate the street frontage and parkland;

(e) non-residential activities within the precinct do not impact on the role and function of the North Ward local centre;

(f) buildings within this precinct are designed to address The Strand parklands; and

(g) built form creates a medium-rise environment (up to 5 storeys in building height).

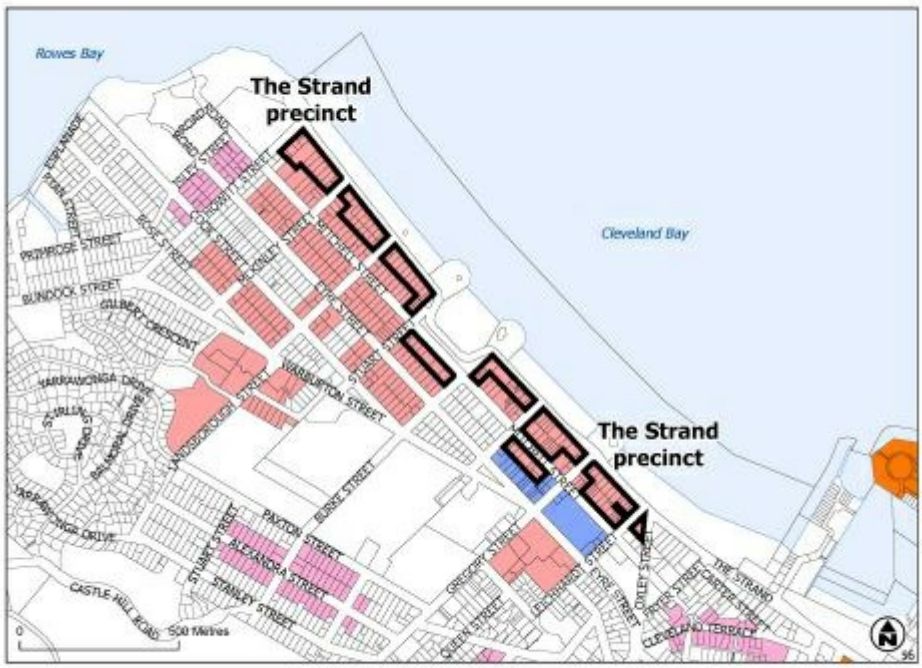

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Figure 6.16 The Strand precinct

North Ward gateway precinct:

(a) the precinct provides a key connectivity route between The Strand and Warburton Street by creating a distinctive built form along Landsborough Street;

(b) development reinforces the gateway role of the routes, creating a view corridor to The Strand and contributing to a sense of arrival and assisting in wayfinding to The Strand;

(c) built form creates a higher-medium rise environment (up to 8 storeys in building height); and

(d) an attractive tropical streetscape is created.

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Figure 6.17 North Ward gateway precinct

North Ward villages precinct:

(a) the North Ward villages are envisaged to contain the highest levels of activity and residential density in North Ward;

(b) the precinct plays a secondary role to nearby centres in accommodating non-residential uses. Non-residential uses are generally limited to small-scale cafes and restaurants accommodated on the ground floor of a residential development;

(c) Gregory Street village will expand its existing role and function as a destination for street dining and entertainment;

(d) non-residential activities within the precinct do not impact on the primacy of the principal centre or the role and function of the North Ward local centre;

(e) Landsborough Street village will develop into a secondary lifestyle focus of activity in North Ward. The role of Landsborough Street village will be to complement (not compete) with Gregory Street; and

(f) built form creates a higher-medium rise environment (up to 8 storeys in building height) along Gregory and Landsborough Streets.

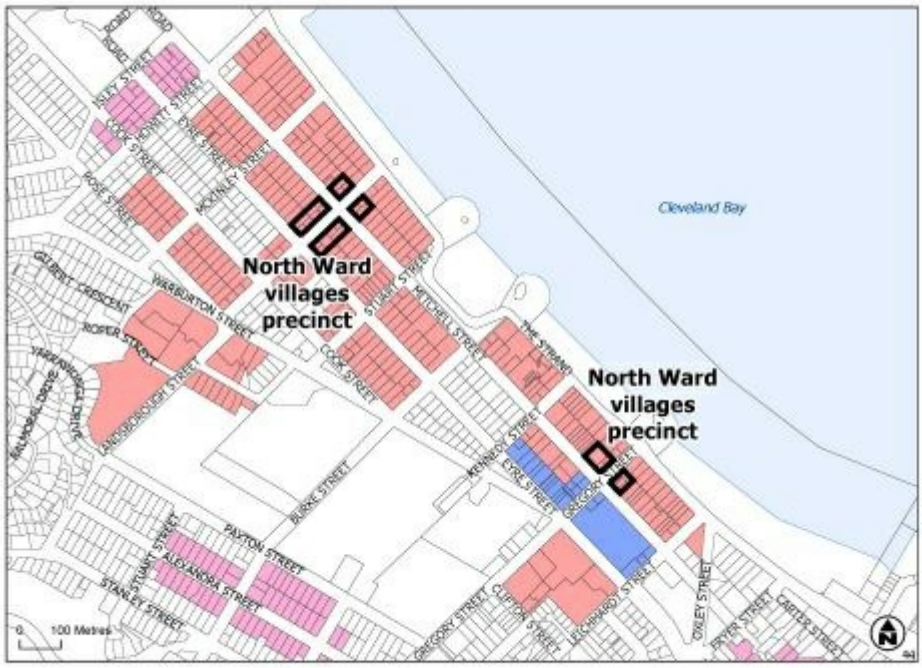

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Figure 6.18 North Ward villages precinct

North Ward medium density precinct:

(a) medium density housing reinforces the role and vibrancy of North Ward;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) throughout the precinct;

(c) development of the former hospital site facilitates reuse of the hospital building for residential purposes and provides for improved accessibility for pedestrians and cyclists; and

(d) development creates a strong orientation to the street and to The Strand wherever possible.

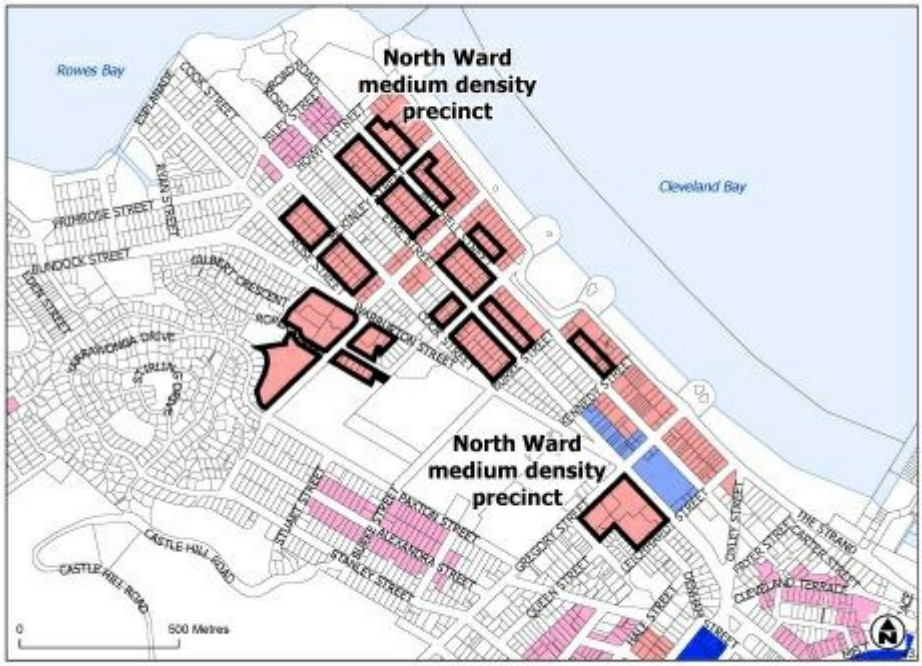

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Figure 6.19 North Ward medium density precinct

Magnetic Island medium density precinct:

(a) the precinct allows for the growth of short-term accommodation which minimises visual impact on the local natural setting, whilst providing opportunity for new investment in tourism;

(b) buildings within the precinct are low-rise (up to 2 storeys in building height) and are located to capitalise on views and beachfront settings;

(c) building scale and massing limits the impact on the natural character of Magnetic Island when viewed from the ocean and foreshore; and

(d) new buildings are in a design style that builds local character by articulation of individual units, incorporating extensive planting and climatically responsive design elements.

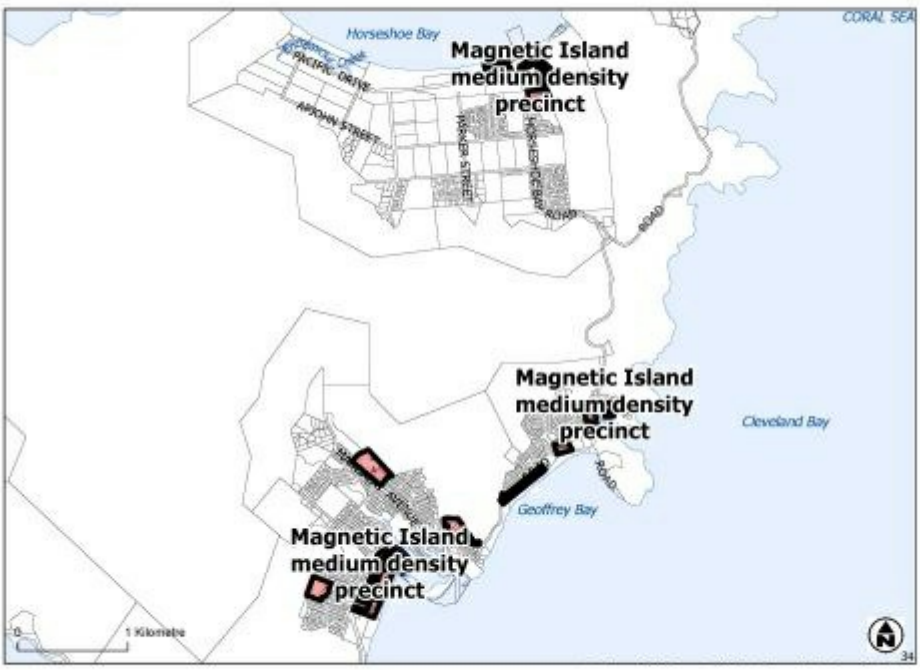

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Figure 6.20 Magnetic Island medium density precinct

Picnic Bay precinct:

(a) family oriented short-term accommodation is the predominant use established within the precinct with some non-residential uses on the ground floor;

(b) built form within the precinct consists of detached dwellings and multiple dwellings up to 2 storeys in building height; and

(c) new buildings are in a design style that builds local character by articulation of individual units, incorporating extensive planting and climatically responsive design elements.

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Figure 6.21 Picnic Bay precinct

Nelly Bay tourist precinct:

(a) the role of this precinct is to provide an attractive arrival place for the entire island, whilst also providing an accessible and convenient tourist hub, including accommodation and supporting tourist information and service facilities;

(b) built form accommodates the highest density short-term tourist accommodation on the island, with building heights up to 4 storeys;

(c) the ground floor of buildings within this precinct is activated by small scale café and restaurant uses where addressing the bay to create a waterfront promenade;

(d) tourist based businesses and services are located along Harbour Drive to support tourist needs for the island; and

(e) new buildings and streetscape improvements are in a design style that builds local character by articulation of buildings, incorporating extensive planting, use of a variety of materials and finishes and climatically responsive design elements.

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Figure 6.22 Nelly Bay tourist precinct

Wills Street precinct:

(a) built form creates a medium-rise environment (up to 4 storeys in building height) throughout the precinct and provides for a sensitive transition in scale to nearby Character residential zoned land.

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Figure 6.23 Wills Street precinct

6.2.2.3 Assessment benchmarks

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based childcare the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO2** Development of the sales office is in place for no more than two years.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO4 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note–**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO6.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other areas which are accessible to the public. Figure 6.24 – Design for casual surveillance illustrates.
	AO6.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high at least 50% transparent.

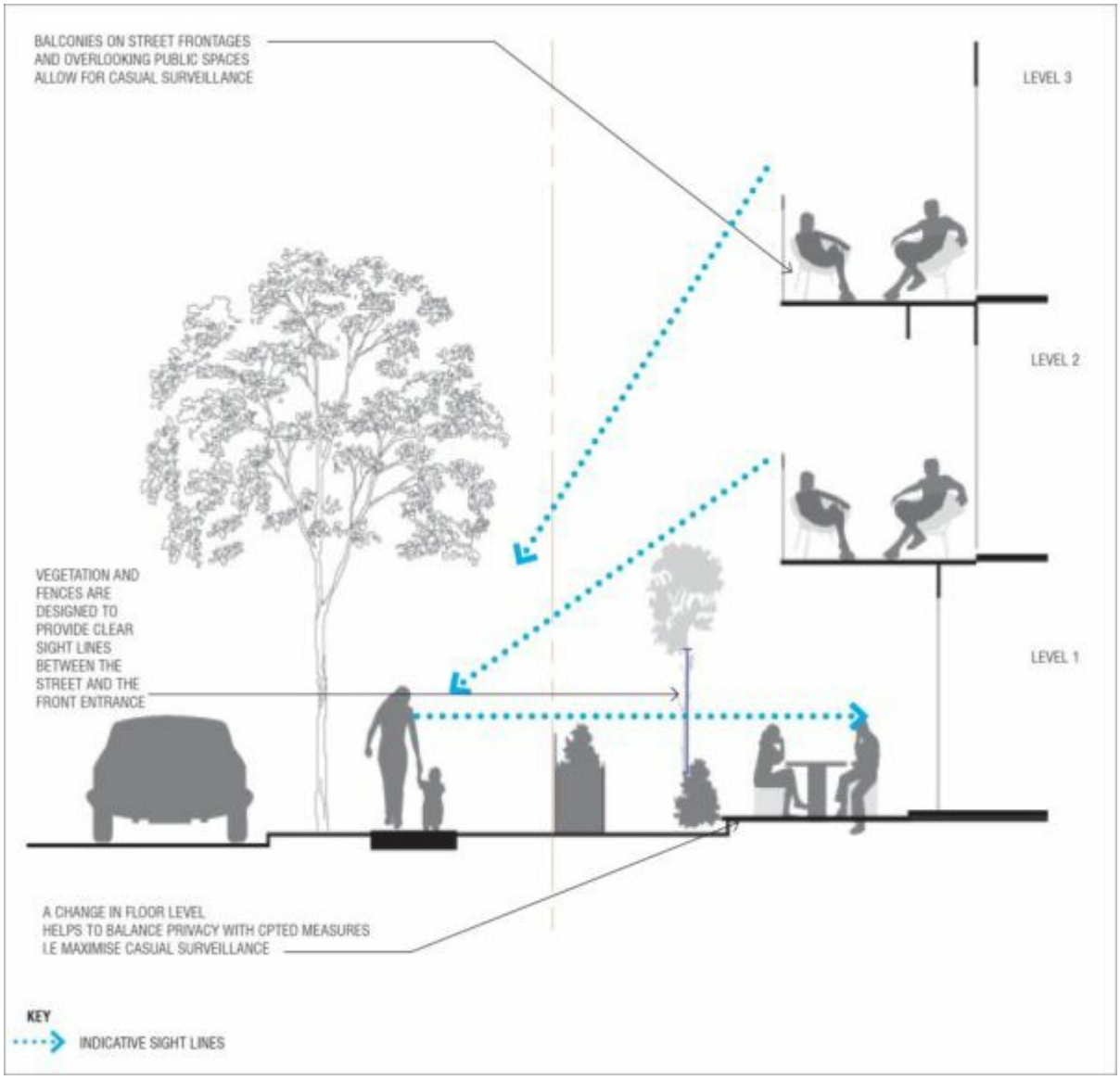
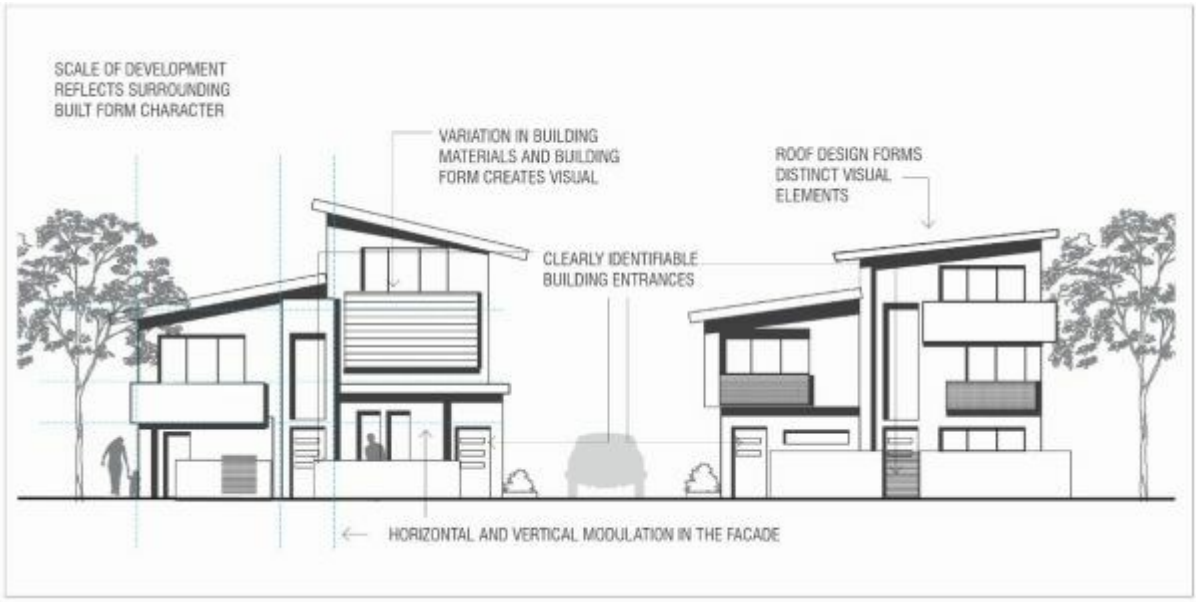


Figure 6.24 – Design for casual surveillance

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO7 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages for a premises on a corner; (f) elements which assist in wayfinding and legibility; and (g) elements which relates to the context including surrounding buildings, parks, streets and open spaces. Figure 6.25 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.



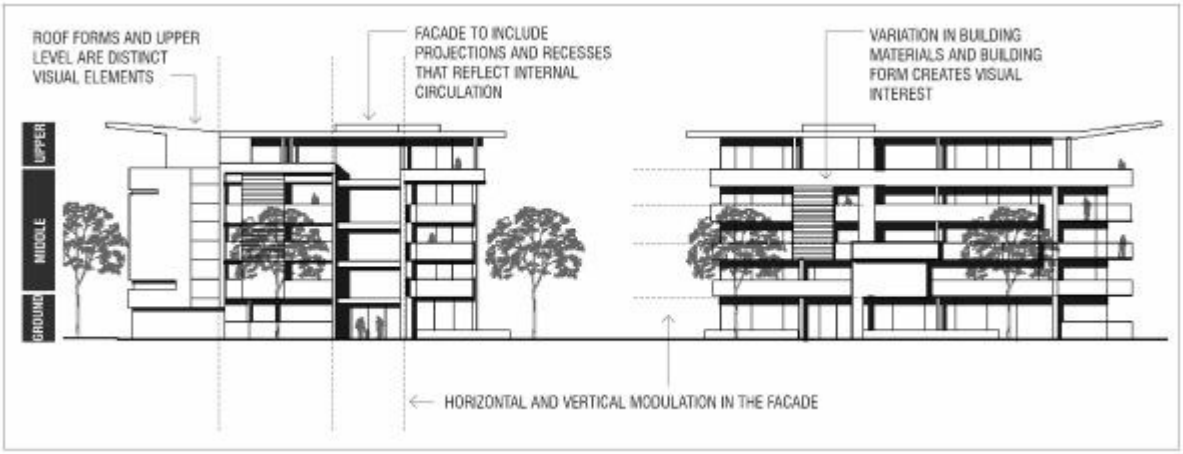


Figure 6.25 – Building design elements

PO8 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO9 Parking facilities are located to be concealed from public view to ensure an attractive streetscape.	**AO9** Vehicle parking structures are located: (a) behind the building setback; or (b) behind the building; or (c) at basement level. Figure 6.26 – Concealment of parking structures illustrates.

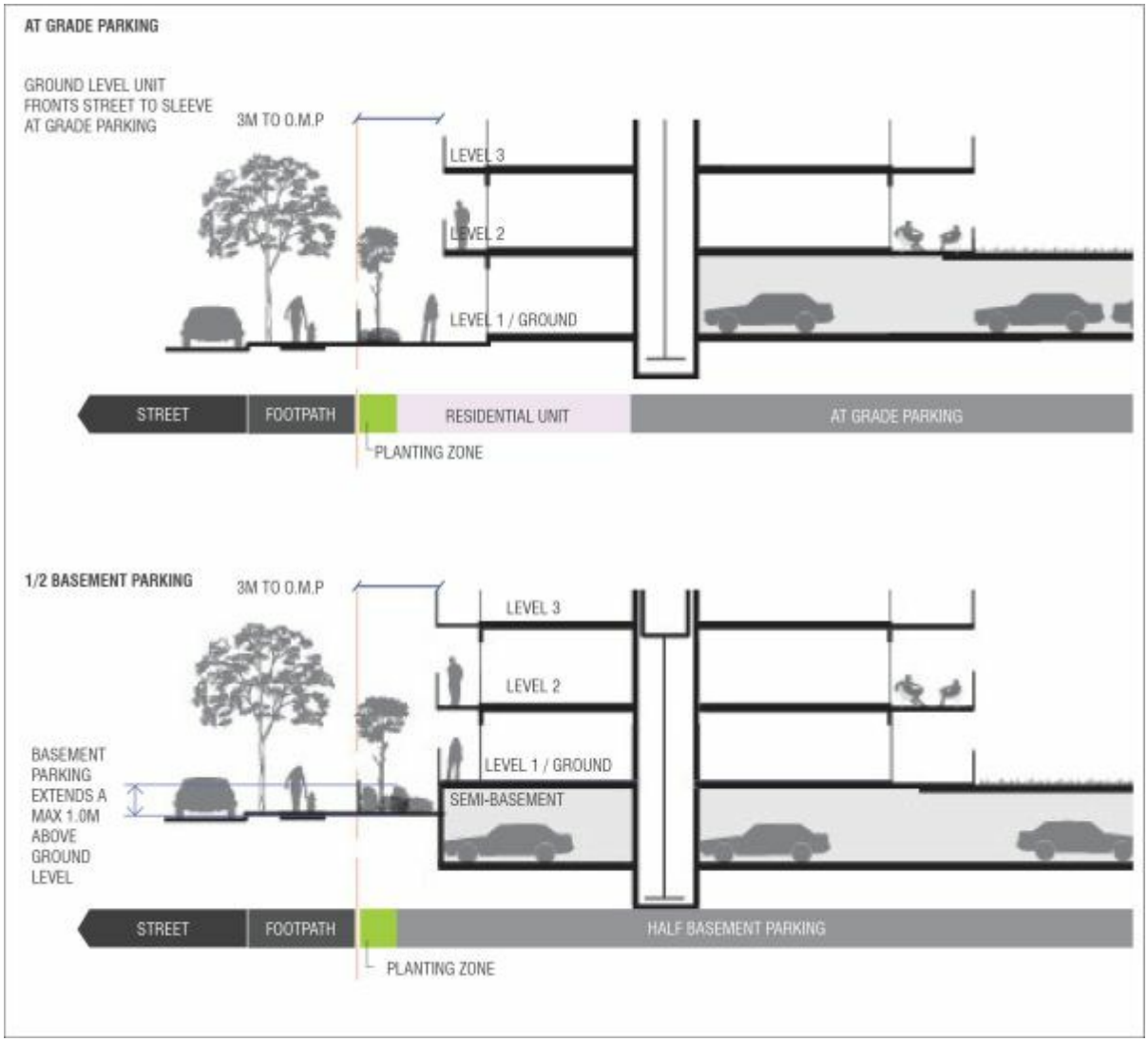


Figure 6.26 – Concealment of parking structures

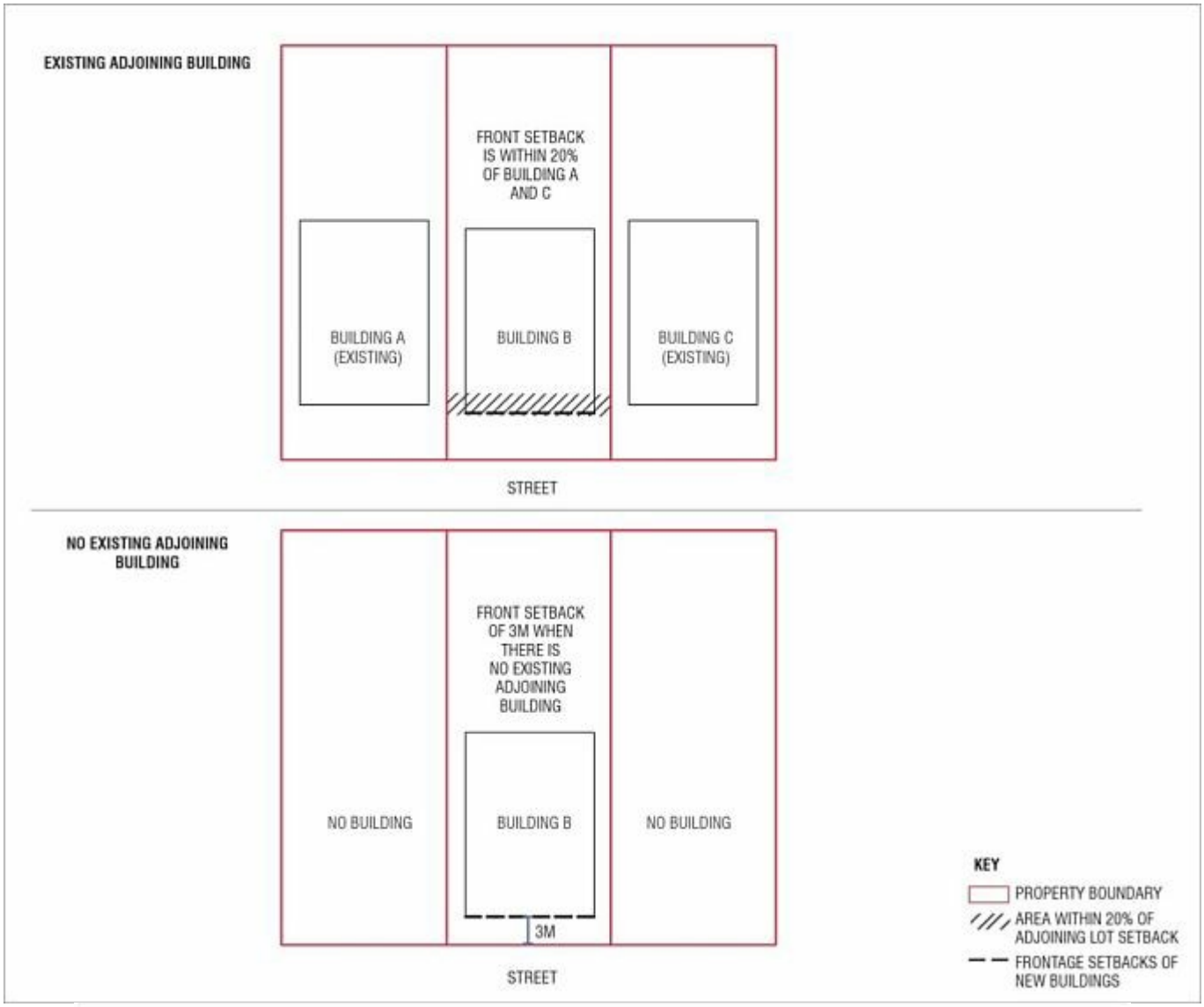
PO10 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a non-residential use	
PO11 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community or as specifically intended for a particular precinct; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with the performance outcome.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility, retirement facility or short-term accommodation with a building height of 3 storeys or less	
Built form	
PO12 Building height and scale is proportionate to the size of the premises and the desired low-rise character of the area.	**AO12** Building design achieves: (a) a site cover that does not exceed 65%; and (b) a building height that does not exceed 3 storeys.
PO13 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; and (c) do not prejudice the development of adjoining sites.	**AO13.1** Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 3m. Figure 6.27 – Building setbacks illustrates.
	AO13.2 The side boundary setback, except for a wall built to the boundary, is a minimum of: (a) 1.5m for a wall up to 4.5m high; (b) 2m for a wall up to 7.5m high; and (c) 2.5m for any part of a wall over 7.5m high. Figure 6.27 – Building setbacks illustrates.
	AO13.3 The rear boundary setback is a minimum of 6m. Figure 6.27 – Building setbacks illustrates.
	AO13.4 A landscape area with a minimum dimension of 1.5m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access only).



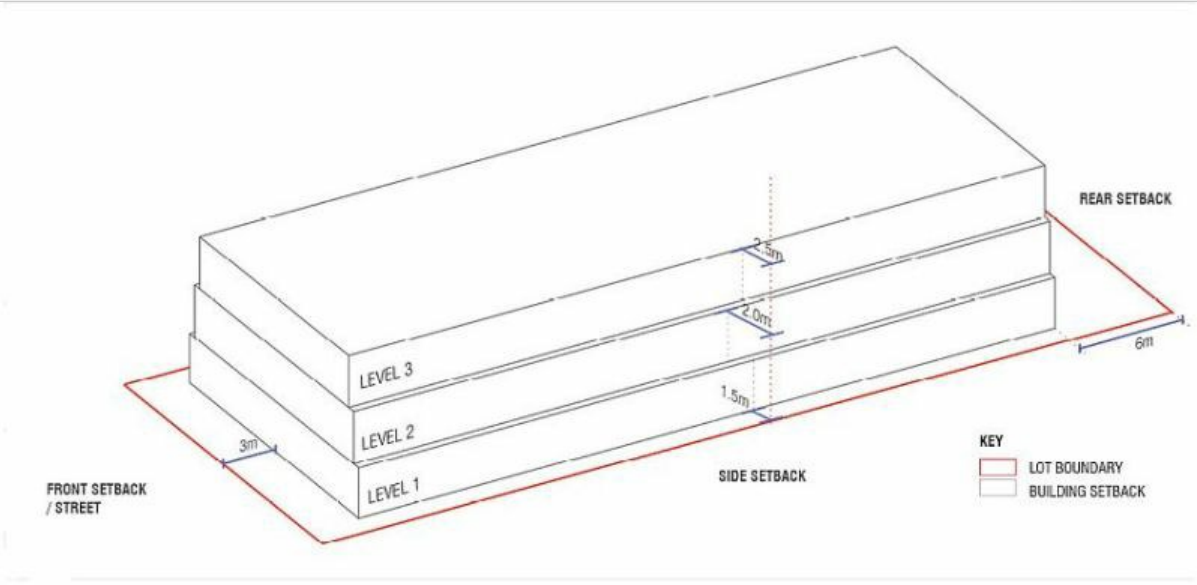


Figure 6.27 – Building setbacks

PO14 Built to boundary walls do not impact on the amenity or privacy of adjoining premises. **Editor's note–**Built to boundary wall heights and lengths may be increased where abutting an existing or proposed built to boundary wall on an adjoining property.	**AO14** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within 1.5m of a habitable room or house on an adjoining site; (c) are not located within the front or rear setback; (d) have a maximum height of 3m; and (e) have a maximum length of 15m.
PO15 Roof form assists in reducing the appearance of building bulk by: (a) articulating individual dwellings; and (b) incorporating variety in design through use of roof pitch, height, gables and skillions.	No acceptable outcome is nominated.
PO16 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO16.1** For a ground floor dwelling, ground floor private open space is provided with: (a) a minimum area of 25m²; (b) a minimum dimension of 4m; and (c) clear of any utilities such as gas, water tanks or air-conditioning units
	AO16.2 Balconies are provided with a minimum area of 9m² for a 1 bedroom unit or 16m² for a 2 or more bedroom unit, with a minimum dimension of 4m and clear of any air conditioning unit or drying space.
	AO16.3 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO16.4 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO17 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO18 Communal open space provides facilities including landscaping and shade treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility, retirement facility or short-term accommodation within a precinct intended for building heights of 4 storeys or more	
Built form	
PO19 Building design creates an enjoyable pedestrian environment and experience through the use of: (a) design elements that promote a sense of human scale at the street level, including use of awnings where appropriate; (b) design that breaks up the ground floor elevation on the principle street frontage into distinct elements; and (c) articulation of the built form above ground floor through use of balconies, recesses and changes in material.	No acceptable outcome is nominated.
PO20 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy, landscaping and amenity for existing and future buildings; and (c) do not prejudice the development of adjoining land.	**AO20.1** The design meets the setback requirements outlined by Table 6.2.2.3(b) — Building setbacks Medium density residential zone. Figure 6.28 – Building setbacks illustrates.
	AO20.2 A deep planting landscape area with a minimum width of 1.5m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access). Figure 6.28 – Building setbacks illustrates.
	AO20.3 A deep planting landscape area with a minimum width of 1.5m is provided along the rear site boundary. Figure 6.28 – Building setbacks illustrates.

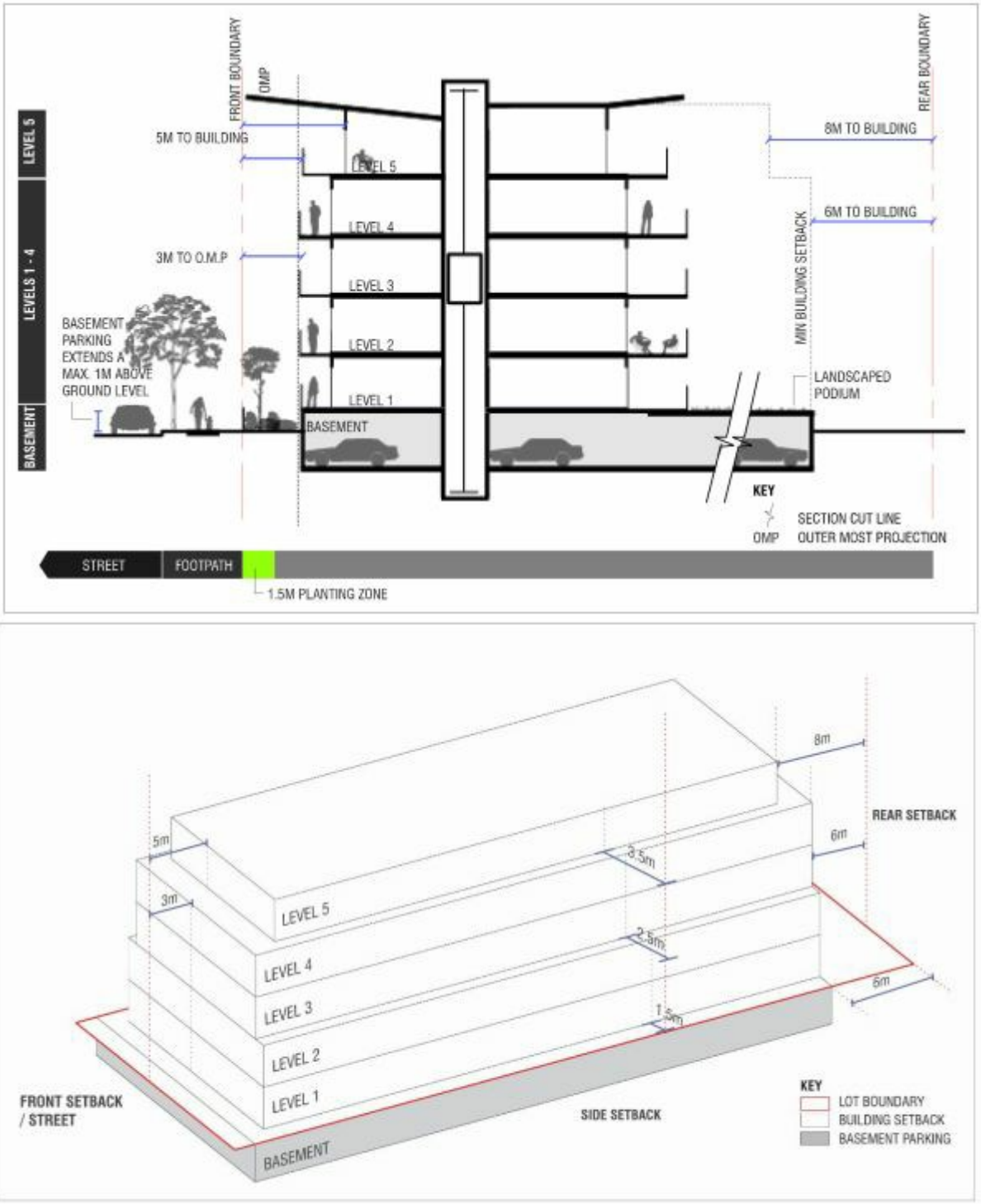


Figure 6.28 – Building setbacks

PO21 Roof forms assist in articulating the facade as a combination of distinct elements integrated with the facade design.	No acceptable outcome is nominated.
PO22 Roof top plant and equipment are contained within roof forms and are screened from the street and from adjoining buildings using a consistent range of non-reflective materials to provide a cohesive design element.	No acceptable outcome is nominated.

PO23 Development provides private open space that is: (a) well-proportioned, appealing and functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO23.1** Balconies are provided with a minimum area of 9m² for a 1 bedroom unit or 16m² for 2 or more bedroom unit, with a minimum dimension of 4m and clear of any air conditioning unit or drying space.
	AO23.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO23.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO24 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities and to mitigate the intensity of the built form.	No acceptable outcome is nominated.
PO25 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa South precinct	
PO26 New road linkages are created in accordance with Figure 6.29 – Thuringowa South precinct concept plan, including an alternative east west link from Riverway Drive to North Beck Drive and to provide a direct link into the Thuringowa Central major centre precinct.	No acceptable outcome is nominated.
PO27 Development creates a compatible interface with the centre activities and facilitates pedestrian and cyclist access to the Thuringowa Central major centre precinct in accordance with Figure 6.29 – Thuringowa South precinct concept plan.	No acceptable outcome is nominated.
PO28 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO28.1** Building height does not exceed 5 storeys where fronting Riverway Drive in the area shown on Figure 6.29 – Thuringowa South precinct concept plan, and 3 storeys otherwise.
	AO28.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m2.

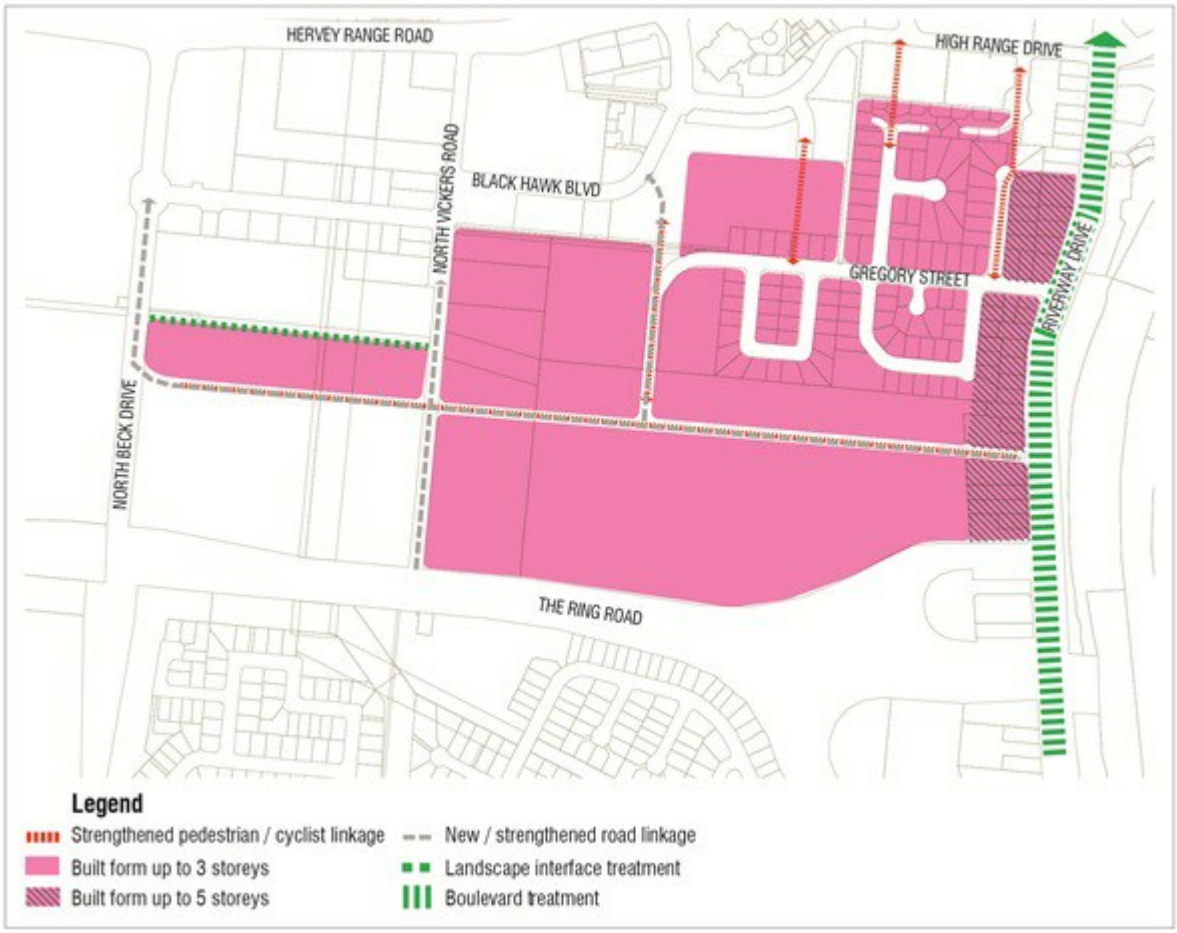


Figure 6.29 – Thuringowa South precinct concept plan

PO29 Development contributes to the boulevard treatment of Riverway Drive, through landscaping and streetscape treatments along the road frontage.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa East precinct	
PO30 Development contributes, through street improvements, to the boulevard treatment of Thuringowa Drive, Riverway Drive and Ross River Road.	No acceptable outcome is nominated.
PO31 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Built form provides for sensitive transitioning in height and scale to nearby Low density residential zoned land.	**AO31.1** Building height does not exceed 5 storeys in the areas shown on Figure 6.30 – Thuringowa East precinct concept plan, and 3 storeys otherwise.
	AO31.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.

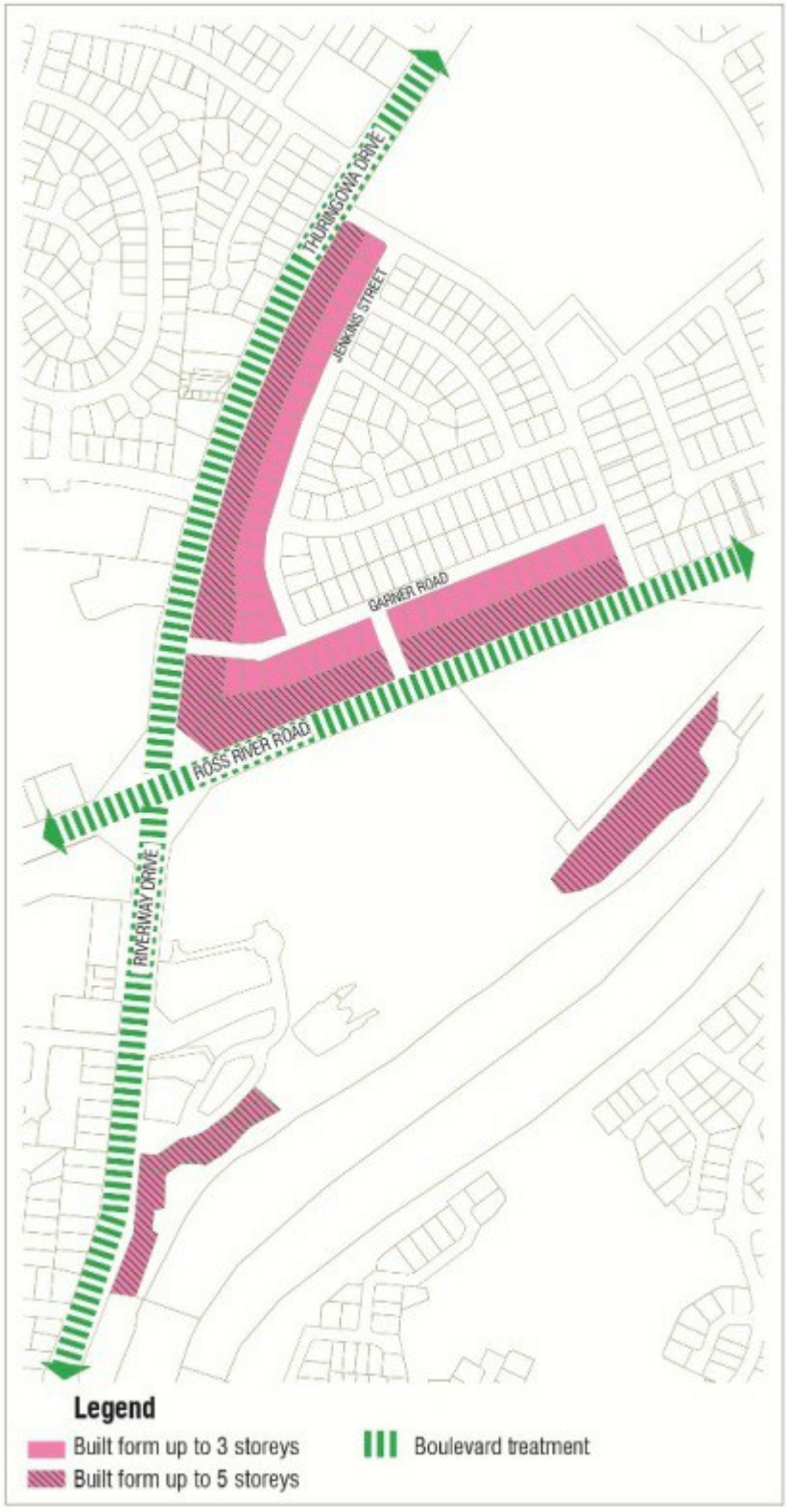


Figure 6.30 – Thuringowa East precinct concept plan

PO32 Access to Ross River Road, Thuringowa Drive and Riverway Drive is consolidated.	**AO32.1** Development sites have a minimum size of 1,000m2 and contain no more than 1 access driveway.
	AO32.2 Access driveways are provided from rear or side streets rather than Thuringowa Drive or Riverway Drive.
PO33 No new non-residential development is established within the precinct.	No acceptable outcome is nominated.
PO34 Expansion of existing non-residential development is minor in nature and does not significantly increase the intensity of non-residential activity.	**AO34** New gross floor area is only added through internal building work to an existing building.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Rossiter Park precinct	
PO35 Development achieves a coordinated redevelopment of this precinct into a high quality medium density urban environment which is highly responsive to the amenity offered by Ross River and its parklands through building orientation, intensity of built form and landscaping treatment. Development site planning is undertaken in accordance with Figure 6.31 – Rossiter Park precinct concept plan.	No acceptable outcome is nominated.
PO36 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for primary orientation of buildings to the street, the provision of building setbacks, on-site services and circulation and open space at ground storey. Development over 3 storeys occurs only on large, amalgamated sites that facilitate well-proportioned buildings permitting primary orientation to the park.	**AO36.1** Building height does not exceed 6 storeys in the area shown on Figure 6.31 – Rossiter Park precinct concept plan, and 3 storeys otherwise.
	AO36.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m2.
PO37 Development facilitates new street connections and promotes visual and pedestrian connectivity through the precinct to Rossiter Park to the south and Aitkenvale major centre precinct to the north, in accordance with Figure 6.31 – Rossiter Park precinct concept plan.	No acceptable outcome is nominated.

PO38 On frontages shown on Figure 6.31 – Rossiter Park precinct concept plan as having a responsive edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) having a primary orientation overlooking the street and Rossiter Park; and (b) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.

Figure 6.31 – Rossiter Park precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale medium density precinct	
PO39 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO39.1** Building height does not exceed 5 storeys.
	AO39.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO40 Pedestrian routes are defined by building streetscape improvements that provide shade and improve pedestrian comfort.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Aitkenvale village precinct **Note**-Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale village precinct	
PO41 Supermarket and showroom retail uses do not occur in this precinct.	No acceptable outcome is nominated.
PO42 Food and drink outlets are established where they are (a) orientated to the street; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above.	No acceptable outcome is nominated.
PO43 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian friendly and visually interesting frontages.	**AO43.1** Front setbacks at the ground floor do not exceed 3m.
	AO43.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO43.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.

PO44 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at the ground storey.	**AO44.1** Building height does not exceed 5 storeys.
	AO44.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO45 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO45** Awnings are provided over outdoor spaces.
PO46 On the frontage shown on Figure 6.32 - Aitkenvale village precinct concept plan as having built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) creating a generally continuous building alignment; (b) having facades which contain windows, doors, materials and features which generate visual interest at the street level; and (c) incorporating an attractive streetscape and planting theme.	No acceptable outcome is nominated.

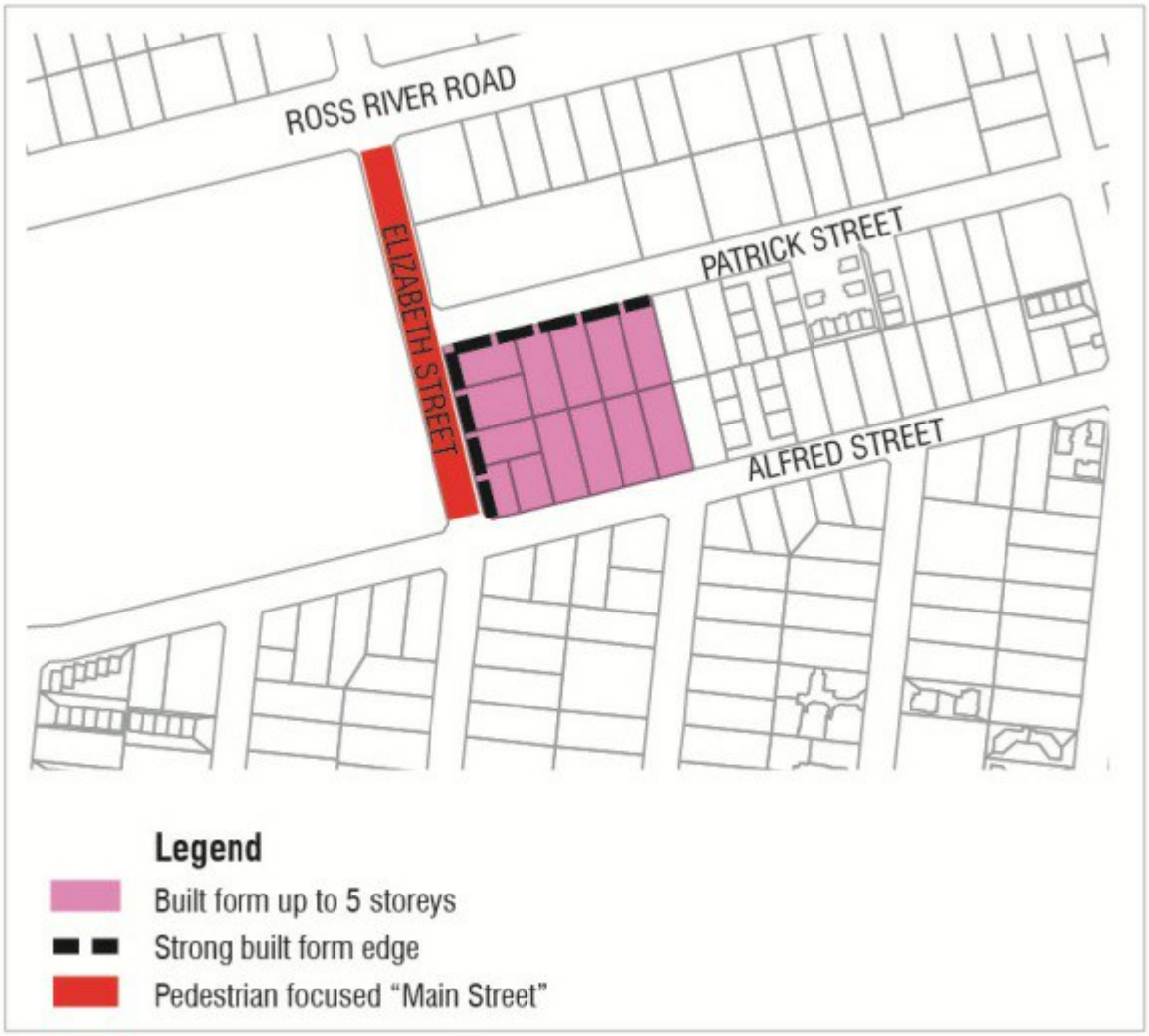


Figure 6.32 Aitkenvale village precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Hyde Park medium density precinct	
PO47 Building height creates a low to medium-rise environment, and transitions to nearby Low density residential zoned land.	**AO47** Building height does not exceed 3 storeys in the area shown on Figure 6.33 – Hyde Park medium density precinct concept plan, and 5 storeys otherwise.
PO48 Development provides for improvements to the open space corridor such that it provides a major recreational node for the precinct and surrounding area, in a manner generally consistent with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO49 Development adjacent to the open space corridor incorporates pedestrian access along the interface, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.

PO50 Development overlooks and provides for casual surveillance of the open space corridor.	No acceptable outcome is nominated.
PO51 Development facilitates the establishment of a new road linkage connecting Woolcock Street to Dillane Street, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan. This new road assists in creating an active and attractive interface between the major centre and the Hyde Park medium density precinct.	No acceptable outcome is nominated.
PO52 Development facilitates the establishment of Virgil Street as the major east-west pedestrian thoroughfare connecting across into the Hyde Park major centre and the open space corridor, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO53 Non-residential uses may establish on the ground floor where fronting Woolcock street and where integrated with residential development in accordance with Figure 6.33 - Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO54 Where incorporating ground floor non-residential uses, the design of buildings provides for pedestrian-friendly and visually interesting frontages.	**AO54** Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum of 0.5m for any length of facade exceeding 10m.
PO55 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO55** Awnings are provided over outdoor spaces.

Figure 6.33 – Hyde Park medium density precinct concept plan

PO56 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of the pedestrian environment along Woolcock Street.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kings Road medium density precinct	
PO57 Building height creates a medium-rise environment.	**AO57** Building height does not exceed 5 storeys.
PO58 Residential uses are appropriately buffered from the railway corridor.	No acceptable outcome is nominated.
PO59 Development provides for enhanced public realm and pedestrian connectivity throughout the precinct and connecting to the showground.	No acceptable outcome is nominated.
PO60 Safe pedestrian access is provided for across Kings Road.	No acceptable outcome is nominated.
PO61 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of the pedestrian environment along Kings Road, in accordance with Figure 6.34 – Kings Road medium density precinct concept plan.	No acceptable outcome is nominated.

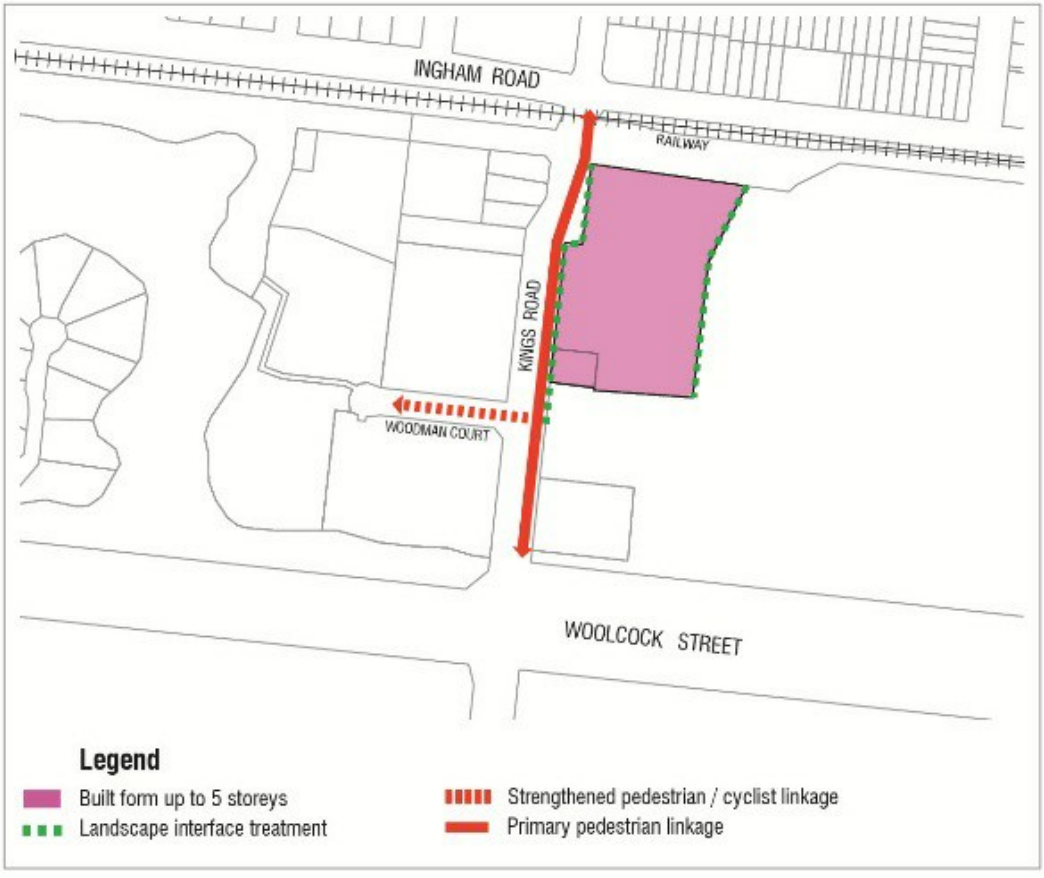


Figure 6.34 – Kings Road medium density precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
The Strand precinct	
PO62 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street and parkland, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO62.1** Building height does not exceed 5 storeys. Figure 6.35 – The Strand conceptual built form illustrates the desired built form.
	AO62.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO63 Food and drink outlets are established where they are: (a) oriented to the street and parkland; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above. Figure 6.35 – The Strand conceptual built form illustrates the desired design principles.	No acceptable outcome is nominated.
PO64 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian friendly and visually interesting frontages.	**AO64.1** Front setbacks at the ground floor do not exceed 3m.
	AO64.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO64.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO65 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage. Figure 6.35 – The Strand conceptual built form illustrates the desired design principles.	**AO65** Awnings are provided over outdoor spaces.

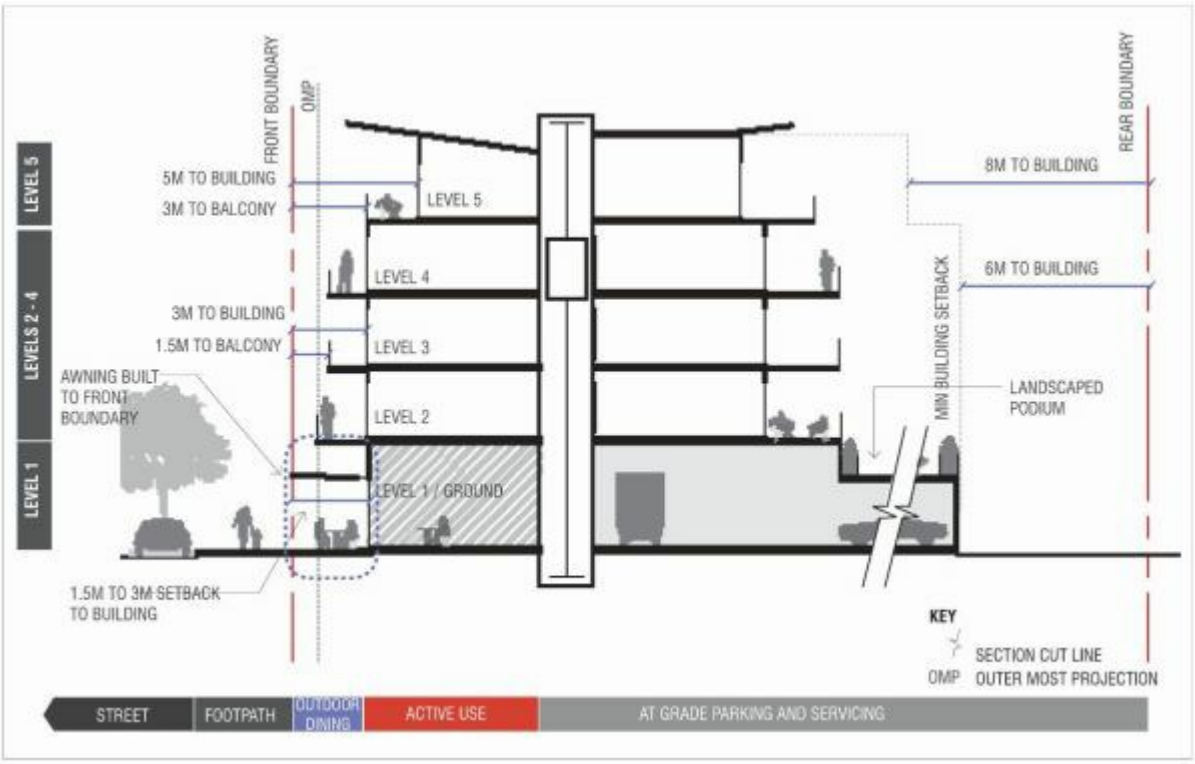


Figure 6.35 – The Strand conceptual built form

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward gateway precinct	
PO66 Building height and scale is consistent with the character desired for the precinct and reinforces Landsborough Street as a primary gateway to The Strand. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Figure 6.36 – North Ward gateway and villages conceptual built form illustrates.	**AO66.1** Building height does not exceed 8 storeys. **AO66.2** Development sites have a minimum size of 1,000m^2 where buildings of 5 storeys or above are proposed.
PO67 The design of buildings in this precinct provides for an arrival and wayfinding statement by: (a) addressing the street and are located to frame the edge of the street and focus view lines to The Strand; (b) creating an entry aesthetic by defining the street edge with a medium density built form; and (c) incorporating a streetscape and planting theme that creates a boulevard treatment of the street.	No acceptable outcome is nominated.

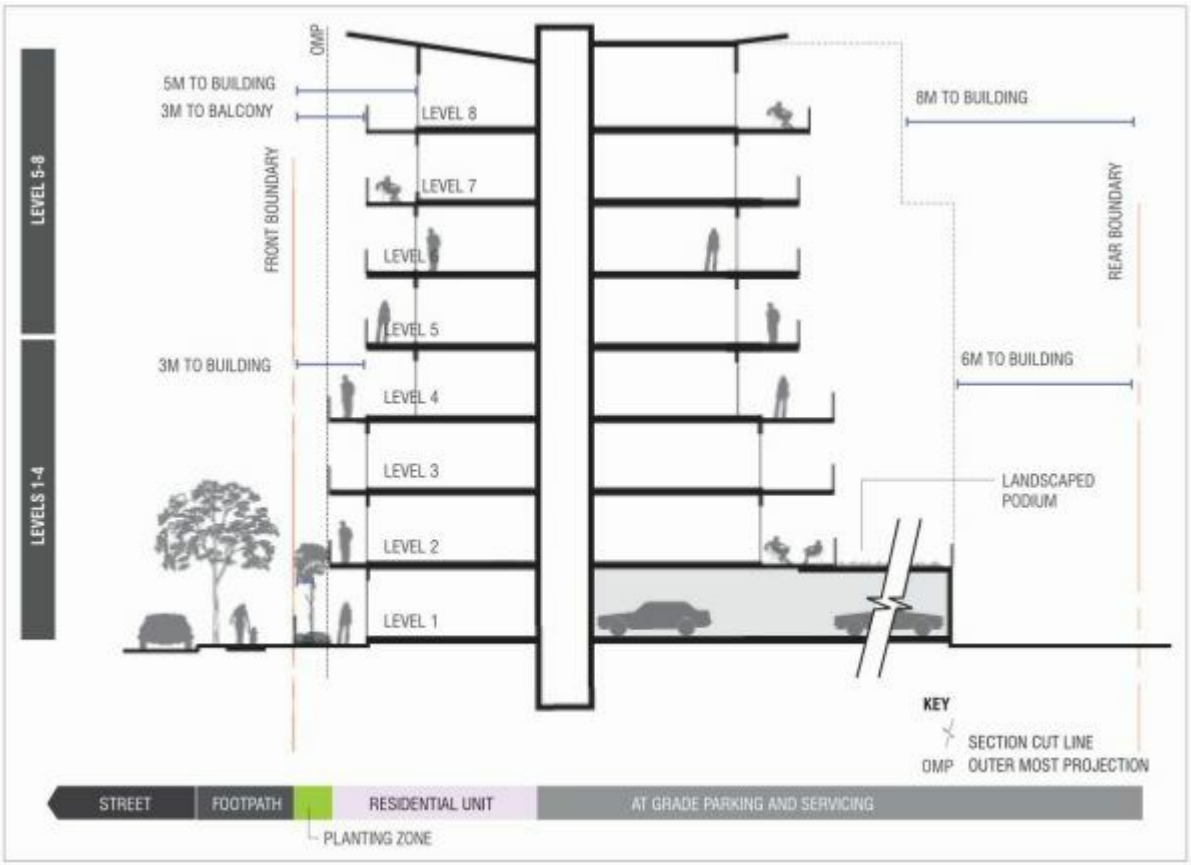


Figure 6.36 – North Ward gateway and villages conceptual built form

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward villages precinct	
PO68 Building height and scale is consistent with the character desired for the precinct and reinforces Gregory and Landsborough Streets as the primary activity spines and gateways to The Strand. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Figure 6.36 – North Ward gateway and villages conceptual built form.	**AO68.1** Building height does not exceed 8 storeys. **AO68.2** Development sites have a minimum size of 1,000m^2 where buildings of 5 storeys or above are proposed.
PO69 Non-residential uses are established where they are: (a) oriented to the street; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above.	No acceptable outcome is nominated.

PO70 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages.	**AO70.1** Front setbacks at the ground floor do not exceed 3m.
	AO70.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO70.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO71 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO71** Awnings are provided over outdoor spaces.
PO72 The design of buildings in this precinct provides for an arrival and wayfinding statement by: (a) focussing view lines to The Strand; (b) creating an entry aesthetic by defining the street edge with a medium density built form; and (c) incorporating a streetscape and planting theme that creates a boulevard treatment of the street. Figure 6.36 – North Ward gateway and villages conceptual built form.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward medium density precinct	
PO73 Building height and scale is consistent with the character desired for the precinct. The former hospital building remains as the most significant building in the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, onsite services and circulation and open space at ground storey.	**AO73.1** Building height does not exceed 5 storeys other than the existing hospital building which is retained at its present height.
	AO73.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO74 Building layout and design on the former hospital site facilitates a high level of pedestrian and cyclist permeability through the site.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Magnetic Island medium density precinct	
PO75 Building design and massing is consistent with the low density scale of the locality and articulates individual dwellings.	**AO75** Building height does not exceed 2 storeys and is predominately in the form of single, single unit or multiple pavilions. Figure 6.37 – Magnetic Island indicative built form outcomes illustrates.

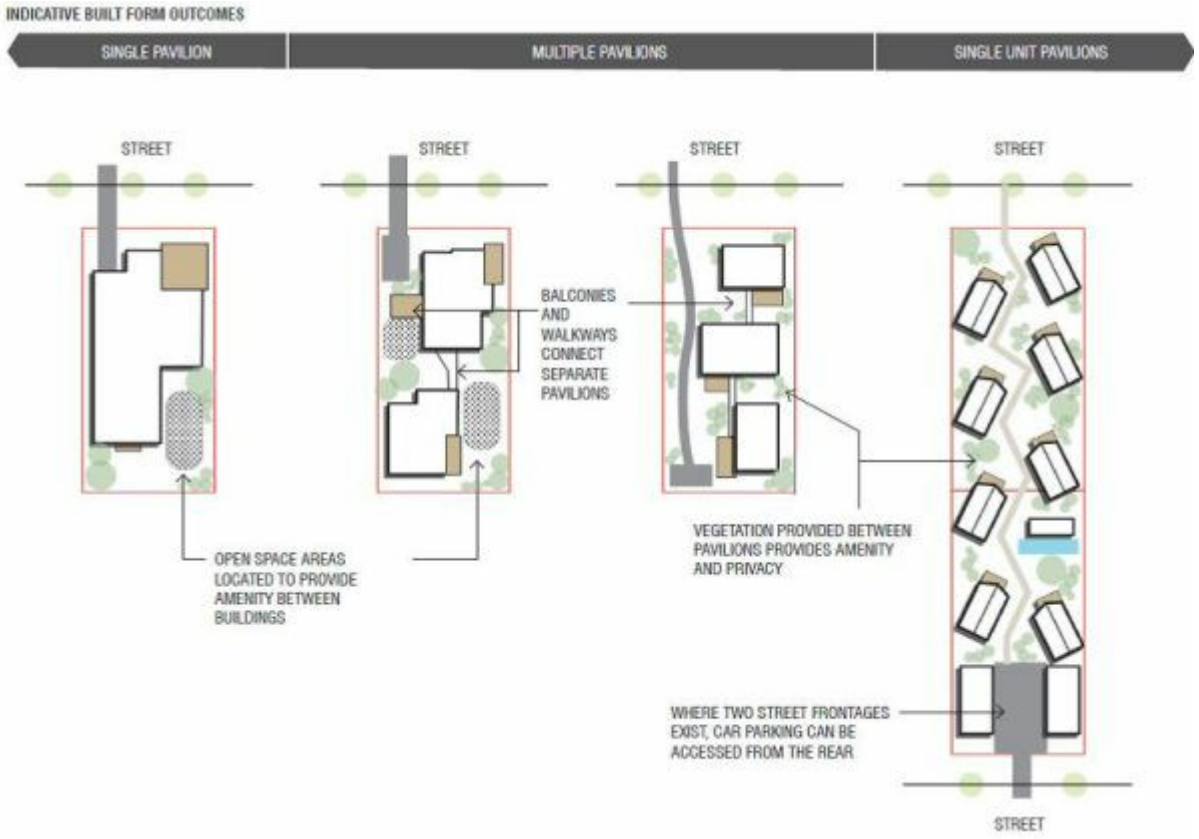


Figure 6.37 – Magnetic Island indicative built form outcomes

PO76 Design and articulation of buildings contribute to the creation of the local tropical character through: (a) use of tropical building design typologies; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay. Figure 6.38 – Examples of the desired tropical building design typologies.	No acceptable outcome is nominated.

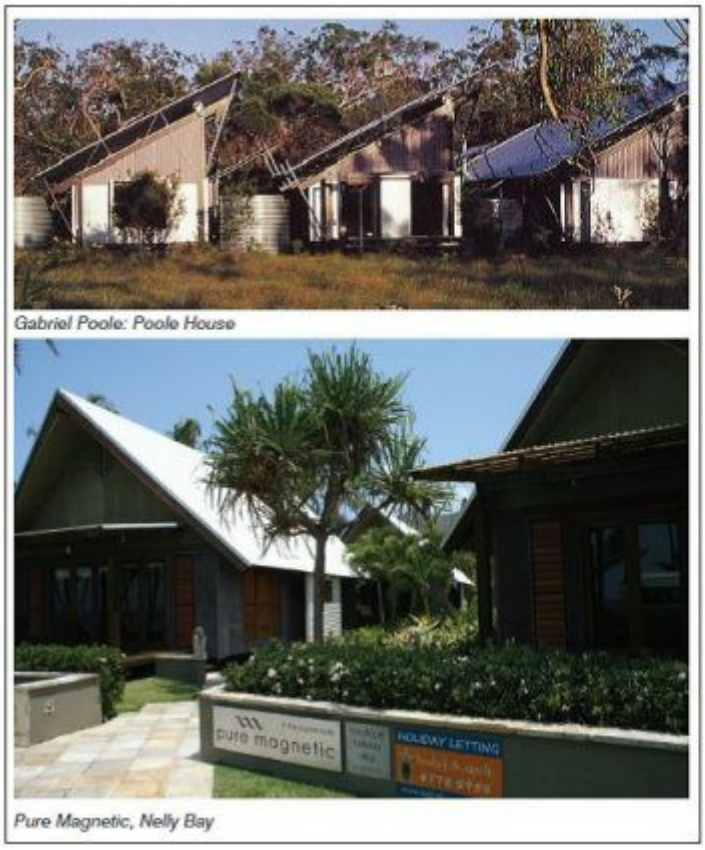


Figure 6.38 – Examples of the desired tropical building design typologies

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Picnic Bay precinct	
PO77 Non-residential uses are provided on the ground floor as part of a mixed use development along Granite Street and along the water frontage.	No acceptable outcome is nominated.
PO78 Building design and massing is consistent with the low density scale of the bay and articulates individual dwellings.	**AO78** Building height does not exceed 2 storeys and is predominately in the form of single, single unit or multiple pavilions. Figure 6.37 – Magnetic Island indicative built form outcomes illustrates.

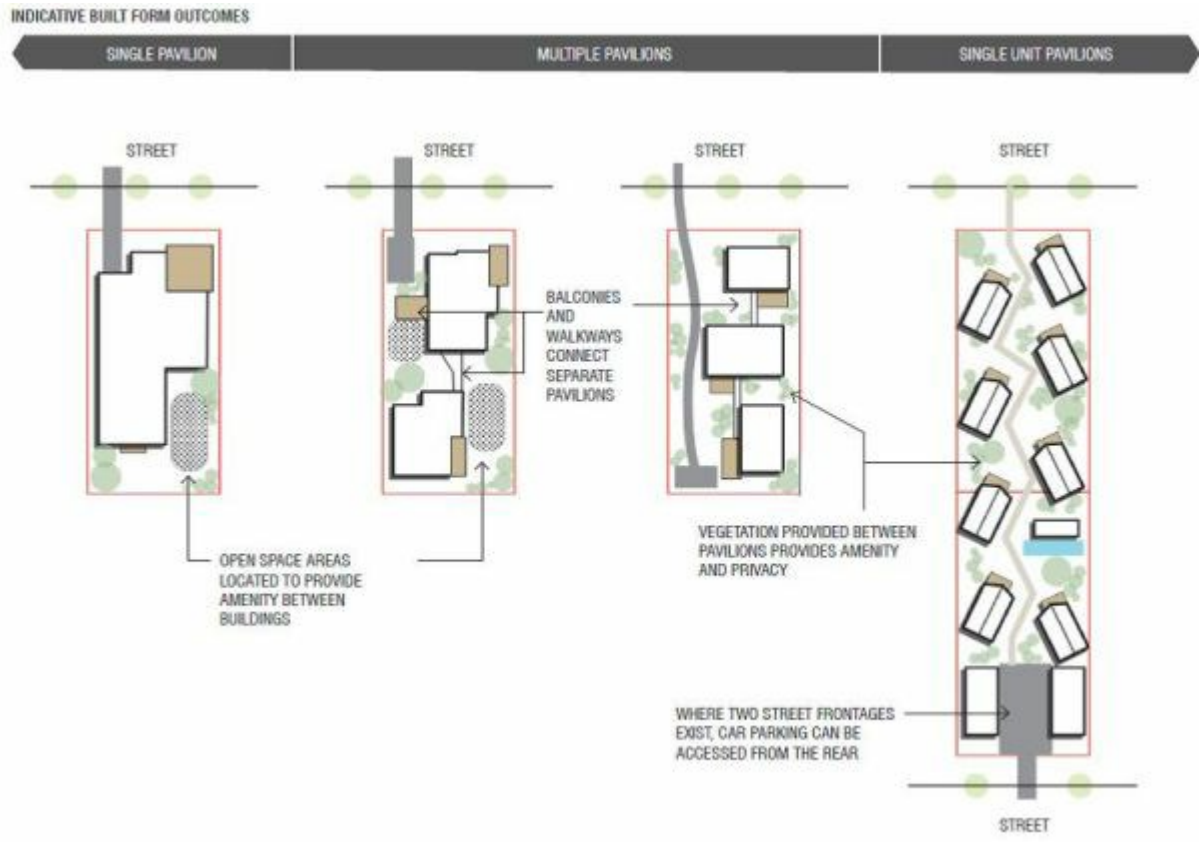
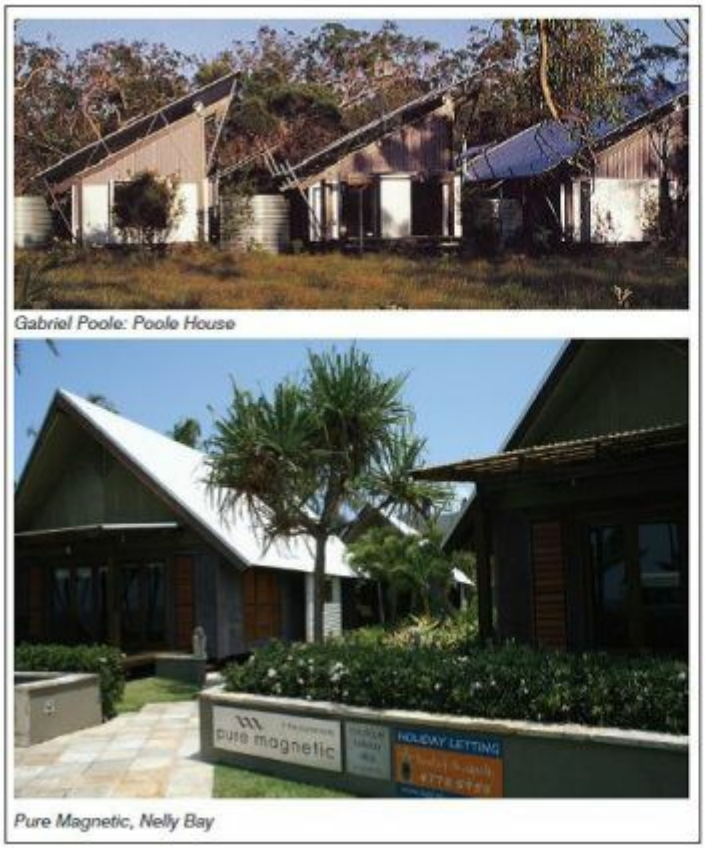


Figure 6.37 – Magnetic Island indicative built form outcomes

PO79 Design and articulation of buildings contribute to the creation of the local tropical character through: (a) use of tropical building design typologies; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay. Figure 6.38 – Examples of the desired tropical building design typologies illustrates.	No acceptable outcome is nominated.



Gabriel Poole: Poole House

Pure Magnetic, Nelly Bay

Troppo Architects: Thiel House, Cullen Bay

Balconies and walkways connect individual pavilions and create transition between indoor and outdoor spaces

Figure 6.38 – Examples of the desired tropical building design typologies

PO80 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages.	**AO80.1** Front setbacks at the ground floor do not exceed 3m.
	AO80.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO80.3 Ground floor dining tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO81 Where incorporating ground floor non-residential uses, weather protection via permanent or operable awnings is provided to usable outdoor spaces at the street frontage.	**AO81** Awnings are provided over outdoor spaces.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay tourist precinct	
PO82 Non-residential uses are provided on the ground floor as part of a mixed use development and contribute to the creation of a waterfront promenade. Figure 6.39 – Nelly Bay waterfront promenade illustrates	No acceptable outcome is nominated.

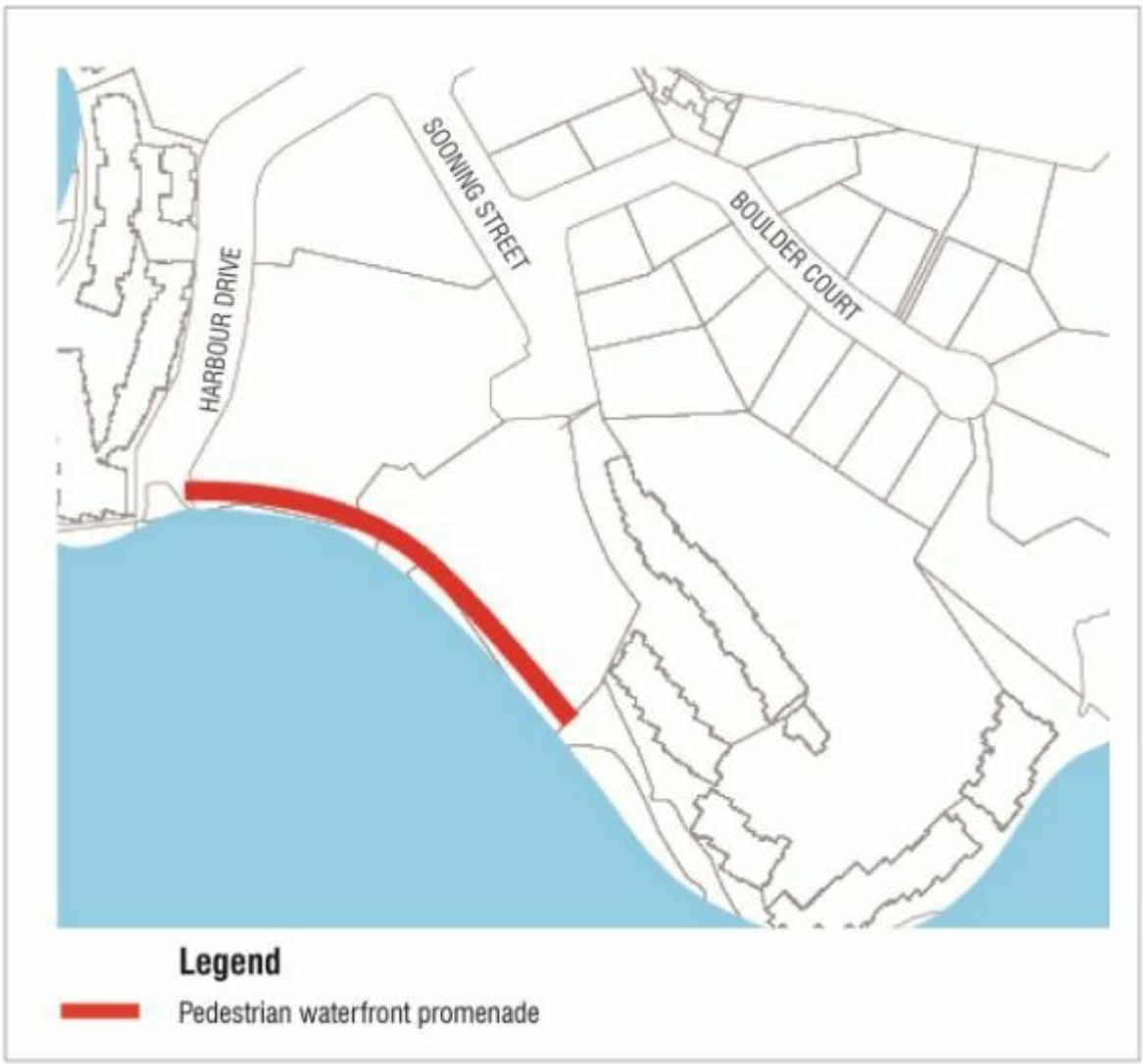


Figure 6.39 – Nelly Bay waterfront promenade

Performance outcomes	Acceptable outcomes
PO83 Tourist based services are located along Harbour Drive.	No acceptable outcome is nominated.
PO84 Building height is of a low to medium-rise scale and building massing is consistent with the low density character of the island.	**AO84.1** Building height does not exceed 4 storeys.
	AO84.2 Development consists of a number of distinct buildings where site frontage exceeds 20m. Figure 6.40 – Indicative building massing illustrates

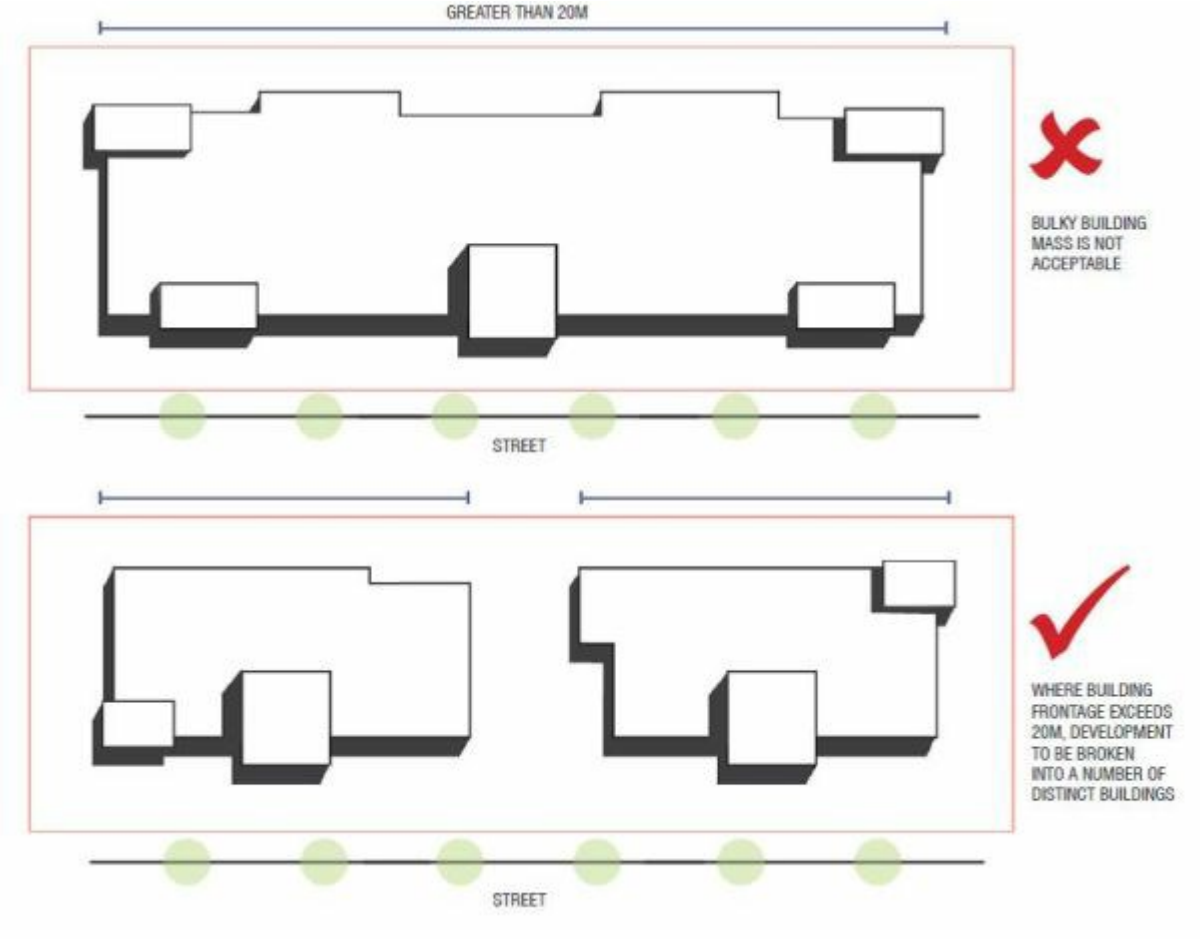


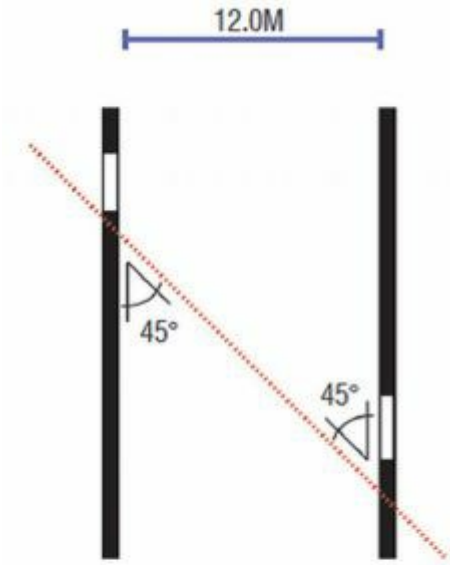
Figure 6.40 – Indicative building massing

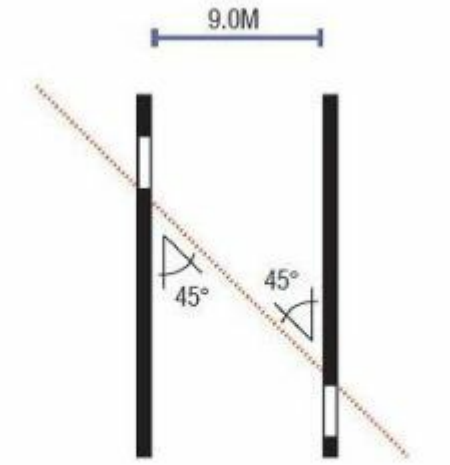
PO85 Design of buildings contribute to the creation of an attractive and safe arrival through maximising views to the bay through use of: (a) balconies, verandas or windows overlooking the bay; and (b) opportunities for indoor and outdoor living spaces.	No acceptable outcome is nominated.
PO86 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages with active ground floors where feasible.	**AO86.1** Front setbacks at the ground floor do not exceed 3m.
	AO86.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO86.3 Ground floor dining tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO87 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO87** Awnings are provided over outdoor spaces.

Table 6.2.2.3(a) - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcome takes precedence.	
Wills Street precinct	
PO88 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation, and open space at ground storey.	**AO88.1** Building height does not exceed 4 storeys.
	AO88.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m².
PO89 Built form provides for sensitive transitioning in height and scale to nearby Character residential zoned land.	No acceptable outcome is nominated.

Table 6.2.2.3(b)-Building setbacks Medium density residential zone

<table>
<tr><th>Level</th><th>Building</th><th>Balconies or outermost projection</th><th>Privacy setbacks for balconies/terraces/windows of habitable rooms</th></tr>
<tr><td colspan="3">Front setbacks</td><td rowspan="15">Development provides a minimum separation distance of:
(a) 12.0m between windows or balconies that are offset by less than 45 degrees; or
 

12.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY LESS THEN 45°
(b) 9.0m between windows or balconies that are offset by 45 degrees or more.
 

9.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY 45° OR MORE</td></tr>
<tr><td>Basement</td><td>1.5m (providing a deep planting zone)</td><td>1.5m</td></tr>
<tr><td>Level 1-4</td><td>3.0m</td><td>1.5m</td></tr>
<tr><td>Level 5 and above</td><td>5.0m</td><td>3.0m</td></tr>
<tr><td colspan="3">Side setbacks</td></tr>
<tr><td>Levels 1-2</td><td colspan="2">1.5m</td></tr>
<tr><td>Levels 3-4</td><td colspan="2">2.5m</td></tr>
<tr><td>Level 5 and above</td><td colspan="2">3.5m</td></tr>
<tr><td colspan="3">Rear setbacks</td></tr>
<tr><td>Basement</td><td rowspan="4">6.0m</td><td>n/a</td></tr>
<tr><td>Level 1</td><td>n/a</td></tr>
<tr><td>Levels 2-4</td><td>4.0m</td></tr>
<tr><td>Level 5 and above</td><td>8.0m</td><td>6.0m</td></tr>
</table>

6.2.3 High density residential zone code

6.2.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.3.2 Purpose

(1) The purpose of the High density residential zone is to provide for higher density multiple dwellings.

(2) The particular purpose of the code is to:

- (a) optimise opportunities for higher density living close to the city's principal centre, in order to maximise accessibility to services, employment and public transport, promote affordable living and maximise day and night-time vibrancy of the centres;
- (b) maintain a level of residential amenity that is consistent with an inner urban and near centre lifestyle; and
- (c) create well-designed built form and public spaces that are pedestrian friendly and provide opportunities for community interaction.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) development provides for high-rise and high density multiple dwellings and short-term accommodation in locations clustered around or near the principal centre (CBD);
- (b) building height steps down from taller buildings in the Principal centre (CBD) zone, and is generally up to 12 storeys;
- (c) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (d) development is designed to incorporate sustainable practices including maximising energy efficiency, water conservation and public and active transport use;
- (e) development is supported by transport infrastructure which is designed to provide and promote safe and efficient public transport use, walking and cycling; and
- (f) non-residential uses occur where they directly support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centres.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Palmer Street precinct:

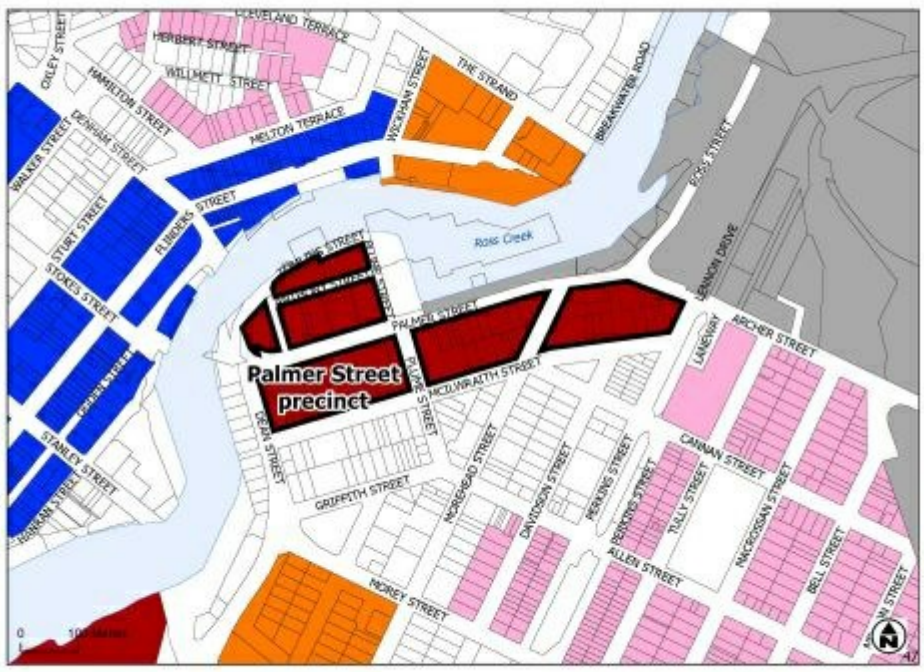
(a) this precinct continues to grow as Townville's primary contemporary entertainment and accommodation destination;

(b) Palmer Street is the continued focus for the establishment of restaurants, cafes and retail at the ground floor within a high quality streetscape;

(c) permanent residential accommodation occurs within this precinct where it does not compromise the function of Palmer Street as an entertainment destination;

(d) the public realm along the Ross Creek waterfront is of a high quality and provides continuous pedestrian access including the linking of the north and south banks by a new pedestrian bridge; and

(e) large-scale offices and other commercial activities are not established within the precinct.



Click here to view high resolution PDF.

Figure 6.41 – Palmer Street precinct

Flinders Street West precinct:

(a) this precinct grows to accommodate high density residential living;

(b) residential accommodation is provided in slender towers and takes advantage of the amenity of Ross Creek and views of Castle Hill, whilst protecting the heritage values of the historic railyards area;

(c) a hub of cultural activities is established within the historic railyards area, including a mix of education and entertainment activities;

(d) high quality public realm in and around the rail buildings is created and utilised for informal and formal performance spaces or events. Dining and local convenience retail may be located at ground storey; and

(e) new pedestrian connections are established within the precinct to:

(i) provide a linear connection along the edge of Ross Creek;

(ii) provide new connections to the Railway Estate precinct;

(iii) enhance the connectivity provided by the east west heritage rail path; and

(iv) provide connectivity within the precinct.

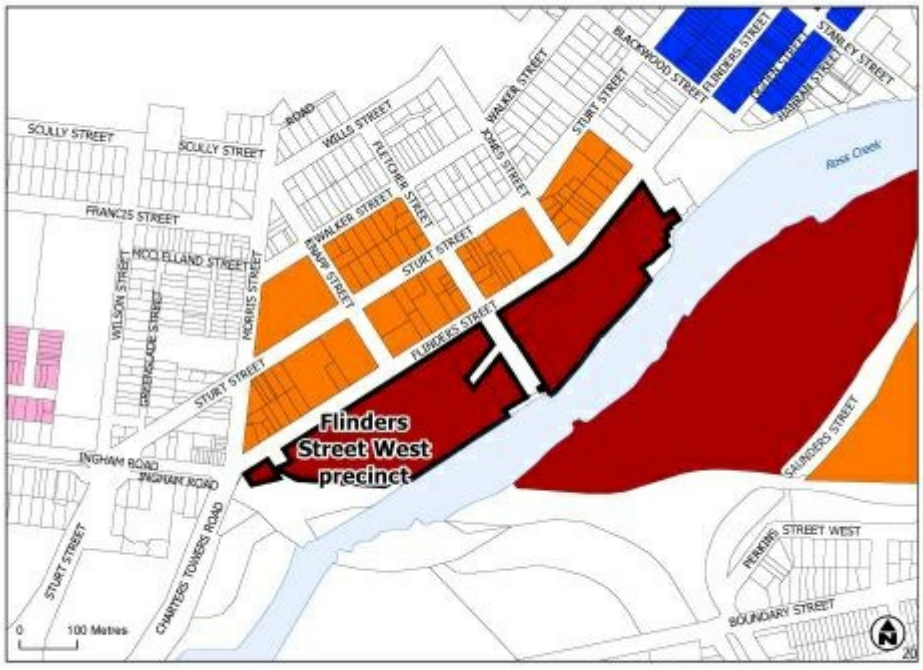


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Figure 6.42 – Flinders Street West precinct

Railway Estate precinct:

(a) development provides a high quality residential environment which capitalises on the precinct's proximity to the principal centre (CBD) and Ross Creek;

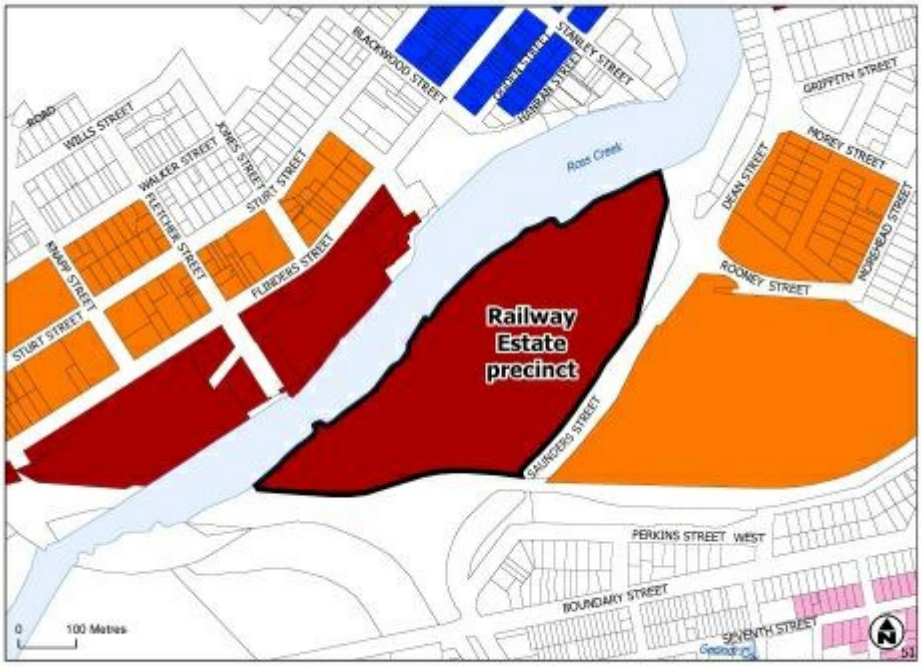
(b) development is predominantly residential in nature set in an attractive urban setting;

(c) a new neighbourhood centre is envisaged within this precinct to service the needs of residents;

(d) a high level of integration with existing and future development in surrounding areas is achieved, having regard to movement networks, open space and recreational facilities and community infrastructure;

(e) movement networks are established to promote walking and cycling and public transport; and

(f) development which is, or has the potential to become, incompatible with future urban development of the area does not occur.



Click here to view high resolution PDF.

Figure 6.43 – Railway Estate precinct

6.2.3.3 Assessment benchmarks

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based child care, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO2** Development of the sales office is in place for no more than two years.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO4 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO6.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other areas which are accessible to the public. Figure 6.44 — Design for casual surveillance illustrates
	AO6.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

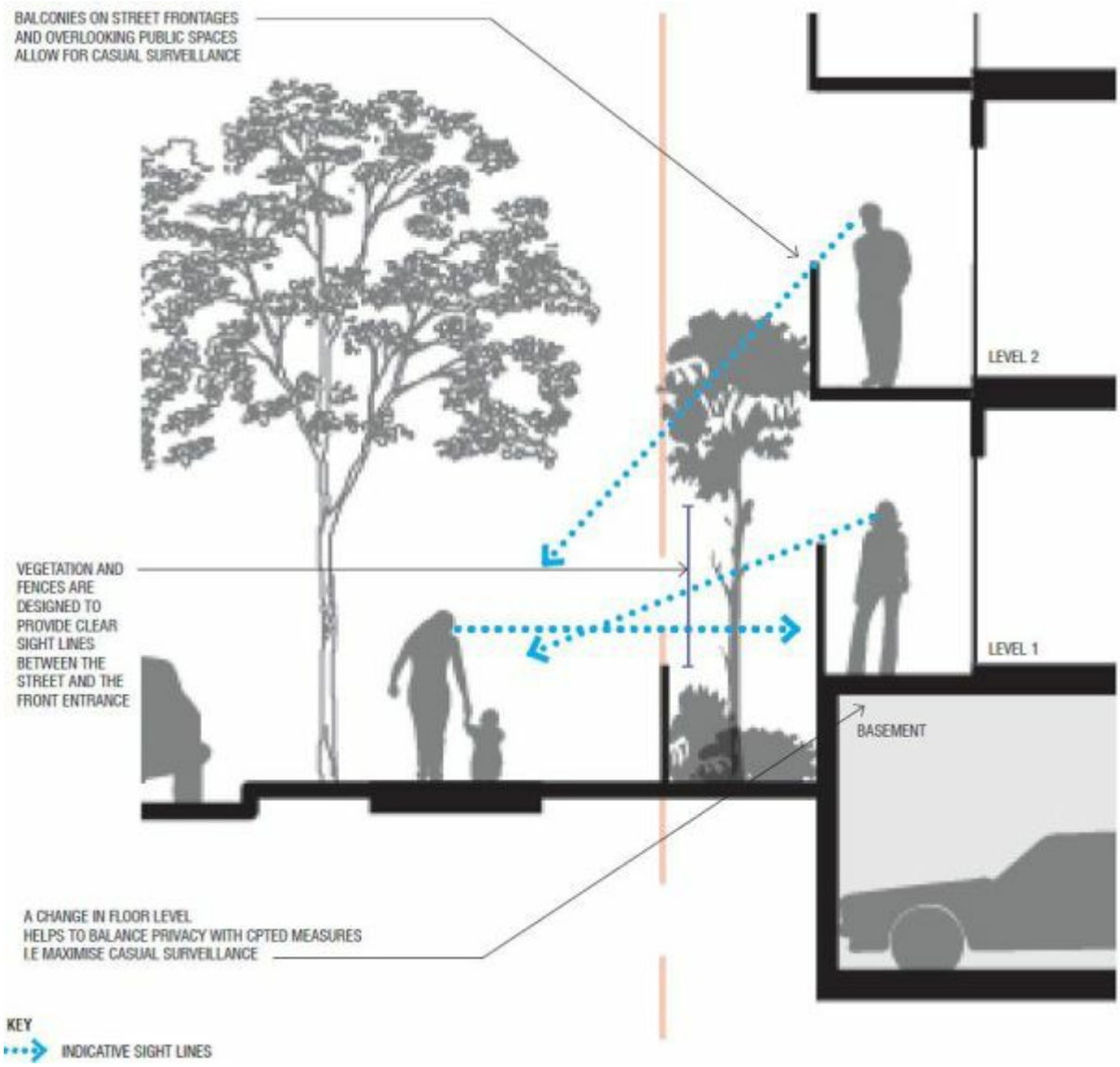


Figure 6.44 – Design for casual surveillance

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO7 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages for a premises on a corner; (f) at lower levels creates human/pedestrian scale experiences; (g) for upper levels, frames streets and public spaces; (h) elements which assist in wayfinding and legibility; and (i) elements which relates to the context including surrounding buildings, parks, streets and open spaces. Figure 6.45 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.

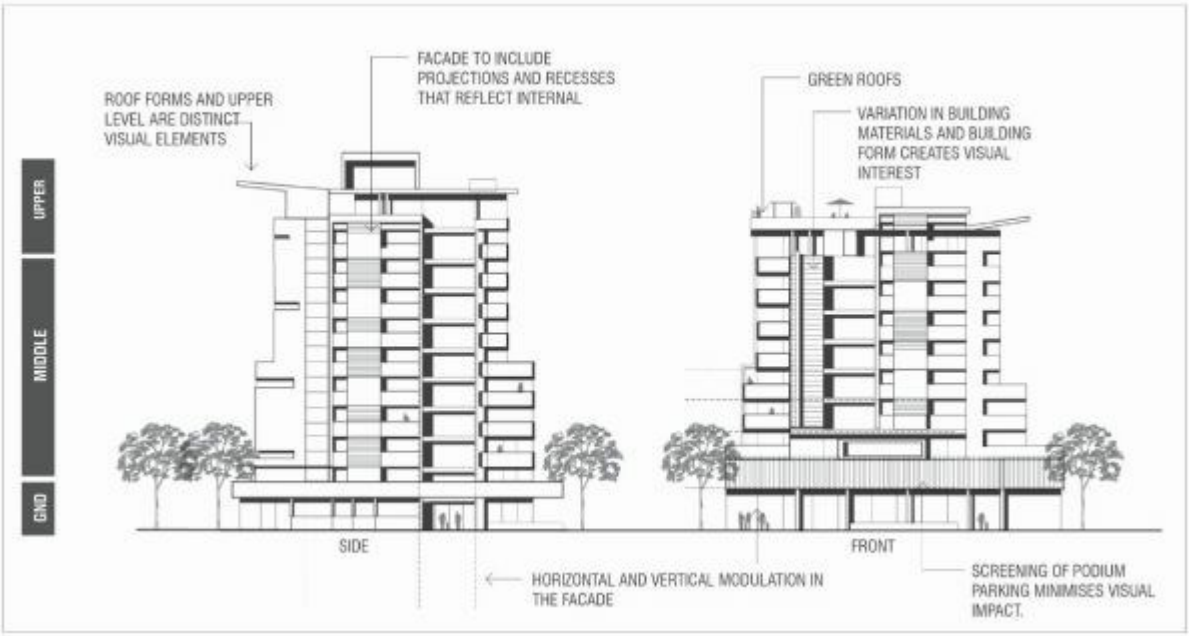


Figure 6.45 – Building design elements

PO8 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.
PO9 The overall shape, configuration and placement of buildings create usable outdoor spaces.	No acceptable outcome is nominated.
PO10 Building height and scale, maintains the primacy of the principal centre (CBD) and is consistent with the character desired for the precinct.	**AO10** Building height does not exceed 12 storeys.
PO11 The size of the development site allows for primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO11** Where accommodating a building of 5 storeys or more, development sites have a minimum size of 1,000m^2.
PO12 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; (c) do not prejudice the development or amenity of adjoining land; (d) retain the openness of street vistas, including to the sky, along major elements of the city grid; and (e) transition to lower scale heritage places and precincts.	**AO12** The design meets the setback requirements outlined by Table 6.2.3.3(b) - Building setbacks High density residential zone unless varied by a relevant precinct.
PO13 Built to boundary walls do not impact on the amenity or privacy of adjoining premises. **Editor's note—**Built to boundary wall heights and lengths may be increased where abutting an existing or proposed built to boundary wall on an adjoining property.	**AO13** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within 1.5m of a habitable room on an adjoining site; (c) have a maximum height of 3m; and (d) have a maximum length of 15m.
PO14 Buildings are designed to achieve good solar access by: (a) minimising the extent of shadows on usable private open space or public spaces; and (b) maintaining access to sunlight for habitable rooms within adjoining premises.	No acceptable outcome is nominated.
PO15 Building caps and rooftops contribute to the: (a) architectural design of the building; and (b) the creation of an attractive roofscape.	No acceptable outcome is nominated.

PO16 Roof top levels incorporate open space or recreational spaces for the users of the building or are significantly dedicated to 'green roof' vegetation.	No acceptable outcome is nominated.
PO17 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO17.1** Balconies are provided with a minimum area of 9m² for 1 bedroom unit or 16m² for 2 or more bedroom unit, with a minimum dimension 4m and clear of any air conditioning unit or drying space.
	AO17.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO17.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO18 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	**AO18** No acceptable outcome is nominated.
PO19 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.
PO20 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian-friendly and visually interesting frontages.	**AO20.1** Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum of 0.5m for any length of the facade exceeding 10m.
	AO20.2 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO21 Where incorporating ground floor non-residential use, weather protection is provided to usable outdoor spaces at the street frontage.	**AO21** Awnings are provided over outdoor spaces.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO22 Parking facilities are located to be concealed from public view to ensure an attractive streetscape. Figure 6.46 — Concealment of parking structures.	No acceptable outcome is nominated.

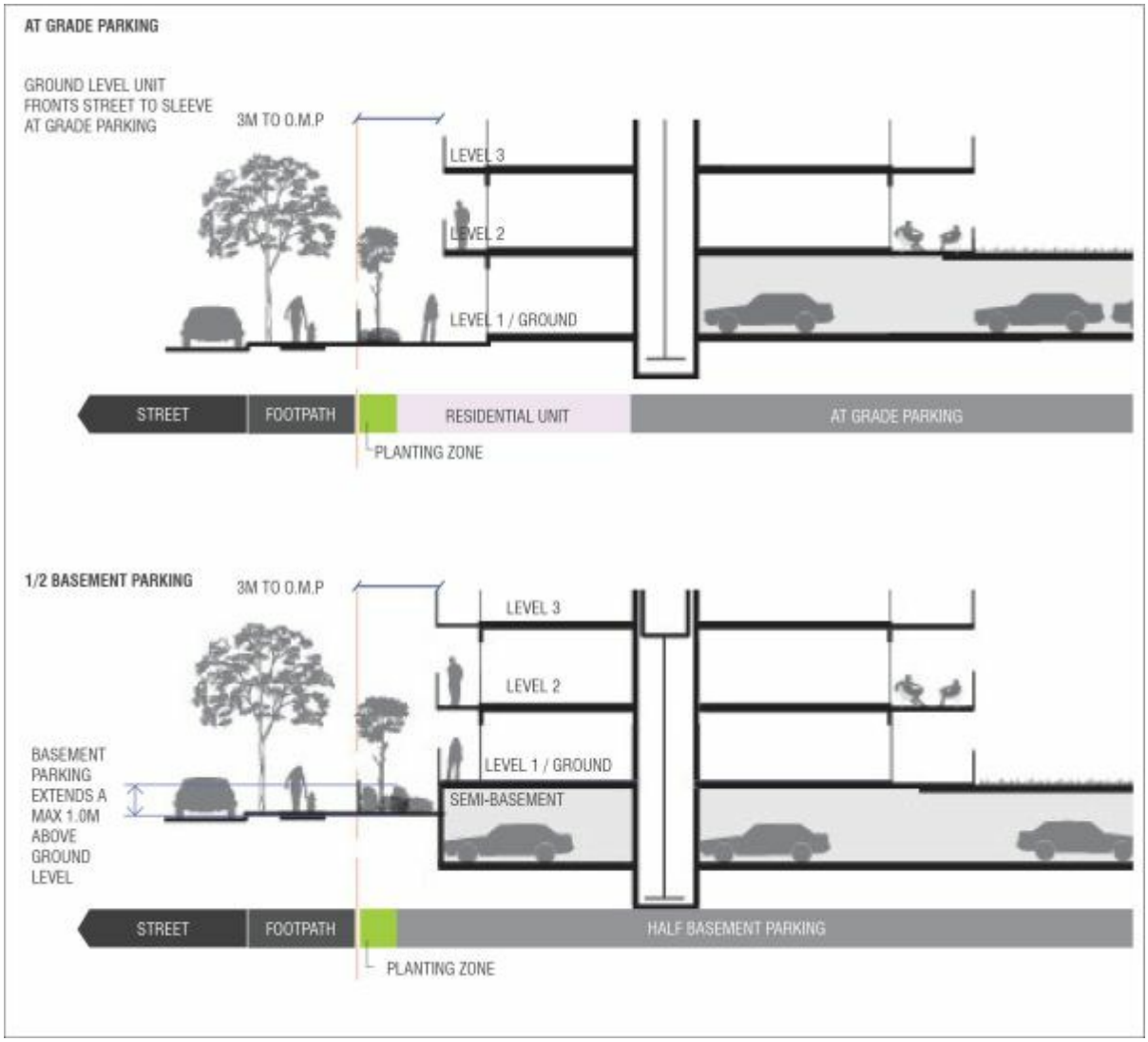


Figure 6.46 – Concealment of parking structures

PO23 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development — where a non-residential use	
PO24 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community or as specifically intended for a particular precinct; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Palmer Street precinct	
PO25 Building height transitions down to create a low-rise interface with the Ross Creek Marina.	**AO25** Building height is in accordance with Figure 6.47 — Palmer Street precinct concept plan.
PO26 The design of buildings contributes to the creation of an interesting and attractive streetscape along Palmer Street by: (a) creating an entry aesthetic which defines the street edge with a high density built form; and (b) incorporating a streetscape and planting theme that creates a boulevard treatment of the street.	No acceptable outcome is nominated.
PO27 Development facilitates or supports primarily high density short-term or permanent accommodation uses.	No acceptable outcome is nominated.
PO28 An open space and pedestrian network is provided in accordance with Figure 6.47 — Palmer Street precinct concept plan which: (a) opens up opportunities for residents and visitors to view Ross Creek; and (b) creates quality walkable pathways along the creek edge in an attractive landscaped environment.	No acceptable outcome is nominated.
PO29 A new public space is provided along the Ross Creek frontage in accordance with Figure 6.47 — Palmer Street precinct concept plan which: (a) reduces the impact of traffic or service areas on pedestrians; (b) furnishes the space to provide a range of opportunities for sitting and social interaction; (c) connects the open space in the west with the yacht club in the east; and (d) provides an attractive environment for buildings to front.	No acceptable outcome is nominated.

PO30 On frontages shown on Figure 6.47 — Palmer Street precinct concept plan as having a built form edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO31 Dining, entertainment and tourist oriented uses occur at ground storey within development identified on the Figure 6.47 — Palmer Street precinct concept plan as active frontage.	No acceptable outcome is nominated.

Figure 6.47 – Palmer Street precinct concept plan

PO32 Buildings contribute to the creation of an attractive and activated edge to Ross Creek by having facades which contain windows, doors, materials and features which generate visual interest.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Flinders Street West precinct	
PO33 Building height transitions down from the principal centre (CBD) interface to lower rise buildings around the historic railyards and surrounding neighbourhoods.	**AO33** Building height is in accordance with Figure 6.48 — Flinders Street West precinct concept plan.
PO34 Development primarily facilitates or supports high density accommodation uses.	No acceptable outcome is nominated.
PO35 Non-residential uses occur at ground storey and may include small-scale offices, retail, community uses and dining where on an active frontage identified on the Figure 6.48 — Flinders Street West precinct concept plan.	No acceptable outcome is nominated.
PO36 Heritage buildings within the historic railyards are refurbished and reused for educational, cultural and community uses.	No acceptable outcome is nominated.
PO37 The ground floor of all non-heritage buildings within the historic railyards are used for educational, cultural and community uses or complementary activities.	No acceptable outcome is nominated.
PO38 An open space and pedestrian network is provided in accordance with Figure 6.48 — Flinders Street West precinct concept plan. Central access within the precinct is designed to be a pedestrian focused shared zone, ensuring that while vehicle access is available pedestrian accessibility is prioritised.	No acceptable outcome is nominated.
PO39 New development or redevelopment within the historic railyards protects heritage values and provides high quality public realm including: (a) informal and formal performance spaces; and (b) spaces for public events or gatherings.	No acceptable outcome is nominated.

PO40 New public spaces are provided in accordance with Figure 6.48 — Flinders Street West precinct concept plan which: (a) create quality walkable connections to public walkways on the river; (b) reduce the impact of traffic or service areas on pedestrians; (c) furnish the space to provide a range of opportunities for sitting and social interaction; and (d) provide an attractive environment for adjoining buildings to front.	No acceptable outcome is nominated.
PO41 On frontages shown on Figure 6.48 — Flinders Street West precinct concept plan as having a built frontage, buildings contribute to the creation of a strong and pedestrian oriented edge to Ross Creek and the street, by: (a) creating a generally continuous building alignment; (b) providing awnings over the footpaths; and (c) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO42 Where shown as “built frontage” on Figure 6.48 – Flinders Street West precinct concept plan buildings contribute to the creation of an attractive and activated edge to Ross Creek and road frontage by having facades which contain windows, doors, materials and features which generate visual interest.	No acceptable outcome is nominated.

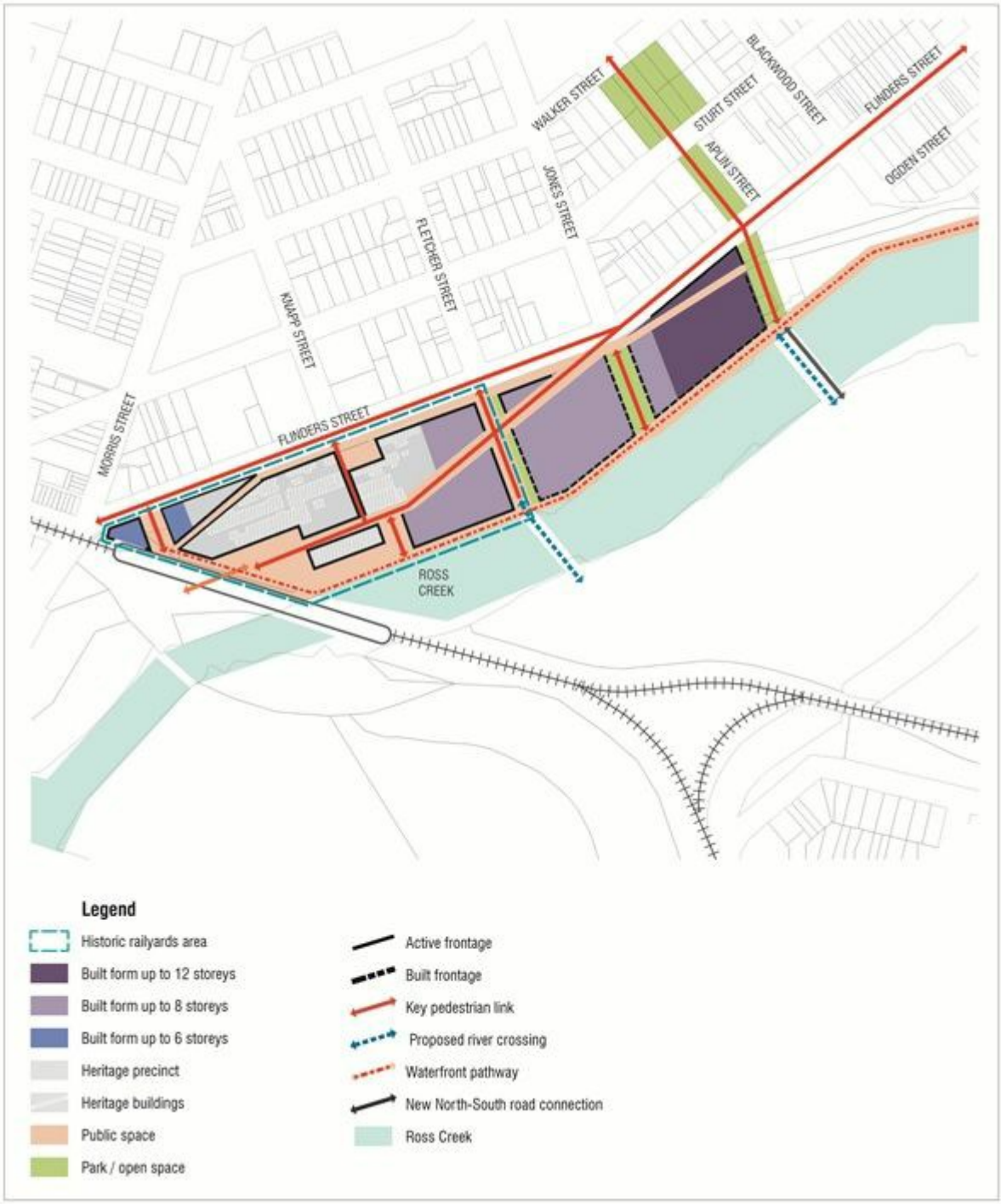


Figure 6.48 – Flinders Street West precinct concept plan

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Railway Estate precinct	
PO43 Development primarily facilitates or supports high density accommodation uses.	No acceptable outcome is nominated.
PO44 A new neighbourhood level centre may establish within the precinct in accordance with Figure 6.49 — Railway Estate precinct concept plan. The new centre is designed to create: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; and (e) active primary frontages with car parking areas sleeved by buildings.	No acceptable outcome is nominated.
PO45 Development does not compromise or compete with the principal centre (CBD) or successful functioning of other centres in the network.	No acceptable outcome is nominated.
PO46 High level pedestrian and cyclist permeability is achieved, and primary elements of an open space, street and pedestrian network are provided in accordance with Figure 6.49 — Railway Estate precinct concept plan.	No acceptable outcome is nominated.

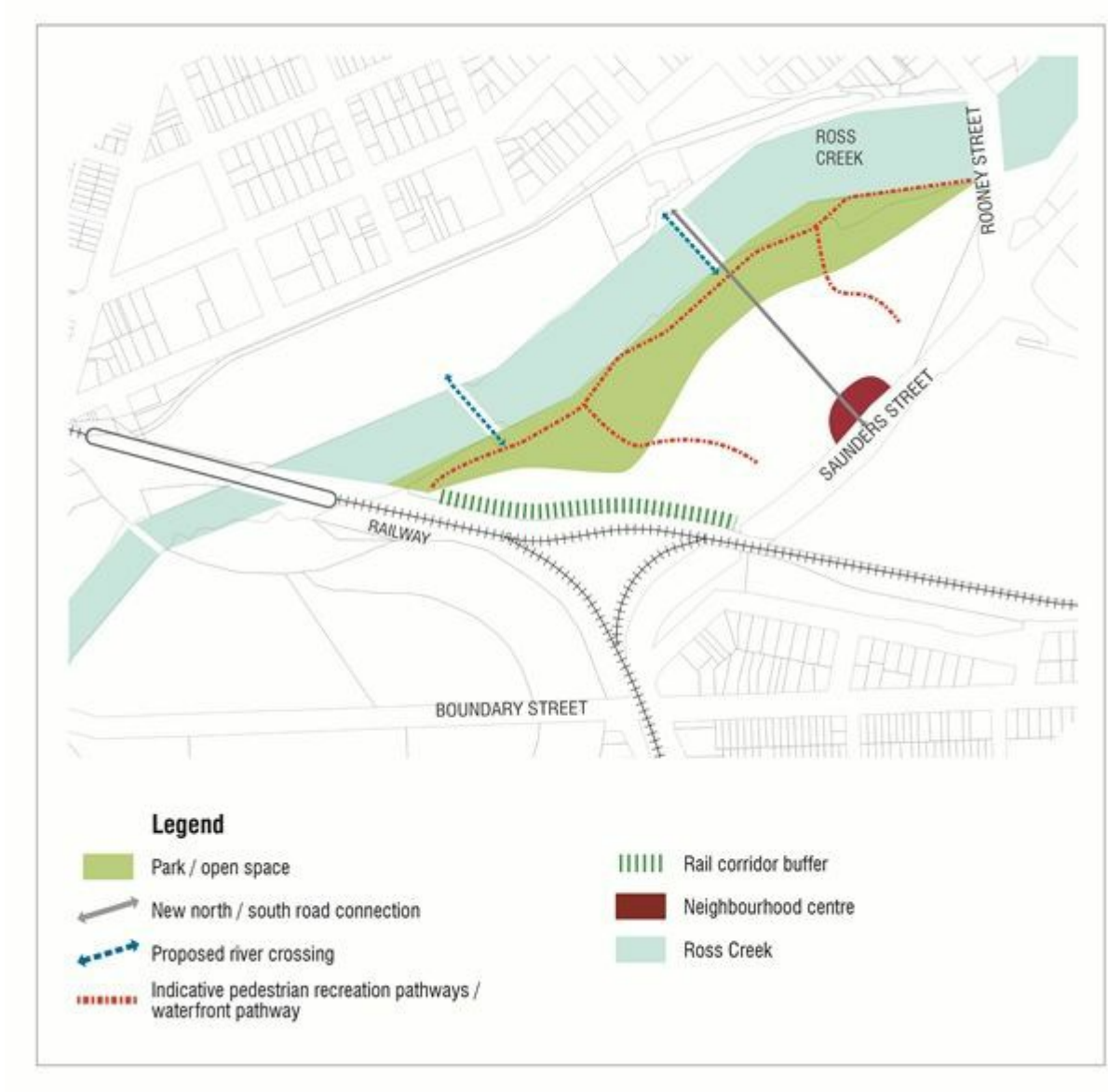
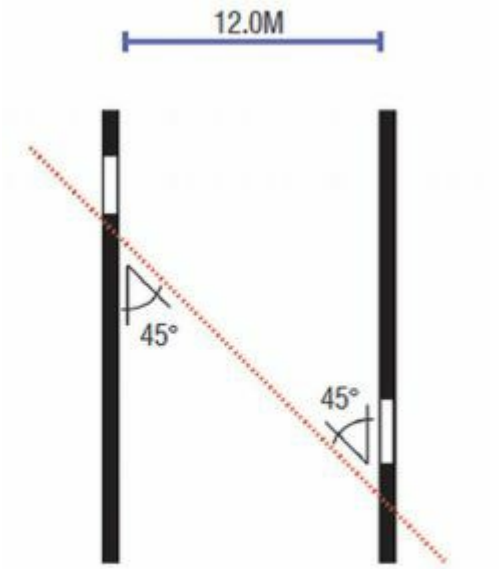
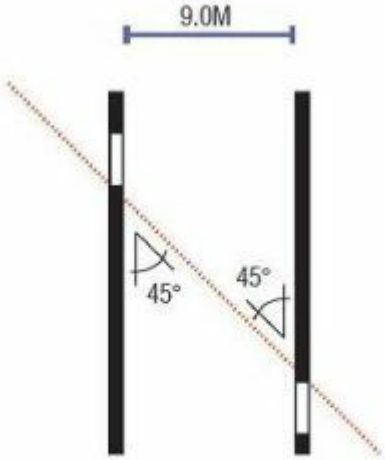


Figure 6.49 – Railway Estate precinct concept plan

PO47 New development provides high quality public realm including: (a) informal and formal performance spaces; (b) spaces for public events or gatherings; and (c) the creation of an attractive and activated edge to Ross Creek.	No acceptable outcome is nominated.
PO48 Development is attractively buffered from the railway, to achieve an acceptable level of residential amenity.	No acceptable outcome is nominated.

Table 6.2.3.3(b)—Building setbacks High density residential zone

<table>
<tr><th>Level</th><th>Building</th><th>Balconies or outermost projection</th><th>Privacy setbacks for balconies/terraces/windows of habitable rooms</th></tr>
<tr><td colspan="3">Front setbacks</td><td rowspan="12">Development provides a minimum separation distance of:
(a) 12.0m between windows or balconies that are offset by less than 45 degrees; or
 

12.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY LESS THEN 45°
(b) 9.0m between windows or balconies that are offset by 45 degrees or more.
 

9.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY 45° OR MORE</td></tr>
<tr><td>Basement</td><td>0m</td><td>n/a</td></tr>
<tr><td>Level 1-4</td><td>3.0m</td><td>1.5m</td></tr>
<tr><td>Level 5 and above</td><td>5.0m</td><td>3.0m</td></tr>
<tr><td colspan="3">Side setbacks</td></tr>
<tr><td>Levels 1-2</td><td colspan="2">1.5m or 0m where the adjoining building is built to boundary.</td></tr>
<tr><td>Levels 3-4</td><td colspan="2">2.5m or 0m where the adjoining building is built to boundary.</td></tr>
<tr><td>Level 5 and above</td><td colspan="2">3.5m</td></tr>
<tr><td colspan="3">Rear setbacks</td></tr>
<tr><td>Basement</td><td rowspan="3">6.0m or 0m where the adjoining building is built to boundary.</td><td>n/a</td></tr>
<tr><td>Level 1</td><td>n/a</td></tr>
<tr><td>Levels 2-4</td><td>4.0m</td></tr>
<tr><td>Level 5 and above</td><td>6.0m</td><td>6.0m</td></tr>
</table>

6.2.4 Rural residential zone code

6.2.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.4.2 Purpose

(1) The purpose of the Rural residential zone code is to provide for residential development on large lots where the intensity of residential development is dispersed.

(2) The particular purpose of the code is to:

- (a) provide for semi-rural lifestyles in which the primary use is dwelling houses on large lots which may have limited access to infrastructure and services;
- (b) provide for some subordinate, and generally domestic scale, rural activities and home based business to occur;
- (c) ensure development maintains the character and amenity of the rural residential locality; and
- (d) ensure any intensification of impacts on nearby ecological values or natural resources is avoided.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) residential development occurs in the form of dwelling houses, to the general exclusion of other more intensive residential uses;
- (b) reconfiguration creates large lots which support a semi-rural lifestyle and avoid intensification of impacts on on-site and on nearby ecological values, natural resources or rural activities;
- (c) lot sizes are sufficient to ensure the protection of environmental values and water quality objectives;
- (d) further expansion of existing rural residential areas does not occur beyond those areas zoned for this purpose;
- (e) home businesses occur to an extent that does not unduly diminish the semi-rural residential amenity, having regard to noise, odour, dust, traffic and other impacts;
- (f) roadside stalls and other sales of produce produced on the site are of a limited scale that is consistent with the semi-rural lifestyle;
- (g) non-residential uses occur within the zone where they primarily support the day-to-day needs of the immediate residential community and do not unreasonably detract from the residential amenity of the area;
- (h) development is buffered from nearby rural land such that the productive use of the rural land is not constrained;
- (i) residential development is protected from the impacts of nearby industrial activities, transport corridors and infrastructure installations and major facilities such as Department of Defence landholdings;
- (j) the natural bushland setting and village character of Balgal Beach and the Magnetic Island townships are maintained. Tourism accommodation in these communities is of a house compatible scale; and
- (k) development does not diminish water quality and does not intensify impacts on other environmental values including remaining areas of ecological significance within the zone.

6.2.4.3 Assessment benchmarks

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure (excluding truck parking); (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than two non-resident employees; (e) where bed and breakfast or farm stay accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 - Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast, farm stay or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

PO2 Heavy vehicle parking: (a) has a direct nexus with a home based business or rural use carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties. **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass.	**AO2.1** Not more than one heavy vehicle is parked on the site. **AO2.2** While on-site, vehicles: (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Roadside stall	
PO3 Roadside stalls are small in scale and do not impact negatively upon the amenity, character or safety of the locality and the safety and efficiency of roads.	**AO3.1** Any structure used for the sale of goods or produce is limited to 20m^2 gross floor area.
	AO3.2 Access to the structure is via the primary property access point.
	AO3.3 Produce or goods sold is grown, made or produced on the land on which the road side stall is erected.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO4 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO4** Development of the sales office is in place for no more than two years.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Animal keeping and cropping	
PO5 Animal keeping and cropping do not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO5.1** Non-residential buildings, animal enclosures, storage facilities and waste disposal areas are set back 50m from any dwelling on an adjoining or nearby site.
	AO5.2 The height of non-residential buildings or facilities does not exceed 2 storeys or 8.5m above ground level, whichever is the lesser.
	AO5.3 Cropping does not involve chemical spraying unless a 40m wide vegetated buffer is provided on the site between the crops which are being sprayed and adjoining land.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development - where a non-residential or tourist accommodation use	
PO6 Non-residential uses established only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO7 Tourism accommodation within Balgal Beach and the Magnetic Island townships is compatible with the village character of these communities.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO8 Development is consistent with the height and scale of surrounding buildings and includes features that contribute to an attractive streetscape.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO9 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) privacy; and (h) outlook.	No acceptable outcome is nominated.
PO10 Landscaping is provided to contribute positively to the city image, particularly along major roads.	No acceptable outcome is nominated.
PO11 Development does not compromise the ongoing productive use of nearby rural land.	No acceptable outcome is nominated.

PO12 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO13 The site layout, size and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention of existing vegetation; (e) providing buffers to protect the ecological functions of waterways; and (f) protecting environmental values and water quality objectives of receiving waters. **Editor's note—**The environmental values and water quality objectives are established under the Environmental Protection Policy (2009). For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated.

6.2.5 Character residential zone code

6.2.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.5.2 Purpose

(1) The purpose of the Character residential zone code is to provide for a particular character of a predominantly residential area.

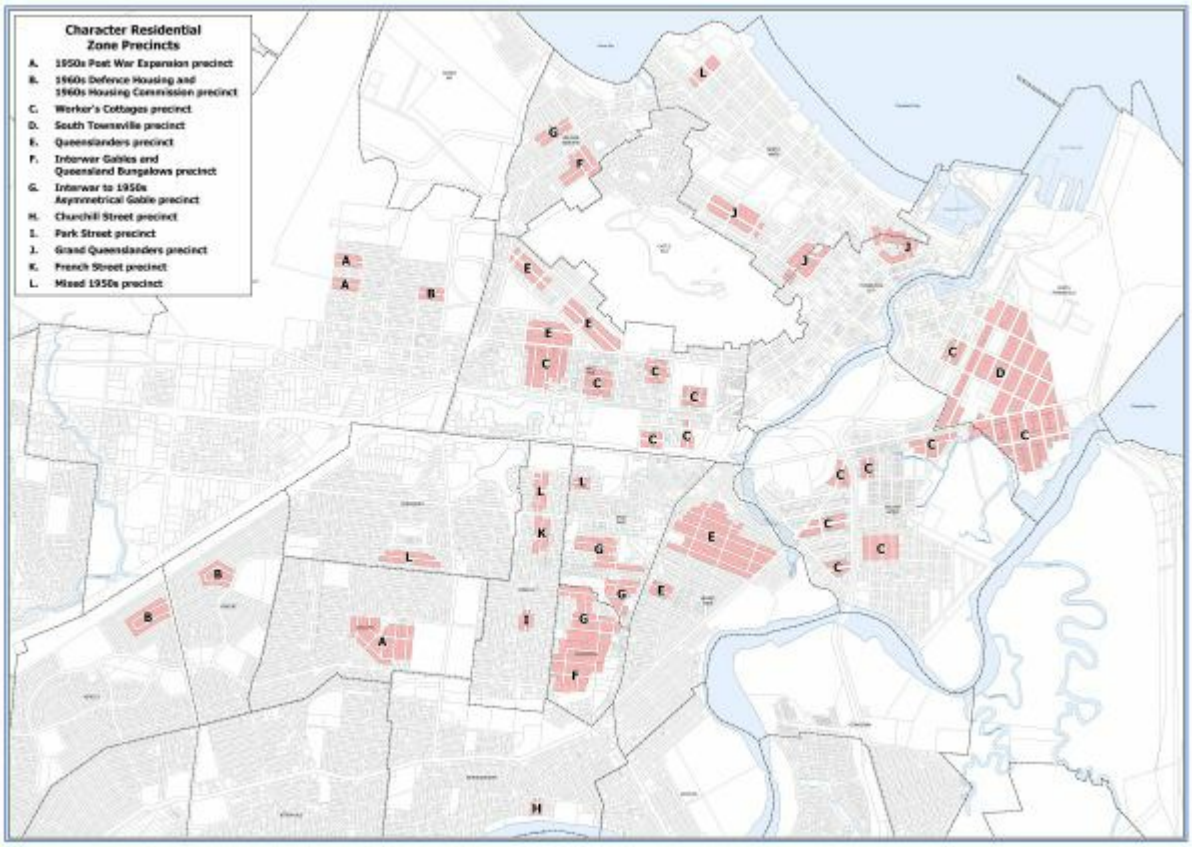
(2) The particular purpose of the code is to:

- (a) protect traditional character and streetscape values of the Character residential zone code by:
  - (i) preventing relocation off the site and demolition of contributing character buildings; and
  - (ii) ensuring the design of any new development is compatible with the places of character value within the zone.
- (b) primarily accommodate dwelling houses and ensure new development is sympathetic to the established character of the street or locality;
- (c) maintain a high level of residential amenity;
- (d) achieve accessible, well serviced and well-designed communities; and
- (e) maintain the low-rise and lower density character of Townsville's suburbs.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) contributing character buildings are protected and retained so they continue to contribute to the traditional character and amenity of the street and neighbourhood;
- (b) new development is limited to that which does not diminish the vernacular architectural character of houses or the traditional streetscape character;
- (c) new development incorporates design elements that are compatible with the established character;
- (d) reconfiguration of lots does not diminish the traditional streetscape character;
- (e) carports and garages do not dominate the frontage and are subservient to contributing character buildings;
- (f) dwelling houses are predominately low-rise, but may be low set or high set;
- (g) development maintains a high level of residential amenity on the site and in the precinct;
- (h) residential development is protected from the impacts of nearby industrial activities, transport corridors and infrastructure installations and major facilities such as the Port of Townsville, Townsville Airport and Department of Defence landholdings; and
- (i) non-residential uses only occur within the zone where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity, and are not better located in nearby centres.

Editor's note—The term "low set" refers to a building elevated 900mm or less. "High set" refers to buildings generally elevated 2,000mm above ground level.



Click here to view PDF high resolution map.

Figure 6.50 – Character residential zone precincts

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

1950s Post War Expansion precinct:

(a) this precinct consists mostly of compact, low set dwelling houses typical of the Queensland Housing Commission in the 1950s;

(b) buildings within this precinct have a low-set appearance and scale consistent with the predominant character of the precinct;

(c) built form maintains the existing setting and rhythm of the streetscape;

(d) the roof profile and overhang of buildings is consistent with that of contributing character buildings; and

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

1960s Defence Housing and 1960s Housing Commission precinct:

(a) this precinct consists mostly of intact Defence housing and Queensland Housing Commission design homes of the 1960s;

(b) buildings within this precinct are elevated, generally high set, and light weight, ventilated design features, and maintains regularity of form and street presentation;

(c) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(d) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(e) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building.

Worker's Cottages precinct:

(a) this precinct consists of low and high set Queensland worker's cottages and bungalows, constructed of lightweight materials;

(b) the consistent character of worker's cottages and interwar houses constructed of lightweight materials is maintained;

(c) buildings in this precinct have open facades which address the street and are consistent with the predominant front façade profile that contributes to the precinct's character;

(d) building floor level height in new development is consistent with adjoining contributing character buildings;

(e) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(f) the roof profile of buildings is consistent with that of contributing character buildings; and

(g) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

South Townsville precinct:

(a) this precinct contains predominantly low set Queensland worker's cottages and a large portion of non-residential facilities that are key attributes to the precinct's character;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) the front façade of buildings is consistent with the predominant front façade profiles of contributing character buildings and does not result in blank facades or facades with small openings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(g) additions, alterations and adaptive reuse of existing non-residential contributing character buildings maintains the legibility of the historic use and is sympathetic to the prevailing residential character of the precinct.

Queenslanders precinct:

(a) this precinct consists of low and high set Queensland workers' cottages and bungalows;

(b) the consistent character of Queensland workers' cottages and interwar houses constructed of lightweight materials is maintained;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) the roof profile of buildings is consistent with that of contributing character buildings;

(f) buildings have a verandah to the front façade which addresses the street and development does not result in blank facades or facades with small openings; and

(g) the subdivision pattern of the precinct is maintained.

Interwar Gables and Queensland Bungalows precinct:

(a) this precinct predominately consists of inter-war high-set dwelling houses and villa style residences with large workers' bungalows which have significant street presence;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

(g) the front facade of buildings addresses and retains street presence; and

(h) the subdivision pattern of the precinct is maintained.

Interwar to 1950s Asymmetrical Gable precinct:

(a) the precinct consists of a mix of Queensland bungalows and inter-war designs;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

(f) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings; and

(g) the subdivision pattern of the precinct is maintained.

Churchill Street precinct:

(a) this precinct contains predominantly older detached, lightweight, post-war dwelling houses, displaying pre-war design elements;

(b) dwelling houses in this precinct are elevated and generally high set;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) buildings within this precinct retain or enhance the setting and rhythm of the streetscape;

(f) the roof profile and overhang of buildings is consistent with that of contributing character buildings; and

(g) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

Park Street precinct:

(a) this precinct contains a mix of high and low set designs from the inter-war period;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) buildings in this precinct retain or enhance the setting and rhythm of the streetscape;

(e) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(g) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

Grand Queenslanders precinct:

(a) this precinct which contains Stanton Hill and Melton Hill, consists of large Queenslanders and other inter-war traditional timber buildings which have an iconic townscape appearance;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings; and

(e) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

French Street precinct:

(a) this precinct consists of large inter-war gabled Queenslander dwelling houses;

(b) dwelling houses in this precinct are elevated and generally high set;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) development maintains the uniformity and consistency of dwelling design style, setting and the rhythm of the streetscape;

(f) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(g) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings; and

(h) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

Mixed 1950s precinct:

(a) the precinct contains older timber dwelling houses and gabled, inter-war and post-war designs;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

and

(f) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

6.2.5.3 Assessment benchmarks

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 - Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.

	AO1.3 Other than where a bed and breakfast or home based childcare the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.
PO2 Commercial vehicle parking: (a) has a direct nexus with a home based business carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO2.1** Not more than one commercial vehicle is parked on the site.
	AO2.2 While on-site, vehicles; (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.
	AO2.3 Any commercial vehicle does not exceed 4.5 tonnes gross vehicle mass and is housed behind the building line.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.

PO4 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and way finding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note–**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development minimises impacts on remaining areas of ecological significance within the zone.	No acceptable outcome is nominated.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Demolition and removal	
PO7 The removal, relocation or a partial or total demolition of a contributing character building only occurs if it can be demonstrated that the: (a) total or partial loss of the building will not contribute to the loss of the character values; (b) total or partial loss of the building will not impact on the rhythm of the streetscape; or (c) the building or part proposed for demolition is not capable of structural repair.	No acceptable outcome is nominated. **Editor's note–**An impact statement produced by a suitably qualified professional may be required to demonstrate that there is no adverse impact on the character of the precinct due to the loss of the place, or a suitably qualified professional provides a report on the buildings condition, demonstrating that the place is not capable of repair. **Editor's note–**Applicants should have regard to the Character Residential planning scheme policy no. SC6.2 for guidance on how to write an impact statement.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Carports and garages	
PO8 When viewed from a street, ancillary buildings such as carports and garages: (a) do not visually dominate the streetscape character; (b) are subservient to existing buildings on the site; (c) do not detract from the character or appearance of the contributing character buildings; and (d) are consistent with the established rhythm of the streetscape.	**AO8** Class 10a structures such as carports, garages: (a) are set back an equal or greater distance from the street as the main building; (b) have a maximum width not exceeding 3m; (c) do not have a garage door or solid face presented to the street; (d) are detached or semi-detached structures with minimum carport roof gap to the building face of 0.6m (as shown in Figure 6.51 – Appropriate carport or garage type and roof gap); (e) have a roof pitch which matches the main building's predominant roof pitch or has a roof pitch no greater than 3 degrees (as shown in Figure 6.52 - Appropriate roof pitch of a carport or garage); (f) have their highest point lower or equal to the gutter/facia level of the main building (as shown in Figure 6.53 - Appropriate height relative to the main building); and (g) are built using materials that complement the existing dwelling (as shown in Figure 6.54 - Appropriate complementary building materials).

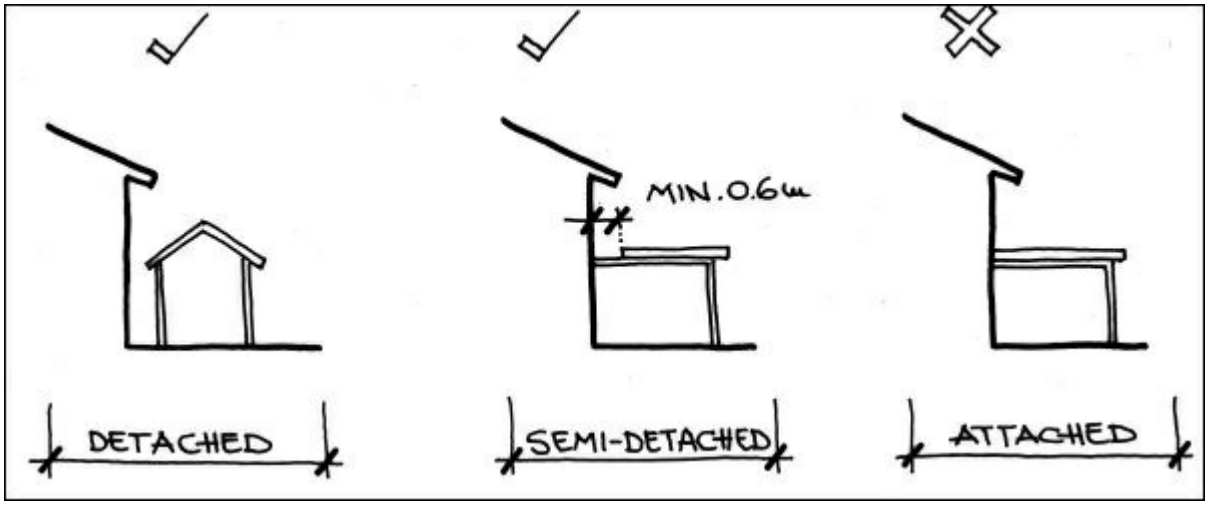


Figure 6.51 - Appropriate carport or garage type and roof gap

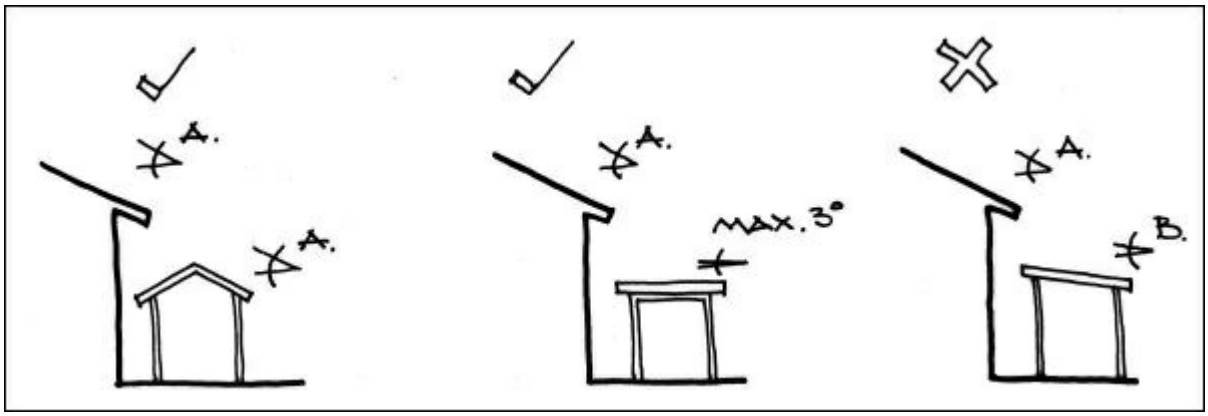


Figure 6.52 - Appropriate roof pitch of a carport or garage

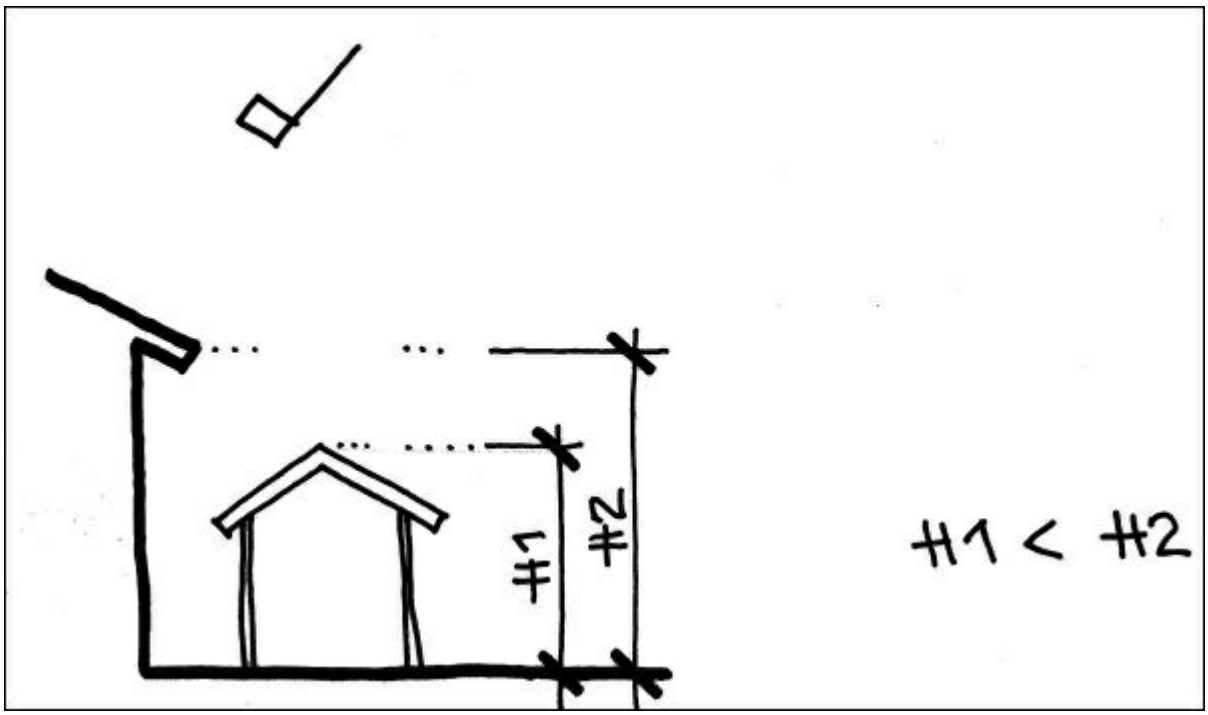


Figure 6.53 - Appropriate height relative to the main building

Figure 6.54 - Appropriate complementary building materials

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development - where a non-residential use	
PO9 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to the Economic impact assessment planning scheme policy no SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Development is of a house compatible scale.	**AO10.1** The use only involves minor building work. OR
	AO10.2 Where a new building is proposed: (a) buildings and other structures do not exceed 8.5m or 2 storeys in building height, whichever is the lesser; (b) the building does not exceed 250m² in gross floor area; (c) site cover does not exceed 60%; and (d) the maximum length of any wall is 12m.

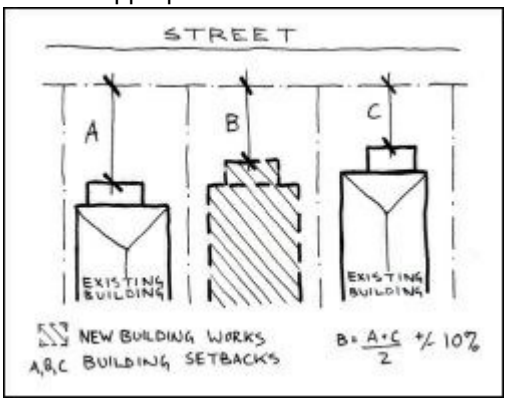
Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

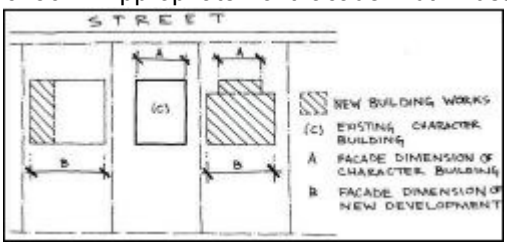
Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

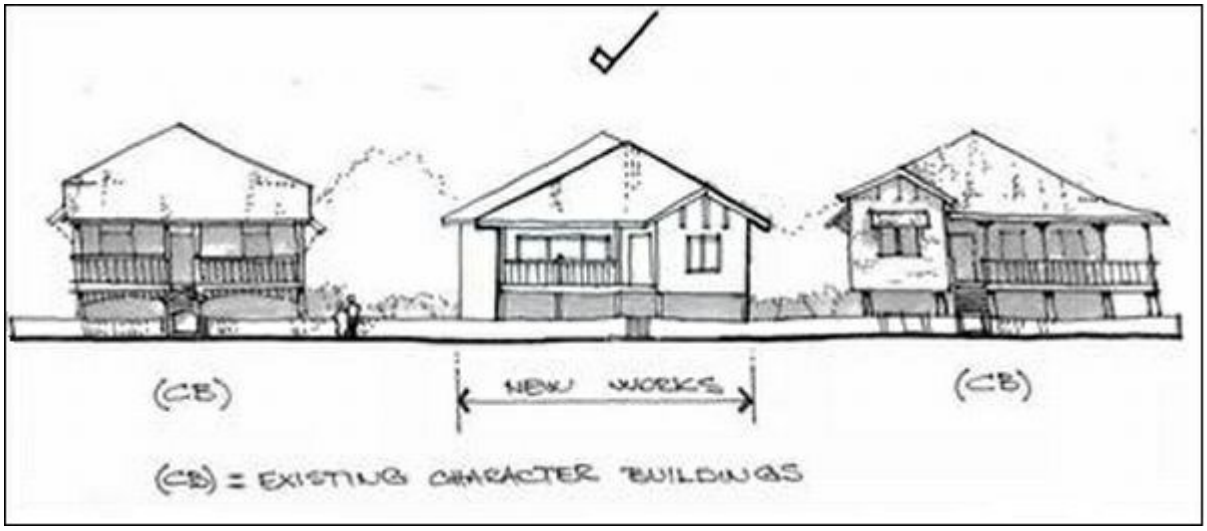
Performance outcomes	Acceptable outcomes
For assessable development	
Reconfiguring a lot	
PO11 Reconfiguration of lots is consistent with the predominant subdivision pattern of the precinct.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development — where a new building, relocation of a contributing character building within the site or extension or alteration to an existing contributing character building	
PO12 Building height is consistent to adjoining contributing character buildings.	**AO12.1** Development does not involve raising or lowering a dwelling by more than 1m.
	AO12.2 Unless otherwise stated for a particular precinct, buildings and structures do not exceed 8.5m or 2 storeys in building height, whichever is the lesser.
PO13 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO13.1** Buildings and extensions are setback from street frontages within 10% of the average front setback of adjoining contributing character buildings. Figure 6.55 — Appropriate front setbacks illustrates.  **Figure 6.55 — Appropriate front setbacks**

	AO13.2 Unless otherwise stated for a particular precinct, the front facade width of the building is the same as the front facade width of the adjoining contributing character buildings, to a minimum depth of 3m. Figure 6. 56 — Appropriate front facade width illustrates.  **Figure 6.56 — Appropriate front facade width**
PO14 Buildings maintain the regularity of building form and street presentation. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome. Figure 6.57 — Street presentation provides indicative guidance.	No acceptable outcome is nominated.



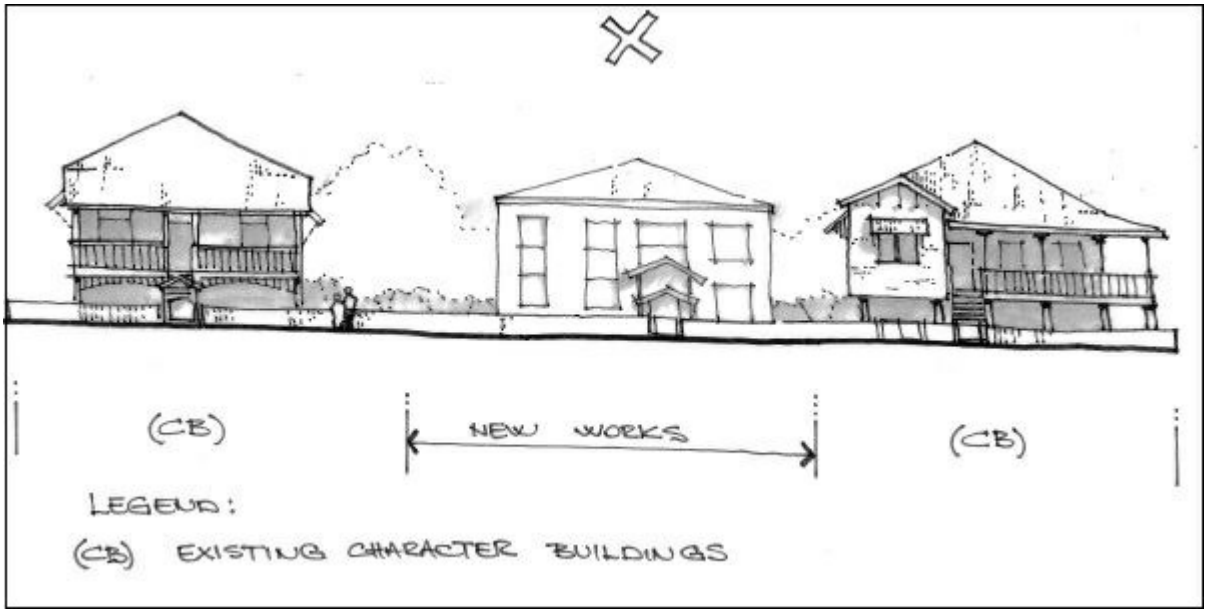


Figure 6.57 – Street presentation

PO15 Buildings use materials that have a lightweight appearance, and assist in reducing building bulk and form. **Editor's note—**Applicants should have regard to the Character planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO15.1** Walls are clad with lightweight materials with an expressed surface profile.
	AO15.2 Roofs are clad with corrugated iron.
	AO15.3 Windows are timber framed or have the appearance of being timber.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
1950s Post War Expansion precinct	
PO16 Buildings have a low-set appearance and scale consistent with the predominant character of the precinct.	**AO16.1** Building height does not exceed 1 storey.
	AO16.2 Dwelling houses have elevated floor levels between 600mm to 750mm above ground level.
PO17 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO17** The front facade width is 8m to 11m wide, to a minimum depth of 3m. Figure 6.58 - 1950s Post War Expansion precinct (Parsons street) illustrates. **Figure 6.58 - 1950s Post War Expansion precinct (Parsons Street)**
PO18 The roof profile is consistent with the predominant roof profile of dwellings that contribute to the precinct's character. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how todemonstrate compliance with this performance outcome.	**AO18** The roof profile is: (a) hipped with a 15 degree to 22.5 degree pitch; or (b) hipped with a 15 degree to 22.5 degree pitch incorporating a hipped or gabled projection towards the street.

PO19 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO19** Roof overhangs are: (a) 600mm wide; and (b) gable end overhangs are 300mm to 400mm wide.
PO20 Window scale and proportions are sympathetic to the predominant character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO20** Windows are half-height with 2, 3, or 4 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio. Figure 6.59 - Half-height vertically proportioned frames in the 1950s Post War Expansion precinct (Kent street) illustrates. **Figure 6.59 - Half-height vertically proportioned frames in the 1950s Post War Expansion precinct (Kent Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
1960s Defence Housing and 1960s Housing Commission precinct	
PO21 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO21** The roof profile is simple gabled or simple hipped with a 10 degree to 15 degree roof pitch.
PO22 The roof overhang is consistent with the predominant roof overhang of the contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO22** Roof overhangs are 750mm to 900mm wide.
PO23 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO24 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO24** Development on any ground floor storey is: (a) semi-enclosed with timber battens from view; and (b) aligned with the upper levels walls. Figure 6.60 - Appropriate enclosure to the ground floor in the 1960s Defence Housing and 1960s Housing Commission precinct (Pixley Street) illustrates. **Figure 6.60 — Appropriate enclosure to the ground floor in the 1960s Defence Housing and 1960s Housing Commission precinct (Pixley Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

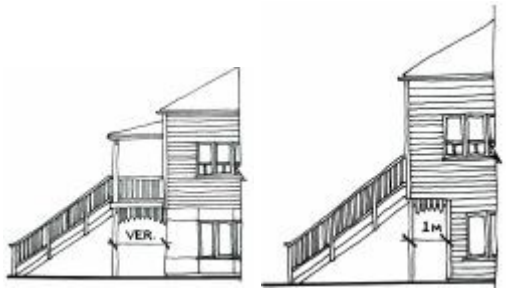
Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Worker's Cottages precinct	
PO25 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO25** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO26 The front facade includes a verandah consistent with the predominant front facade profile of the contributing character buildings.	**AO26.1** The front facade includes an open or semi-enclosed front verandah for a minimum 60% width of the front facade; OR **AO26.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across 60% or more of the front facade of the dwelling and wrap around one or both sides of the front facade for a minimum of 2m and the enclosure is capable of being reversed. Figure 6.61 - A front verandah in the Worker's Cottages precinct (Castling Street) illustrates. **Figure 6.61 — A front verandah in the Worker's Cottages precinct (Castling Street)**

PO27 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO27** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.62 - Appropriate enclosures to the ground floor illustrates. **Figure 6.62 — Appropriate enclosures to the ground floor**
PO28 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO28.1** The roof profile is simple hipped or pyramid with a 15 degree to 25 degree roof pitch.
	AO28.2 Verandahs are contained under the main roof form, or roofed separately with skillion or gently curved roofs.
PO29 Window scale and proportions, and window hoods and awnings are sympathetic to the predominant character of the precinct. **Editor' note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO29.1** The windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO29.2 Where windows are not sheltered by a verandah or roof overhang (which has a minimum overhang of 600mm), window hoods are provided.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
South Townsville precinct	
PO30 Building height and building floor level height are consistent to adjoining contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO30** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO31 The front facade is articulated with openings consistent with the predominant front facade profile of the contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO31.1** The front façade includes an open or semi-enclosed front verandah, at a minimum 60% width of the front facade. OR **AO31.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across 60% or more of the front facade of the dwelling and wrap around one or both sides of the front facade for a minimum of 2m and the enclosure is capable of being reversed.
	AO31.3 Where the front facade exceeds 8.5m in width, the front verandah wraps around one or both sides of the dwelling house.
PO32 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO32** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah; Figure 6.63 - appropriate enclosures to the ground floor illustrates.  **Figure 6.63 — Appropriate enclosures to the ground floor**

PO33 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO33.1** The roof profile is: (a) simple hipped or pyramid with a 15 degree to 25 degree roof pitch; or (b) side gabled with a 15 degree to 25 degree roof pitch.
	AO33.2 Verandahs are contained under the main roof form, or roofed separately with skillion or gently curved roofs.
PO34 Window scale and proportions and window hoods or awnings are sympathetic to the dominant character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO34.1** The windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO34.2 Where windows are not sheltered by a verandah or roof overhang (which has a minimum overhang of 600mm), window hoods are provided. Figure 6.64 - vertically proportioned frames with window hoods in the South Townsville precinct (Bell Street) illustrates. **Figure 6.64 — Vertically proportioned frames with window hoods in the South Townsville precinct (Bell Street)**
PO35 Additions, alterations and adaptive reuse of existing contributing non-residential character buildings maintain the legibility of the historic use and are sympathetic to the prevailing residential character of the precinct.	No acceptable outcome is nominated. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Queenslanders precinct	
PO36 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO36** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO37 The front facade includes a verandah consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO37.1** The front facade includes an open or semi-enclosed front verandah across, at a minimum 60% width of the front facade.
	AO37.2 Where the front facade exceeds 9m in width the front verandah wraps around one or both sides of the dwelling house. Figure 6.65 - A front verandah that wraps around both sides in the Queenslanders precinct (Ackers Street) illustrates. **Figure 6.65 — A front verandah that wraps around both sides in the Queenslanders precinct (Ackers Street)**

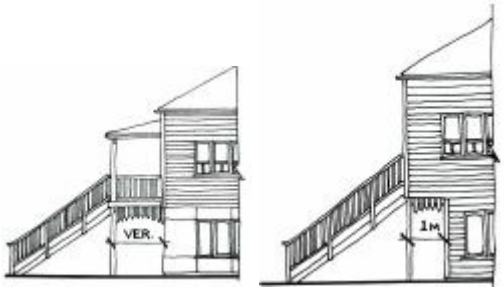
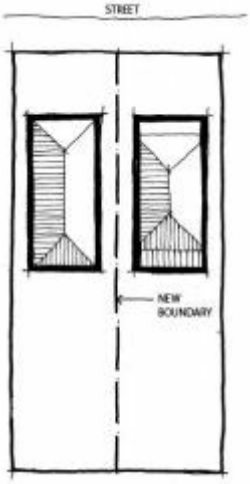
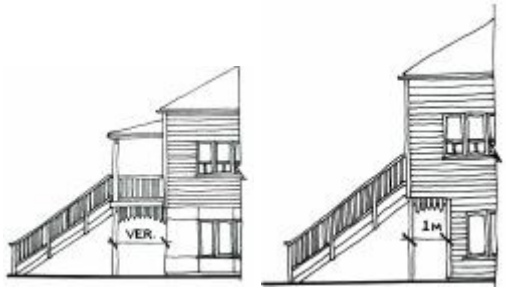
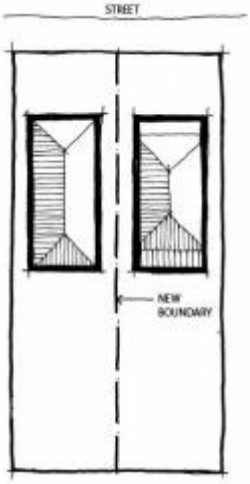
PO38 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO38** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.66 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.66 — Appropriate enclosures to the ground floor**
PO39 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO39** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.67 - Lot design illustrates.  **Figure 6.67 - Lot design**
PO40 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO40.1** The roof profile of new building works is a simple hipped or pyramid main roof with a 17.5 degree to 27.5 degree roof pitch. **AO40.2** Verandahs are contained under the main roof form, or roofed separately with a skillion roof.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Interwar Gables and Queensland Bungalows precinct	
PO41 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO41** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO42 The front facade is articulated with openings consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO42** The front facade includes: (a) an open front verandah; or (b) an enclosed or semi-enclosed front verandah with window, louvres or screens continuous across the front facade of the dwelling. Figure 6.68 - A front verandah in the Interwar Gables and Queensland Bungalows precinct (McKillop Street) illustrates. Figure 6.69 - An enclosed front verandah with continuous windows across the front facade in the Interwar Gables and Queensland Bungalows precinct (Chapman Street) illustrates. **Figure 6.68 — A front verandah in the Interwar Gables and Queensland Bungalows precinct (McKillop Street)** **Figure 6.69 — An enclosed front verandah with continuous windows across the front facade in the Interwar Gables and Queensland Bungalows precinct (Chapman Street)**

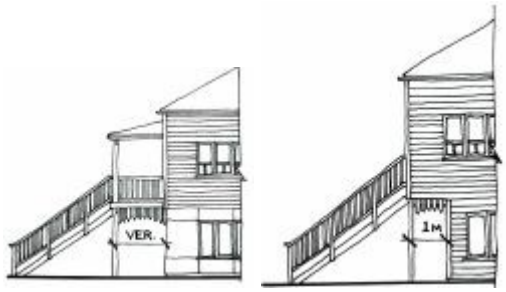
PO43 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO43** Development on any ground floor storey includes a valance and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.70 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.70 — Appropriate enclosures to the ground floor**
PO44 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO44** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.71 - Lot design illustrates.  **Figure 6.71 - Lot design**
PO45 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO45.1** The roof profile is: (a) simple hipped or pyramid, roofed with asymmetrical gable projections with a 22.5 degree to 27.5 degree roof pitch; or (b) gable fronted with asymmetrical gable projections with a 17.5 degree to 22.5 degree roof pitch.
	AO45.2 The primary roof form extends over the entire floor plan, including any front or side verandahs.

PO46 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO46.1** Windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO46.2 Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of two vertically proportioned frames or have bay windows. Figure 6.72 - Half-height vertically proportioned window located symmetrically under gable in the Interwar Gables and Queensland Bungalows precinct (Lawson Street) illustrates. **Figure 6.72 — Half-height vertically proportioned window located symmetrically under gable in the Interwar Gables and Queensland Bungalows precinct (Lawson Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Interwar to 1950s Asymmetrical Gable precinct	
PO47 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO47** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.

PO48 The front facade profile is articulated consistent with the predominant front façade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO48** The front facade includes: (a) asymmetrical projecting building forms, or steps in plan, a minimum of 1.2m in depth; or (b) open or semi-enclosed front verandah across the full width of the building. Figure 6.73 — Asymmetrical projecting building forms for a minimum 1.2m in depth (Burton Street) illustrates. **Figure 6.73 — Asymmetrical projecting building forms for a minimum 1.2m in depth (Burton Street)**
PO49 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO49** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.74 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.74 - Appropriate enclosures to the ground floor**

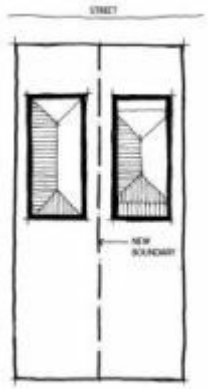
PO50 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO50** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.75 - Lot design illustrates.  **Figure 6.75 - Lot design**
PO51 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO51.1** The roof form is: (a) simple hipped or pyramid with a 22.5 degree to 30 degree roof pitch with asymmetrical gable projections; or (b) gable fronted with a 17.5 degree to 22.5 degree roof pitch with asymmetrical gable projections. **AO51.2** Where front verandahs are included, they are contained under the main roof form.
PO52 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO52.1** Windows have a minimum of 3 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio. **AO52.2** Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of two vertically proportioned frames or have bay windows. Figure 6.76 - Symmetrically located bay windows under gable (Hooper Street) illustrates. **Figure 6.76 — Symmetrically located bay windows under gable (Hooper Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

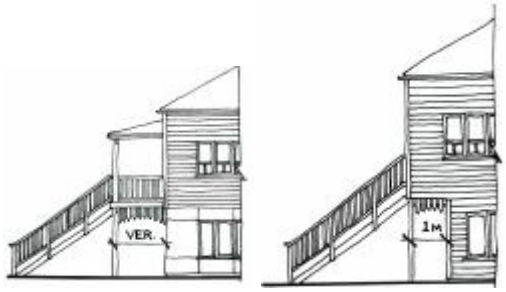
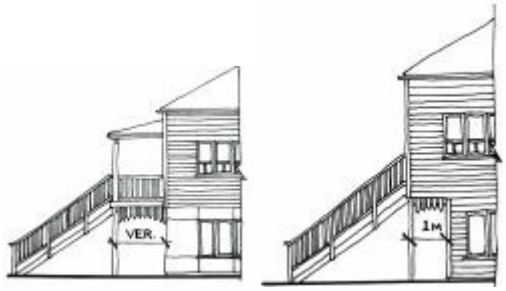
Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Churchill Street precinct	
PO53 Building height and building floor level height are consistent to adjoining contributing character buildings.	No acceptable outcome nominated.
PO54 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO54** The front facade width is 11.5m to 13.5m wide.
PO55 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO55** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.77 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.77 — Appropriate enclosures to the ground floor**
PO56 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO56** The roof pitch is between 15 degree to 20 degree.
PO57 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO57** Roof overhangs are 450mm to 750mm wide.
PO58 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO58** Windows are half height with a minimum of 3 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Park Street precinct	
PO59 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO59** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO60 The front facade openings are consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO60.1** The front facade includes: (a) a front verandah; or (b) a bay window.
	AO60.2 Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across the full width of the verandah.
PO61 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO61** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.78 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.78 — Appropriate enclosures to the ground floor**
PO62 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO62** The front facade width is 9m to 12.5m wide.
PO63 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO63** The roof pitch is between 15 degree to 30 degree.

PO64 The roof overhang is consistent with the dominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO64** Roof overhangs are 400mm to 600mm wide.
PO65 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO65** Windows are half height with a minimum of 3 vertically proportioned frames, where the window height is greater than its width by a 3:1 ratio.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—this code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Grand Queenslanders precinct	
PO66 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO66** Dwelling houses: (a) have a floor level a minimum of 700mm above ground level; or (b) are 2 storeys.
PO67 The front facade profile is articulated with openings consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO67.1** The front facade includes an open or semi-enclosed front verandah for the full width of the building and extends around at a minimum, down 2m one or both sides. OR **AO67.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across the full width of the verandah. Figure 6.79 - An open front verandah for the full width of the front facade; including removable blinds (Alexandra Street) illustrates. **Figure 6.79 — An open front verandah for the full width of the front facade; including removable blinds (Alexandra Street)**

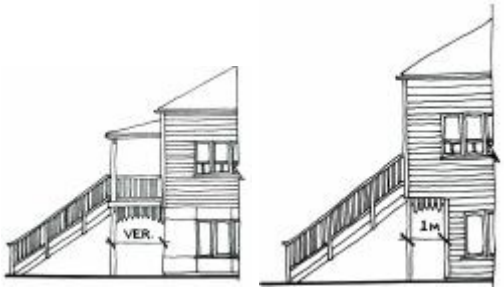
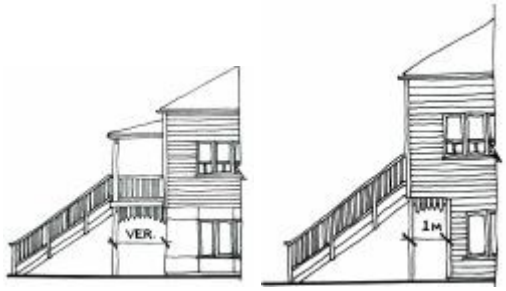
PO68 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO68** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.80 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.80 — Appropriate enclosures to the ground floor**
PO69 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO69.1** The roof profile is simple hipped or pyramid main roof, with a 17.5 degree to 27.5 degree roof pitch.
	AO69.2 Verandahs are contained under the main roof form, or roofed separately with a skillion roof.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

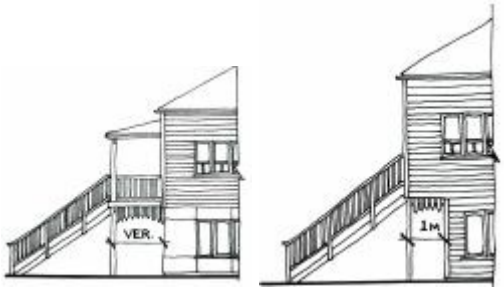
Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
French Street precinct	
PO70 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO70** Dwelling houses have a floor level minimum of 2m above ground level or is 2 storeys.
PO71 The front facade is articulated consistent with the predominant front facade of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO71** The front facade includes asymmetrical projecting building forms or steps in plan, a minimum of 1.2m in depth.
PO72 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO72** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.81 - Appropriate enclosures to the ground floor.  **Figure 6.81 — Appropriate enclosures to the ground floor**
PO73 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO73** The front facade width is 10m to 12m wide.
PO74 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO74** Roof form is 17.5 degree in pitch and is simple hipped or pyramid and includes asymmetrical gable fronted projections.
PO75 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO75** Roof overhangs are: (a) a minimum of 400mm wide; and (b) with gable end overhangs a minimum of 200mm wide.

PO76 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO76.1** Windows have a minimum of 3 vertically proportioned frames. Where the frame height is greater than its width by a 3:1 ratio.
	AO76.2 Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of 2 vertically proportioned frames or have bay windows. Figure 6.82 - Symmetrically located windows under gable (French Street) illustrates. **Figure 6.82 — Symmetrically located windows under gable (French Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Mixed 1950s precinct	
PO77 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO77** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO78 The front facade is articulated consistent with the predominant front facade of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO78** The front facade includes asymmetrical projecting building forms; or steps in plan, a minimum of 1.2m in depth. Figure 6.83 - Asymmetrical projecting building forms a minimum 1.2m in depth (Goodwin Street) illustrates. **Figure 6.83 — Asymmetrical projecting building forms a minimum 1.2m in depth (Goodwin Street)**

PO79 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO79** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.84 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.84 —Appropriate enclosures to the ground floor**
PO80 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO80** The roof profile is: (a) hipped with a 15 degree to 20 degree pitch; or (b) simple hipped or pyramid with asymmetrical gable projections with a 17.5 degree to 22.5 degree roof pitch.
PO81 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO81** Roof overhangs are 400mm to 600mm wide.
PO82 Window scale and proportions are sympathetic to the predominant character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.

6.3 Centre zones category

6.3.1 Neighbourhood centre zone code

6.3.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.1.2 Purpose

(1) The purpose of the Neighbourhood centre zone code is to provide for a small mix of land uses to service residential neighbourhoods.

It includes small-scale convenience shopping, professional offices, community services and other uses that directly support the immediate community.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes the efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) neighbourhood centres contain a generally limited range of retail, commercial and community-related activities which are focused on meeting the basic, day-to-day convenience needs of a surrounding neighbourhood within a walkable catchment. Neighbourhood centre catchments are in the order of 1,500 households;
- (b) neighbourhood centres are located as an integral part of residential communities. Wherever possible they are co-located with other local facilities such as child care centres, parks or community uses;
- (c) centres do not compromise the intended role or successful functioning of higher order centres or each other;
- (d) residential development may occur within the centres, primarily where integrated in a mixed use development;
- (e) the built form and layout of a centre reinforces its integration with the local neighbourhood and creates a safe and pleasant community meeting place;
- (f) centres create a pedestrian-focussed frontage, activated by shop fronts, awnings and kerbside activities. Buildings are low-rise and smaller scale in nature;
- (g) the design of centres gives priority to improved accessibility by walking and cycling; and
- (h) centres are designed and operated to avoid adverse impacts on the amenity of surrounding residential neighbourhoods.

6.3.1.3 Assessment benchmarks

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Hours of operation are consistent with maintaining a reasonable level of amenity for nearby land in a residential zone.	**AO1** Hours of operation are limited to 6am to 10pm.
PO2 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO2.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO2.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirement*.
PO3 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO3** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO4 Residential uses within the centre are provided with a reasonable level of privacy.	**AO4.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO4.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO5 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO5** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Buildings are low-rise and are designed to break down the facade into finer-scaled components.	**AO6.1** All buildings and structures do not exceed 2 storeys or 8.5m in building height, whichever is the lesser.
	AO6.2 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m.
PO7 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO7.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO7.2 On-site car parking is provided to the side or the rear of buildings or below ground level, and is not located at the street frontage.
	AO7.3 Entrances to buildings face the street.
	AO7.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO7.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
	AO7.6 Clear windows are provided at ground storey and where provided, grille or translucent security screens are used rather than solid shutters, screens or roller-doors.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space is provided of at least 4m^2 for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO9 Development is consistent with the intended role, scale and character of the neighbourhood centre and does not compromise the intended role or successful functioning of other centres.	**AO9** The combined area of all existing and proposed shops, shopping centres, offices, service industries, health care services and food and drink outlets within the centre do not exceed a total gross leasable area of 1,000m^2. For other uses, no acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Showrooms are not established in the neighbourhood centre.	No acceptable outcome is nominated.
PO11 Development facilitates opportunities for appropriate co-location of community-related activities or facilities to the extent practical.	No acceptable outcome is nominated.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO12 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO13 Streetscape treatments are provided to enhance amenity and to contribute positively to the city image, particularly along major roads and streets.	No acceptable outcome is nominated.

PO14 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.
PO15 Development is designed and located so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO15.1** Buildings are set back 2m from any boundary shared with a residential zone, or half the height of that part of the building, whichever is the greater.
	AO15.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone, and **AO15.2.2** A landscaped buffer with a minimum width of 2m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO15.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO16 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO16** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO17 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO18 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

6.3.2 Local centre zone code

6.3.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Local centre zone.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.2.2 Purpose

(1) The purpose of the Local centre zone code is to provide for a limited range of land uses and activities to service local needs. It includes local shopping, local employment nodes, commercial, cafes and dining, entertainment, community services and residential development where it can integrate and enhance the fabric of the activity centre, but it is not the predominant use.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) local centres provide a range of retail, commercial and community activities that are focused on grocery shopping and local service needs of their surrounding catchments. They may include a single full-line supermarket and a small range of specialty shops, food and drink outlets, personal services and local offices;
- (b) local centres provide a significant focal point for the surrounding community. Wherever possible they are co-located with or include other local facilities such as child care centres, parks or community uses;
- (c) centres do not compromise the intended role or successful functioning of higher order centres or other local centres. Local centre catchments are in the order of 3,000 to 5,000 households;
- (d) residential development may occur within the centres, primarily where integrated in a mixed use development;
- (e) the built form and layout of a centre creates a safe and pleasant community meeting place. Centres create pedestrian-focussed public spaces and street frontages, activated by shop fronts, awnings and kerbside activities;
- (f) buildings are low-rise and create a sensitive transition in scale from the surrounding neighbourhood;
- (g) the design of centres gives priority to improved accessibility by walking and cycling;
- (h) centres are designed and operated to avoid adverse impacts on the amenity of surrounding residential neighbourhoods; and
- (i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Rising Sun local centre precinct:

(a) development facilitates the consolidation of local centre uses in the area bounded by Ross River Road, Cross Street, and Bowen Road;

(b) built form, public space and streetscape treatments in this area contribute to a distinct character for the local centre, in particular on the frontages of Ross River Road, Cross Street, and Bowen Road; and

(c) development of this precinct facilitates a consolidation of vehicular access points.

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Figure 6.85 — Rising Sun local centre precinct

North Ward local centre precinct:

(a) development reinforces the character of this centre as a mixed use café and dining hub, with residential or tourist accommodation uses, in addition to its local service role;

(b) built form, public space and streetscape treatments in this area contribute to an integrated character for the centre, with a focus on the frontage of Gregory Street; and

(c) built form creates a higher-medium rise environment (up to 8 storeys in building height) along Gregory Street, transitioning down to medium rise (up to 5 storeys) behind.

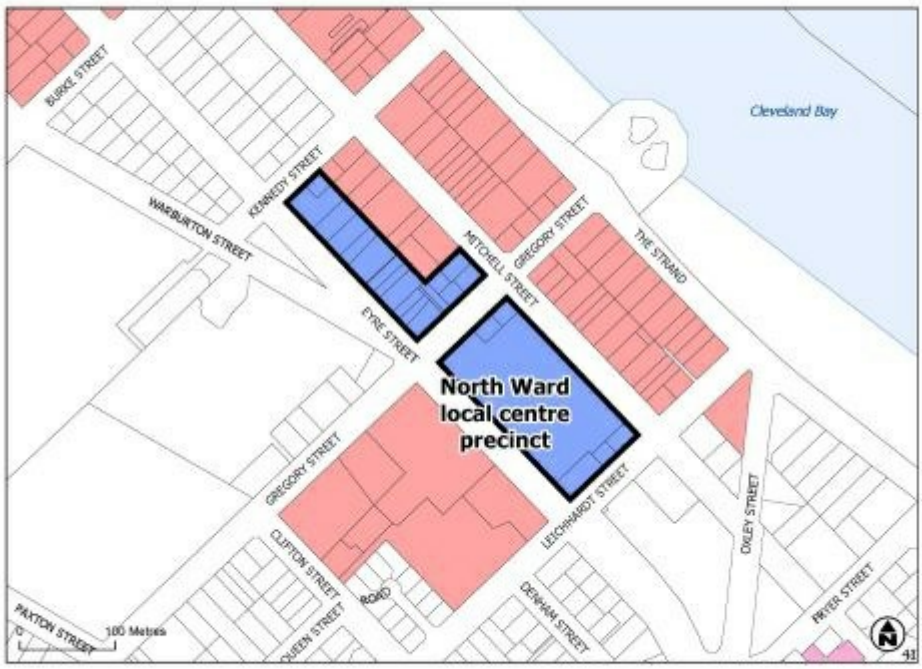

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Figure 6.86 - North Ward local centre precinct

6.3.2.3 Assessment benchmarks

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Hours of operation are consistent with maintaining a reasonable level of amenity for nearby land in a residential zone.	**AO1** Hours of operation are limited to 6am to 10pm.
PO2 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO2.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO2.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO3 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO3** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO4 Residential uses within the centre are provided with a reasonable level of privacy.	**AO4.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO4.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO5 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO5** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Buildings are low-rise and are designed to break down the facade into finer scaled components, avoiding large expanses of blank walls.	**AO6.1** All buildings and structures do not exceed 2 storeys or 8.5m in building height, whichever is the lesser.
	AO6.2 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m.

PO7 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO7.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO7.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO7.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO7.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO7.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Community uses, community care centres, clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Role and function	
PO9 Development is consistent with the intended role, scale and character of the local centre and does not compromise the intended role or successful functioning of other local or higher order centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Showrooms are not established in the local centre.	No acceptable outcome is nominated.
PO11 Development facilitates opportunities for appropriate co-location of community-related activities or facilities to the extent practical.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Centre design and built form	
PO12 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for the people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian-friendly and visually interesting frontages to street and public spaces; (e) optimum energy efficiency; (f) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (g) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO13 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO14 Streetscape treatments are provided at the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO18.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO18.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO18.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO18.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.

PO19 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO19** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Rising Sun local centre precinct	
PO21 Development is consistent with Figure 6.87 — Rising Sun local centre precinct concept plan, including an internal public space and parking area that is framed by buildings with an active edge.	No acceptable outcome is nominated.
PO22 Frontages shown on Figure 6.87 — Rising Sun local centre precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO23 Frontages shown on Figure 6.87 — Rising Sun local centre precinct concept plan as having built form edge are well-defined by a continuous building façade built to the street edge, awnings and significant use of glazing.	No acceptable outcome is nominated.

Figure 6.87 – Rising Sun local centre precinct concept plan

PO24 Development contributes to the boulevard treatment of Ross River Road and Bowen Road through landscaping and streetscape treatments along the road frontage in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.
PO25 Vehicular access to the site is constrained to one single point of entry from Ross River Road and Bowen Road in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.
PO26 Development at the intersection of Ross River Road and Bowen Road creates a landmark gateway to the Rising Sun Local Centre. Built form, landscape and streetscape treatment at this intersection reinforces a gateway statement in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.

PO27 Built form, landscape and streetscape treatment at the corner of Ross River Road and Bowen Road, creates a gateway to the Rising Sun local centre.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward local centre precinct	
PO28 Building height and scale is consistent with the character desired for the precinct and reinforces Gregory Street as the primary activity spine and gateway to The Strand.	**AO28** Building height does not exceed 8 storeys where fronting Gregory Street or 5 storeys otherwise.
PO29 Development primarily consists of retail, commercial and dining activities at ground level and residential or tourist accommodation above.	No acceptable outcome is nominated.
PO30 Development is consistent with Figure 6.88 — North Ward local centre precinct concept plan.	No acceptable outcome is nominated.
PO31 Development provides for an internal public space and parking area that is framed by buildings with an active edge within the block bounded by Gregory, Mitchell, Leichardt and Eyre Streets, in accordance with Figure 6.88 — North Ward local centre precinct concept plan.	No acceptable outcome is nominated.
PO32 Development at the intersection of Gregory Street and Eyre Street creates a landmark gateway to the North Ward local centre. Built form, landscape and streetscape treatment at this intersection reinforces a gateway statement.	No acceptable outcome is nominated.
PO33 Frontages shown on Figure 6.88 — North Ward local centre precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO34 Frontages shown on Figure 6.88 — North Ward local centre precinct concept plan as having a built form edge are well-defined by a continuous building facade built to the street edge, awnings and significant use of glazing.	No acceptable outcome is nominated.

Figure 6.88 – North Ward local centre precinct concept plan

PO35 Development contributes to the boulevard treatment of Eyre Street and the integration of the Gregory Street village environment through landscaping and streetscape treatments.	No acceptable outcome is nominated.

6.3.3 District centre zone code

6.3.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.3.2 Purpose

(1) The purpose of the District centre zone code is to provide for a mix of uses and activities. It includes a concentration of land uses including retail, commercial, residential, offices, administrative and health services, community, entertainment and recreational facilities capable of servicing a district.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) district centres provide a community focus for weekly or fortnightly shopping trips and a range of services, and include Idalia, Deeragun, Rasmussen, Annandale and a future centre at Shaw. Retail functions are anchored by major supermarkets with a wide range of speciality shops; however, these centres operate as multifunctional community hubs. They contain a range of district level personal and community services such as community centres and health and fitness facilities;

Editor's note—the centre in Shaw is within the Emerging community zone. It is planned within the Greater Ascot area.

(b) centres do not compromise the intended role or successful functioning of higher order centres or other district centres. District centre catchments are in the order of 5,000 to 8,000 households. They do not contain discount department stores;

(c) the mix of uses promotes a vibrant centre which includes medium density residential development and active day and night-time uses;

(d) showrooms may occur within the district centres, but are generally located and designed so that they do not detract from the intended built form, pedestrian focus and accessibility of the district centres;

(e) district centres provide a major focal point for their catchment communities. The built form and layout of a centre creates a safe and pleasant community meeting place. Centres create pedestrian-focussed public spaces and street fronts, kerbside activities, awnings and landscape and streetscape treatments;

(f) buildings are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood;

(g) the design of district centres gives priority to improved accessibility to and within centres by walking, cycling and public transport;

(h) centres are designed and operated to minimise adverse impacts on the amenity of surrounding residential neighbourhoods; and

(i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Idalia district centre precinct:

(a) Idalia will develop to provide a focus for larger format showrooms for the southern parts of the city, and will complement, but not undermine the role of the Domain Central precinct on the northern side of Townsville. It will service a wider catchment than other district centres in this respect. Other retail functions of this centre do not expand substantively; and

(b) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.89 — Idalia district centre precinct

Annandale district centre precinct:

(a) no significant expansion of this centre for retail purposes occurs; and

(b) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.90 — Annandale district centre precinct

Deeragun district centre precinct:

(a) further outward expansion of the centre or the establishment of additional supermarkets does not occur;

(b) development assists in consolidating the centre, and facilitates improved integration and connectivity;

(c) showrooms servicing the district catchment may be accommodated; and

(d) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.91 — Deeragun district centre precinct

Rasmussen district centre precinct:

(a) further outward expansion of the centre does not occur;

(b) showrooms servicing the district catchment may be accommodated in the longer term; and

(c) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

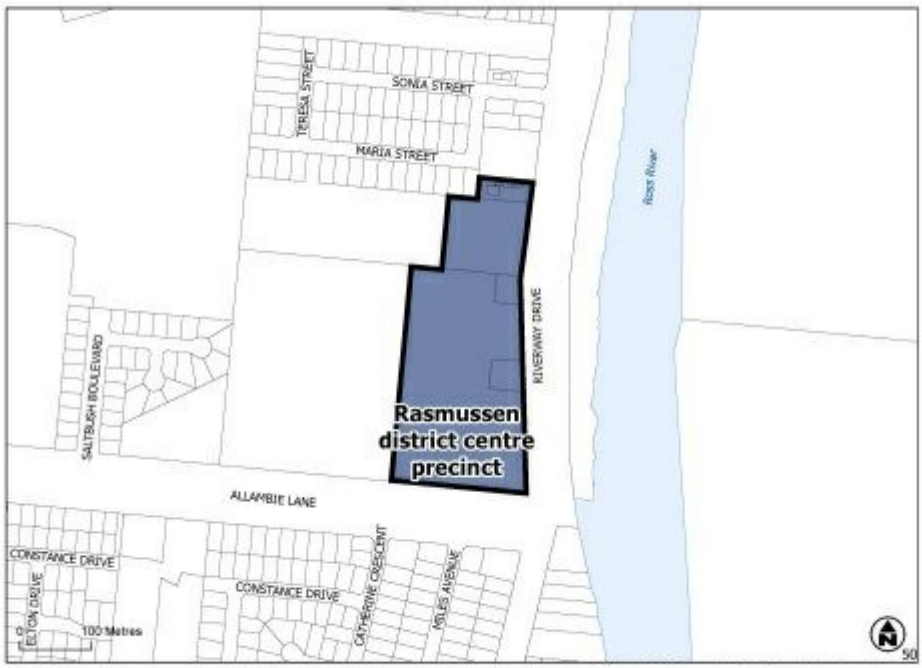

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Figure 6.92— Rasmussen district centre precinct

6.3.3.3 Assessment benchmarks

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of $9m^2$; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the district centre and does not compromise the intended role or successful functioning of other district or higher order centres. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO6 Development facilitates a range of uses that contributes to the vibrancy of the centre and provides for a compatible mix of active day and night-time uses.	No acceptable outcome is nominated.
PO7 Development facilitates opportunities for appropriate co-location of residential uses and community-related activities or facilities within the centre, to the extent practical.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Centre design and built form	
PO8 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian-friendly and visually interesting frontages to streets and public spaces; (e) optimum energy efficiency; (f) a well-integrated mix of uses; (g) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (h) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.

PO9 Buildings are low-rise and are designed to break down the facade into finer scaled components, avoiding large expanses of blank walls.	**AO9.1** Building height does not exceed 3 storeys.
	AO9.2.1 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m. or **AO9.2.2** Where showrooms are proposed, the maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
PO10 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO10.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO10.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO10.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO10.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO10.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
PO11 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO12 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO13 Buildings housing residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO13** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO14 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO18.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO18.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO18.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO18.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO19 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO19** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO21 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO21** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Showrooms	
PO22 Showrooms are designed and located as an integrated part of the centre, having regard to the continuity of built form and streetscapes, active street frontages and pedestrian and cyclist accessibility and circulation.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Deeragun district centre precinct	
PO23 Development in the Deeragun district centre precinct contributes to the consolidation and integration of the centre.	No acceptable outcome is nominated.

6.3.4 Major centre zone code

6.3.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.4.2 Purpose

(1) The purpose of the Major centre zone code is to provide for a mix of uses and activities. It includes concentrations of higher order retail, commercial, offices, residential, administrative and health services, community, cultural and entertainment facilities and other uses capable of servicing a sub-region in the planning scheme area.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) Hyde Park, Aitkenvale, Thuringowa Central and the future Julago and Burdell major centres act as the most significant centres for the Townsville community after the principal centre (CBD). They service sub-regional catchments and do not compromise the intended role or successful functioning of other major centres or the CBD;

Editor's note—The Julago and Burdell areas are included in the Emerging community zone. The future major centre at Burdell is planned within the North Shore area.

(b) these centres operate as major multifunctional community hubs. They contain the highest order of community, retail and office based functions after the principal centre (CBD), including sub-regional level services such as theatres, major libraries and community centres and health and educational facilities. However, they do not contain any additional department stores;

(c) major centres evolve as vibrant mixed use places where people live, work and play in a high density environment which is active both during the day and night-time and includes residential uses;

(d) major centres are highly accessible by walking and cycling from surrounding medium density residential areas;

(e) major centres become a hub for major public transport routes providing frequent services to other parts of the city, and development facilitates convenient access to public transport facilities as a priority;

(f) showrooms occur within the major centres, but are generally located and designed so that they do not detract from the intended built form, pedestrian focus and accessibility;

(g) centre design and built form creates a walkable and legible pedestrian-focussed environment, with a range of connected, safe and pleasant public spaces forming community focal points. Public spaces and primary pedestrian circulation streets are activated by shop fronts, awnings and kerbside activities;

(h) the height and scale of buildings reinforce the character, legibility and accessibility of the centre. Centres predominantly contain medium-rise buildings. However, a human scale and attractive, pedestrian friendly environment is created at street level;

(i) centres are designed to create a desirable interface with surrounding neighbourhoods, providing for attractive streetscapes and transitioning of building form and scale and minimising potential land use conflicts; and

(j) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts and sub-precincts:

Aitkenvale major centre precinct:

(a) The Aitkenvale major centre builds on existing uses and underutilised land to become a diverse major activity centre;

(b) Aitkenvale leverages its location on the transport corridor to the principal centre (CBD) and James Cook University and Townsville Hospital;

(c) the existing department store at Aitkenvale is not significantly expanded and no additional department store is established;

(d) housing includes student and visitor accommodation to reinforce links with the James Cook University and Townsville Hospital; and

(e) Ross River Road and Nathan Street become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

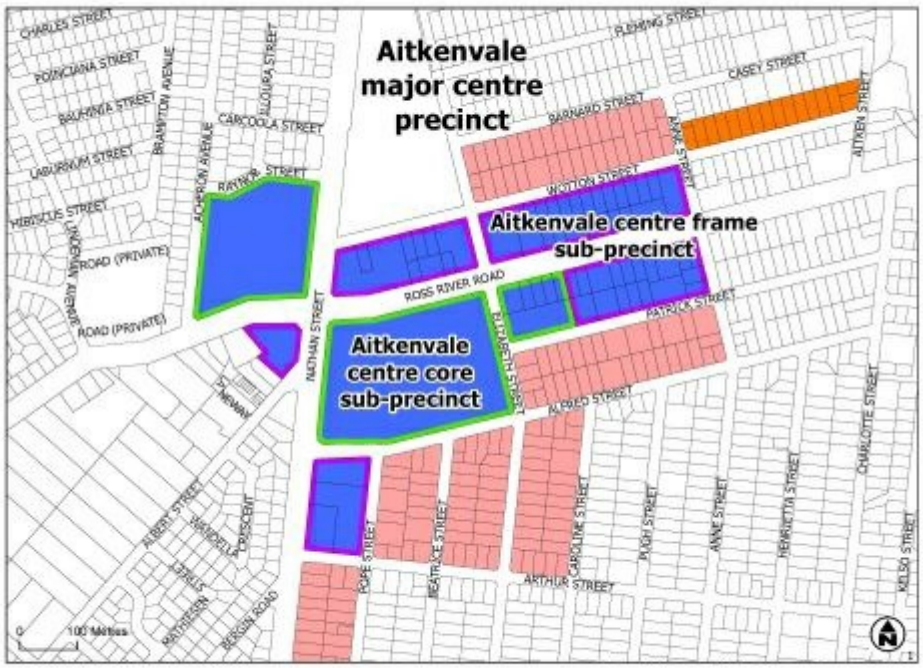

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Figure 6.93 – Aitkenvale major centre precinct

Aitkenvale centre core sub-precinct:

(i) the Aitkenvale centre core encompasses the retail focus of the centre;

(ii) the mix of uses within this sub-precinct is diversified as part of future redevelopment to include additional uses including shopping, office, higher density residential uses, community facilities and dining and entertainment uses;

(iii) residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(iv) a new town square is accommodated within the south-east corner of the sub-precinct. This space is sleeved by medium-rise built form fronting Alfred and Elizabeth Streets;

(v) Elizabeth Street is the focus for the creation of an active main street environment;

(vi) frontages to Nathan Street and Ross River Road are treated with a responsive built form that avoids unarticulated or 'back of house' design responses;

(vii) linkages between the Aitkenvale centre core sub-precinct (north and south sides of Ross River Road), the Aitkenvale centre frame sub-precinct and the surrounding Medium density residential zone are improved through the strengthening of primary pedestrian linkages along Nathan and Elizabeth Streets; and

(viii) streetscaping along Nathan and Elizabeth Street frontages also occurs to improve the interface between the site and the street whilst also improving the pedestrian streetscape environment and experience.

Aitkenvale centre frame sub-precinct:

(i) the centre frame sub-precinct complements the retail core with a mix of uses including additional shopping, offices, community and residential uses that reinforce the centre's role as a mixed use activity centre;

(ii) residential components are accommodated in mixed use developments, with retail or commercial uses at the ground storey; and

(iii) buildings have a strong relationship with their street frontage by contributing to streetscape improvements, passive surveillance, and creation of an identifiable major centre.

Thuringowa Central major centre precinct:

(a) development in the Thuringowa Central major centre continues to grow and diversify the range of activities within the centre. However, a department store is not established within this centre;

(b) higher density housing includes student and visitor accommodation to reinforce economic links with the James Cook University and Townsville Hospital;

(c) the centre is focussed on a new main street and town square along High Range Drive, which provides a strong connector between Riverway and the Willows sub-precinct;

(d) further outward expansion of the centre does not occur, with all new development contributing to the increasing consolidation of the centre and the clear definition of its edges;

(e) new development facilitates improved permeability within the centre for pedestrians and cyclists, provides for safer and shadier pedestrian routes and promotes access to public transport facilities;

(f) a bus interchange forms a focal point within the centre that is well-connected to the Thuringowa town centre heart sub-precinct, the Willows sub-precinct and the surrounding neighbourhoods;

(g) built form is highest and most intensive in the Thuringowa town centre heart sub-precinct, decreasing to the centre edges;

(h) visual and physical connections to Pioneer Park and Riverway are maximised wherever possible; and

(i) Thuringowa Drive, Riverway Drive and Hervey Range Road become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

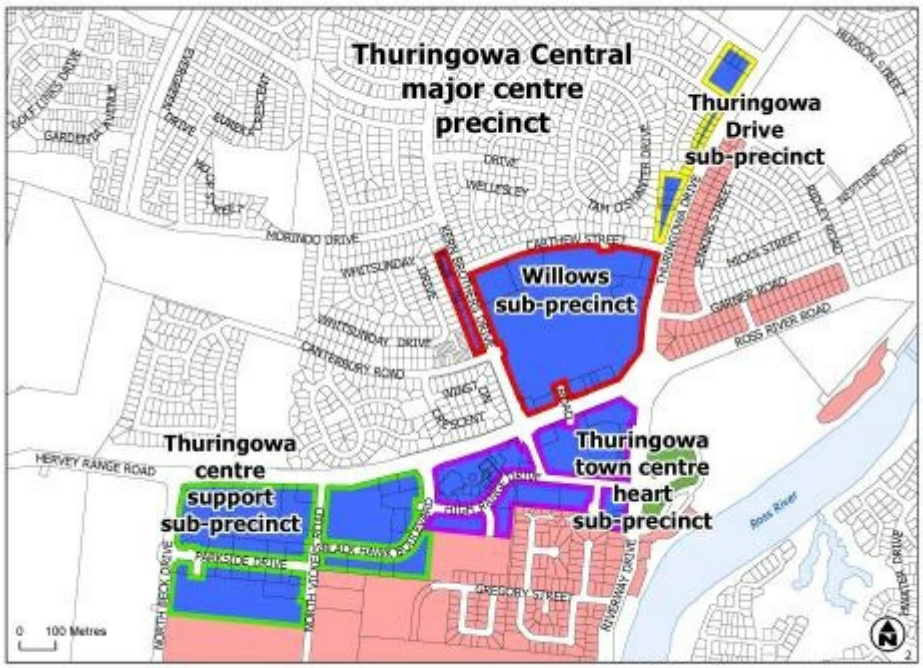

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Figure 6.94 – Thuringowa Central major centre precinct

Thuringowa town centre heart sub-precinct:

(i) a new main street and town square for Thuringowa Central are created along High Range and Pioneer Drive, and provides a community heart and a strong connection between Riverway and the Willows sub-precinct;

(ii) the sub-precinct contains a concentrated mix of uses, including shopping, office, higher density residential uses, community facilities and dining and entertainment uses. Residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(iii) the sub-precinct contains the highest and most concentrated built form within Thuringowa Central, with the most intensive built form along Riverway Drive and the main street sections of High Range and Pioneer Drives;

(iv) buildings along High Range and Pioneer Drive create a strong relationship with the street frontage and facilitate a highly activated environment, accommodating day and night-time activities, shop fronts, outdoor dining and other opportunities for community interaction;

(v) development creates a strong relationship with Hervey Range Road, Riverway Drive and Blackhawk Boulevard, by sleeving the sub-precinct with buildings that are oriented to the street and screen parking areas behind;

(vi) pedestrian spaces and pathways are provided with extensive shading;

(vii) parking is consolidated wherever practicable and is screened and separated from the street by buildings;

(viii) pedestrian and cyclist linkages are improved to the residential neighbourhood to the south and to the centre sub-precincts to the west and north. Additional and safe pedestrian crossings are provided across Hervey Range Road to the Willows sub-precinct; and

(ix) development minimises impacts on the amenity of adjoining residential land to the south of the sub-precinct.

Willows sub-precinct:

(i) this sub-precinct is the primary shopping destination for Thuringowa Central but may also contain a mix of other office, higher density residential uses, community facilities and dining and entertainment uses;

(ii) an improved relationship between built form and Thuringowa Drive, Hervey Range Road and Kern Brothers Drive is created by sleeving the sub-precinct with buildings oriented to the street and screening parking areas;

(iii) built form assists in reducing the internalised orientation of the shopping centre, creating a sense of external activity and reducing the visual dominance of the parking areas;

(iv) development facilitates pedestrian connections with the Thuringowa town centre heart sub-precinct and the surrounding residential neighbourhood; and

(v) development along Kern Brothers Drive and Carthew Street provides an attractive interface and minimises impacts on the amenity of nearby residential land.

Thuringowa Drive sub-precinct:

(i) a mix of office, shops, service industries and residential uses occur within this sub-precinct;

(ii) the corner of Thuringowa Drive and Hinchinbrook Drive creates a gateway to Thuringowa Central. Built form at this corner reinforces this gateway function;

(iii) development facilitates a more continuous building line along Thuringowa Drive, by providing a strong building edge along the street front and locating parking areas to the side or rear of buildings; and

(iv) access points and parking are consolidated wherever practicable.

Thuringowa centre support sub-precinct:

(i) larger format showroom uses, service industries and some low impact industries are accommodated in this sub-precinct. The sub-precinct may also contain office uses and community facilities, but does not contain shopping uses other than those of a convenience nature;

(ii) buildings are oriented to the street frontages, and streetscape is improved through the quality of the adjoining built form and landscaping;

(iii) built form is generally lower rise and less intensive than in the rest of the Thuringowa Central major centre;

(iv) convenient pedestrian connections are created to the Thuringowa town centre heart sub-precinct; and

(v) development along the edges of this sub-precinct provides an attractive interface and minimises impacts on the amenity of nearby residential land.

Hyde Park major centre precinct:

(a) the Hyde Park major centre contains an increasing diversity of business activities and community services. However, a department store is not located within this centre, and no significant expansion of showroom based floor space is intended;

(b) residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(c) development facilitates improved integration with surrounding residential and activity areas, including the showgrounds. Wherever possible, the interface with the lake is enhanced and opportunities for recreational use improved;

(d) Virgil and Dillane Streets are established as primary linkages to new infill residential development within the Hyde Park medium density precinct. Virgil Street becomes the major east-west pedestrian thoroughfare for the locality;

(e) development provides for appropriate immunity to flooding and drainage characteristics; and

(f) development facilitates improved public transport, pedestrian and cyclist connectivity to the principal centre (CBD), particularly along Woolcock Street.

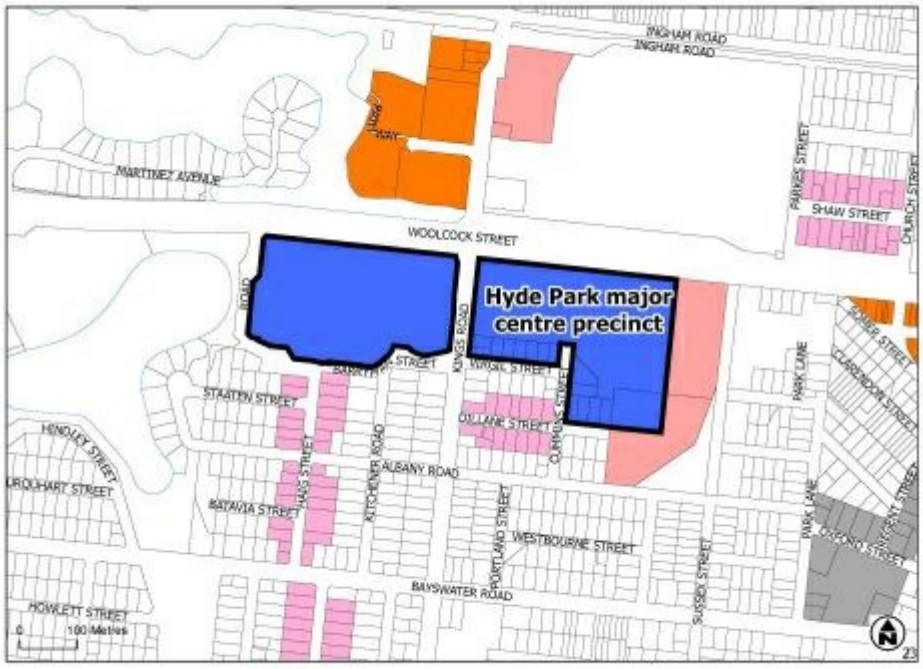

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Figure 6.95 – Hyde Park major centre precinct

6.3.4.3 Assessment benchmarks

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the major centre and does not compromise the intended role or successful functioning of the principal centre (CBD) or other major centres. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

PO6 Development facilitates a range of uses that contributes to the vibrancy of the centre and provides for a compatible mix of active day and night-time uses.	No acceptable outcome is nominated.
PO7 Development facilitates opportunities for appropriate co-location of residential uses and community-related activities or facilities with retail or commercial development within the centre, to the extent practical.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Centre design and built form	
PO8 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; (e) optimum energy efficiency; (f) a well-integrated mix of uses; (g) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (h) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO9 Buildings create a human scale at street level.	No acceptable outcome is nominated.
PO10 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	No acceptable outcome is nominated.
PO11 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO12 Parking areas are not located along the street frontage.	No acceptable outcome is nominated.
PO13 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.

PO14 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO18** Refuse storage areas loading/unloading or other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO19 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO19.1** Buildings are set back 4m from any boundary shared with a residential zone.
	AO19.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO19.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO19.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO21 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO21** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Showrooms	
PO22 Showrooms are designed and located as an integrated part of the centre, having regard to the continuity of built form and streetscapes, active street frontages and pedestrian and cyclist accessibility and circulation.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Aitkenvale major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale centre core sub-precinct	
PO23 Development facilitates a town square sleeved by medium-rise mixed use built form at the corner of Elizabeth and Alfred Streets, in accordance with Figure 6.96 — Aitkenvale major centre precinct concept plan.	No acceptable outcome is nominated.
PO24 Development assists in creating a main street environment along Elizabeth Street by facilitating an active edge incorporating externally oriented shops, dining and entertainment uses at the ground storey. Buildings contribute to the creation of this active edge by incorporating features such as: (a) primary building entrances; (b) awnings to provide shade for pedestrians; and (c) significant use of glazing or transparent materials.	No acceptable outcome is nominated.

PO25 On frontages shown on Figure 6.96 — Aitkenvale major centre precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the full width of footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO26 The visual dominance of the parking areas is reduced by buildings sleeving road frontages and by landscape screening.	No acceptable outcome is nominated.
PO27 Pedestrian connections between the centre core north and centre core south are improved wherever possible.	No acceptable outcome is nominated.
PO28 Development provides for pedestrian and cyclist connections to the Rossiter Park precinct and to surrounding areas.	No acceptable outcome is nominated.
PO29 Pedestrian routes are defined by buildings streetscape improvements that provide shade and improve pedestrian comfort.	No acceptable outcome is nominated.
PO30 Building height assists in identifying the centre core as the primary focus of activity within the centre and as a mixed use environment.	**AO30** Building height does not exceed: (a) 8 storeys where as part of a mixed use development and located in accordance with Figure 6.96 - Aitkenvale major centre precinct concept plan; and (b) 5 storeys otherwise.

Figure 6.96 – Aitkenvale major centre precinct concept plan

PO31 Development contributes to the boulevard treatment of Nathan Street and Ross River Road through streetscape and landscape treatments.	No acceptable outcome is nominated.
PO32 Development provides sufficient land and infrastructure to support a new bus interchange along Elizabeth Street.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Aitkenvale major centre sub-precincts **Note—**where acceptable outcomes in this section vary from those provided earlier in this code, the precinct- based acceptable outcomes take precedence.	
Aitkenvale centre frame sub-precinct	
PO33 On frontages shown on Figure 6.96 — Aitkenvale major centre precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the full width of footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.

Figure 6.96 – Aitkenvale major centre precinct concept plan

PO34 Development provides for pedestrian and cyclist connections to surrounding areas wherever practicable.	No acceptable outcome is nominated.
PO35 Development contributes to the boulevard treatment of Nathan Street and Ross River Road through streetscape and landscape treatments.	No acceptable outcome is nominated.
PO36 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO37 Parking areas are sleeved by buildings which screen them from street frontages.	No acceptable outcome is nominated.
PO38 Building height creates a medium-rise environment and assists in identifying the centre core as the primary focus of activity within the centre and as a mixed use environment.	**AO38** Building height does not exceed 5 storeys.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa town centre heart sub-precinct	
PO39 Development facilitates or supports a mix of uses and day and night-time activity throughout the sub-precinct.	No acceptable outcome is nominated.
PO40 Shops, dining and entertainment uses are predominant at the ground storey along the main street section of High Range Drive and Pioneer Drive, identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.
PO41 Residential and office uses are accommodated but do not interrupt ground storey activation by shopping and dining uses along the main street section of High Range Drive and Pioneer Drive, identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.
PO42 Development facilitates a town square at the corner of High Range and Pioneer Drive.	No acceptable outcome is nominated.

PO43 On frontages shown on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO44 Building height reinforces the sub-precinct's role as the heart of Thuringowa Central, and is generally medium-rise. The tallest buildings in the sub-precinct occur along Riverway Drive and the main street section of High Range and Pioneer Drives.	**AO44** Building height does not exceed: (a) 8 storeys fronting Riverway Drive and the main street section of High Range and Pioneer Drives, consistent with Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan; and (b) 5 storeys otherwise.
PO45 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO46 Parking areas are sleeved by buildings which screen them from street frontages.	No acceptable outcome is nominated.
PO47 Development provides for pedestrian and cyclist connections from Riverway and Pioneer Park to the Willows sub-precinct and to surrounding areas in accordance with Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.

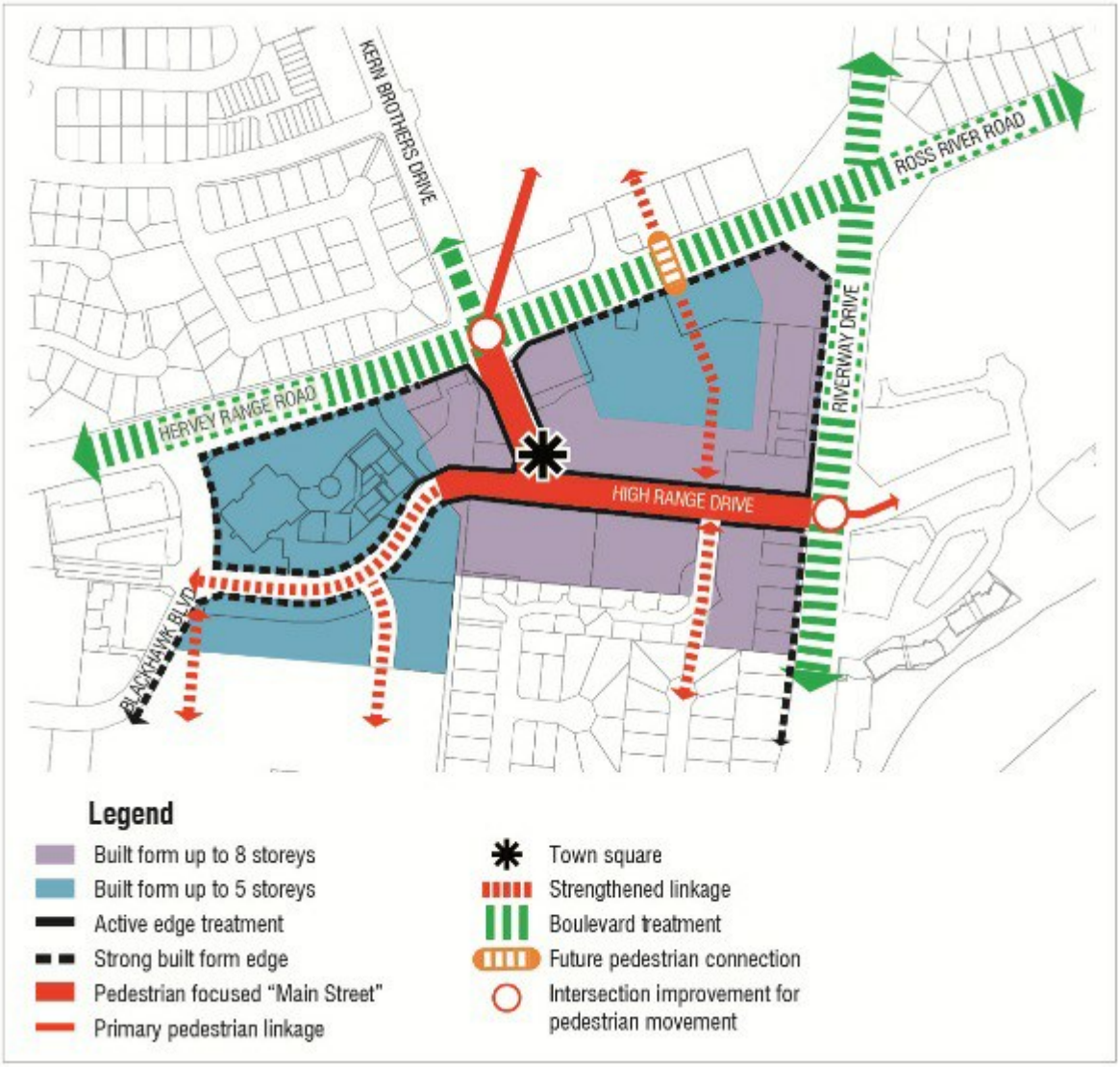

Figure 6.97 – Thuringowa town centre heart sub-precinct concept plan

PO48 Development contributes to the boulevard treatment of Riverway Drive and Hervey Range Road through streetscape and landscape treatments as identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Willows sub-precinct	
PO49 Development assists in creating strong edges at the street by buildings that are oriented to the street frontages, identified on Figure 6.98 — Willows sub-precinct concept plan.	No acceptable outcome is nominated.

PO50 Development assists in reducing the internalised orientation of the shopping centre by facilitating externally oriented uses.	No acceptable outcome is nominated.
PO51 The visual dominance of the parking areas are reduced by buildings sleeving road frontages and by landscape screening.	No acceptable outcome is nominated.
PO52 Built form generates visual interest at the street level, having regard to the proportion of openings, windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO53 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO54 Visual connections to Pioneer Park and Riverway are maximised wherever possible.	No acceptable outcome is nominated.
PO55 Development provides for pedestrian and cyclist connections to the Town centre heart sub-precinct, Riverway and Pioneer Park and to surrounding areas in accordance with Figure 6.98 — Willows sub-precinct concept plan.	No acceptable outcome is nominated.

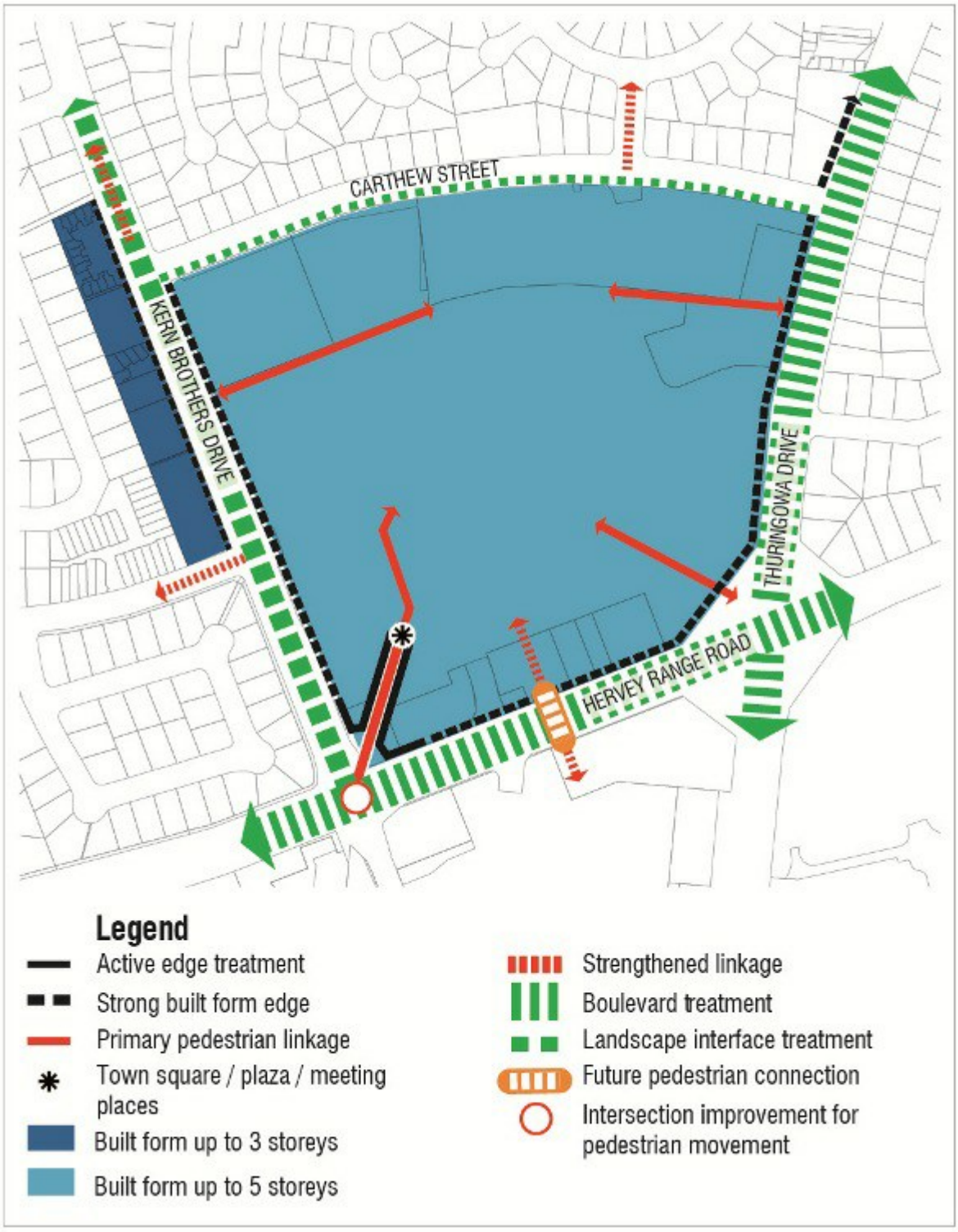

Figure 6.98 – Willows sub-precinct concept plan

PO56 The main pedestrian route connecting to the Town centre heart sub-precinct is defined by buildings and uses creating an active edge.	No acceptable outcome is nominated.
PO57 Building height is generally medium rise, but provides for a transition in building heights to the surrounding neighbourhood.	**AO57** Building height does not exceed 5 storeys within the block bounded by Thuringowa Drive, Hervey Range Road Kern Brothers Drive and Carthew Street, and 3 storeys otherwise, as identified on Figure 6.98 – Willows sub-precinct concept plan.
PO58 Landscaping and streetscape treatments are provided along Kern Brothers Drive and Carthew Street to enhance the outlook from the surrounding neighbourhood.	No acceptable outcome is nominated.
PO59 Development contributes to the boulevard treatment of Riverway Drive and Hervey Range Road through streetscape and landscape treatments.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa Drive sub-precinct	
PO60 Strong edges at the street are created by buildings that are oriented to the street frontages and forming a continuous building line, as identified on Figure 6.99 – Thuringowa sub-precinct concept plan.	No acceptable outcome is nominated.
PO61 Built form generates visual interest at the street level, having regard to the proportion of openings windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO62 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO63 Building height is generally low-rise.	**AO63** Building height does not exceed 3 storeys.
PO64 As identified on Figure 6.99 –Thuringowa sub-precinct concept plan, the corner of Thuringowa Drive and Hinchinbrook Drive creates a gateway to Thuringowa Central. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement, and landscape treatment along Hinchinbrook Drive assists in connecting and unifying the sub-precinct.	No acceptable outcome is nominated.

PO65 Development contributes to the boulevard treatment of Thuringowa Drive through streetscape and landscape treatments.	No acceptable outcome is nominated.

Figure 6.99 – Thuringowa Drive sub-precinct concept plan

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa centre support sub-precinct	
PO66 Supermarket and discount department store retail uses do not occur in this sub-precinct.	No acceptable outcome is nominated.
PO67 Buildings are oriented to the street frontages along Hervey Range Road and Blackhawk Boulevard, and the streetscape is improved through the quality of the adjoining built form and landscaping, as identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO68 All building frontages to Hervey Range Road and Blackhawk Boulevard, are provided with large windows and clearly identifiable building entrances.	No acceptable outcome is nominated.
PO69 A pedestrian connection is provided between Blackhawk Boulevard and High Range Drive, in accordance with Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO70 Development facilitates new road linkages between Blackhawk Boulevard and the residential neighbourhood to the south in accordance with Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.

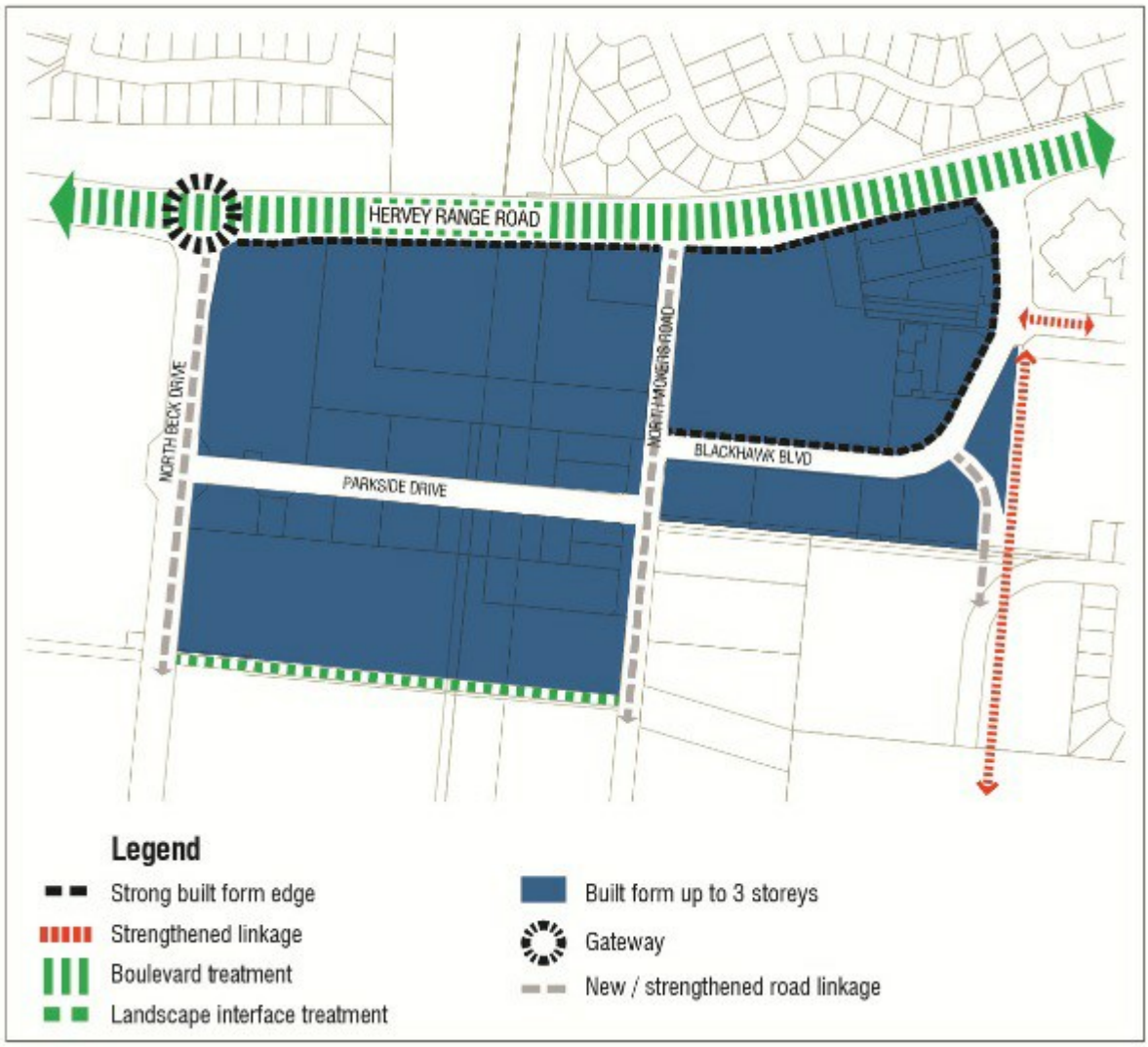

Figure 6.100 – Thuringowa centre support sub-precinct concept plan

PO71 Building height is generally low-rise.	**AO71** Building height does not exceed 3 storeys.
PO72 Landscaping and streetscape treatments are provided along North Beck Drive and Vickers Road North to enhance the outlook from the surrounding neighbourhood.	No acceptable outcome is nominated.
PO73 The appearance of development along the southern edge of this sub-precinct is enhanced through landscape treatment, as identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO74 As identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan, the corner of North Beck Drive and Hervey Range Road creates a gateway to Thuringowa Central. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement.	No acceptable outcome is nominated.

PO75 Development contributes to the boulevard treatment of Hervey Range Road through streetscape and landscape treatments.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Hyde Park major centre precinct **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Hyde Park major centre precinct	
PO76 Strong edges at the street are created by buildings that are oriented to the street frontages and forming a continuous building line, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan.	No acceptable outcome is nominated.
PO77 Built form generates visual interest at the street level, having regard to the proportion of openings, windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO78 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO79 Building height is generally medium rise.	**AO79** Building height does not exceed 5 storeys.
PO80 Development facilitates the establishment of a new road linkage connecting Woolcock Street to Dillane Street, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan. This new road assists in creating an active and attractive interface between the major centre and the Hyde Park medium density precinct.	No acceptable outcome is nominated.
PO81 Development facilitates the establishment of Virgil Street as the major east-west pedestrian thoroughfare connecting across Kings Road and east into the Hyde Park medium density precinct and the nearby open space corridor, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan.	No acceptable outcome is nominated.

Figure 6.101 – Hyde Park major centre precinct concept plan

Table 6.3.4.3 - Accepted development subject to requirements and assessable development (Part)

PO82 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of pedestrian environment along Woolcock Street and Kings Road.	No acceptable outcome is nominated.
PO83 Landscape treatment along Virgil Street, Dillane Street and the parkland assists in connecting and unifying the precinct.	No acceptable outcome is nominated.

6.3.5 Principal centre (CBD) zone code

6.3.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.5.2 Purpose

(1) The purpose of the Principal centre (CBD) zone code is to provide for the largest and most diverse mix of uses and activities in Townsville.

It includes key concentrations of high-order retail, commercial, employment, residential, health services, administrative, community, cultural, recreational and entertainment activities and other uses, capable of servicing the planning scheme area.

(2) The particular purpose of the code is to:

(a) re-enforce the Townsville central business district (CBD) as the economic heart of the region, and the primary location for business, government and administration uses;

(b) promote the principal centre (CBD) as the location for the highest order activities and facilities of the city including retail, commercial, cultural, civic, sporting, and recreational uses;

(c) consolidate Townsville as Queensland's second capital and be an exemplar city in tropical urban sustainability; and

(d) ensure the principal centre (CBD) contributes to the identity, character and life of the city.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the principal centre (CBD) is a vibrant mixed use place where people live, work and play in a high density environment which is active both during the day and night-time;

(b) the principal centre is the highest order centre in Townsville and services a regional catchment, supported by a network of centres;

(c) the principal centre is the focus for the highest intensity of retail, commercial, administrative, government and employment uses in the city and is the primary location for major office and commercial buildings;

(d) the principal centre offers a more distinctive and higher order retailing than the major centres in an outdoor, main street environment that is characterised by arcades, laneways and footpath dining. The preferred location for any new department store in Townsville is in the Flinders Street retail precinct;

(e) high density residential development, tourist and short-term accommodation are located within the principal centre (CBD);

(f) new, larger scale strategic facilities, such as sports arenas, stadiums, convention centres and entertainment centres are located in other zones outside the CBD. These facilities are intended to be located close to the fringe of and well-connected to the CBD. Shops and commercial uses associated with these facilities do not compromise the CBD;

(g) the scale and density of development creates a critical mass of people living and working in the principal centre, to support the provision of the highest order of public and active transport facilities and promotes sustainable transport choices including public transport, walking and cycling;

(h) the principal centre (CBD) is a major hub for most public transport routes providing a single interchange to access frequent services to other parts of the city. An on-street transport interchange for bus routes to and through the CBD is to be located immediately adjacent to the Flinders Street retail precinct;

(i) Flinders Street, Ogden Street and Hanran Street are slow-speed vehicle environments and provide the main pedestrian and cycle spines through the principal centre. Through traffic is diverted to the fringes, including Walker Street, Blackwood Street, Denham Street and Stanley Street;

(j) pedestrian and cycle access is complemented by a network of shared paths along the banks of Ross Creek and new pedestrian and cycle creek crossings;

(k) Stokes Street is intended to be the primary east-west pedestrian spine linking the Civic and administration precinct, public transport interchange, commercial office, retail heart, Flinders Street, Victoria Bridge and Palmer Street;

(l) public realm provides a platform for public life and is characterised by high quality streetscapes, landscape elements, planting and hardscape materials reflective of the climate and character of Townsville;

(m) a variety of public open space areas at different scales and forms are provided for event and gathering spaces throughout the city, including public plazas, parks and gardens. These are appropriate to the required use and include:

(i) Flinders Square forming the primary civic event and gathering space;

(ii) a new 'front door' to Castle Hill at 'The Cutting', incorporating an information and interpretive centre, viewing platform over the CBD and providing walking track access to Castle Hill;

(iii) Flinders Street East park and plaza, which create a waterfront park for passive recreation, taking advantage of views and amenity; and

(iv) Flinders Street spine, which forms a linear plaza street from Stanley Street to Wickham Street with wider footpaths and slow vehicle speeds.

(n) natural features are retained, enhanced and buffered from the impacts of adjacent uses. Impacts are minimised through location, design, operation and management requirements;

(o) public spaces and streets are activated by shop fronts and kerbside activities at the ground storey whilst awnings over the full width of the footpaths provide protection from the elements;

(p) development is designed to incorporate exemplar sustainable practices including new technologies in maximising energy efficiency, water conservation and climate-responsive design principles;

(q) the height and scale of buildings reinforce the principal role of the centre and contribute to character, legibility and accessibility of the centre. The principal centre predominantly contains high-rise buildings. However, a human scale and attractive, pedestrian friendly environment is created at street level; and

(r) buildings located to the north of Sturt Street do not extend above the maximum height of buildings to the south of Sturt Street.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Civic and administration precinct:

(a) the Civic and administration precinct anchors the top of the principal centre (CBD) and is focused around government, administration and civic functions, such as the library and courthouse, local and state government departments;

(b) high quality public and semi-public spaces are incorporated into development to support the community function of these buildings, particularly at the intersection of Stokes and Walker Streets;

(c) lower building forms are contained in this precinct in response to the local topography and the need to provide an appropriate interface with adjoining residential land uses to the north of Wills Street;

(d) building heights in the precinct do not exceed 8 storeys; and

(e) building forms reflect a 'building in plaza' form incorporating a tower design with side and rear setbacks. Recesses in the ground level accommodate plaza spaces which are particularly focussed on presentation to Walker Street.

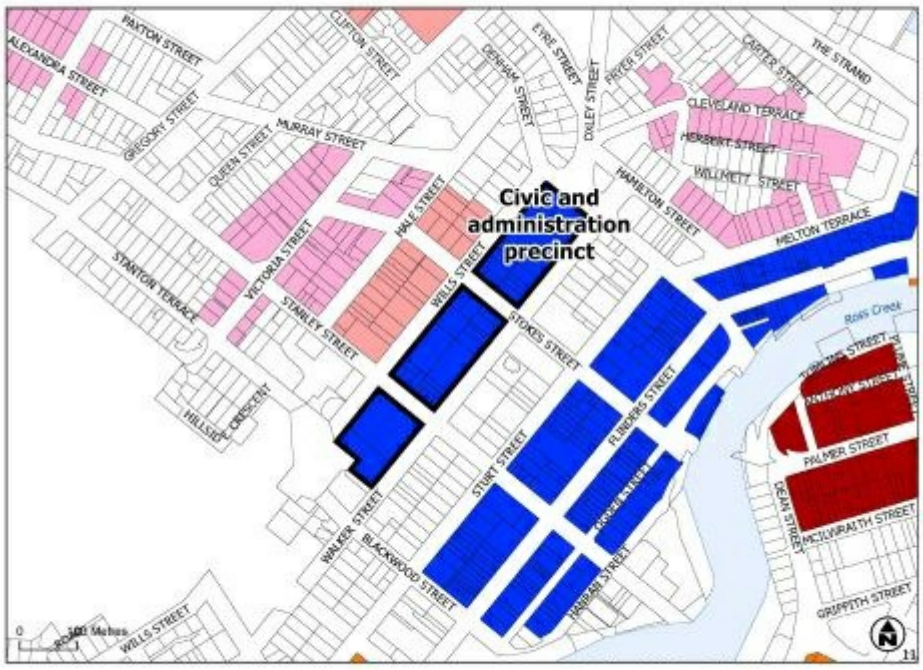

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Figure 6.102 – Civic and administration precinct

Flinders Street retail precinct:

(a) the Flinders Street retail precinct is the core focus for future retail activity and the provision of a new department store in this precinct is highly desired and actively encouraged;

(b) department stores, arcades and internal retail developments connect directly into Flinders Street, supporting the retail spine and do not detract from the attractiveness and activity on the street;

(c) highly attractive and permeable pedestrian-based built form is created with a highly active ground floor and cross block links available during operating hours;

(d) this precinct includes a large concentration of historic buildings. New buildings reflect and integrate with this built form with a low podium height and continuous frontages;

(e) taller building elements are set back from the street frontage to allow for light and air into the street and maintain the outdoor quality and human scale of the street;

(f) shop fronts, café and or restaurant premises are continuous along both sides of the street. Retail is the predominant use; and

(g) parking is not situated at the street frontage at the ground floor, and does not detract from the street activity or create blank walls. Parking structures are screened with green walls, planting, vines, creepers or public art. There are no blank facades along Flinders Street.

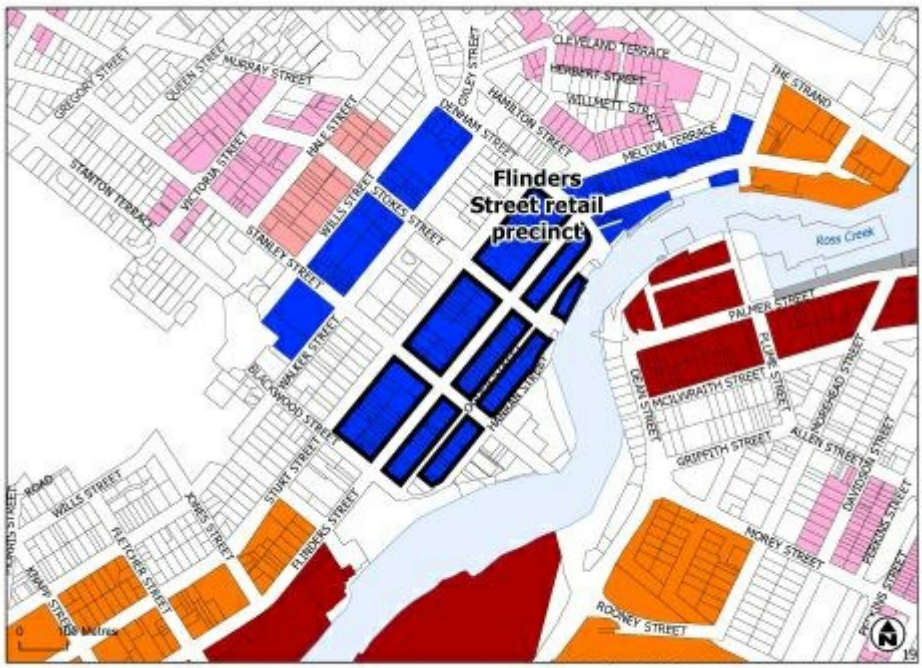

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Figure 6.103 – Flinders Street retail precinct

Flinders Street East precinct:

(a) the Flinders Street East precinct frames the eastern end of the principal centre (CBD). The precinct will continue to emerge as a vibrant entertainment and boutique shopping location, integrated with the principal centre (CBD) but with its own unique identity as a destination;

(b) the precinct will continue to develop at a lower scale than the rest of the principal centre (CBD);

(c) re-use of existing heritage buildings is actively encouraged, and new buildings are designed to respect the heritage attributes of the precinct;

(d) building height fronting Flinders Street East and Melton Terrace is low-rise and consistent with the scale of nearby character and heritage buildings;

(e) retail uses do not compete with the rest of the principal centre (CBD), and will generally be of a boutique shopping and convenience nature;

(f) active uses such as restaurants and pubs are located to the Flinders Street frontage, with new development to Melton Terrace to predominantly consist of residential uses; and

(g) new development contributes to a consistent pallet of local streetscape elements and designs, resulting in the continuing development of a local streetscape character for the precinct.

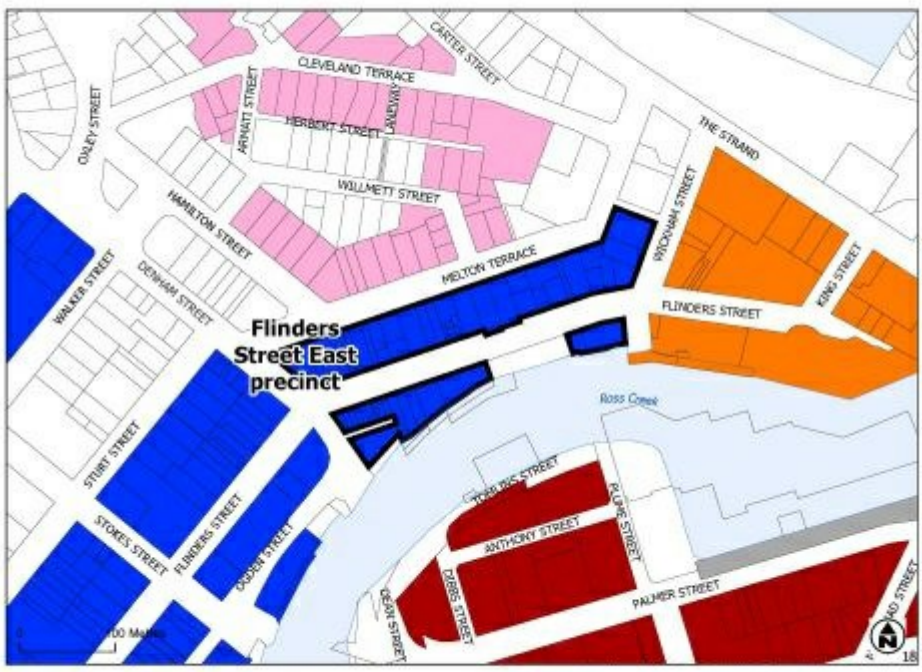

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Figure 6.104 – Flinders Street East precinct

6.3.5.3 Assessment benchmarks

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum of 9m^2; (b) a minimum dimension of 3m; and (c) clear of any utilities, water tanks and air conditioning units.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the principal centre. The growth of retail and office floor space and residential uses within this centre allow for it to expand into its intended role as the economic and administrative heart of the region.	No acceptable outcome is nominated.
PO6 Development is generally in accordance with the Figure 6.105 – Principal centre concept plan.	No acceptable outcome is nominated.

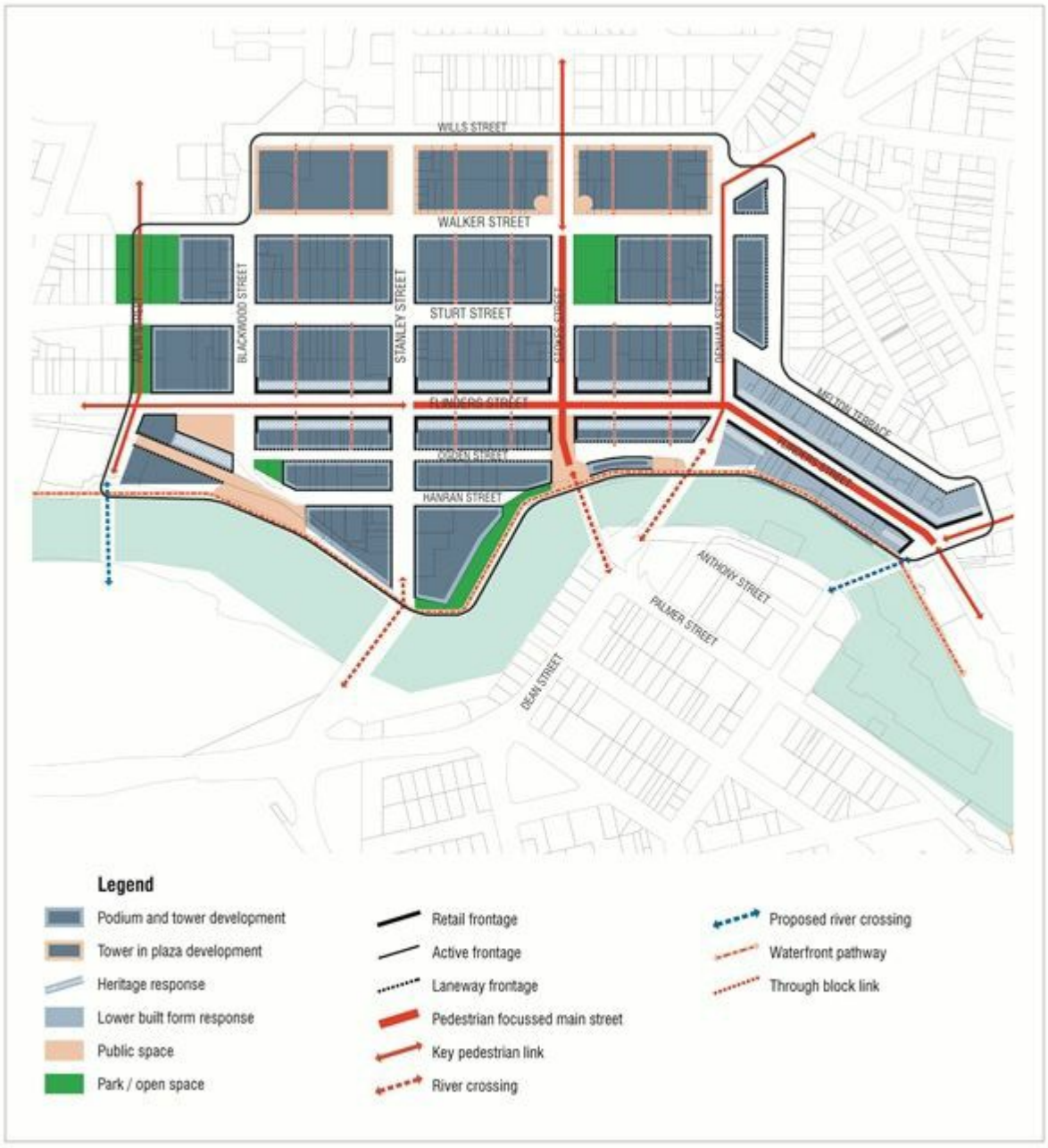

Figure 6.105 – Principal centre concept plan

PO7 Ground floor and podium level development is occupied with uses that contribute to: (a) the core economic, entertainment and cultural functions of the principal centre (CBD); (b) the vitality and vibrancy of the city's public domain; and (c) a compatible mix of active day and night-time uses.	**AO7.1** Podium level development accommodates non-residential uses.
	AO7.2 Uses at ground storey are active and include: (a) retail; or (b) cafes and restaurants incorporating outdoor dining; or (c) services and commercial offices which generate a high level of pedestrian traffic; or (d) recreational and entertainment; or (e) community and cultural uses; or (f) entrance foyers to commercial and residential uses above.

	AO7.3 Car parking is located in basements unless servicing significant citywide infrastructure or unresolvable geotechnical issues means basement parking is inappropriate or unachievable. In this case, parking is located above ground floor.
PO8 Tower development forms are occupied by uses that contribute to the accommodation of a critical mass of people (a resident or working population) within the principal centre (CBD).	**AO8** Uses within tower elements are predominantly: (a) residential accommodation either short or long-term; or (b) commercial offices; or (c) a combination of these.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO9 Building heights, site cover and setbacks contribute to the legibility, distinctiveness and place making of the city centre by creating an attractive skyline, and reinforcing the sense of primacy of the principal centre (CBD) core through built form outcomes.	**AO9.1** Unless otherwise stated for a particular precinct: (a) buildings greater than 8 storeys have a podium for a minimum of 2 storeys up to a maximum of 4 storeys, and a tower above, in accordance with Figure 6.106 – Tower and podium form; or (b) buildings of 8 storeys or less have a single tower form in accordance with Figure 6.107 – Single tower form.
	AO9.2 Unless otherwise stated for a particular precinct, setbacks and site cover are: (a) for buildings greater than 8 storeys incorporating tower and podium, in accordance with Figure 6.106 – Tower and podium form, and the following: Design Provisions - Zone & Precinct Codes Acceptable Outcome Building Form: > 8 Storey's: Tower & Podium Podium: Height: up to 4 storeys; Site Cover: 100%; SETBACKS Front: 0m; Side: 0m; Rear: 0m Tower: Height: 20 storeys + (including podium); Site Cover: 60%; SETBACKS Front: 4m; Side: 3m; Rear: 10m

	(b) for buildings 8 storeys or less and in a single tower form, in accordance with Figure 6.107 – Single tower form, and the following: **Design Provisions - Zone & Precinct Codes** **Acceptable Outcome** **Building Form**: Tower **Height**: Up to 8 storeys **Site Cover**: 70% **SETBACKS** – **Front:** 0m; **Side:** 3m; **Rear:** 6m
PO10 Building heights and massing: (a) contribute to the intended role, scale and character of the principal centre by: (i) accommodating sufficient floor space to provide critical mass and intensity of use to activate the city; (ii) concentrate major development in the CBD core and transition building height at the fringes to ensure appropriate interface with lower scale adjoining developments; and (iii) maximising active uses at lower levels to activate, interact with and overlook street frontages. (b) is appropriate to the character and climate of Townsville and: (i) retains the openness of street vistas, including to the sky, along major elements of the city grid; (ii) provides privacy, natural light penetration and air circulation; (iii) provide transition to and design compatibility with lower scale heritage places and precincts; and (iv) retains an appropriate relationship with established streetscapes. (c) contributes to safe, active streets and public domain, by: (i) defining the street space with human scale elements; (ii) retains the continuity of facades along the street; and (iii) addressing all streets and public spaces with active uses, windows, doors, openings and balconies.	No acceptable outcome is nominated.

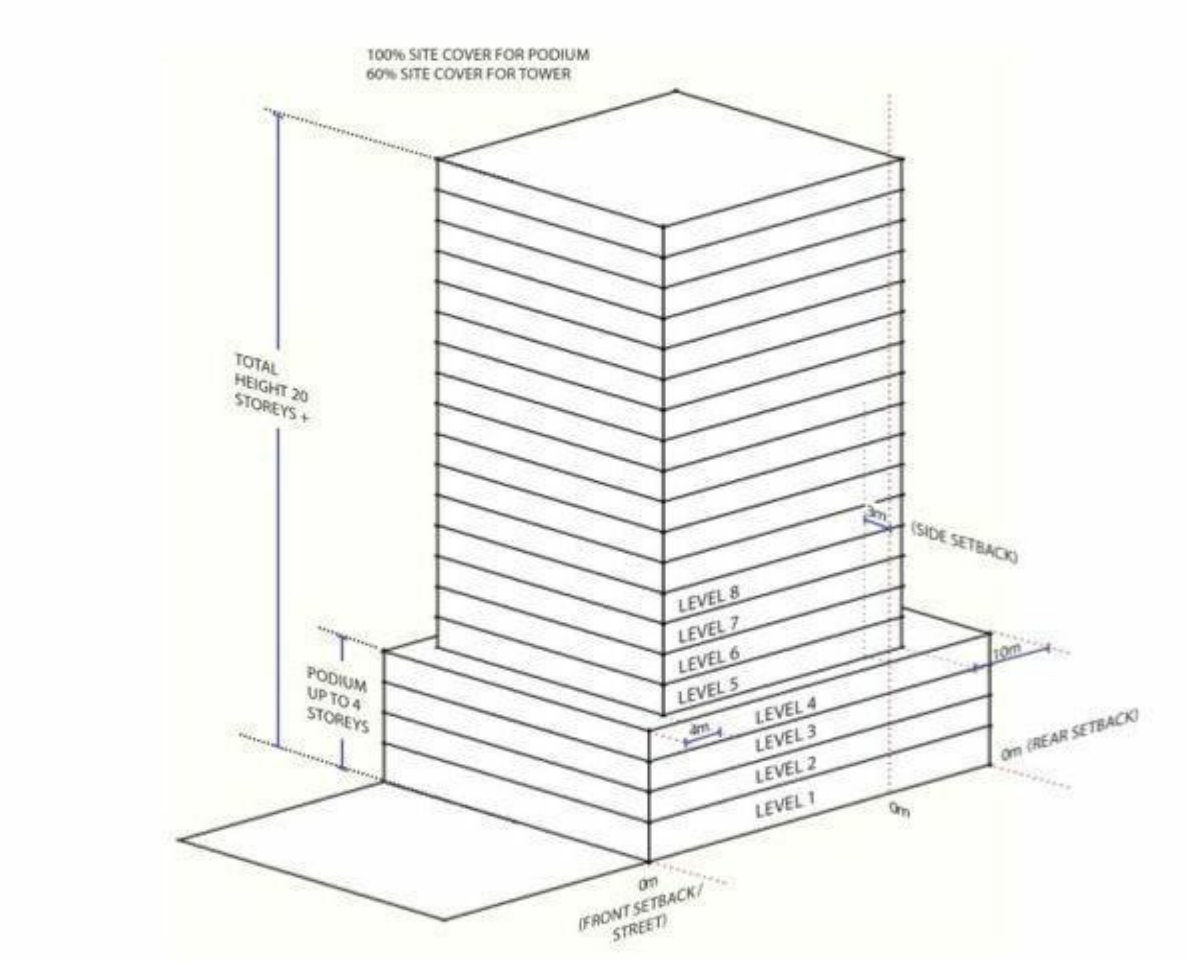

Figure 6.106 – Tower and podium form

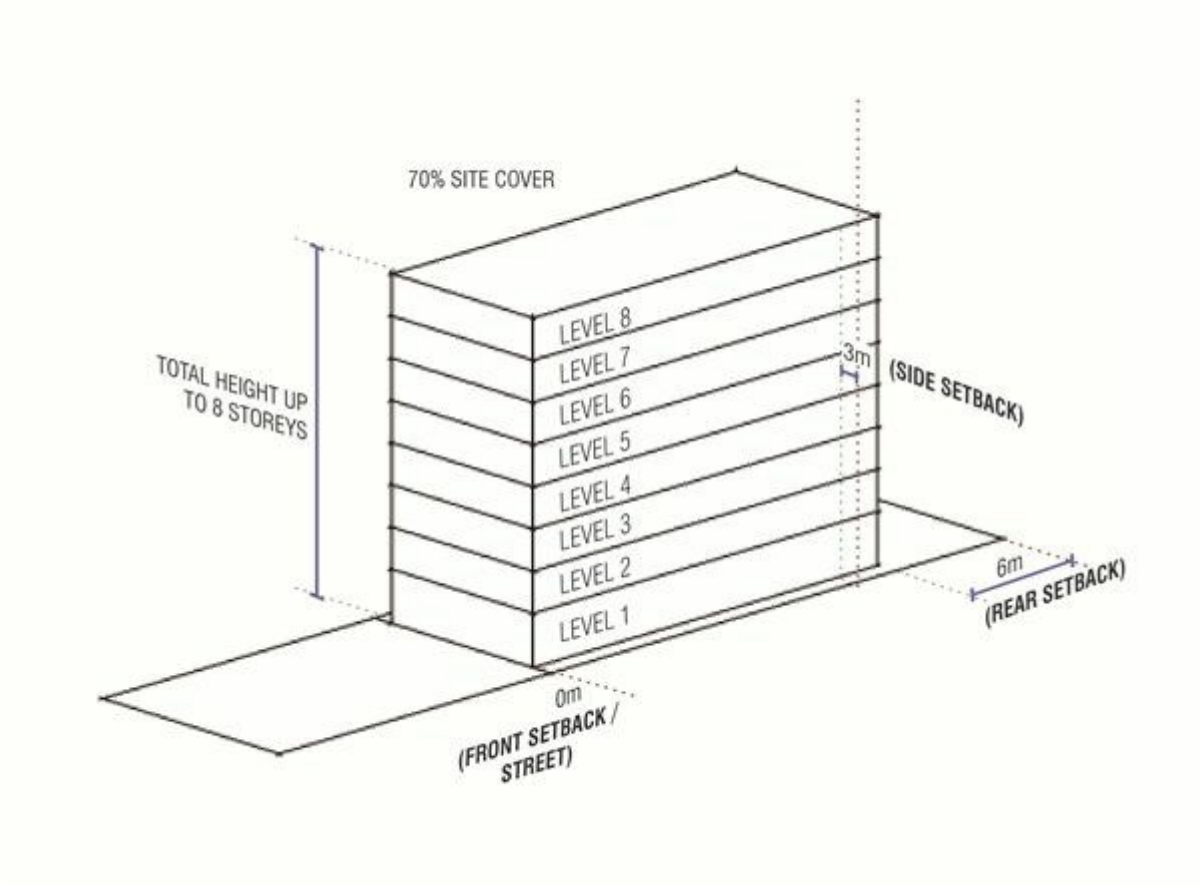

Figure 6.107 – Single tower form

PO11 Tower forms are clearly defined slender building elements with adequate spacing between them to provide for privacy, natural light penetration and air circulation.	**AO11.1** Maximum horizontal dimension for a tower on any side is 40m or 75% of the width of the site, whichever is the lesser.
	AO11.2 On a site greater than 3,000m^2, more than 1 tower is provided.
PO12 Ground floor and podium forms relate positively to streets and public spaces, and activate the public domain by incorporating: (a) operable elements within the building facade such as large window openings, sliding doors, window seating; (b) strong visual and physical connections between internal and external spaces; (c) usable outdoor/semi-outdoor spaces that support outdoor lifestyles and engage with the public realm; and (d) a gradual transition between the public domain and private outdoor or building spaces.	No acceptable outcome is nominated.
PO13 Through block connections are provided in accordance with Figure 6.105 – Principal centre concept plan which are publicly accessible during normal working/operating hours.	No acceptable outcome is nominated.

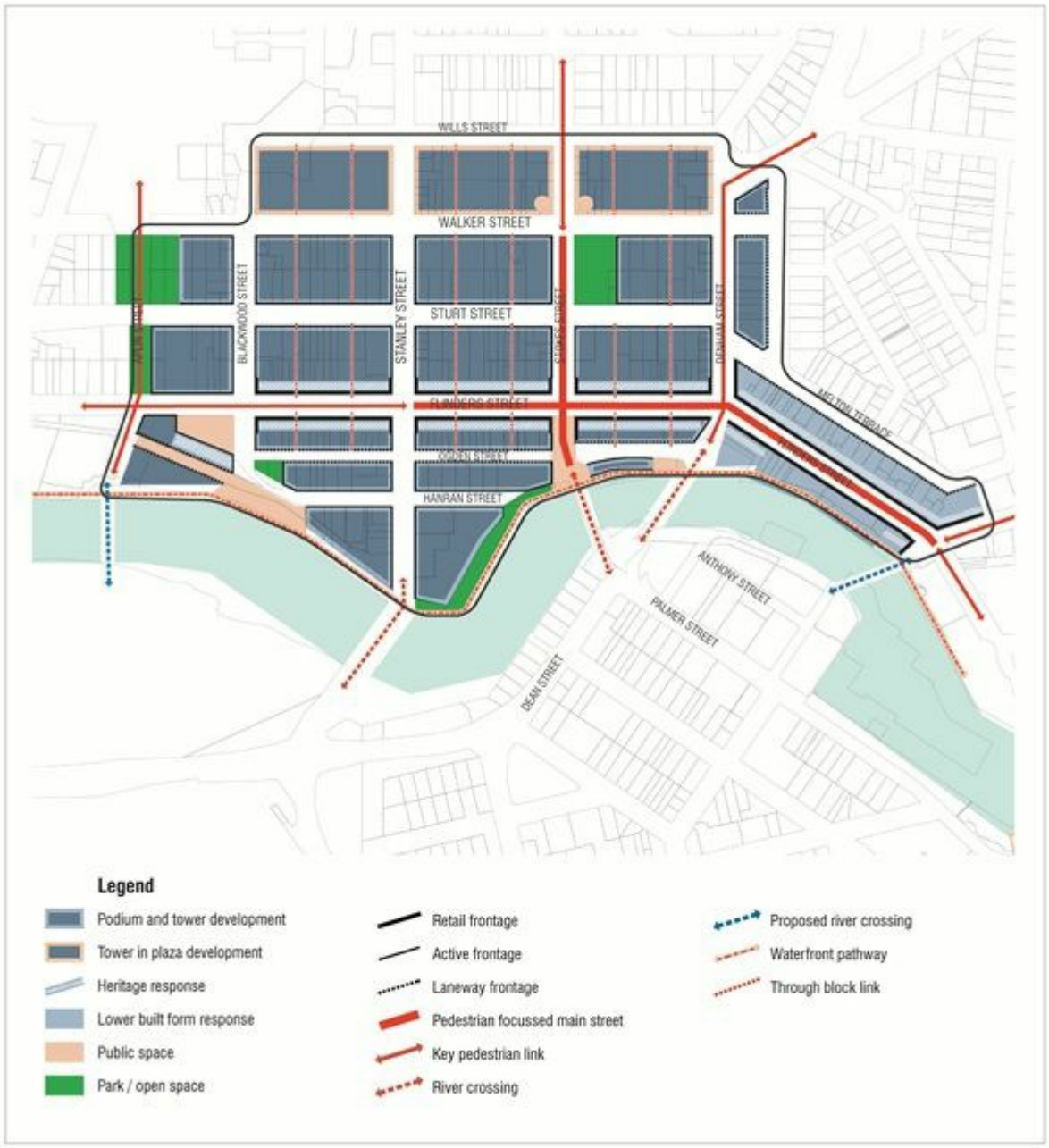

Figure 6.105 – Principal centre concept plan

PO14 Development provides continuity of building facades with adjoining buildings or provides appropriate transitions where a difference necessarily exists.	No acceptable outcome is nominated.
PO15 Ground floor and podium forms exhibit a human scale through: (a) the incorporation of detailed building elements; (b) articulation and definition of windows and openings including framing; (c) creation of a finer grain building rhythm, through design articulation such as variations in horizontal and vertical profiles, and variation in occupancy layouts within the overall building; and (d) where development sites are amalgamated, design of ground floor premises and facade to reflect the original lot widths.	No acceptable outcome is nominated.
PO16 Buildings or towers make a positive contribution to the skyline by: (a) exhibiting exceptional architectural design and quality; (b) utilising high quality materials that contribute to the tropical/Townsville character, are easily maintained and do not readily stain, discolour or deteriorate; and (c) articulating the building silhouette.	No acceptable outcome is nominated. **Editor's note–**where new buildings are proposed within the Principal centre (CBD) zone a design statement/response document is to be submitted with any development application demonstrating achievement of the relevant performance outcomes.
PO17 Roofscapes make a positive contribution to the attractiveness and function of the city through: (a) integrating them with the architectural design of the building; (b) service structures, lift motor rooms, externally mounted air conditioning units and mechanical plant designed as an architectural feature or with attractive screening; (c) creation of a coherent skyline for the city centre; and (d) creation of attractive and usable visual, open space, recreational or ecological spaces, including at podium level.	No acceptable outcome is nominated.
PO18 Buildings do not incorporate any type of glass or other surface that is likely to reflect solar rays that could create undue nuisance, discomfort or hazard to any part of the surrounding locality.	**AO18** Any reflective glass material has: (a) a level of light reflectivity of not greater than 20%; and (b) a level of heat transmission of not less than 20%.

PO19 Fenestration and sun control elements are used to: (a) minimise solar heat gain on building walls and windows; (b) reduce glare; (c) enrich the tropical character; and (d) provide texture to the building facades.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO20 Development facilitates the safety and security of people and property having regard to: (a) maximising opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) provision of adequate lighting; (d) appropriate signage and wayfinding mechanisms; (e) minimisation of entrapment locations; (f) building entrances, loading and storage areas that are well lit and lockable after hours; and (g) provision of direct movements along desire lines with clear unobscured sight lines. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO21 Ground storey pedestrian footpaths and access ways are the same level as, and connect without any lip or step to, the footpath and abutting pedestrian areas on neighbouring sites. Where the footpath is sloping, entries to the building are at the same level as the footpath.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO22 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO23 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO23.1** Private open space is provided as a balcony with: (a) a minimum area of 9m^2 for a 1 bedroom unit or 16m^2 for a 2 or more bedroom unit; and (b) a minimum dimension of 3m, clear of any utilities such as gas, water tanks or air-conditioning units.
	AO23.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO23.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO24 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO25 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

PO26 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and public spaces; (b) contribute to pedestrian comfort through shade; (c) create green rooves, walls or other sustainable building elements; and (d) screen unsightly components.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Loading and servicing	
PO27 The design and location of parking areas, refuse storage areas, loading/unloading and servicing areas, plant and building control on-site: (a) minimise disruption or breaks in building frontages; and (b) are screened from view from the street and adjoining uses.	**AO27.1** Non-active frontage (vehicle access, fire egress, control room, plant, building services etc.) occupies a maximum 8m or 25% of the primary frontage, whichever is the lesser.
	AO27.2 Refuse storage areas, loading and services bays are: (a) contained within the ground floor or podium built form; and (b) screened from the street by active uses/occupied building space.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Public domain	
PO28 Footpaths and pathways provide all weather protection within a safe, unobstructed and attractive environment. Awnings are: (a) continuous and compatible with existing awnings; (b) allow for street trees and landscaping; (c) visually safe and amenable; (d) located along key pedestrian routes and connects key destinations; (e) contributes to legibility and wayfinding; (f) do not impede the normal flow of pedestrians; and (g) constructed of materials that reflect the tropical climate and character of Townsville.	**AO28.1** Awnings are provided in accordance with Figure 6.108 – Awning location.
	AO28.2 Awnings: (a) are located above ground floor and is a minimum of 3.2m and generally not more than 4.2m above pavement height; (b) extend from the face of the building and is set back from the inside of the kerb line: 1.5m; (c) are continuous across all street frontages of the site; (d) are contiguous with adjoining buildings and awnings; (e) are cantilevered from the building and does not include posts within the footpath (except within the Flinders Street East precinct); (f) are provided with under awning lighting; and (g) are constructed of lightweight materials.
	AO28.3 Additional pedestrian shelter is provided as free-standing shade structures (such as umbrellas) which: (a) are constructed of lightweight materials; (b) have a minimum number of posts; (c) are a minimum 2.5m above pavement height; and (d) maintain the normal flow of pedestrians.

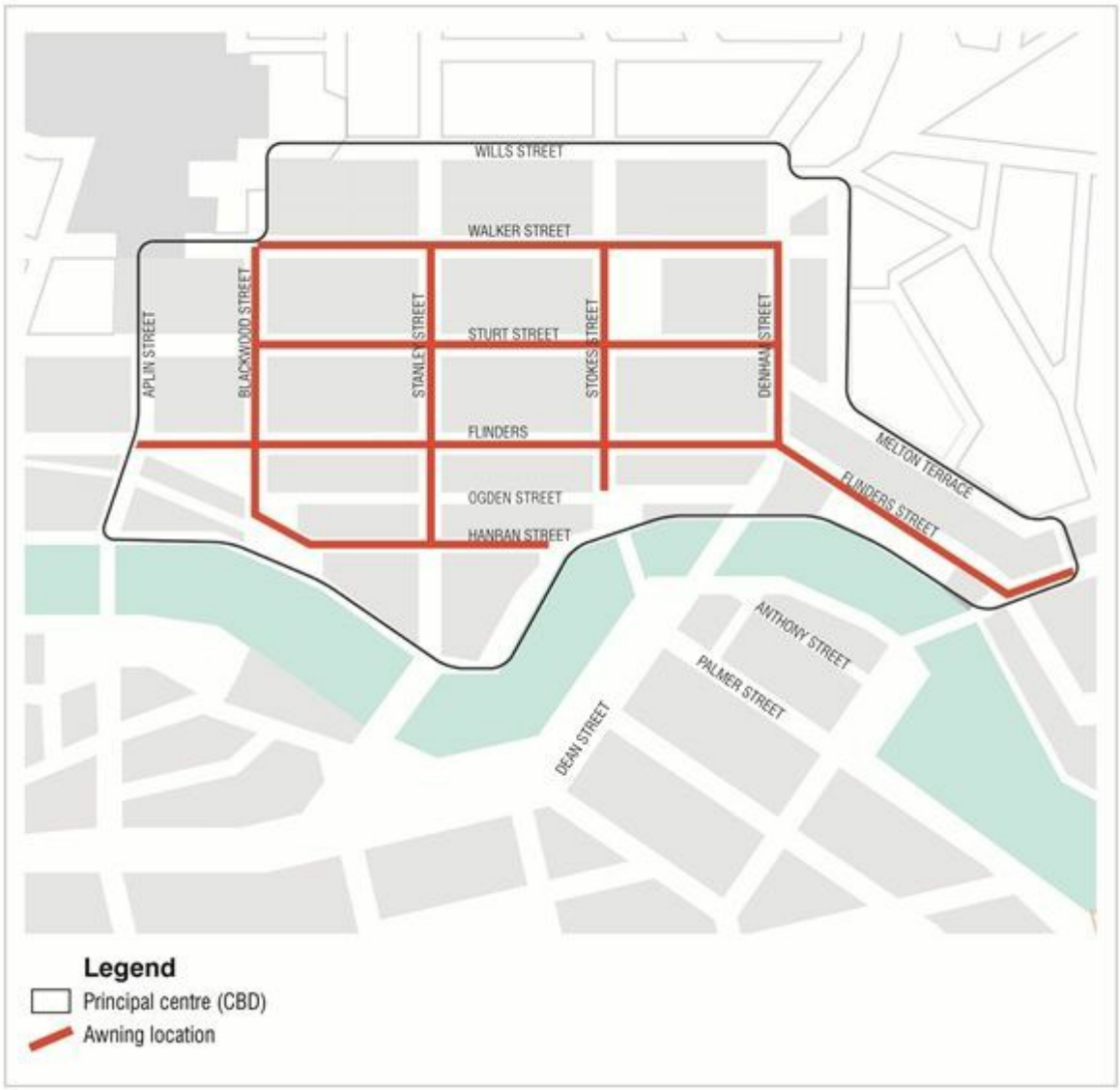

Figure 6.108 – Awning location

PO29 Where the ground floor is setback and upper podium levels overhang, or awnings are provided, these are cantilevered to avoid columns, ensuring no visual or physical obstruction occurs between the footpath and ground floor premises.	No acceptable outcome is nominated.
PO30 The location and placement of steps, escalators, ramps, lifts, automatic teller machines and other facilities which require queuing, standing areas or waiting such as bus stops and taxi ranks: (a) do not impede the normal flow of pedestrians; (b) maintain visibility and good sight lines; and (c) provide adequate space for queuing, standing areas.	**AO30** Any steps, escalators, ramps, lifts and automatic teller machines are set back 1.5m from the building facade at ground floor to allow for adequate waiting space in a manner that does not create concealment spots.
PO31 Pedestrian movement is continuous, convenient, safe and comfortable. Development: (a) provides pathways at street level and not provided via overhead bridges; (b) provides additional through block connections; (c) provides direct connections between key destinations; and (d) priorities pedestrian movement throughout the CBD.	No acceptable outcome is nominated.
PO32 Footpath and public realm design delivers pedestrian spaces that: (a) accommodate the requirements of the adjacent land use and the likely pedestrian traffic; (b) provide all weather protection; (c) provide vegetation that contributes to the city's tropical character; and (d) are constructed and maintained to a consistent standard.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Provision of public spaces	
PO33 A variety of public spaces are provided throughout the principal centre (CBD) and include: (a) small-scale spaces; (b) laneways; (c) public promenades; (d) public squares; (e) urban boulevards; (f) parks and gardens; (g) performance spaces; and (h) arcades and through block links.	**AO33** New public spaces, corridors, pathways and through block connections are provided in accordance with Figure 6.105 – Principal centre concept plan.
PO34 Development adjoining Ross Creek contributes to the provision of a continuous riverside bikeway/walkway linking Reid Park to The Strand and extending out to the Breakwater precinct. The pathway system: (a) provides a shared path for pedestrians and cyclists; (b) is safe and attractive providing opportunities for pausing and weather protection along the route; and (c) provides direct connections between the pathway and the adjoining street network.	**AO34** Any development on premises adjoining Ross Creek provides: (a) a fully publicly accessible riverside walkway/bikeway that is dedicated to council and has a minimum unobstructed pavement width of 4.5m and a minimum overall width of 6m; (b) tree planting, lighting, balustrading, and pavement treatment are provided along the full length and within the pathway; and (c) furniture, including seating, awnings and public art for weather protection are provided at the intersection of the pathway and key streets.

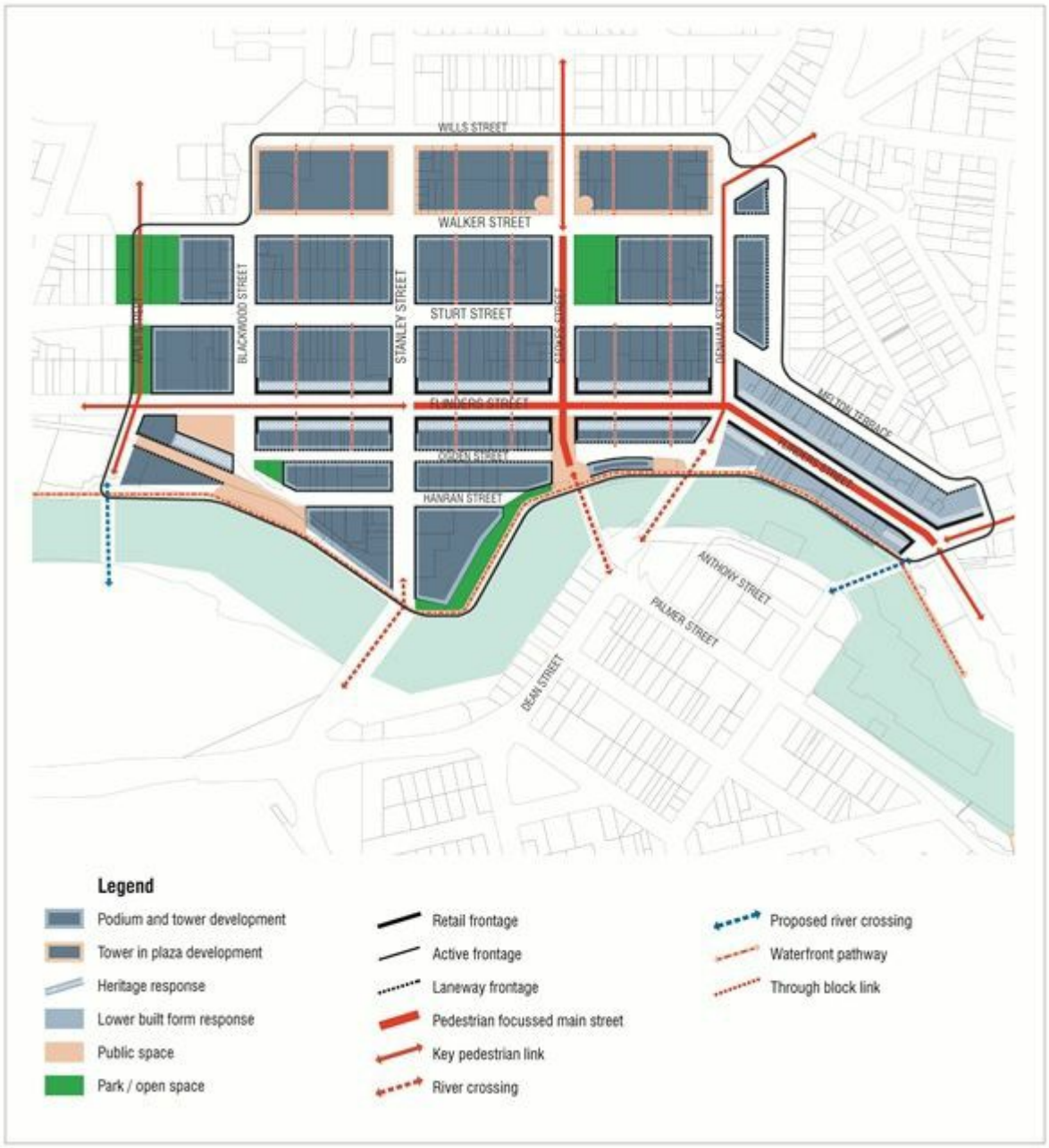

Figure 6.105 – Principal centre concept plan

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Civic and administration precinct	
PO35 Development facilitates or supports a mix of uses and day and night-time activity throughout the precinct including: (a) civic, administration, government, education and commercial office buildings are the predominant uses; and (b) shops, dining, café and restaurant uses may occur at the ground storey along street frontages and adjoining public entrances and forecourts.	No acceptable outcome is nominated.
PO36 Building form and massing reflect a distinctive 'building in plaza' setting to contribute to the civic character and identity of the precinct including: (a) substantial areas of the ground plane given over to public access; (b) a high quality public realm including both hard and soft-scape materials; (c) creation of stand-alone pavilions; and (d) consistent single, uniform building elements.	**AO36.1** Buildings: (a) do not have a site cover exceeding 60% of the site; and (b) incorporate a significant space as an entrance plaza/waiting or meeting area. Figure 6.109 — Civic and administration precinct built form illustrates the desired outcome. **AO36.2** Building setbacks are: (a) a minimum of 5m from street and side boundaries; (b) a minimum of 6m from the rear boundary; and (c) are generally consistent for the full height of the building on a single side, with only minor (less than 1m) indents or projections in the facade. Figure 6.109 — Civic and administration precinct built form illustrates the desired outcome.

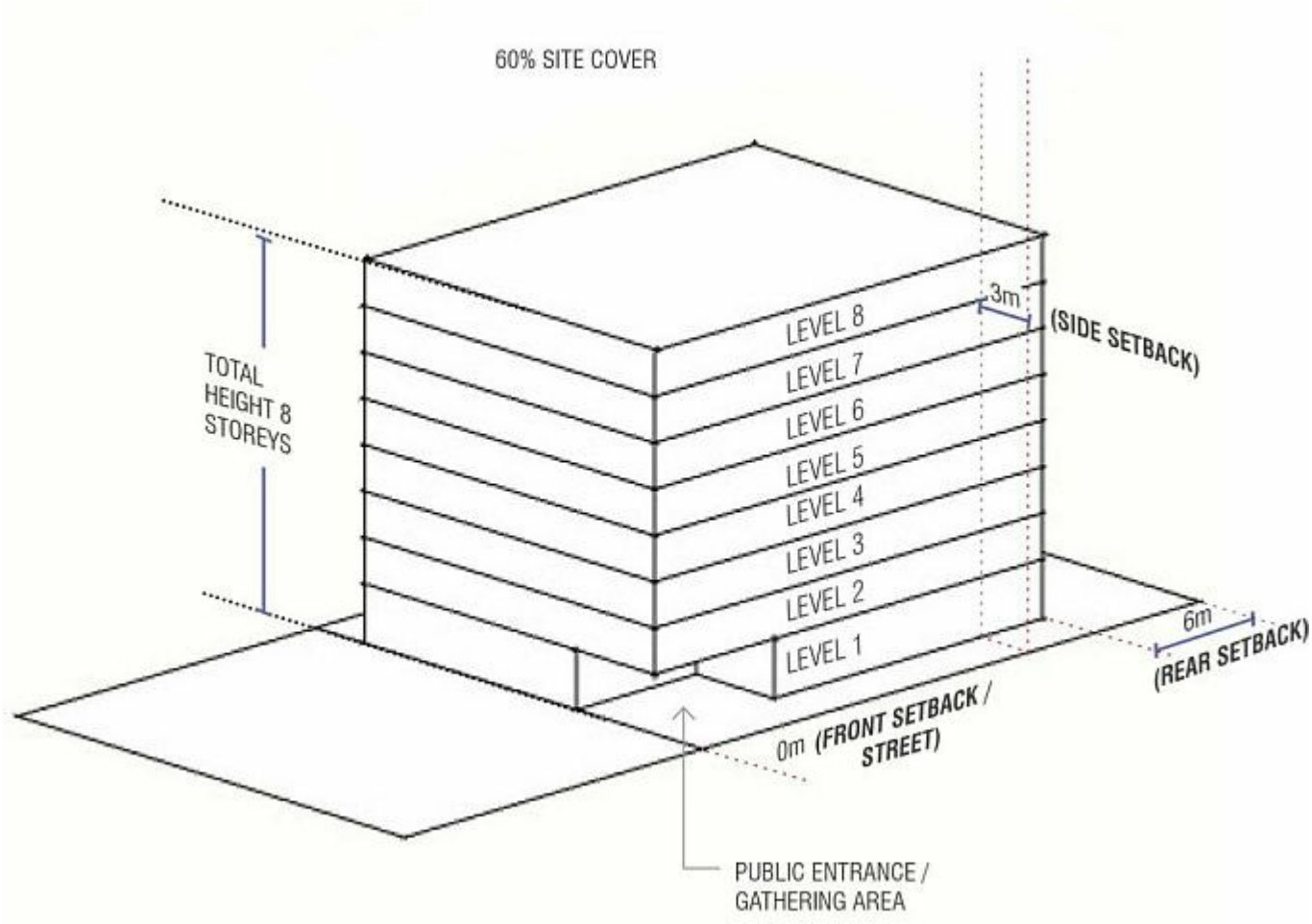

Figure 6.109 – Civic and administration precinct built form

PO37 Building heights and setbacks contribute to the legibility, distinctiveness and place making of the city centre by contributing to an attractive skyline, and reinforce the sense of primacy of the principal centre (CBD) core through built form outcomes. Buildings in the Civic and administration precinct provide a transition from the built form intensity and scale to the central parts of the CBD to adjoining residential development generally at a lower scale.	**AO37** Building height does not exceed 8 storeys.
PO38 Overall building siting and location on the site: (a) provides glimpses of Castle Hill between buildings as a constant reference point, wherever possible; and (b) creates spaces in and around the building which are proportionate to the overall dimensions of the building.	No acceptable outcome is nominated.
PO39 At the ground floor, design is to incorporate innovative responses to public realm interface, including the use of additional corner setbacks integrated with public entrances and gathering areas.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street retail precinct	
Role and function	
PO40 Ground floors of buildings on Flinders Street frontage are occupied by uses that have a visible presence on and interaction with the street and public domain. Predominant uses reflect the role of this precinct as the focus for retail uses within the principal centre (CBD) and the highest order retailing in the city by: (a) retail and other active uses at ground floor along Flinders Street and Odgen Street in this precinct; (b) accommodating specialist retailing; and (c) accommodating a department store.	**AO40** New development provides at least the same amount of retail floor space as existed prior to that development, ensuring there is no net loss.
PO41 Active uses including retail, shops, banks, active commercial tenancies and café uses are located: (a) at ground floor along Flinders Street and Odgen Street; (b) along the ground floor of any through block links, arcades or indoor retail developments; and (c) at upper levels where indoor retail developments.	No acceptable outcome is nominated.
PO42 Any department or discount department store has a frontage to Flinders Street and is incorporated into larger retail and entertainment development where possible.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street retail precinct	
Building form and massing	
PO43 Building heights and massing: (a) reflect and respond to the scale of adjoining historic building forms; (b) facilitate a high degree of pedestrian amenity by: (i) minimising overshadowing and adverse wind effects; (ii) providing for good light penetration and air circulation with visibility to the sky; and (c) ensure the scale and character of the heritage buildings is the prevailing built form.	**AO43.1** Along the Flinders Street frontage and Sturt Street frontage: (a) podium height is a maximum of 4 storeys; (b) where adjoining a heritage or character building, podium height is a maximum of 2 storeys, or is within 20% of the height of the adjoining building height; (c) podium development is built to boundary on all site boundaries; (d) towers are set back from Flinders Street a minimum of 10m; (e) towers are set back from Sturt Street a minimum of 4m; and (f) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.110 – Flinders Street retail precinct building massing, and the following: Design Provisions - Zone & Precinct Codes Acceptable Outcome Building Form: Heritage Frontage and Tower set back from street Podium / Tower Height: 2-3 storey's Flinders Street; 4 storeys Sturt St & Ogden St / 20 storeys + (including podium) Site Cover: 100% / 60% SETBACKS Front/ Street: 0m / 20m Flinders St, 4m Sturt & Ogden St SETBACKS Side: 0m / 3m SETBACKS Rear: 0m / 10m or between tower elements

AO43.2

Along the Ogden Street frontage:

(a) podium height is maximum of 4 storeys;

(b) podium development is built to boundary on all site boundaries;

(c) the tower are setback a minimum of 5m from the street frontage; and

(d) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.106 – Tower and podium form, and the following:

Design Provisions - Zone & Precinct Codes

Acceptable Outcome

Building Form		> 8 Storey's:	Tower & Podium
		Podium	**Tower**
Height		up to 4 storeys	20 storeys + (including podium)
Site Cover		100%	60%
SETBACKS	**Front:**	0m	4m
	Side:	0m	3m
	Rear:	0m	10m

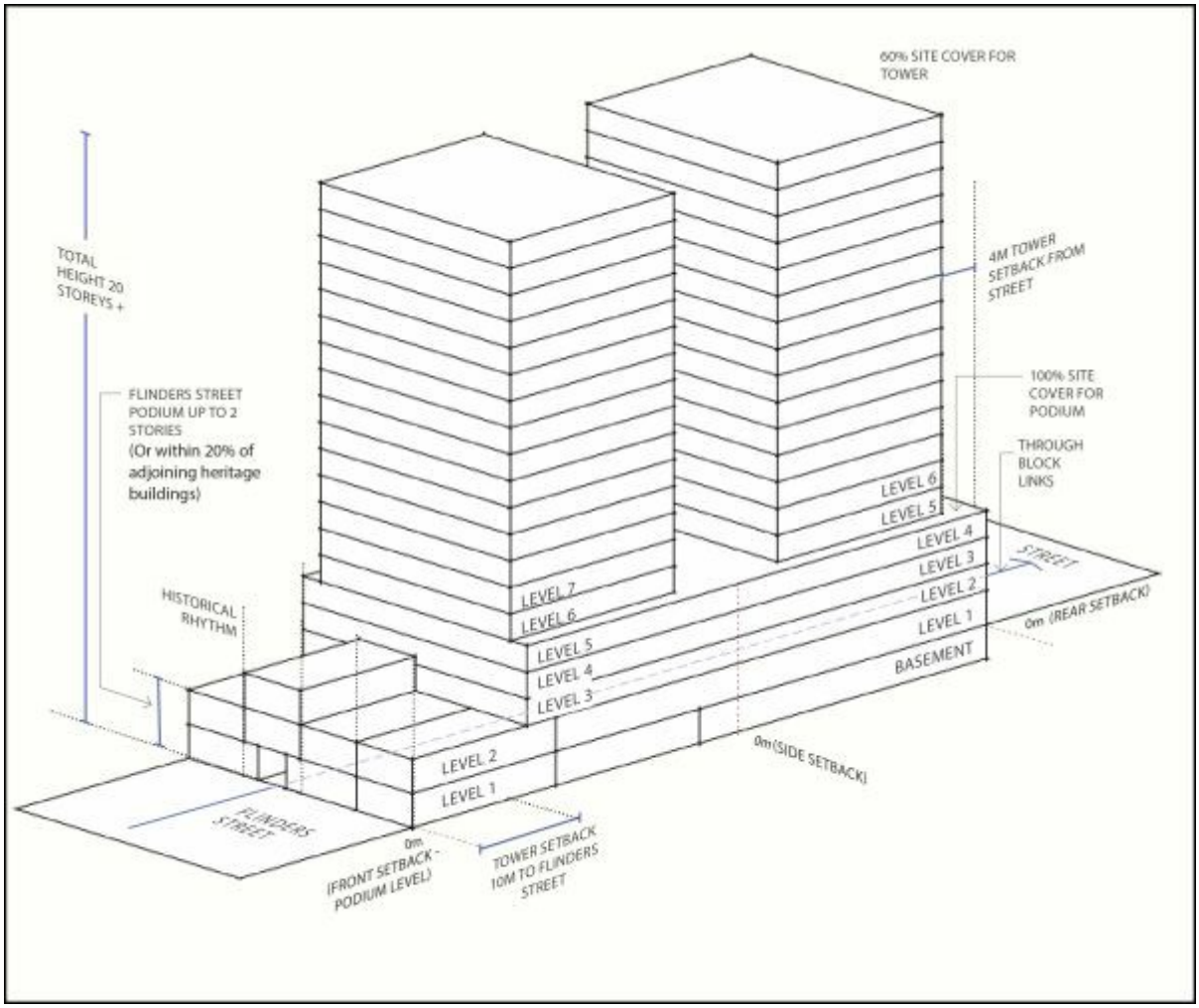

Figure 6.110 – Flinders Street retail precinct building massing

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street East precinct	
Role and function	
PO44 Development is consistent with the role of this precinct as the focus for entertainment and late night-time economy.	No acceptable outcome is nominated.
PO45 Development contributes to a mix of day and night-time activity on Flinders Street (East) which enhances the safety of the precinct, including some retail uses and nightclub entertainment facilities with extended operating hours for daytime dining.	No acceptable outcome is nominated.
PO46 Retail uses are not established to a level that would undermine the Flinders Street retail precinct as the primary shopping area in the principal centre (CBD).	**AO46** Where retail uses are provided these are located at ground floor and do not contribute to the overall retail frontage on the street exceeding 40% of the entire length of the street frontage at ground floor.
PO47 Where short-term accommodation is located within this precinct it is accommodated above ground floor.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

<table>
<tr><th>Performance outcomes</th><th>Acceptable outcomes</th></tr>
<tr><td colspan="2">Flinders Street East precinct</td></tr>
<tr><td colspan="2">Building form and massing</td></tr>
<tr><td>PO48
Building heights and massing:
(a) reflect and respond to the scale of adjoining heritage building forms;
(b) create a predominantly continuous built edge to the street at the ground storey; and
(c) retain views to and from Melton Hill to South Townsville (Tomlins Street).</td><td>AO48
In the Flinders Street East precinct:
(a) building height along Flinders Street (East) is 3 storeys or within 20% of the adjoining heritage buildings;
(b) no towers are established;
(c) buildings are set back 0m from Flinders Street (East);
(d) side setbacks do not exceed 1.5m;
(e) building height along Melton Terrace is a maximum of 2 storeys above the level of the adjoining road; and
(f) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.111 – Flinders Street East building massing, and the following:
Design Provisions - Zone & Precinct Codes
Acceptable Outcome
<table><tr><td colspan="2">Building Form</td><td>Heritage frontage with development behind</td></tr><tr><td colspan="2">Height</td><td>Flinders Street East: 2-3 storeys
Melton Terrace: 2 storeys</td></tr><tr><td colspan="2">Site Cover</td><td>100%</td></tr><tr><td rowspan="3">SETBACKS</td><td>Front/ Street:</td><td>Flinders Street East:
0m for levels 1-3
20m for levels 3+
Melton Terrace: 3m</td></tr><tr><td>Side:</td><td>0m</td></tr><tr><td>Rear:</td><td>N/A</td></tr></table></td></tr>
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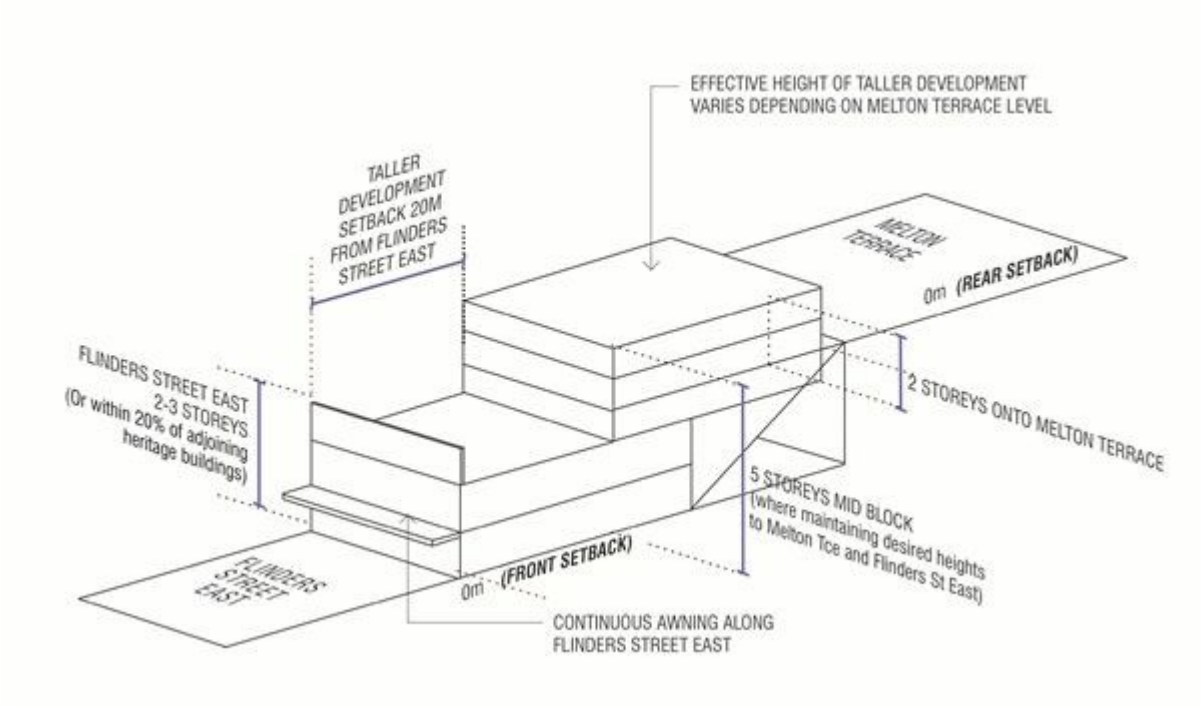

Figure 6.111 – Flinders Street East building massing

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street East precinct	
Roof form and awnings	
PO49 Roof form is contemporary and contributes to tropical design character, complementing but not mimicking heritage building elements.	No acceptable outcome is nominated.

6.3.6 Specialised centre zone code

6.3.6.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.6.2 Purpose

(1) The purpose of the Specialised centre zone code is to provide for one or more specialised uses.

(2) The particular purpose of the code is to:

(a) recognise the role and function of each of the specialised centres and guide development within each centre; and

(b) protect each centre from encroachment by development which may impact on that role and function.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the zone accommodates large public, commercial or institutional facilities which are significant to the economic and social well-being of Townsville but are not appropriately included in other zones. These centres include Domain Central, the James Cook University-Townsville Hospital precinct, Lavarack Barracks, Townsville Airport, Port of Townsville and major medical precincts;

Editor's note—While the planning scheme does not regulate land within some of these sites, this code is intended to give direction to development within or in the vicinity of these sites, to the extent possible.

(b) the centres perform a specific function for the Townsville and wider North Queensland community, and are major nodes of business activity, services or employment;

(c) these centres generally have strong relationships with the other multifunctional activity centres in Townsville, but do not incorporate the breadth and depth of activities of these other centres and do not compete with or undermine the retail and commercial functions of these other centres;

(d) development supports and is compatible with the primary focus for the centre. The specialised centre retains its dominant function and new development does not prejudice its ongoing operation or significantly impact on the amenity of nearby sensitive uses;

(e) shops and shopping centres within these centres are limited to convenience retail, food and drink outlets servicing on-site businesses, workers and, where they exist, residents. Offices are limited to those directly related to the primary focus of the centre;

(f) specialised centres grow in a consolidated way that makes efficient use of the zoned area. Development near the boundaries of specialised centres is located and designed to minimise impacts on sensitive land uses in other zones;

(g) development surrounding a specialised centre does not impact on the continued functioning and expansion of the centre for its intended primary purpose;

(h) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour; and

(i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts and sub-precincts:

Townsville Airport precinct:

(a) the long-term operation and expansion of the Townsville Airport is supported for both Department of Defence purposes, and to satisfy the primary air transport needs of the Townsville and North Queensland regions;

(b) the timely and cost-effective provision of aeronautical infrastructure is facilitated;

(c) aviation-related related businesses, research and technology industries and low impact industries are accommodated;

(d) development is not of a type or scale that undermines the successful operation of the principal centre (CBD) or major centres in Townsville; and

(e) residential development is limited to short-term accommodation.

Editor's note—The Townsville Airport does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important joint defence and civil functions through this zoning and acknowledges the intentions of Townsville Airport's master planning document.

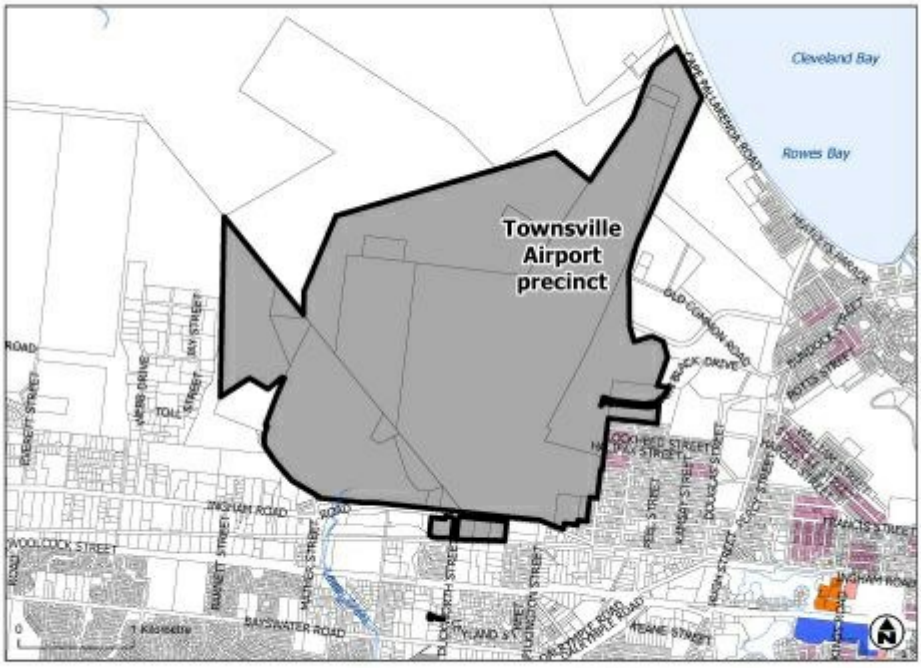

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Figure 6.112 – Townville Airport precinct

Port of Townsville precinct:

(a) the long-term operation of the Port of Townsville is protected for the benefit of the local and regional economy;

(b) the operations of the port are protected from incompatible land uses and activities on nearby land; and

(c) waterfront development within the port is integrated with the Palmer Street and The Strand areas where possible, to maximise community access to and use of waterfront areas.

Editor's note—The Port of Townsville does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning and the acknowledges the intentions of Port of Townsville's master planning documents.

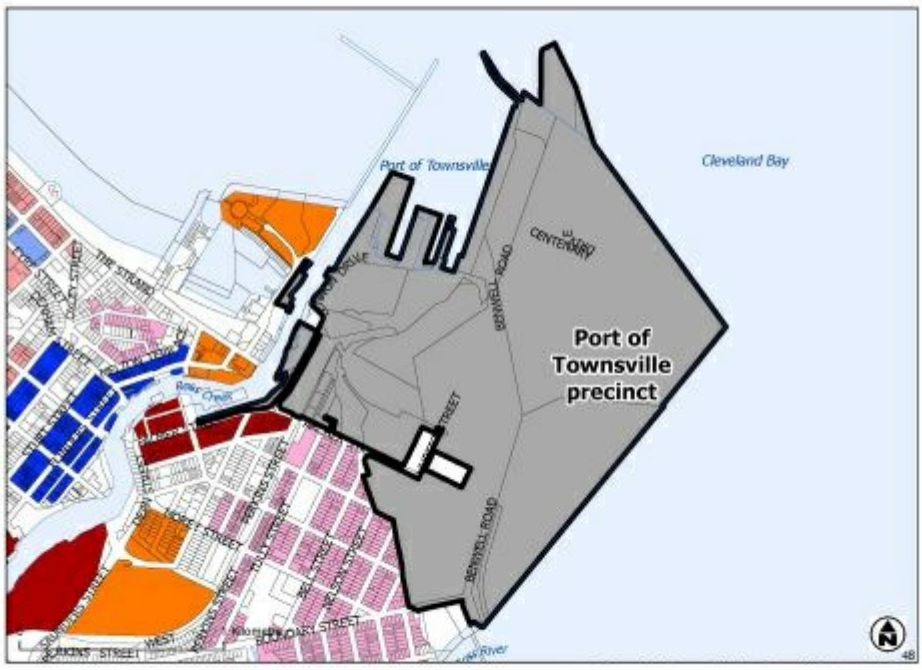

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Figure 6.113 – Port of Townsville precinct

Lavarack Barracks precinct:

(a) the ongoing use and development of the barracks area for Department of Defence-related purposes, including aviation, communications, logistics, administration, training, and accommodation and recreation facilities for defence personnel is protected; and

(b) to the extent practicable, development is encouraged to create an attractive frontage to University Road.

Editor's note—Lavarack Barracks does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning.

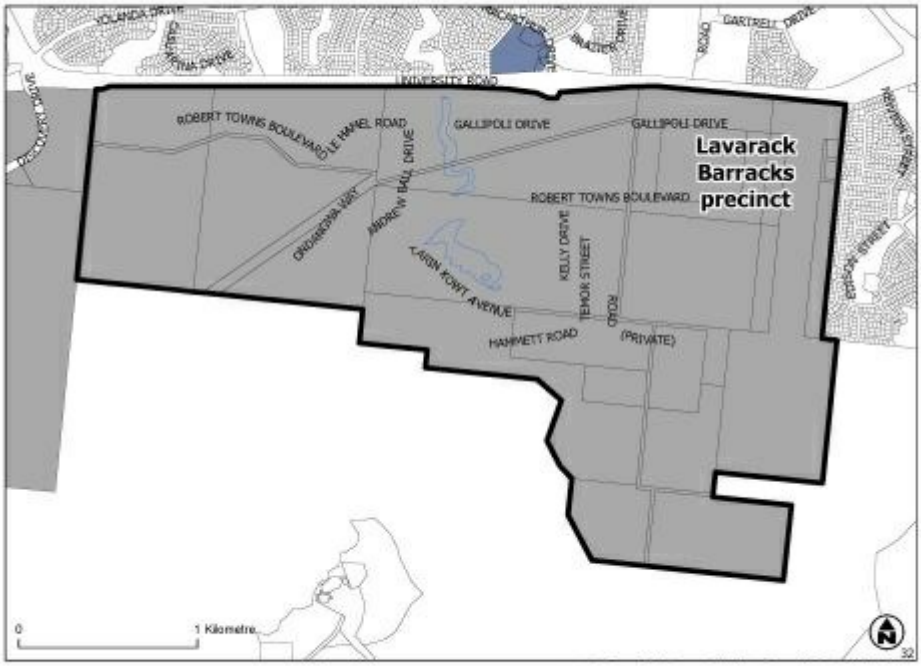

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Figure 6.114 – Lavarack Barracks precinct

Domain Central precinct:

(a) this centre accommodates showrooms primarily servicing the northern Townsville community;

(b) apart from small-scale food and drink outlets, Domain Central is not substantially expanded to include further shops or shopping centres; and

(c) the integration of this centre is strengthened through built form and layout, and pedestrian-based accessibility is improved.

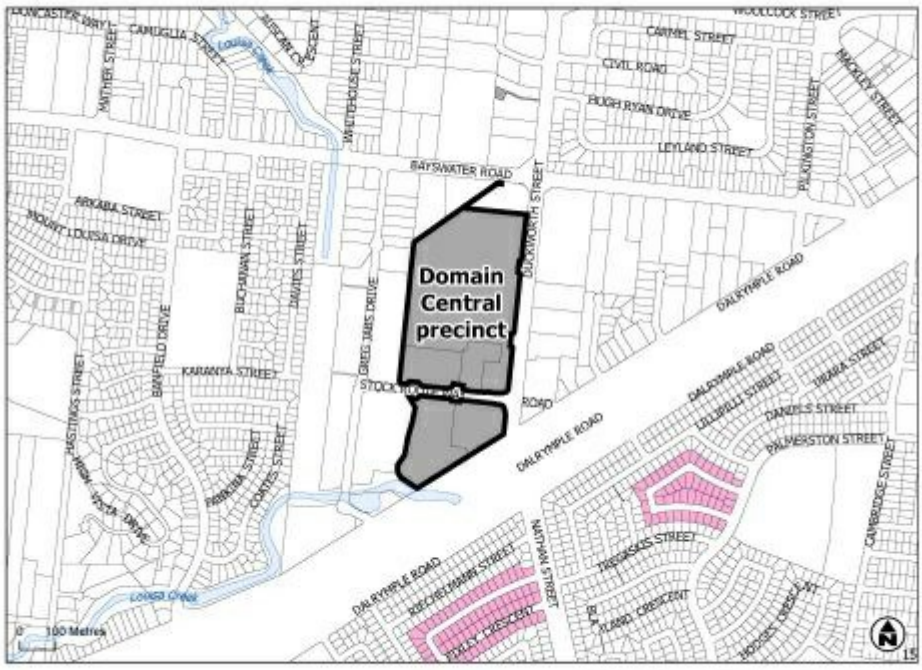

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Figure 6.115 – Domain Central precinct

Fulham Road medical precinct:

(a) the precinct continues to be the focus for private acute medical services in the Townsville region;

(b) the continued efficient and effective operation of the hospital is protected;

(c) the precinct accommodates medical centres, medical offices and health care services, research and technology industries, accommodation and other activities that support or are otherwise allied to the hospital activities;

(d) the hospital has the highest scale and intensity of any use within the precinct; and

(e) development facilitates an active pedestrian environment along Fulham Road which promotes connectivity to adjoining areas including Anderson Park.

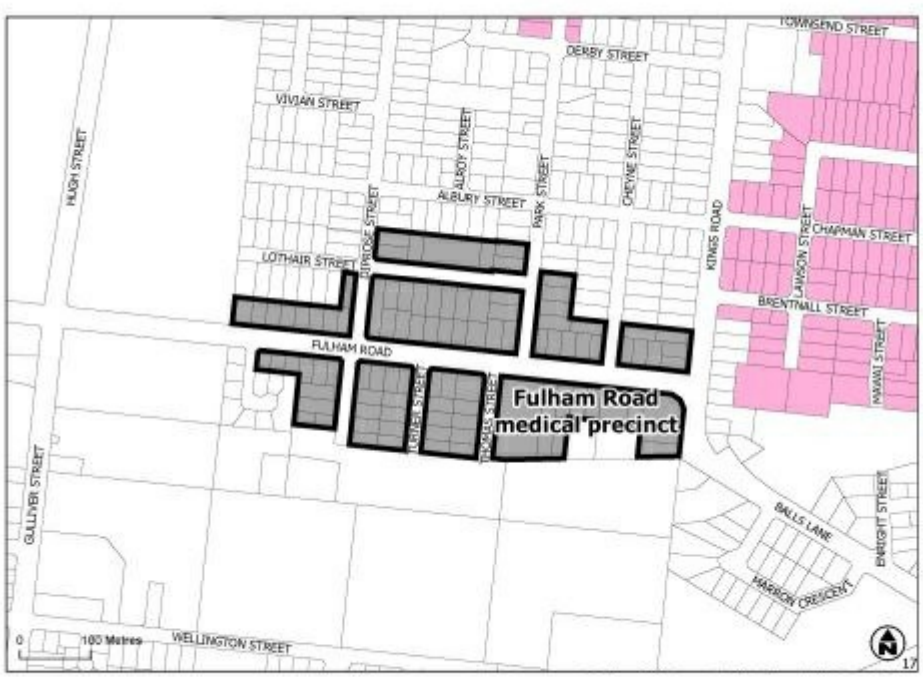

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Figure 6.116 – Fulham Road medical precinct

Bayswater Road medical precinct:

(a) the continued efficient and effective operation of the hospital is protected;

(b) the hospital has the highest scale and intensity of any use within the precinct;

(c) the precinct accommodates medical centres, medical offices and health care services, research and technology industries, accommodation and other activities that support or are otherwise related to the hospital activities;

(d) the primary hospital entry and pedestrian activity within the precinct is focused around the Oxford Street and Regent Street intersection;

(e) Oxford and Regent Street are active pedestrian environments and direct pedestrian connections are provided through the hospital site; and

(f) parking associated with the hospital and other allied health uses is provided in consolidated areas.

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Figure 6.117 – Bayswater Road medical precinct

James Cook University-Townsville Hospital precinct:

(a) the James Cook University-Townsville hospital precinct is evolving into a 'world-class knowledge community' with a focus on the tropics and on sustainability. Prominent land uses include health and education services and a range of research and technology industries;

(b) the land use mix and scale of development reflects the role of the precinct in the city and the tropics. Land uses which benefit and enhance the knowledge community are accommodated. Development not related to the focus of the precinct, and that would adversely affect other centres, is not established;

(c) the precinct changes from a collection of single use campuses into a mixed use urban centre. The precinct integrates existing institutions and is integrated into the wider city including strong links to the CBD and the Aitkenvale and Thuringowa Central major centres;

(d) the James Cook University-Townsville Hospital precinct takes on a specific role in leadership in sustainability. Development provides exemplar and culture changing projects in areas like public transport, housing, public spaces and community development as well in its traditional academic and healthcare focus;

(e) the James Cook University-Townsville Hospital precinct exhibits increased self-containment compared to normal practice, with people living and working within the centre. Development minimises the use of finite resources like land, energy, water and wastewater. An overall test for all development at the centre, including residential development, is that it exemplifies sustainable development in all its realms;

(f) an emerging and sustainable resident community is well-connected to the wider city by active and public transport;

(g) car dominance within the precinct is redressed, with walking and cycling given priority in all development components;

(h) development does not extend into areas of landslip or bushfire risk, high scenic amenity or local, regional or state ecological significance; and

(i) development is well-designed at the centre, precinct, street, public space and building scales.

Editor's note—Development of James Cook University (Douglas Campus), which is undertaken in terms of a Ministerial Designation, does not fall within the regulatory jurisdiction of the Townsville City Plan.

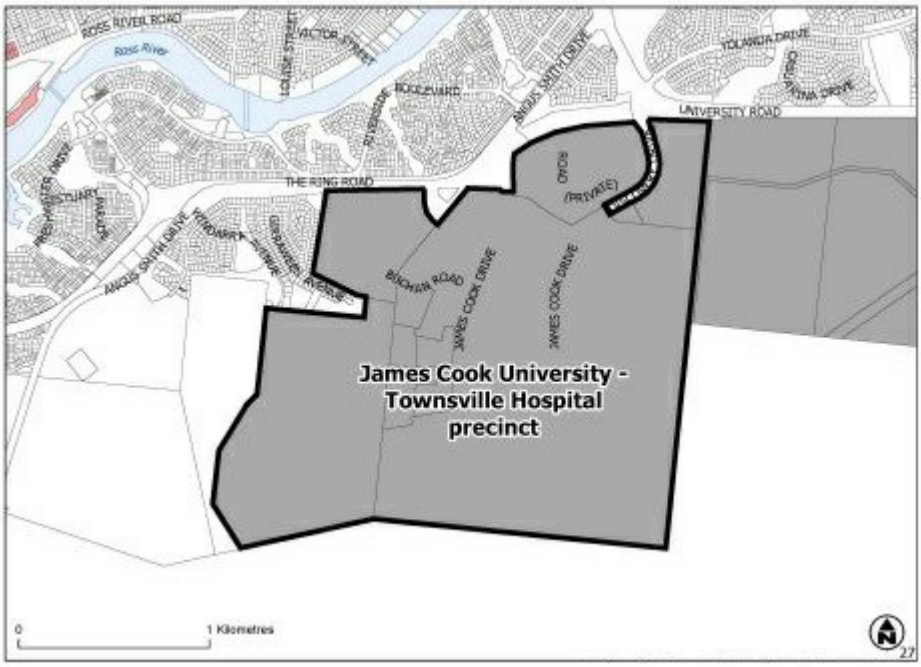

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Figure 6.118 – James Cook University-Townsville Hospital precinct

Discovery Central sub-precinct:

(i) at the heart of the precinct, development at Discovery Central exhibits the most intensive mix of uses and is busy with people throughout the day, week and year;

(ii) Discovery Central provides a strong focus for the hospital and university communities. Significant uses include research institutions and teaching facilities. Student and short-term accommodation is also present;

(iii) at street level, shops, cafes and bars are part of the mix;

(iv) Discovery Central is focussed on the 'ideas market', a significant public space located on the axis between the hospital and university library, and Mt Stuart Street, a new urban street connecting east-west through the centre. Pocket parks and small-scale spaces punctuate the area;

(v) buildings are 4 to 6 storeys and frame the street with no setbacks. Many buildings are mixed use;

(vi) footpaths and public spaces are well shaded. Walking is the best way to get around Discovery Central;

(vii) retail, including a supermarket, and other business uses support the daily needs of the knowledge community and are only established when need is demonstrated. Comparison shopping is not found here; and

(viii) buildings, streets and spaces are well-designed. The image and identity speaks strongly of Townsville's climate and place in the 21st century.

Discovery village sub-precinct:

(i) dwelling density within the precinct achieves a minimum net residential density of 30 dwellings per hectare through a mix of housing types including a range of townhouses, apartments and small lot homes. A focus on traditional dwelling houses does not occur;

(ii) buildings and neighbourhood design exhibit exemplar sustainable and social principles;

(iii) development does not alter the natural topography and maximises the retention of vegetation through street and housing design;

(iv) housing areas are well-connected to the central parts of the campus via pedestrian paths;

(v) a high quality public realm is created with passive recreation areas overlooked by verandahs and other living spaces in residences, shaded footpaths along all streets and a high level of permeability for pedestrians and bicycles; and

(vi) housing design provides exemplar responses to the Dry Tropics climate having regard to building massing and depth, solar orientation and shading and use of cooling and water sensitive landscape elements.

Editor's note—Sub-precincts are shown in Figure 6.123 — James Cook University-Townsville Hospital centre strategy plan.

6.3.6.3 Assessment benchmarks

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO1 Development does not prejudice or detract from the primary function of the specialised centre.	No acceptable outcome is nominated.
PO2 Other uses occur on a site where they: (a) directly support or are directly allied with the primary function of the particular centre; and (b) are subordinate to that primary function.	No acceptable outcome is nominated.
PO3 Development is consistent with the intended role, scale and character of the centre and does not compromise the intended role or successful functioning of the other specialised centres, the Principal centre (CBD) or major centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO4 Shops and shopping centres accommodate convenience retail, food and drink outlets, service industries and other services providing for the day-to-day needs of on-site businesses, workers, visitors or residents.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Design and built form	
PO5 The design of the precinct provides for: (a) efficient use of the available land; (b) a coherent and integrated built form, public realm and circulation networks; (c) central, accessible and attractive public spaces for people to congregate and interact; (d) continuity and complementarity of streetscape and landscape characteristics; (e) pedestrian friendly and visually interesting frontages to streets and public spaces; (f) optimum energy efficiency; (g) a compatible mix of uses; (h) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (i) sensitive transitioning of built form and uses to surrounding land. **Editor's note—**Applicants may be requested to prepare centre design master plans to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO6 Building setbacks and orientation provide for an attractive streetscape that is sympathetic to existing characteristics of the local area.	No acceptable outcome is nominated.
PO7 Development is sympathetic to the scale of surrounding buildings, avoids expanses of blank walls and includes features that contribute to an attractive streetscape.	**AO7.1** The maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
	AO7.2 Landscaping is provided along the street frontage, including substantive planting along at least 50% of the length of the frontage.
PO8 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO9 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO10 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO11 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO12 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO13 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO14 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO14.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO14.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO15 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO15** The open area used for the storage of refuse, vehicles, machinery, goods and materials used on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.
PO16 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) to contribute to pedestrian comfort through shade; and (c) to screen servicing components.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout, size and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention of existing vegetation; and (e) providing buffers to protect the ecological functions of waterways; and protects environmental values and water quality objectives of receiving waters. **Editor's note—**The environmental values and water quality objectives are established under the Environmental Protection (Water) Policy (2009). For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Domain Central precinct	
PO18 Domain Central is not substantially expanded to include further shops or shopping centres.	No acceptable outcome is nominated.
PO19 Development is consistent with the height of existing buildings in the area.	**AO19** Building height does not exceed 3 storeys.
PO20 Buildings create an attractive, safe and pleasant pedestrian-focussed environment along street frontages.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Fulham Road medical precinct	
PO21 Development creates a medium-rise environment with the highest built form, scale and intensity centred on the hospital, and built form stepping down to a low-rise environment at the eastern and western edges of the precinct.	**AO21** Development occurs in accordance with building heights shown on Figure 6.119 — Fulham Road medical precinct concept plan.
PO22 Development has a direct nexus with the hospital or other medical uses within the precinct. The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of the CBD, district or major centres.	No acceptable outcome is nominated.
PO23 Development provides an active interface at the street level.	**AO23.1** Buildings are oriented to all street frontages and have points of entry visible to each street frontage.
	AO23.2 Non-residential uses occur at the street level where shown as a primary or secondary active frontage on Figure 6.119 — Fulham Road medical precinct concept plan.
	AO23.3 Development provides outdoor seating and dining along the primary active frontage.
	AO23.4 Development involving the expansion of the Mater Hospital provides a formal entrance along Park Street.
PO24 Building setbacks: (a) assist in defining key activity areas; (b) create a well-defined edge to the street; and (c) provide a soft edge to the adjoining parkland.	**AO24.1** Buildings setbacks at ground level are in accordance with Figure 6.119 — Fulham Road medical precinct concept plan.
	AO24.2 Buildings built to 6 storeys are setback 20m from any property boundary.
PO25 Development provides protection from the weather for pedestrians along the frontage of the site.	**AO25** Development provides a 3m wide awning along the frontage of the site where identified on Figure 6.119 — Fulham Road medical precinct concept plan as having either a primary or secondary active frontage.
PO26 Private open space is located and oriented to allow passive surveillance of the street.	**AO26** Residential uses above the street level incorporate balconies and are setback 3m to the building wall. Figure 6.120 — Residential uses above street level illustrates.

Figure 6.119 – Fulham Road medical precinct concept plan

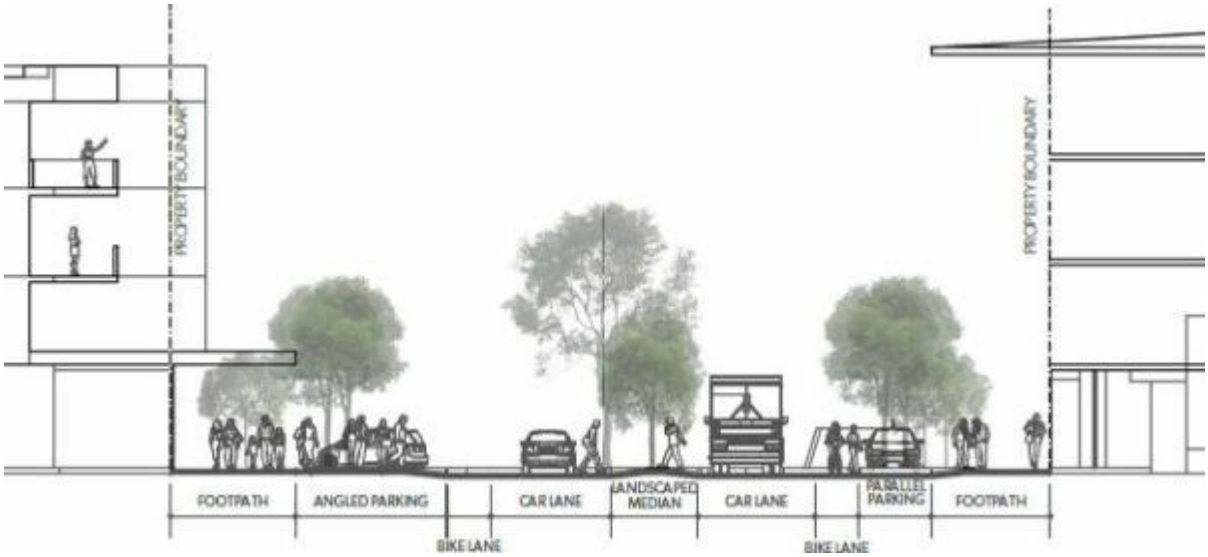


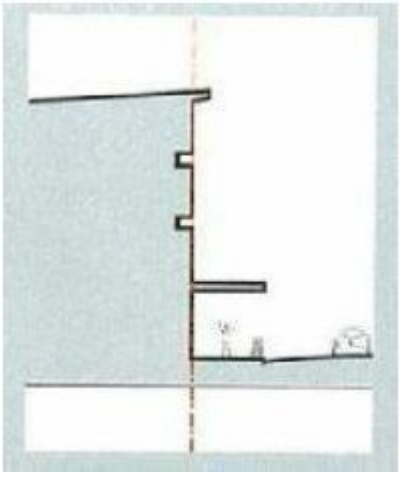
Figure 6.120 – Residential uses above street level

PO27 Development facilitates clear and safe pedestrian links between Anderson Park and Fulham Road.	No acceptable outcome is nominated.
PO28 Parking and access are consolidated and do not dominate the street frontage.	**AO28.1** Parking is provided within or behind buildings and is screened so that it is not visible from the street.
	AO28.2 Development does not obtain access to Fulham Road between Diprose Street and Thomas Street.
PO29 Where possible, development provides shared access and parking with adjoining uses.	No acceptable outcome is nominated.
PO30 Where development has a common boundary with Anderson Park, opportunities for overlooking and casual surveillance to the Park are created through the orientation of buildings and private open space.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Bayswater Road medical precinct	
PO31 Development creates a medium-rise environment with the highest built form, scale and intensity centred on the hospital.	**AO31** The maximum building height is in accordance with Figure 6.121 — Bayswater Road medical precinct concept plan.
PO32 Development has a direct nexus with the hospital or other medical uses within the precinct. The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of the CBD, district or major centres.	No acceptable outcome is nominated.
PO33 Buildings are oriented to the street frontages and have points of entry visible to each street frontage.	No acceptable outcome is nominated.
PO34 Development provides an active and pedestrian-friendly interface at the street level.	**AO34.1** Non-residential uses occur at the street level.
	AO34.2 Where development has an active frontage identified in Figure 6.121 — Bayswater Road medical precinct concept plan: (a) buildings are built to the street boundary; and (b) development provides a 3m wide awning over the footpath. Figure 6.122 — Buildings built to the frontage illustrates.

Figure 6.121 – Bayswater Road medical precinct concept plan



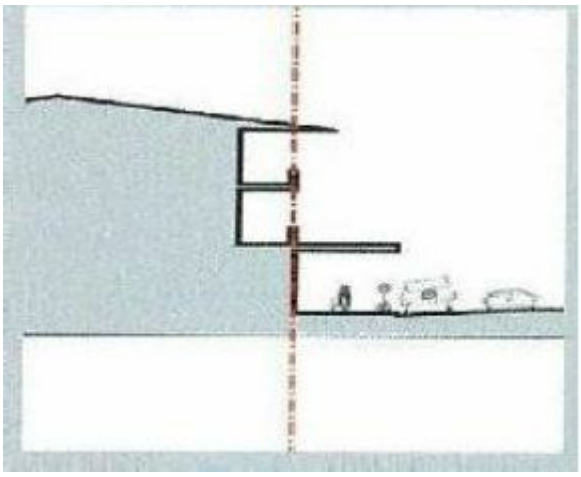


Figure 6.122 – Buildings built to the frontage

PO35 The primary pedestrian entrance to the Mater hospital is oriented to Oxford Street and the Oxford Street/Regent Street intersection.	No acceptable outcome is nominated.
PO36 Development facilitates a direct pedestrian connection from Bayswater Road through the Mater hospital site to the Oxford and Regent Street intersection.	No acceptable outcome is nominated.
PO37 Development on the hospital site facilitates the consolidation of parking within a centralised parking facility.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
James Cook University-Townsville Hospital precinct	
PO38 Development is generally in accordance with the land use allocations shown in Figure 6.123 — James Cook University- Townsville Hospital centre strategy plan and is consistent with the following intentions: (a) Townsville Hospital sub-precinct — development facilitates the efficient operation of Townsville's major hospital and ensures integration of the hospital and university campuses into a seamless urban centre; (b) Discovery Central sub-precinct — development creates a vibrant community heart containing the most intensive mix of uses; (c) Enterprise Village sub-precinct— development facilitates the establishment of knowledge businesses and industries; (d) Academic Core sub-precinct — development facilitates continued operation and expansion of educational purposes; (e) University Village sub-precinct and College sub-precinct — development facilitates student accommodation; (f) Discovery School sub-precinct — development facilitates the establishment of a new high school; (g) Discovery Village sub-precinct — development creates a mixed density residential community which has strong links to the university and hospital; and (h) Green Space sub-precinct — accommodates natural areas within the centre including watercourses, environmental areas and corridors, parks and sport and recreation area.	No acceptable outcome is nominated. **Editor's note—**The first stage of Discovery Village may develop as a pioneer project to demonstrate the sustainability principles sought.
PO39 The land use mix and scale of development have a direct nexus with, and enhance, the knowledge community focus.	No acceptable outcome is nominated.
PO40 The community is well-connected internally and to the wider city by active and public transport.	No acceptable outcome is nominated. **Editor's note -** Future growth of the precinct will increase transport demand. In order to support development in this precinct, and the preferred pattern of development in Townsville as a whole, improved public transport to this precinct will be necessary. Planning has identified the need to preserve a potential route for a rapid bus transit corridor and identify potential sites for Townsville Hospital and James Cook University Bus Stations.

PO41 Development exemplifies leadership in economic, social and environmental sustainability.	No acceptable outcome is nominated. **Editor's note—**For guidance, refer to Discovery Rise Design Guidelines adopted by the place making panel established for James Cook University (JCU).
PO42 Development is well-designed at the precinct, street, public space and building scales.	No acceptable outcome is nominated. **Editor's note—**For guidance, refer to Discovery Rise Design Guidelines adopted by the place making panel established for James Cook University (JCU).
PO43 Development is well planned and orderly, and within the capacity of available infrastructure.	No acceptable outcome is nominated. **Editor's note—**Council will request that an area/precinct scale structure plan — comprising land use, infrastructure, staging, urban design and implementation - is prepared and agreed to by the place making panel established for JCU before development takes place.
PO44 Development does not extend in to areas of landslip or bushfire risk, high scenic amenity or local, regional or state ecological significance.	No acceptable outcome is nominated.

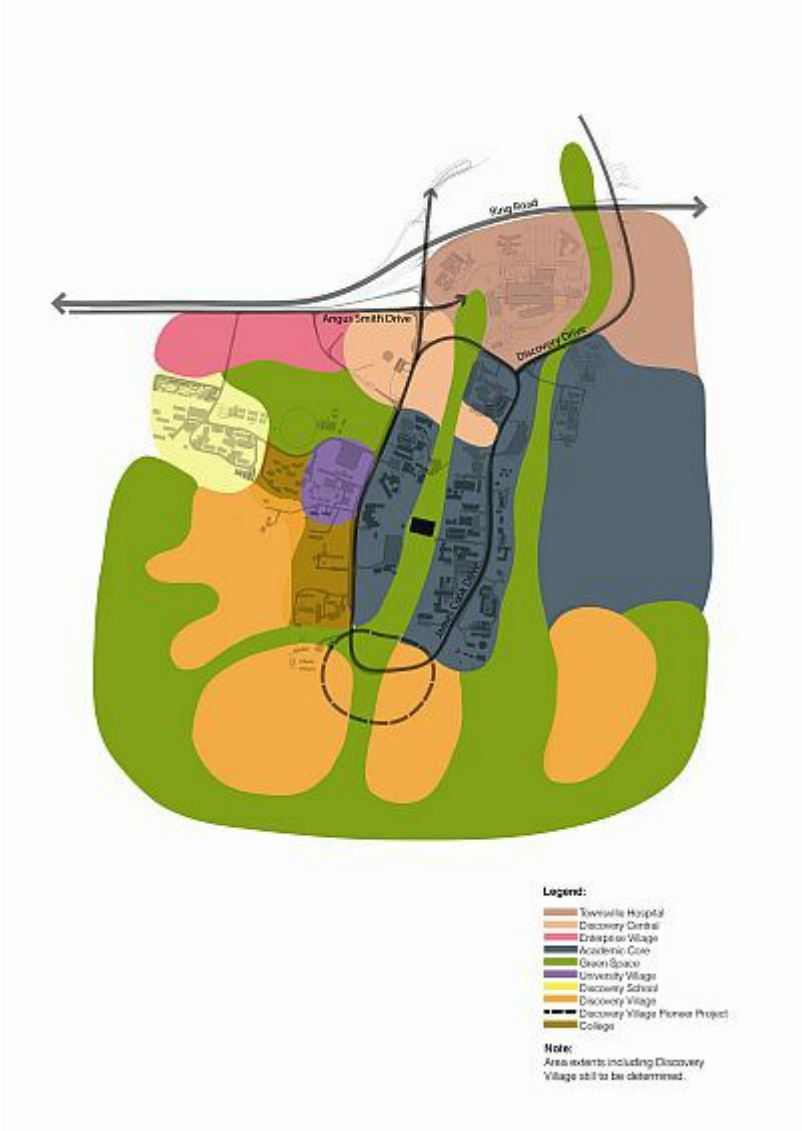


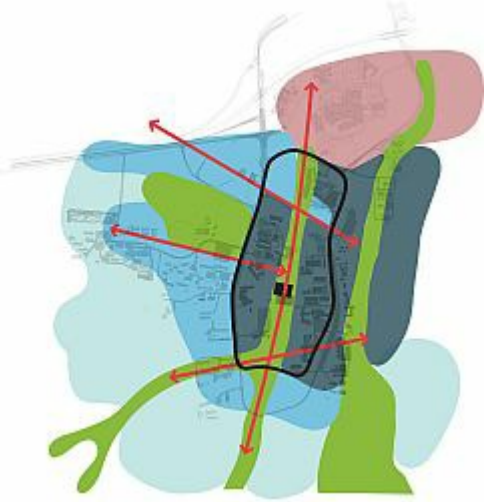
Figure 6.123 – James Cook University-Townsville Hospital centre strategy plan

PO45 Development complies with and advances the design concepts set out in Figure 6.124 – James Cook University-Townsville Hospital precinct development concepts.	No acceptable outcome is nominated.

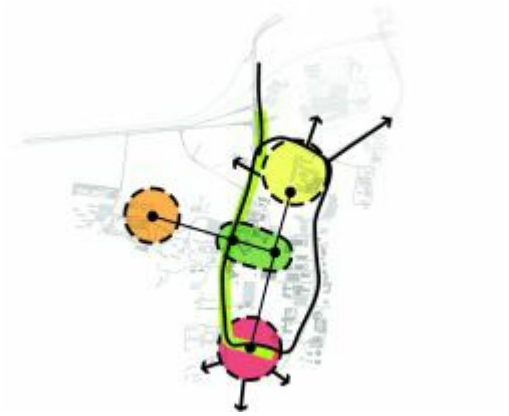
1. **Axes**
Original axes/view lines from Birell's 1964 Master Plan.

2. **Academic Core**
This needs to be retained as the heart of Discovery Rise.

3. **Connect Academic Core to New Uses:**
Existing campus axes from 'key connectors' linking new development around academic core into the heart of the campus.
Denser development closer to the academic core.

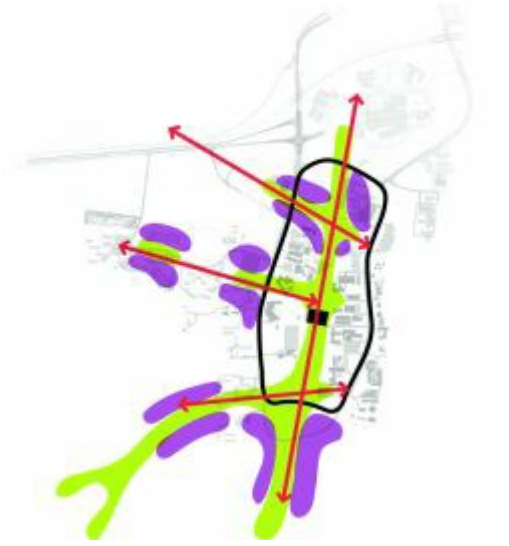


4. **Hubs Interconnected**
Create 'hubs' of mixed academic and new uses.



5. **Public Spaces**
Public spaces are located along 'key connectors', in the centre of significant hubs.

6. **Density**
Create greatest density along 'key connectors' streets, pedestrian pathways and public spaces.



7. **Pedestrian and Cycle Paths**
Create an interconnected network of paths and bike routes emphasising linkages into the campus heart and academic core. These paths are cool, shaded and green.

8. **Road Network**
James Cook Drive as primary circulating street, slower speed, shady street environments for east-west connecting streets. New street to link to existing neighbouring suburban development to the west.

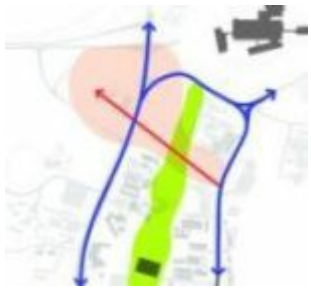
9. **Public Transport**
Existing bus and taxi set down areas on Mt Stuart Street, at Discovery Village and at Discovery School. Approximately 10-20m wide corridor to be reserved for a future rapid bus transit corridor and associated Townsville Hospital and James Cook University Bus Stations, to be determined through collaborative planning between Townsville Hospital, James Cook University, Department of Transport and Main Roads and Townsville City Council.

Figure 6.124 - James Cook University-Townsville Hospital precinct development concepts

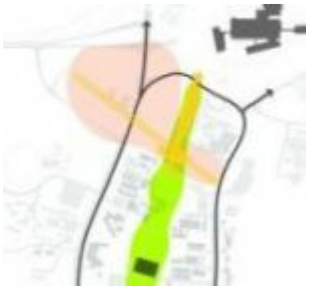
Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Discovery Central sub-precinct	
PO46 Development accommodates the primary structural elements shown in Figure 6.125 — Discovery Central primary elements.	No acceptable outcome is nominated.

1. Pedestrian Paths



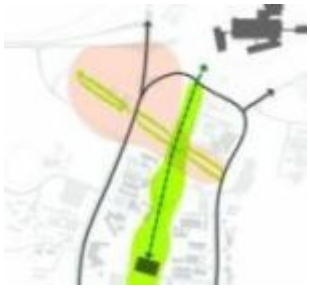
2. Road Linkages



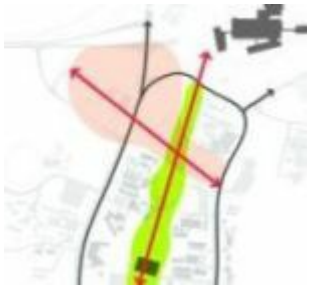
3. Public Spaces

4. Frontage Treatment

5. Shading



6. Greenspace Corridors

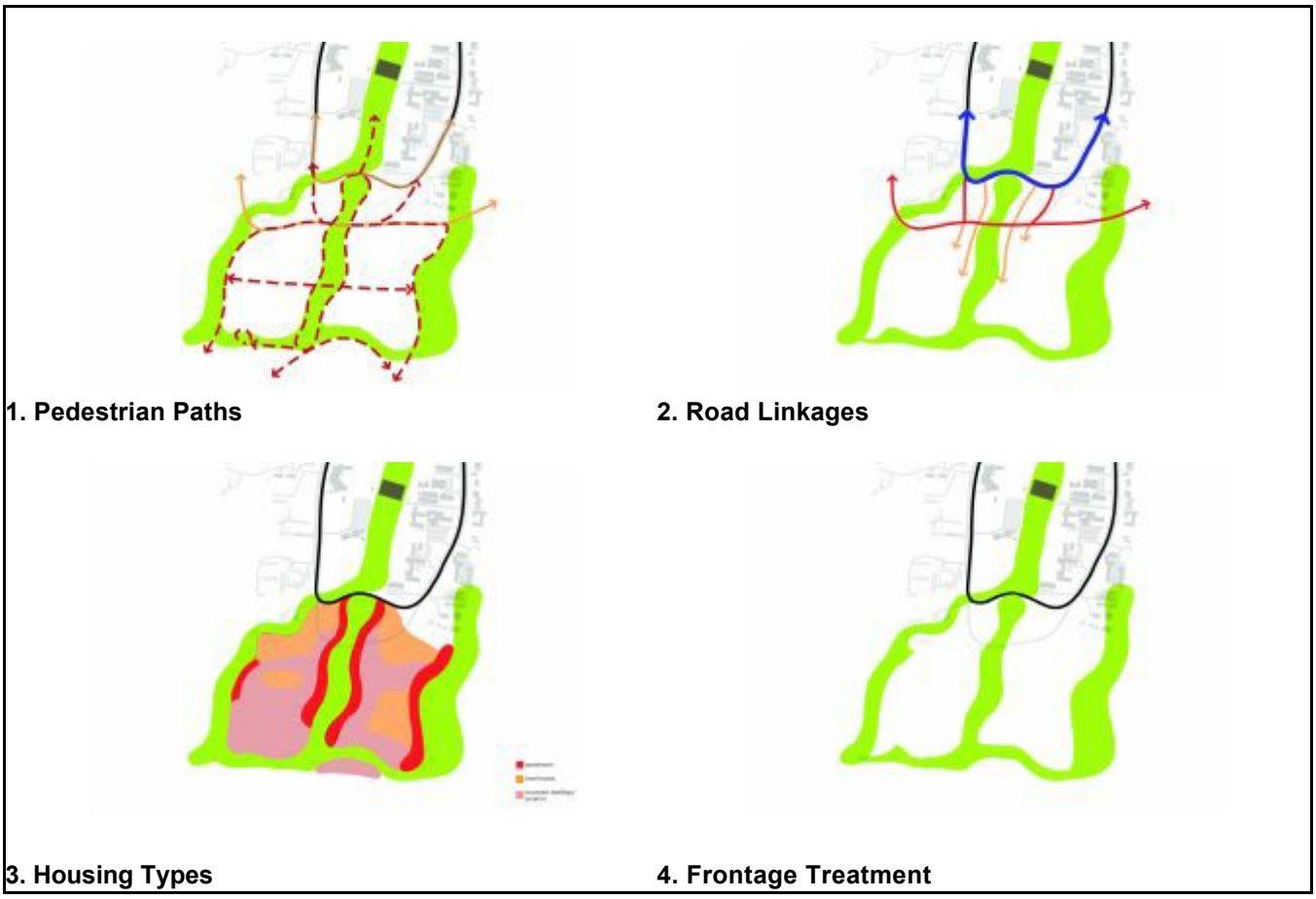


7. View and Connection Axes

Figure 6.125 – Discovery Central primary elements

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Discovery Village sub-precinct	
PO47 Development accommodates the primary structural elements shown in Figure 6.126 — Discovery Village primary elements.	No acceptable outcome is nominated.



1. Pedestrian Paths

2. Road Linkages

3. Housing Types

4. Frontage Treatment

Figure 6.126 – Discovery Village primary elements

PO48 Development occurs at medium densities that optimise public transport and walkability, and sustainable living.	**AO48** Dwelling density within the precinct achieves a minimum net residential density of 30 dwellings per hectare.

6.3.7 Mixed use zone code

6.3.7.1 Application

This code applies to assessing a development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.7.2 Purpose

(1) The purpose of the Mixed use zone code is to provide for a mixture of development that may include service industry, business, retail, residential, tourist accommodation and associated services and low impact industrial uses.

(2) The particular purpose of the code is to guide a range of activities which create an attractive mixed business and living environment and which do not compromise the principal centre (CBD), district or major centres.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) this zone accommodates small to medium-sized pockets and corridors of mixed use development throughout Townsville, which are generally close to centres, significant entry points, and providing interface between residential, commercial, retail or industrial uses;
- (b) mixed use areas do not compromise the intended role or successful functioning of other centres. They do not contain full line supermarkets, discount department stores or department stores;
- (c) unless otherwise stated for a particular precinct, the areas in this zone evolve to contain a wider mix of medium density residential uses as well as dining, convenience shops and specialty retailing, small-scale office uses, professional services, and service and low impact industries;
- (d) uses such as showrooms and outdoor sales may occur in the zone, other than within the Breakwater precinct. Where they occur, showrooms are located and designed so that they contribute to the attractiveness, pedestrian focus and continuity of the streetscape;
- (e) built form and landscaping create an attractive, pedestrian oriented streetscape, and visual amenity along major roads is improved;
- (f) mixed use areas identified along major roads are designed to encourage a consolidation of built form and activities, access points and signage. Commercial strip development does not extend beyond the zoned mixed use land along major roads;
- (g) where they occur, residential uses are designed to minimise adverse impacts on occupants as a result of noise and other characteristics of the local environment;
- (h) development facilitates improved accessibility by walking, cycling and public transport. Along major roads, access is managed to avoid conflict points and to give priority to pedestrian and cyclist movements;
- (i) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (j) development is designed and operated to minimise adverse impacts on the amenity of surrounding residential neighbourhoods; and
- (k) opportunities for energy efficiency through built form are maximised.

Editor's note—To remove any doubt, each development site does not need to contain a mixed use development.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts.

Magnetic Island villages precinct:

(a) development within this precinct supports the consolidation of retail, business, and service industry activities in dedicated activity nodes for residents and visitors to the various townships around Magnetic Island; and

(b) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and the use of a variety of materials and finishes.

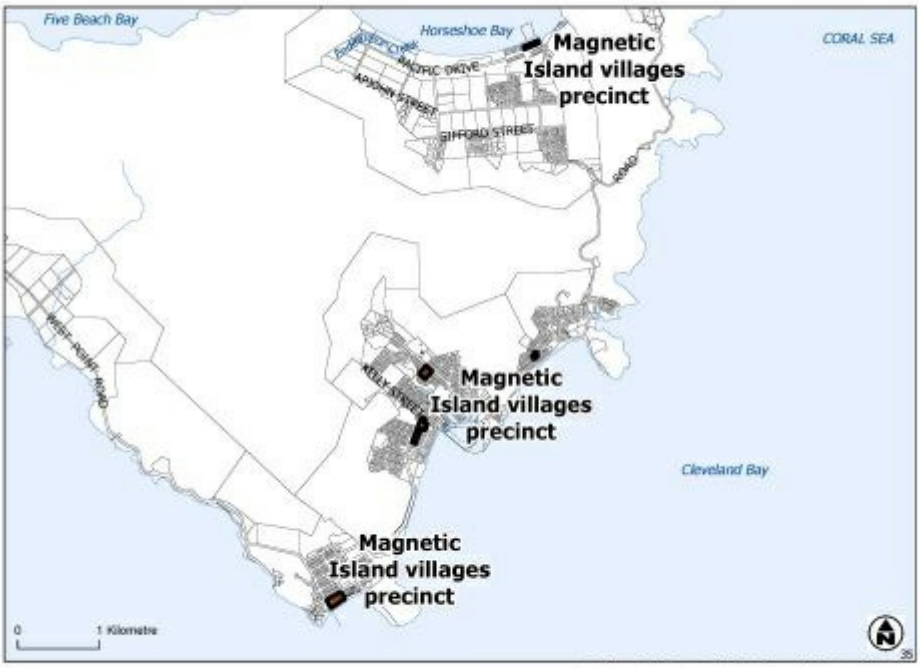


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Figure 6.127 – Magnetic Island villages precinct

Nelly Bay sub-precinct:

(i) a range of tourist and residential uses is provided, including:

  (A) the continuation of small-scale retail and other uses which support tourism; and

  (B) island-style low-rise medium density residential and short-term accommodation close to tourist uses.

(ii) buildings within the precinct are low-rise (up to 2 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

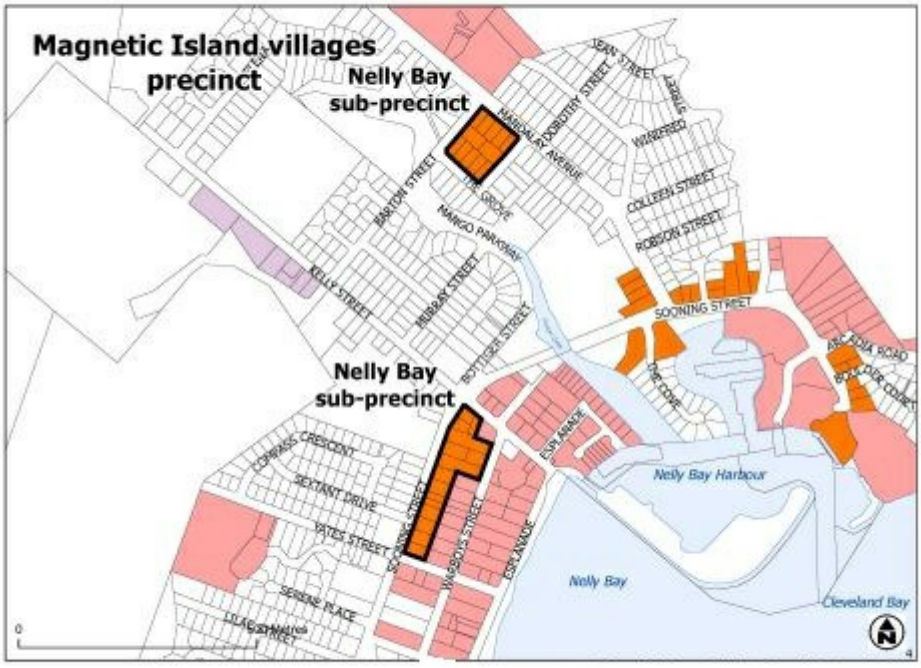

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Figure 6.128 – Nelly Bay sub-precinct

Picnic Bay sub-precinct:

(i) development supports tourism activities and contributes to the revitalisation of existing retail and food related uses including:

(A) cafes and restaurants; and

(B) the consolidation of new tourist and retail uses, in the vicinity of the hotel and the jetty/promenade.

(ii) buildings within the precinct are low-rise (up to 3 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

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Figure 6.129 – Picnic Bay sub-precinct

Horseshoe Bay sub-precinct:

(i) development supports the ongoing tourism focus in this location, facilitating the consolidation of retail, office and tourist activity. Short-term accommodation occurs in a ‘shop-top’ format; and

(ii) buildings within the precinct are low-rise (up to 2 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

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Figure 6.130 – Horseshoe Bay sub-precinct

Nelly Bay gateway precinct:

(a) development supports the creation of a gateway within proximity to the primary entrance point to Magnetic Island, at the Nelly Bay ferry terminal;

(b) local tourism-related and other retail and commercial uses and services are encouraged to establish in this precinct;

(c) development creates a strong relationship with Sooning Street and Mandalay Avenue, by sleeving the roads with buildings that are oriented to the street and screening parking areas behind;

(d) buildings within the precinct are low-rise (up to 3 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island; and

(e) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and the use of a variety of materials and finishes.

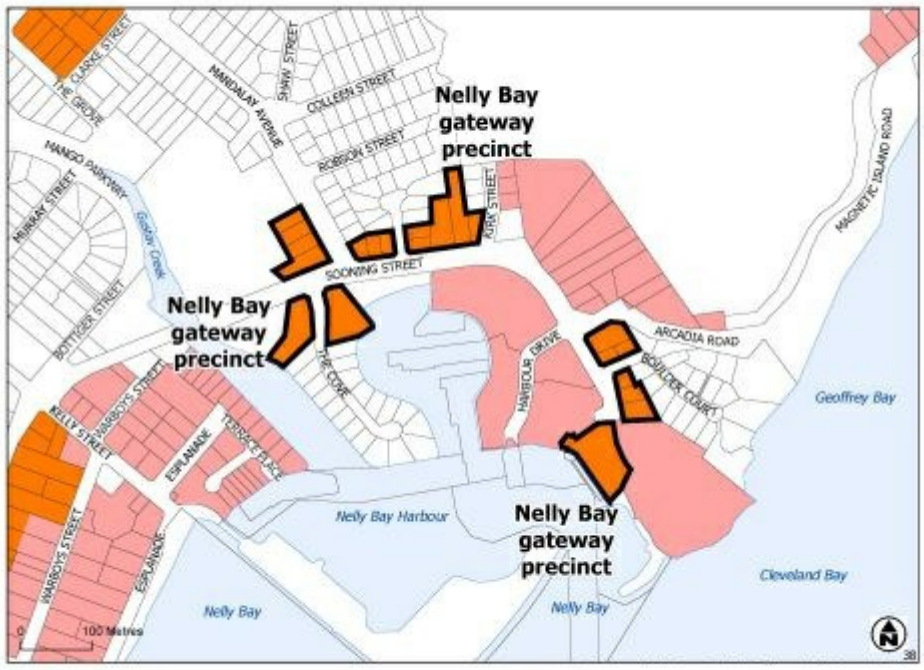

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Figure 6.131 – Nelly Bay gateway precinct

Arcadia Central precinct:

(a) development facilitates the transformation of the precinct as a defined local centre of activity for Arcadia including uses such as shops, small offices, medium density residential and tourist accommodation;

(b) development creates a strong relationship with Marine Parade and Armand Way, by sleeving the precinct with buildings that are oriented to the street and screening parking areas behind;

(c) development incorporates central community space with road frontage, located opposite the beach. Pedestrian connections are provided to surrounding uses such as the restaurants and cafes;

(d) buildings within the precinct are low-medium rise (up to 4 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island; and

(e) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and use of a variety of materials and finishes.

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Figure 6.132 – Arcadia Central precinct

Kirwan Traders precinct:

(a) small-scale commercial buildings are established, to provide space to incubate small, locally-based businesses;

(b) built form and streetscape treatments in this area contribute to a distinct character as a business hub, in particular on the frontages of Tavern Street, Carlton Street, Castlemaine Street and Burnda Street; and

(c) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

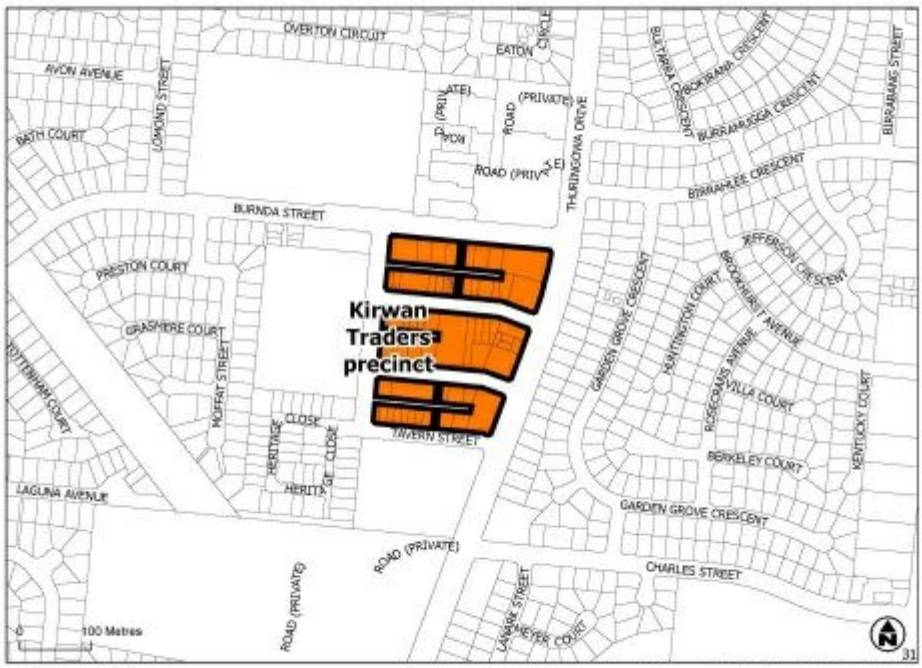

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Figure 6.133 – Kirwan Traders precinct

Charters Towers Road business precinct:

(a) built form and streetscape treatments in this area combine to create a distinct character as a business hub, in particular on the frontages of Woolcock Street, Charters Towers Road and Somer Street;

(b) development at the intersection of Charters Towers Road and Woolcock Street is appropriately treated and designed to serve as a significant gateway feature;

(c) new development located along the frontage of Charters Towers Road supports a transition to new and well-designed commercial activities, including small-scale offices and local service businesses;

(d) residential uses occur in this precinct where they do not restrict or impact on the intended industrial and commercial activities; and

(e) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

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Figure 6.134 – Charters Towers Road business precinct

CBD gateway precinct:

(a) this precinct provides for an emerging employment and business area in proximity to, and supporting the development of the principal centre (CBD). Uses in the precinct are intended to include service and low impact industrial uses, convenience shopping and showroom activities;

(b) offices occur where ancillary to industrial uses on the site;

(c) residential uses occur within this precinct where they do not restrict or impact on the intended industrial and commercial activities;

(d) Flinders Street (West) is reinforced as a significant gateway to the principal centre (CBD);

(e) the location of convenience shopping assist in reinforcing key intersections along Flinders Street (West); and

(f) improved pedestrian linkages to the principal centre (CBD) and Ross Creek are created.

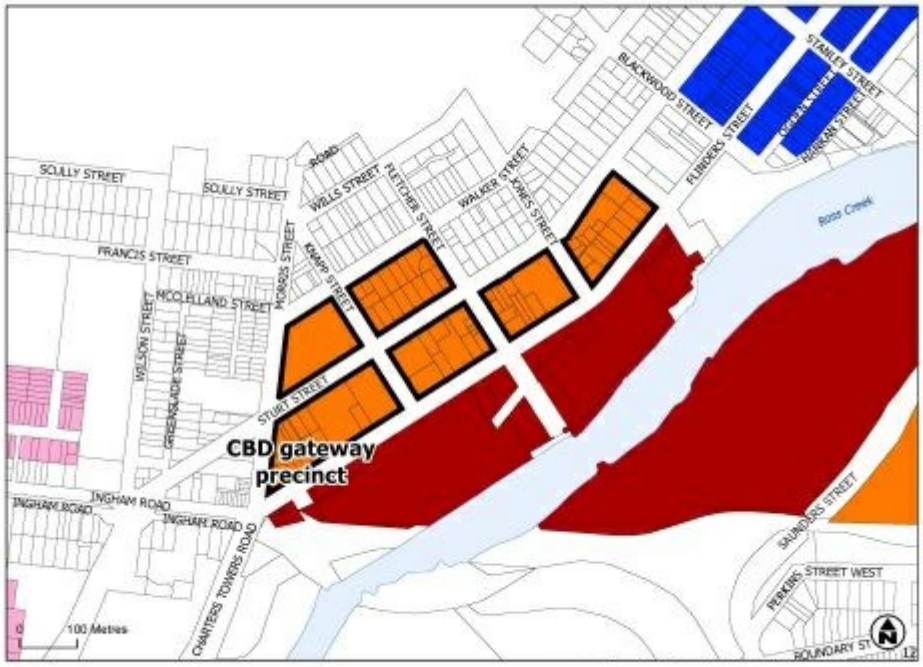

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Figure 6.135 – CBD gateway precinct

South Townsville Railyards and Dean Park precinct:

(a) the South Townsville Railyards and Dean Park present a significant opportunity for the delivery of future strategic infrastructure and 'city making' facilities for the whole of Townsville;

(b) the current use of the South Townsville Railyards site is protected until such time as these uses are relocated or become redundant. At that time, redevelopment of this area facilitates:

  (i) the provision of a city centre based sports stadium within an urban setting that relies on a nexus with public transport access;

  (ii) the redevelopment of Dean Park to create a usable parkland of approximately half its current size;

  (iii) the provision of an entertainment and convention centre on the other half of the Dean Park site; and

  (iv) the provision of a bus layover and driver facilities;

(c) interim uses do not compromise the future development of the land;

(d) new development is located and designed to be well-connected to the principal centre (CBD) and nearby high density residential areas;

(e) servicing and loading facilities in new development are considered within the overall design minimising impacts on surrounding residential uses and public spaces;

(f) the intended major facilities may be supported by a mix of complementary uses including service and low impact industry, office, retail and showroom activities, and residential uses, in a low to medium-rise built form; and

(g) Development of a commercial nature is not of a type or size that detracts from the function of the principal centre (CBD), district centres or major centres.

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Figure 6.136 – South Townsville Railyards and Dean Park precinct

Wotton Street precinct:

(a) the precinct provides for a transition between service and low impact industries to the north and the mixed use area to the south adjoining Ross River Road;

(b) residential uses occur in this precinct where they do not restrict or impact on the intended industrial and commercial activities and where they are located above ground storey non-residential uses; and

(c) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

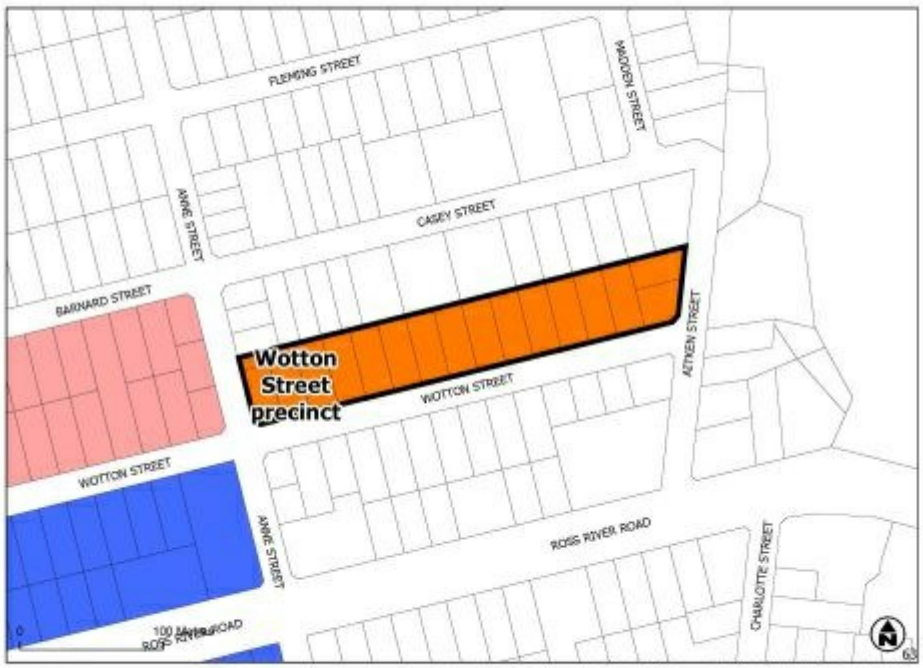

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Figure 6.137 – Wotton Street precinct

Breakwater precinct:

(a) the Breakwater precinct accommodates ongoing use and further development of residential, tourism and entertainment uses;

(b) the precinct will grow to establish a landmark high quality accommodation and entertainment destination for Townsville's tourists and residents;

(c) development includes the establishment of a new marina and waterfront pathway on the seaward side of the point, dining, boat club, local convenience facilities and tourist activities, as well as short and long-term accommodation. The precinct does not contain low impact industries other than where there is a nexus with a future marina or boat club;

(d) pedestrian access is focussed on a waterfront pathway, and includes integrated pedestrian pathways providing a high level of permeability throughout the precinct;

(e) development facilitates the consolidation of the casino and allied uses as a highly significant destination for Townsville. Should the Townsville Entertainment Centre re-locate, redevelopment of this site occurs which:

  (i) facilitates a range of activities including short-term accommodation, markets and a new boat club;

  (ii) integrates private and public transport options;

  (iii) enables reuse of existing surface parking areas; and

(f) short-term or permanent high density residential accommodation, is predominant in the central and western part of the precinct. Where adjoining the future marina, uses at the ground floor include local dining and shops.

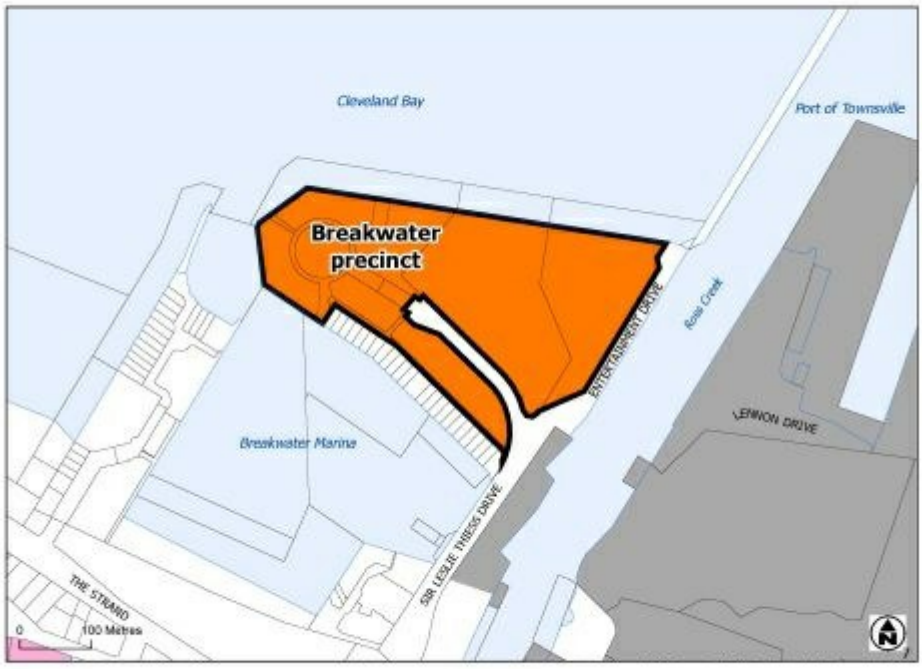

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Figure 6.138 – Breakwater precinct

King Street quarter precinct:

(a) the precinct provides for a revitalised tourism and education based destination in proximity to the principal centre (CBD), and functions as a focus point of activity between the CBD and the Breakwater precinct;

(b) development facilitates the establishment of allied educational uses such as a centre of excellence for marine studies;

(c) the precinct also includes high quality accommodation, dining and entertainment facilities. Residential uses are focused in the pocket of land bounded by Wickham and King Streets;

(d) development protects and respects the values of heritage buildings in the precinct, including the Queens Hotel;

(e) pedestrian permeability is improved through the provision of linkages through and between development sites, and through the continuation of a waterfront pathway along Ross Creek;

(f) improved vehicle circulation and visual links between the CBD, the King Street quarter precinct and the Breakwater precinct are created; and

(g) new parkland is established at the southern end of Anzac Park, and a new pedestrian and visual link across Ross Creek is created in line with the southern end of The Strand.

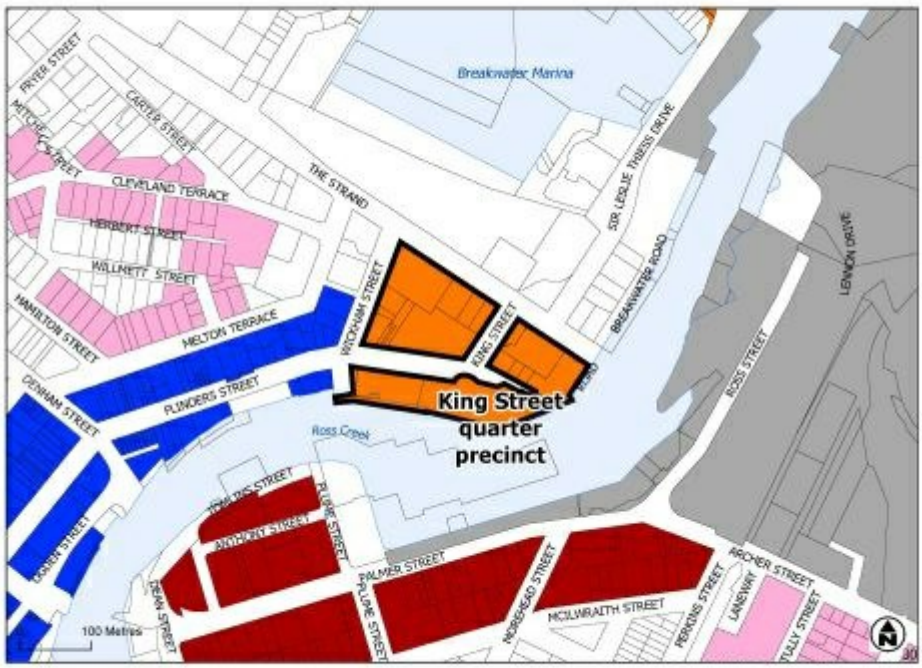

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Figure 6.139 – King Street quarter precinct

Kings Road precinct:

(a) redevelopment facilitates a change in focus for the area to include medium density residential uses and a range of smaller scale retail, dining and entertainment activities that contribute to the area's day and night-time vibrancy;

(b) the precinct plays a support role to the Hyde Park major centre in accommodating non-residential uses;

(c) development creates a medium-rise built form, with variation in built form to create visual interest across the precinct;

(d) the interface with the lake is enhanced through building frontages which orientate towards the lake and contain active uses at street level; and

(e) impacts on residential amenity from the rail corridor and showgrounds are minimised.

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Figure 6.140 – Kings Road precinct

6.3.7.3 Assessment benchmarks

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V)* *Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks and air conditioning units.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of other centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Built form is generally low to medium rise.	**AO6** All buildings and structures do not exceed 3 storeys in building height, except where stated otherwise for a particular precinct.
PO7 Built form provides for a sensitive transitioning in height and scale from surrounding land uses.	No acceptable outcome is nominated.
PO8 Development contributes to an attractive, coherent and integrated streetscape, by: (a) ensuring buildings assist in defining and enclosing the street frontage; (b) improving the continuity of built form; and (c) using complementary landscaping and streetscape treatments.	No acceptable outcome is nominated.
PO9 Built form is designed to: (a) create a pedestrian rather than car oriented street frontage; (b) break down the facade into finer scaled components; and (c) avoid large expanses of blank walls oriented to the street.	**AO9.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath, except where stated otherwise for a particular precinct.
	AO9.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO9.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO9.4 The maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
	AO9.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
PO10 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO11 Built form maximises use of natural ventilation, solar heating and cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO12 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and way finding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO13 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	No acceptable outcome is nominated.
PO14 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.
PO15 New development provides for safe vehicular and pedestrian access and efficient operation of surrounding roads.	**AO15** Either: (a) development provides no net increase in driveway crossovers; or (b) lots are consolidated to gain access from a minor or lower-order road, except where stated otherwise for a particular precinct.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO16 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO17 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO17.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO17.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO17.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO17.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO18 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO18** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO19 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

PO20 Streetscape treatments are provided to enhance amenity to contribute positively to the city image, particularly along major roads and streets.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Magnetic Island villages precinct	
PO21 Convenient and legible connections are provided for pedestrians and cyclists to the precinct, particularly having regard to linkages to the bay foreshore, residential areas in the community and the open space network.	No acceptable outcome is nominated.
PO22 Building design and massing is consistent with the low-density scale of the Magnetic Island character and articulates individual buildings.	**AO22** Building height does not exceed 2 storeys, or when in the Picnic Bay sub-precinct 3 storeys.
PO23 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO24 The design of buildings in this precinct provides for pedestrian-friendly and visually interesting frontages.	No acceptable outcome is nominated.
PO25 Suitable vegetation screening and treatments are provided within the building setback, to minimise the visual impact of the buildings.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Arcadia Central precinct	
PO26 Development supports the creation of a new community node for Arcadia in accordance with Figure 6.141 — Arcadia Central precinct concept plan.	No acceptable outcome is nominated.

PO27 Frontages shown on Figure 6.141 — Arcadia Central precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO28 Development on the corner of Marine Parade and Armand Way creates a gateway to Arcadia. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement.	No acceptable outcome is nominated.
PO29 Building height is of a low to medium-rise scale and building massing is consistent with the low density character of Magnetic Island.	**AO29** Building height does not exceed 4 storeys.
PO30 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO31 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages to the foreshore and the open space network.	No acceptable outcome is nominated.
PO32 Access points are minimised along Marine Parade.	No acceptable outcome is nominated.
PO33 New pedestrian connnections consistent with Figure 6.141 — Arcadia Central precinct concept plan are provided.	No acceptable outcome is nominated.
PO34 Increased public open space and improvements to the public domain are provided throughout the precinct.	No acceptable outcome is nominated.

Figure 6.141 – Arcadia Central precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay gateway precinct	
PO35 Development in this precinct supports the creation of a high quality activity hub for Nelly Bay and Magnetic Island, in accordance with Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.
PO36 Development creates a gateway to Nelly Bay and Magnetic Island. Built form, landscape and streetscape treatment reinforces a key entry point to the village.	No acceptable outcome is nominated.
PO37 Frontages shown on Figure 6.142 — Nelly Bay gateway precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO38 Streetscaping and landscaping provides increased shade and amenity for pedestrians along roads indicated as having local streetscape treatment on Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.
PO39 Building design and massing is consistent with the low density scale and character of Magnetic Island.	**AO39** Building height does not exceed 3 storeys.
PO40 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO41 Access arrangements are appropriate for the volume, frequency and type of vehicle usage.	**AO41** Access points are limited to Sooning Street, Mandalay Avenue and The Cove with minimal crossovers.
PO42 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages to the ferry terminal, foreshore and the open space network.	No acceptable outcome is nominated.

PO43 Mixed use development contributes to the creation of a waterfront promenade. Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.

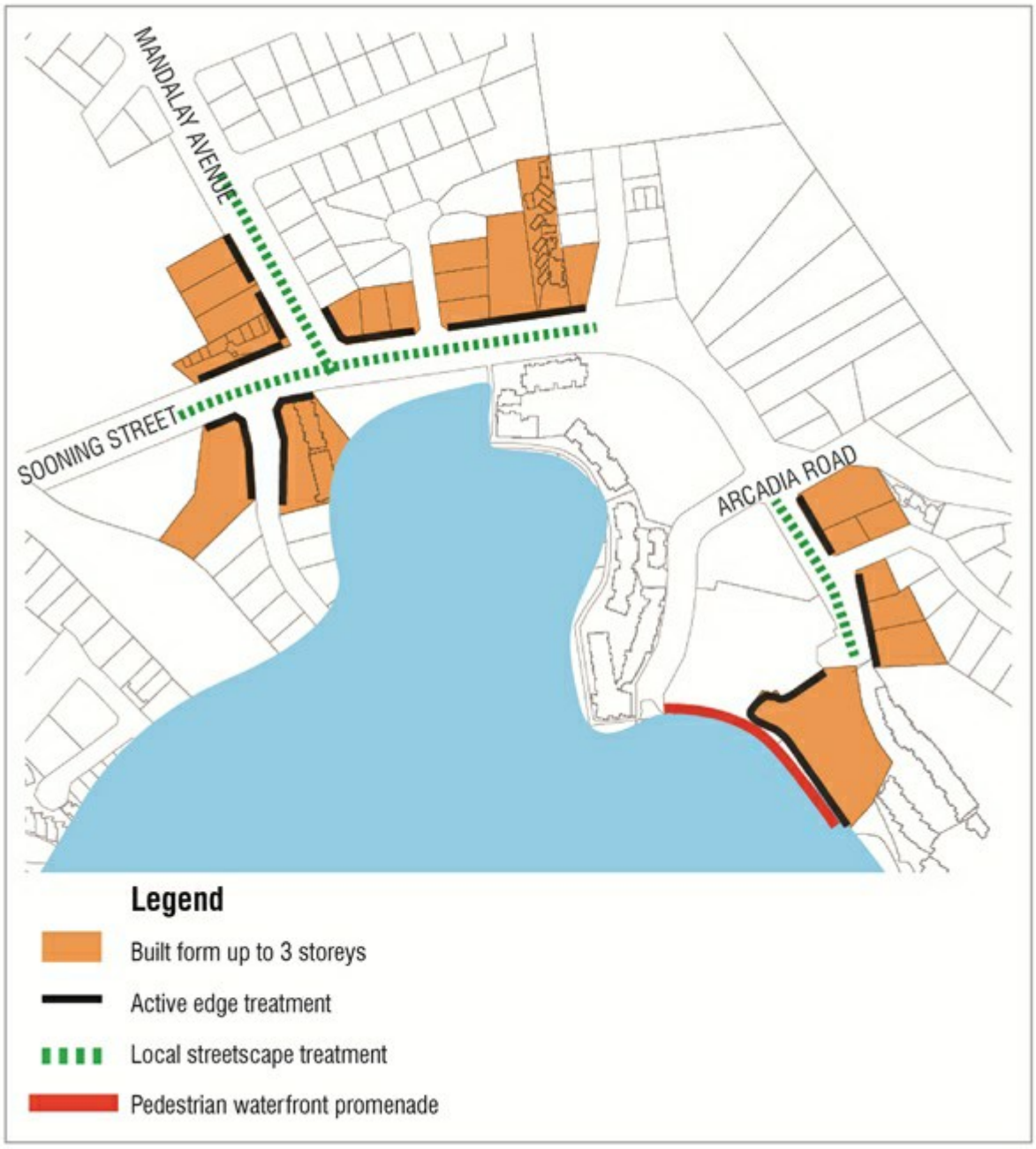

Figure 6.142 – Nelly Bay gateway precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kirwan Traders precinct	
PO44 Built form, landscape and streetscape treatment along Thuringowa Drive reinforces the precinct identity as a place for business.	No acceptable outcome is nominated.
PO45 Landscape and streetscape treatments are provided along Tavern Street, Carlton Street, and Laguna Avenue which reflect the intended character of the precinct.	No acceptable outcome is nominated.
PO46 Building size and bulk are consistent with the scale and character of the Kirwan Traders precinct, and retain an appropriate relationship with the established streetscape.	**AO46** Development involves reuse of existing buildings that contribute to the built form character and context of the immediate area.
PO47 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	**AO47** Access to on-site parking is provided through the rear access lanes connecting to Toohey Street.
PO48 Development on the corner of Thuringowa Road and Burnda Street, and Burnda Street and Toohey Street, creates a gateway to Kirwan Traders precinct. Built form, landscape and streetscape treatment at these corners reinforces a gateway statement.	No acceptable outcome is nominated.
PO49 Development provides mid-block linkages and increased open space for the public on private land, particularly on larger sites and those sites with two street frontages.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note**—Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Charters Towers Road business precinct	
PO50 Development in this precinct supports the transition of the precinct from a predominantly low impact industry area to a mixed business focus.	No acceptable outcome is nominated.
PO51 Development along Woolcock Street contributes positively to the city image.	**AO51** Buildings are setback 4m from Woolcock Street, and incorporate a landscaped buffer along that road frontage.
PO52 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	**AO52** Access to on-site parking is provided through the rear access lanes connecting to Yeatman Street.
PO53 Development on the corner of Woolcock Street and Charters Towers Road, creates a gateway to Charters Towers Road business area. Built form, landscape and streetscape treatment at these corners reinforces a gateway statement. Figure 6.143 – Charters Towers Road business precinct concept plan	No acceptable outcome is nominated.
PO54 Development provides mid-block linkages and increased open space for the public on private land, particularly on larger sites and those sites with two street frontages.	No acceptable outcome is nominated.
PO55 Development contributes to the boulevard treatment of Ross River Road and Woolcock Street through landscaping and streetscape treatments along the road frontages.	No acceptable outcome is nominated.

Figure 6.143 – Charters Towers Road business precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
CBD gateway precinct	
PO56 Along Flinders Street (West), development responds to the role of the street as a key entrance to the principal centre (CBD), and presents high quality built form, landscape and streetscape treatment.	No acceptable outcome is nominated.
PO57 Shops primarily service workers within the precinct and are located only at key nodes formed by the intersections of Flinders Street (West) and Knapp and Fletcher Streets.	**AO57** Shops are located at the nominated intersections and include only convenience stores, newsagents and café/takeaway food premises limited to less than 250m^2 gross floor area per tenancy.

PO58 Buildings are generally low to medium rise and ensure the protection of the visual primacy of the principal centre (CBD).	**AO58** Building height does not exceed 6 storeys on the frontage of Flinders Street (West), and transition to 4 storeys where situated to the north of Sturt Street. In accordance with Figure 6.144 — CBD gateway precinct concept plan.
PO59 Development contributes to an attractive, coherent and integrated streetscape, by: (a) ensuring buildings assist in defining and enhancing the Flinders Street (West) frontage; (b) improving the quality and continuity of built form; and (c) using complementary landscaping and streetscape treatments.	No acceptable outcome is nominated.
PO60 Pedestrian links are provided and reinforced in accordance with Figure 6.144 — CBD gateway precinct concept plan.	No acceptable outcome is nominated.

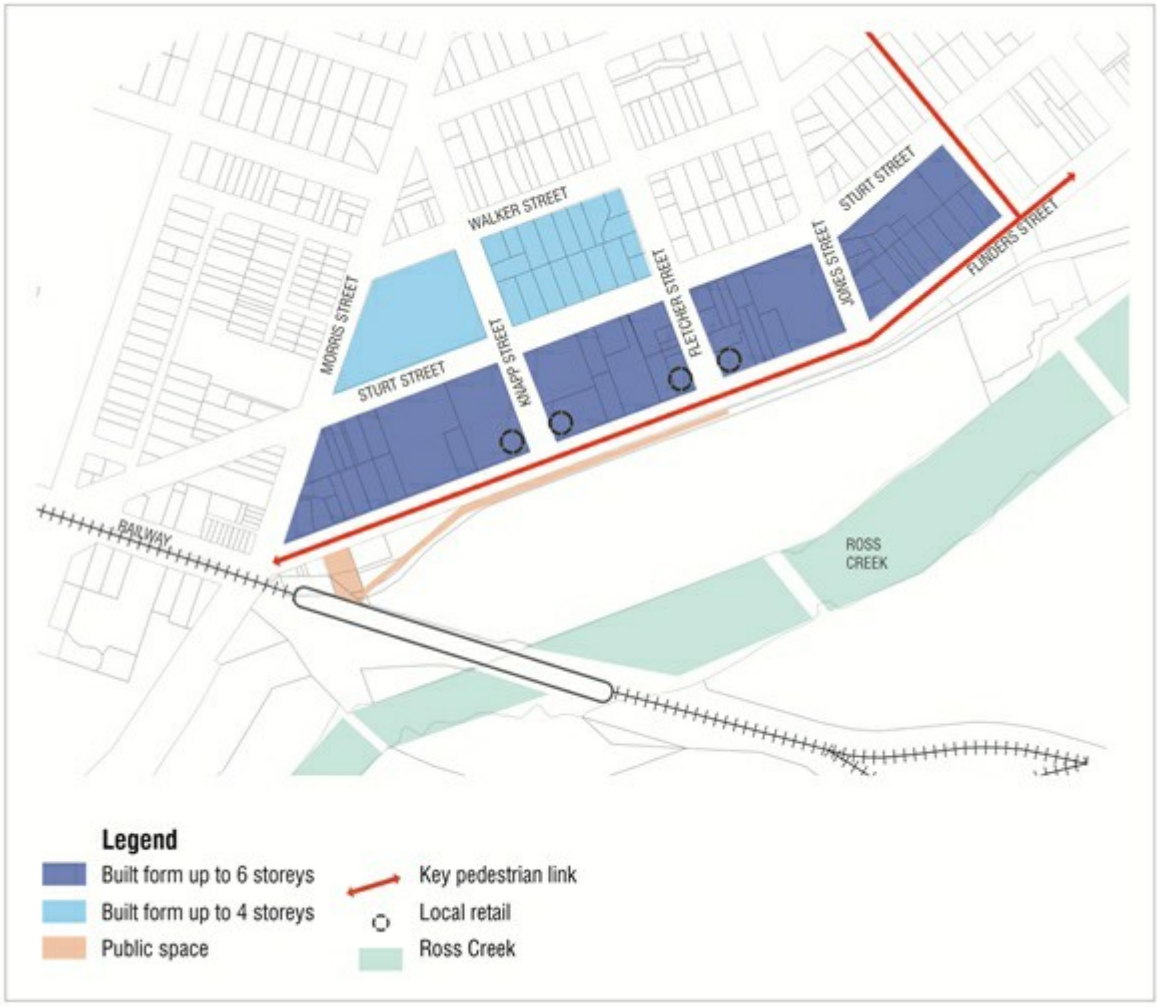

Figure 6.144 – CBD gateway precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
South Townsville Railyards and Dean Park precinct	
PO61 Development is generally in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan.	No acceptable outcome is nominated.
PO62 Development in the precinct: (a) integrates all aspects of the land use elements through good built form and public realm treatments; and (b) appropriately stages development and particularly the sequencing of supporting infrastructure including transport and access, parking and services.	No acceptable outcome is nominated.
PO63 A new entertainment centre and a range of allied uses are established on the Dean Park site, in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan. The development: (a) incorporates leading tropical design; (b) is oriented to both the Saunders Street and Rooney Street frontages; (c) establishes uses which promote a high level of pedestrian movement and interaction along Saunders Street and Rooney Street, creating an active edge; (d) provides a new public plaza at the Saunders and Rooney Street corner, integrating with the future plaza area for the stadium opposite; and (e) has its primary vehicular and public transport access via a new road alignment extending from Barlow Street. A new bus terminus and driver facilities are provided in this location.	No acceptable outcome is nominated.

PO64 A stadium is established on the northern corner of the existing railyards land, in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan. The development: (a) is capable of being used for multiple events; (b) incorporates leading tropical design; (c) provides extensive public space surrounding the stadium structure; (d) is oriented to both the Saunders Street and Rooney Street frontages; (e) establishes uses which promote a high level of pedestrian movement and interaction along Saunders Street and Rooney Street, creating an active edge; (f) provides a new public plaza at the Saunders and Rooney Street corner, integrating with the future plaza area for the stadium opposite; and (g) facilitates vehicle access by construction of a new public road around the stadium.	No acceptable outcome is nominated.
PO65 Land to the south of the stadium site and backing onto the rail line predominantly consists of service and low impact industry and commercial uses.	No acceptable outcome is nominated.
PO66 Access to and permeability within the precinct are facilitated including: (a) the extension of Barlow Street to provide a new road extension from South Townsville to Saunders Street; (b) an upgrade of the Saunders Street and Rooney Street intersection, with a focus on ensuring pedestrian access and amenity and sense of arrival to the precinct; and (c) improved pedestrian priority and accessibility in street profile and streetscaping for all streets surrounding the stadium site, including Saunders, Rooney, and Morehead Streets and Perkins Street West.	No acceptable outcome is nominated.
PO67 Parking for the entertainment centre and stadium is established sequentially as key components of the precinct occur, and may include a staged program of parking solutions at grade and in various areas of the precinct over time. Ultimately, parking for both facilities is to be incorporated within the built form.	No acceptable outcome is nominated.

Figure 6.145 – South Townsville Railyards and Dean Park precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Wotton Street precinct	
PO68 The ongoing activities of the low impact industrial area to the north are not compromised.	**AO68** Development provides the following along the common boundary with adjacent industrial uses: (a) a minimum 3m wide landscaped buffer; and (b) a solid 1.8m fence along the full length of the boundary.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Breakwater precinct	
PO69 Development is generally in accordance with Figure 6.146 — Breakwater precinct concept plan.	No acceptable outcome is nominated.
PO70 A new marina is established on the seaward side of the precinct, and includes a new boat launch facility as shown on Figure 6.146 — Breakwater precinct concept plan.	No acceptable outcome is nominated.
PO71 An open space and pedestrian network is provided as identified on Figure 6.146 — Breakwater precinct concept plan, and includes the provision of a boardwalk adjoining the future marina, pedestrian links along all waterfront areas, and a new park at the north eastern point of the precinct.	No acceptable outcome is nominated.
PO72 Where shown as an 'active frontage' on Figure 6.146 — Breakwater precinct concept plan, new buildings contribute to the creation of an attractive and activated edge to the waterfront by having facades which contain windows, doors, materials and features which generate visual interest and engagement with the water frontage.	No acceptable outcome is nominated.
PO73 Dining, entertainment and tourist-oriented uses occur at the ground storey.	No acceptable outcome is nominated.
PO74 Development within the Breakwater entertainment area shown on Figure 6.146 — Breakwater precinct concept plan supports the consolidation of the casino and allied uses, including short-term accommodation, boat club and market.	No acceptable outcome is nominated.

PO75 Development within the Breakwater living area shown on Figure 6.146 — Breakwater precinct concept plan primarily facilitates high density short or long-term accommodation uses, with local dining and shops at the ground floor where adjoining the future marina.	No acceptable outcome is nominated.
PO76 Building heights ensure the protection of the visual primacy of the principal centre (CBD), the retention of key views to Castle Hill and Melton Hill, and to the sea and Magnetic Island.	**AO76** Building heights are in accordance with Figure 6.146 — Breakwater precinct concept plan.

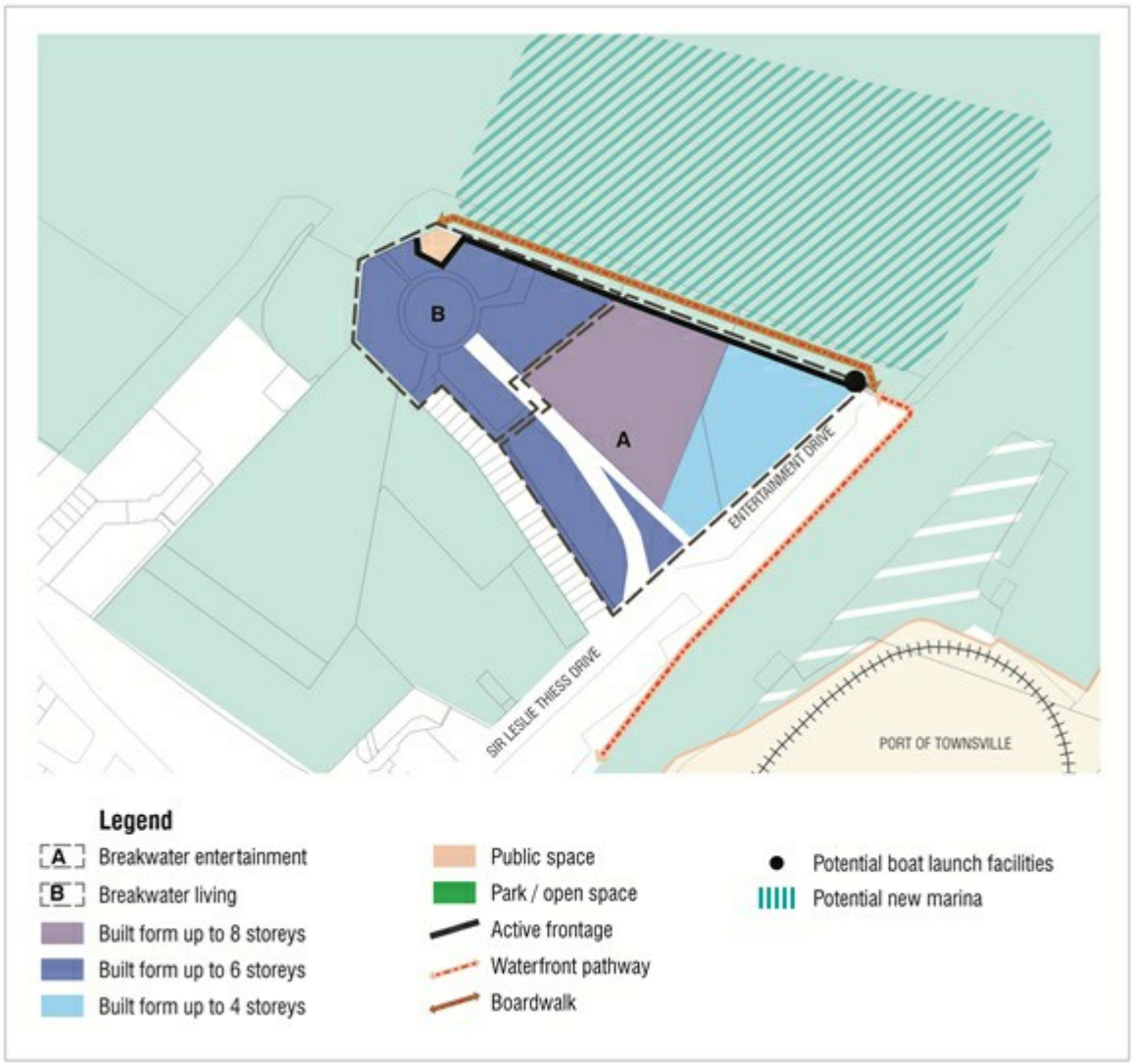

Figure 6.146 – Breakwater precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
King Street quarter precinct	
PO77 Development is generally in accordance with Figure 6.147 — King Street quarter precinct concept plan.	No acceptable outcome is nominated.
PO78 Development supports a mix of uses, including day and night-time activity.	No acceptable outcome is nominated.
PO79 Café and restaurant uses establish predominantly at the ground floor along the street frontages to Wickham Street, King Street and Flinders Street, and also to Ross Creek frontages.	No acceptable outcome is nominated.
PO80 Residential uses including long and short-term accommodation are predominantly located in the area bounded by Flinders Street, King Street and Wickham Street and The Strand.	No acceptable outcome is nominated.
PO81 Building height is medium rise, and ensures the protection of the visual primacy of the principal centre (CBD). The tallest buildings occur in the centre of the Wickham Street/King Street/Flinders Street/The Strand block.	**AO81** Building heights are in accordance with Figure 6.147 — King Street quarter precinct concept plan.
PO82 An open space and pedestrian network is provided as identified on Figure 6.147 — King Street quarter precinct concept plan, and includes: (a) the provision of, pedestrian links along all waterfront areas; (b) an extension to Anzac Park (following realignment of Sir Leslie Thiess Drive and King Street); (c) a new open space and pedestrian link to the southern end of The Strand linking to a future pedestrian creek crossing; and (d) pedestrian through block links.	No acceptable outcome is nominated.

PO83 Where shown as 'active frontage' on Figure 6.147 — King Street quarter precinct concept plan, new buildings contribute to the creation of an attractive and activated edge to the street frontage by; (a) being built to the street frontage; (b) having facades which contain windows, doors, materials and features which generate visual interest and engagement with the street frontage; (c) providing awnings to all street frontages; and (d) providing a continuous building alignment.	No acceptable outcome is nominated.

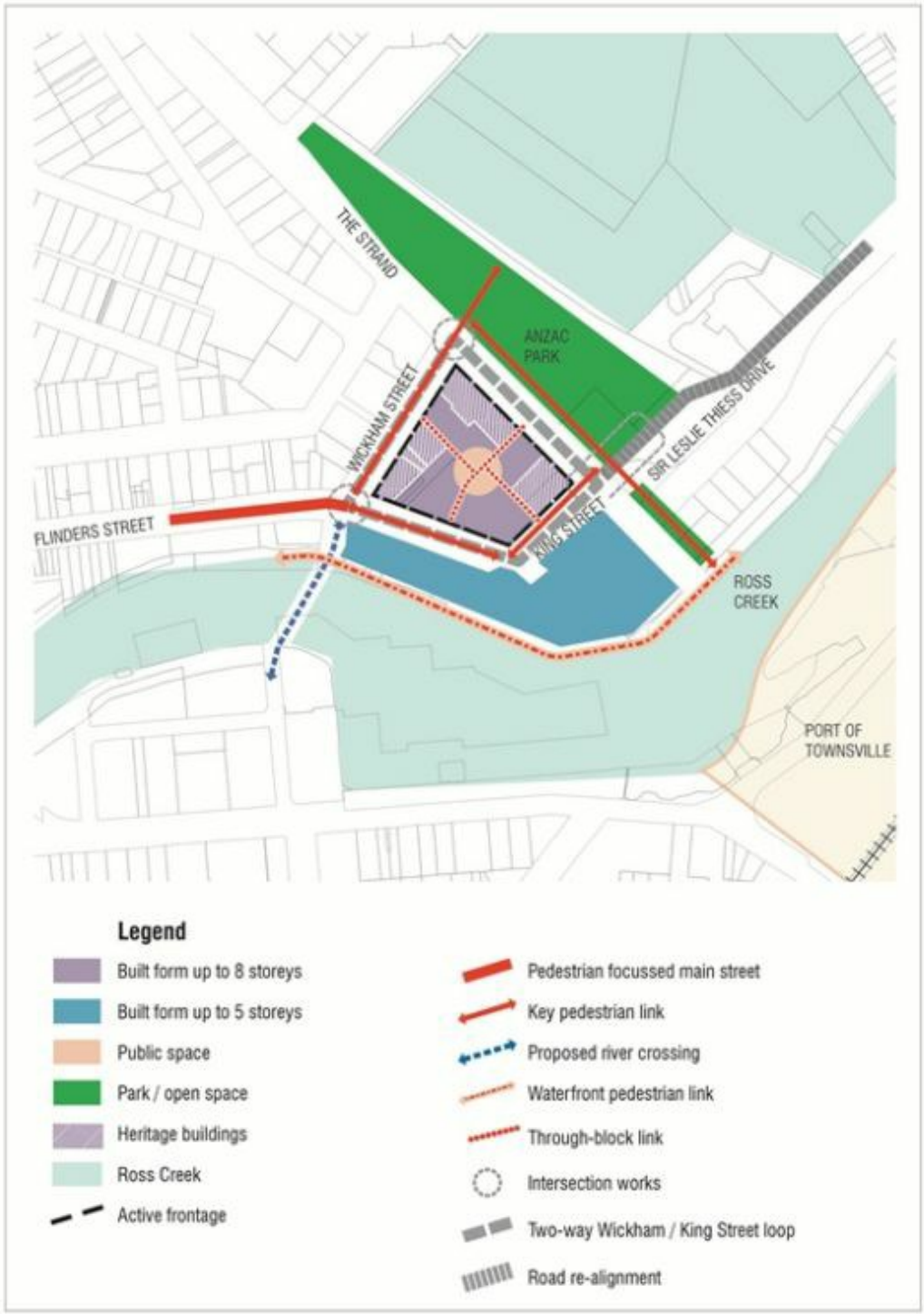

Figure 6.147 – King Street quarter precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kings Road precinct	
PO84 Building height creates a medium-rise environment.	**AO84** Building height does not exceed 5 storeys.
PO85 Development provides for enhanced public realm and pedestrian connectivity, in accordance with Figure 6.148 — Kings Road precinct concept plan, including: (a) enhanced north south and east west links through the precinct; (b) a civic node on the lake frontage; (c) enhanced pedestrian access to and along the lake; and (d) a primary pedestrian and cycle pathway along Kings Road.	No acceptable outcome is nominated.
PO86 The civic node at the lake frontage is sleeved by active street level uses.	No acceptable outcome is nominated.
PO87 Residential uses are appropriately buffered from the railway corridor.	No acceptable outcome is nominated.

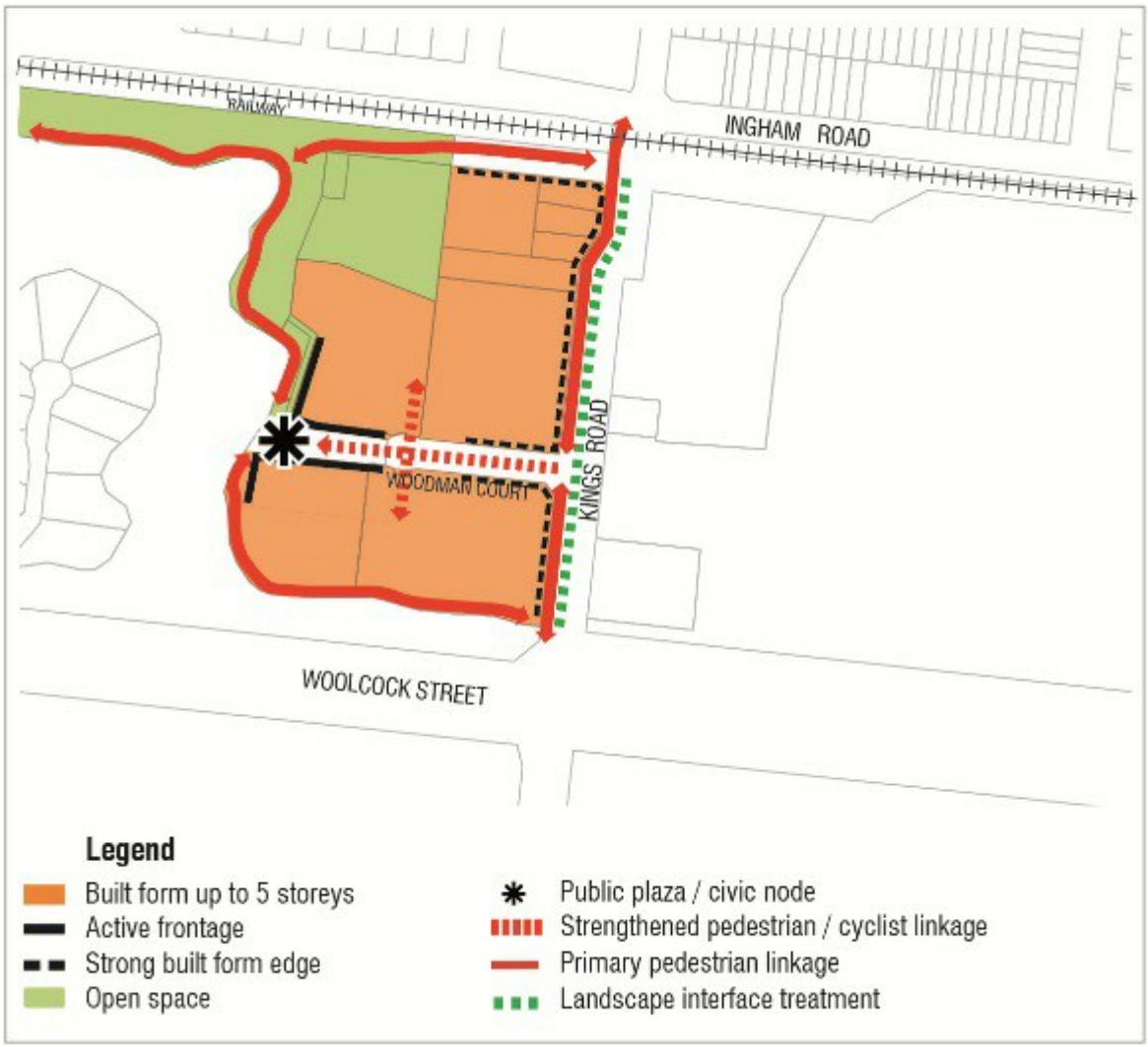

Figure 6.148 – Kings Road precinct concept plan

6.4 Community facilities and open space zone category

6.4.1 Sport and recreation zone code

6.4.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.1.2 Purpose

(1) The purpose of the Sport and recreation zone code is to provide for a range of organised activities that include sport, cultural and educational activities where the uses require a level of built infrastructure.

It includes built structures, such as clubhouses, gymnasiums, public swimming pools and tennis courts, and infrastructure to support the activities, safe access and essential management, where required to meet community needs.

(2) The particular purpose of the code is to ensure:

- (a) residents have convenient access to sport and recreation activities which are safe, attractive and appropriate for the community's needs; and
- (b) development minimises impacts on surrounding land.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) local, district, regional and specialised sports parks provide for a variety of formal sporting activities and a range of training and competition infrastructure;
- (b) development directly supports the primary recreational function of the site or provides for the co-location of a complementary and compatible community-related activity;
- (c) development does not restrict public access and does not detract from the primary function of the site for sport and recreation activities;
- (d) development provides for safe and convenient internal pedestrian and cyclist pathways and external connections to existing and proposed public transport infrastructure and surrounding activities wherever possible;
- (e) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (f) facilities are sited, designed and operated to minimise adverse impacts on surrounding land; and
- (g) adverse impacts on any ecological values are avoided where land includes or adjoin natural habitats such as bushland, wetlands or waterways, or act as a buffer between natural and developed areas.

(4) The purpose of the zone will also be achieved by the following additional outcomes for particular precincts:

Balgal Beach golf course precinct:

(a) development of the precinct maintains the golf course and other outdoor recreational facilities and provides an integrated mix of residential and small-scale tourist accommodation;

(b) reconfiguration facilitates a range of lot sizes to accommodate dwelling houses typically on lots with an average size of 600m^2;

(c) the ultimate development of the entire precinct does not result in more than 590 residential lots for dwelling house purposes;

(d) tourist-oriented development may also occur in the form of small-scale, low-rise accommodation and support facilities;

(e) building scale and massing limits the impact on the natural character of Balgal Beach; and

(f) development of the precinct does not compromise the efficient and orderly provision of infrastructure.

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Figure 6.149 – Balgal Beach golf course precinct

Cluden precinct:

(a) Development facilitates the ongoing operation of the Cluden racecourse and is directly associated with or ancillary to horse racing.

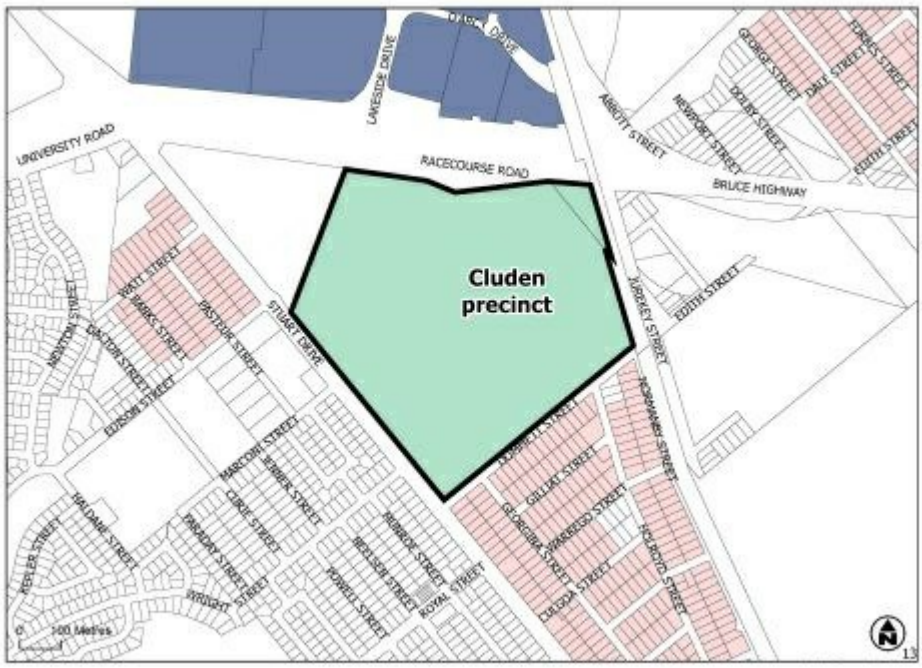

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Figure 6.150 – Cluden precinct

6.4.1.3 Assessment benchmarks

Table 6.4.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Built form	
PO1 Development does not substantially exceed the height of existing buildings in the area or is designed to sympathetically transition from lower rise neighbouring buildings.	**AO1** Building height does not exceed 3 storeys.
PO2 Building setbacks and orientation provide for an attractive streetscape that is compatible with existing characteristics of the local area.	**AO2** Buildings are set back from street and road frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO3 Development minimises the bulk of buildings to assist integration with surrounding development.	**AO3** Walls are articulated so that they do not exceed a length of 15m without a change in plane of at least 0.75m depth.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Amenity	
PO4 Development provides adequate separation, buffering and screening from residential uses and land within a residential zone so that adverse impacts on privacy and amenity are minimised.	**AO4.1** Buildings and structures are set back 6m or half of the building height, whichever is greater from any boundary shared with a residential use or land within a residential zone.
	AO4.2 Site access and parking, servicing or outdoor storage areas are setback 6m from any boundary shared with a residential use or land within a residential zone.
	AO4.3 Where buildings, parking, servicing or outdoor storage areas are located within 15m of any boundary shared with an residential use or land within a residential zone, the following is provided: (a) a minimum 1.8m high solid screen fence; or (b) a landscaped buffer area consisting of dense screen planting of a minimum 3m width. **Editor's note—**Landscaping is to be provided to a standard specified in the Landscape code.
	AO4.4 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO5 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO5** The open area used for the storage of refuse, vehicles, machinery, goods and materials on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO6 Development does not compromise the effective operation of the primary use.	**AO6** No more than one (1) caretaker's accommodation unit is provided on the site.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community use and club	
PO7 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO7** At least one (1) lockable storage space of a minimum of 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO8 The site predominantly accommodates sport and recreational activities and facilitates optimum use of the land for the intended sport or recreational purpose.	No acceptable outcome is nominated.
PO9 Non-recreation uses occur only where they: (a) directly support the primary function of the site; or (b) are a compatible community-related activity.	No acceptable outcome is nominated.
PO10 Development does not impede public access to and use of facilities.	No acceptable outcome is nominated.
PO11 Buildings, structures and use areas are designed to ensure efficient use of buildings and facilities, and provide for multiple or shared use of facilities where practicable.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO12 Development maintains a high level of general amenity within the site and for surrounding areas, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance criterion.	No acceptable outcome is nominated.
PO13 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO15 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.
PO16 Safe and convenient pedestrian and cyclist circulation is provided for as an integrated component of the site layout.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns, ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Balgal Beach golf course precinct	
PO18 Development does not reduce the area dedicated to the golf course and other outdoor recreational uses or reduce its amenity or functionality.	No acceptable outcome is nominated.
PO19 Reconfiguration of a lot does not result in more than 590 lots or detached dwelling house purposes across the entire precinct.	No acceptable outcome is nominated.
PO20 Reconfiguration creates lots that have sufficient area and dimension to facilitate residential development.	**AO20** Lots have an average size of 600m^2.
PO21 Tourist-oriented development is small-scale and low rise.	**AO21** Building height does not exceed 2 storeys.
PO22 Design and articulation for tourism-oriented development contributes to the natural character of the locality through tropical architectural design elements and the natural setting of buildings within the landscape.	No acceptable outcome is nominated.
PO23 Development is within the capacity of available infrastructure and is supported by adequate infrastructure, including: (a) connection to reticulated water and sewage networks; (b) connection to stormwater drainage system; and (c) constructed roads.	No acceptable outcome is nominated. **Editor's note-**Council will request an overall area/precinct-scale structure plan - comprising land use, infrastructure, staging, urban design for the entire precinct before development takes place.

6.4.2 Open Space zone code

6.4.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.2.2 Purpose

(1) The purpose of the Open space zone code provides for informal recreation where the built form is not essential to the enjoyment of the space.

It may provide for local, district and regional scale parks which serve the recreational needs of a wide range of residents and visitors.

Where required to meet community needs, development may include shelters, amenity facilities, picnic tables, and playgrounds and infrastructure to support safe access and essential management.

(2) The particular purpose of the code is to ensure:

- (a) residents have convenient access to parks and opportunities for informal outdoor recreation that are safe, attractive and appropriate for the community's needs; and
- (b) places that contribute to the visual amenity and character of the city are protected; and
- (c) the environmental and drainage functions of open space are protected.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) open space is accessible to the general public for a range of informal outdoor recreation activities at local, district and regional levels;
- (b) development directly supports the primary recreational function of the site or provides for the co-location of a complementary and compatible community-related activity;
- (c) development does not restrict public access and does not detract from the site's primary open space function, visual quality or cultural values;
- (d) land within the zone is generally free from buildings other than ancillary structures which enhance the utility and enjoyment of the open space and buildings required for small-scale clubs and community facilities;
- (e) development provides for safe and convenient internal pedestrian and cyclist pathways and external connections to existing and proposed public transport infrastructure and surrounding activities wherever possible;
- (f) facilities are sited, designed and operated to minimise adverse impacts on surrounding land;
- (g) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (h) the drainage functions of open space are protected and development is compatible with these functions; and
- (i) adverse impacts on any ecological values are avoided where land includes or adjoin natural habitats such as bushland, wetlands or waterways, or act as a buffer between natural and developed areas;

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Riverway precinct:

(a) development in Pioneer Park and Riverway is subordinate to, and does not compromise, its primary role and function as a pedestrian-focussed recreational and open space area; and

(b) connections between Pioneer Park and Riverway and Thuringowa central major centre are reinforced, including the creation of an active entry precinct along Village Boulevard.

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Figure 6.151 – Riverway precinct

6.4.2.3 Assessment benchmarks

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Built form	
PO1 Built form: (a) is limited in scale and extent; (b) is visually unobtrusive and maintains the open, parkland character; and (c) does not restrict access to utility or enjoyment of the open space.	**AO1.1** Building height does not exceed 1 storey.
	AO1.2 Buildings do not exceed a site cover of 5%.
	AO1.3 Buildings are set back 10m from any site boundary.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community use and club	
PO2 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO2** At least one (1) lockable storage space of a minimum of 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO3 Land predominantly accommodates parks and any development facilitates optimum enjoyment and use of the land for informal recreation purposes.	No acceptable outcome is nominated.
PO4 Other than at Riverway precinct, non-recreational uses occur only where: (a) they directly support the primary function of the site or are a compatible community-related activity; and (b) have a built form that is limited in scale and extent.	No acceptable outcome is nominated.
PO5 Development does not impede public access to and use of facilities.	No acceptable outcome is nominated.
PO6 Development does not detract from the site's visual quality or cultural values.	No acceptable outcome is nominated.
PO7 Development is compatible with any drainage function of the land and does not interfere with that function.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO8 Development maintains a high level of amenity within the site and for surrounding areas, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance criterion.	No acceptable outcome is nominated.
PO9 Landscaping is provided to enhance the appearance of the development and assist in its integration with the open space setting.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO10 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO11 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, other parts of the open space network, sport and recreational activities, centres and community-related activities.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO12 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Riverway precinct	
PO13 Leisure focussed shops and dining uses are established along Village Boulevard opposite High Range Drive, creating an active link to the town centre heart precinct and a gateway feature for Riverway. This gateway area may incorporate a residential component in the form of shop top housing.	No acceptable outcome is nominated.

6.4.3 Community facilities zone code

6.4.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.3.2 Purpose

(1) The purpose of the Community facilities zone code is to provide for community-related activities and facilities whether under public or private ownership.

These may include the provision of municipal services, public utilities, government installations, hospitals and schools, transport and telecommunication networks and community infrastructure of an artistic, social or cultural nature.

(2) The particular purpose of the code is to ensure:

(a) the effective location, design and operation of a wide variety of community-related activities and facilities so that these facilities adequately meet the needs of current and future users; and

(b) community-related activities and facilities are provided in a safe, accessible and attractive environment, and minimise impacts on surrounding land uses.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the zone primarily accommodates a variety of community-related activities and facilities such as community uses, educational establishments, emergency services, places of worship and utility installations in a manner that best meets community needs;

(b) other complementary uses may occur within the zone, where community-related activities and facilities remain the dominant use and continue to effectively meet community needs;

(c) development does not prejudice the ongoing operation and expansion of community activities and facilities;

(d) where appropriate, development enables the co-location of community-related activities and facilities;

(e) development facilitates improved accessibility by walking, cycling and public transport, and facilitates easy access by all members of the community, including older and less mobile people and people with disabilities;

(f) unless separation is required due to safety and operational requirements of the use, integration with surrounding areas is strengthened through built form and site layout;

(g) buildings provide for an attractive, pedestrian friendly environment at street level;

(h) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour; and

(i) development is sited, designed and operated to minimise adverse impacts on surrounding land.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Picnic Bay community facilities precinct:

(a) the intersection of Birt Street and Nelly Bay Road creates a gateway to Picnic Bay. Built form and streetscape treatments at this intersection reinforces this gateway function;

(b) development of this precinct supports a transition from the existing landfill uses to form a more community-focussed hub including uses such as education, open space, recreation and other community facilities; and

(c) design of built form and public spaces is of high quality and is consistent with the low density Magnetic Island character.

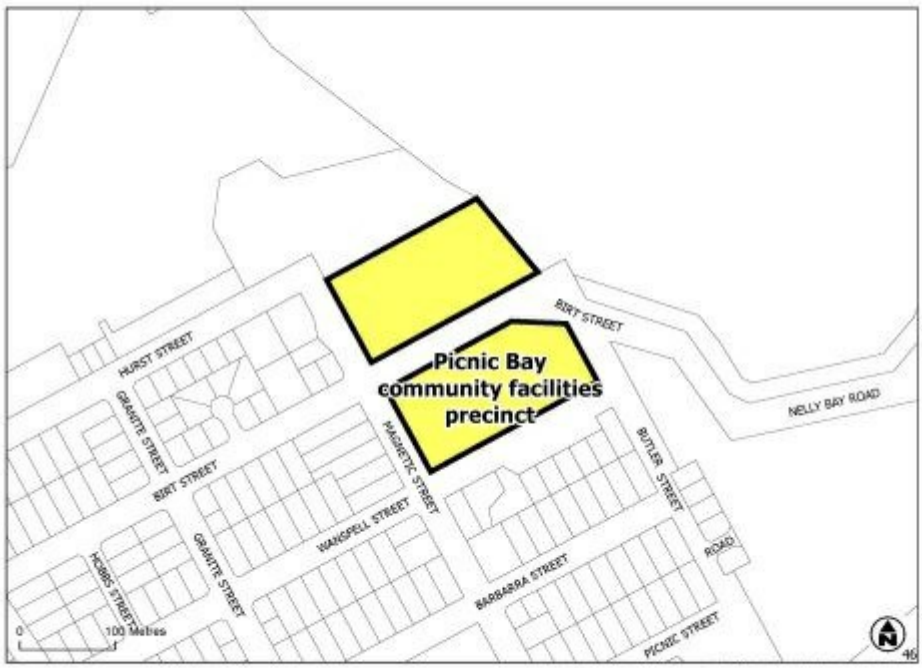

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Figure 6.152 – Picnic Bay community facilities precinct

6.4.3.3 Assessment benchmarks

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development – where involving a new building or expansion to an existing building	
Built form	
PO1 Development does not substantially exceed the height of existing buildings in the area.	**AO1** Building height does not exceed 3 storeys.
PO2 Building setbacks and orientation provide for an attractive streetscape that is compatible with existing characteristics of the local area.	**AO2** Buildings have their main face to the street and are set back from that frontage: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO3 Development minimises the bulk of buildings to assist integration with surrounding development.	**AO3** Walls are articulated so that they do not exceed in length of 15m without a change in plane of at least 0.75m depth.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building	
Amenity	
PO4 Development provides adequate separation, buffering and screening from residential uses and land within a residential zone so that adverse impacts on privacy and amenity are minimised.	**AO4.1** Buildings are set back 6m or half the height of that part of the building, whichever is the greater, from any boundary shared with a residential use or land within a residential zone.
	AO4.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential use or land within a residential zone. OR **AO4.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential use or land within a residential zone. **Editor's note–**landscaping is to be provided to a standard specified in Section 9.3.3 Landscape code.
	AO4.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO5.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting.*
	AO5.2 Outdoor lighting is provided in accordance with *Australian Standard AS1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO6 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO6** The open area used for the storage of refuse, vehicles, machinery, goods and materials used on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO7 Development does not compromise the effective operation of the primary use.	**AO7** No more than one (1) caretaker's accommodation unit is provided on the site.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community uses and clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space of a minimum of $4m^2$ is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO9 The site accommodates community-related activities or facilities in a manner that safely and efficiently meet community needs.	No acceptable outcome is nominated.
PO10 Other uses occur on a site where they: (a) support or are otherwise complementary to the community-related activities or facilities on the site; and (b) are subordinate to those activities or facilities.	No acceptable outcome is nominated.
PO11 Development does not prejudice the ongoing operation and expansion of existing uses on the site.	No acceptable outcome is nominated.
PO12 Development facilitates opportunities for appropriate co-location of community-related activities or facilities.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO13 Development maintains a level of amenity appropriate to the use and minimises impacts on surrounding land, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO14 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns, ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Picnic Bay community facilities precinct	
PO18 Development in this precinct supports a transition from the existing use as a waste facility to uses which present as a gateway feature and key community node for Picnic Bay.	No acceptable outcome is nominated.
PO19 The existing land fill site is rehabilitated to a standard that is suitable to accommodate a range of community activities.	No acceptable outcome is nominated.
PO20 Building height and massing is consistent with the low density scale of the Magnetic Island character and articulates individual buildings.	**AO20** Building height does not exceed 2 storeys.
PO21 Design of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) the natural setting of buildings within the landscape; and-Accepted development subject to requirements (c) maximising views to the bay.	No acceptable outcome is nominated.
PO22 Built form, landscape and streetscape treatment at the intersection of Birt Street and Nelly Bay Road reinforces a gateway statement.	No acceptable outcome is nominated.
PO23 Vehicle access points along Birt Street are minimised.	**AO23** Access points are limited to only one either side of Birt Street within this precinct.

6.4.4 Environmental management and conservation zone code

6.4.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.4.2 Purpose

(1) The purpose of the Environmental management and conservation zone code is to provide for the protection, restoration and maintenance of areas identified as supporting significant biological diversity and ecological integrity.

(2) The particular purpose of the code is to ensure that areas of conservation value, including land in the protected estate (including council owned or controlled land held for conservation) and some privately owned land are maintained and protected from the impacts of development.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) the conservation values of the land are maintained or enhanced;
- (b) these areas remain undeveloped apart from small-scale facilities that support conservation, low impact nature-based recreational activities on the land and essential infrastructure; and
- (c) adverse impacts on ecological features and processes are avoided.

6.4.4.3 Assessment benchmarks

Table 6.4.4.3—Assessable development

Performance outcomes	Acceptable outcomes
For assessable development only	
PO1 Development is limited to: (a) development that facilitates conservation activities on the land; or (b) development that provides information or education of visitors directly connected to the values of the land; or (c) development that is ancillary to and directly supports visitation to the land for conservation or recreation purposes consistent with (a) or (b), for example through the provision of light refreshments; or (d) the establishment of infrastructure that cannot practicably be located elsewhere; or (e) the establishment of a single dwelling house or caretaker's accommodation unit.	No acceptable outcome is nominated.
PO2 Tourist accommodation is not established.	**AO2** No acceptable outcome is nominated.
PO3 The footprint of any development is minimal and built form is of a low key, low-rise scale.	**AO3.1** Development occurs within existing buildings.
	AO3.2 Development does not involve any clearing of vegetation.

PO4 The land is not further subdivided.	**AO4** No new lots are created.
PO5 Environmental values on the site are maintained or enhanced.	No acceptable outcome is nominated.

6.5 Industry zones category

6.5.1 Low impact industry zone code

6.5.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.1.2 Purpose

(1) The purpose of the Low impact industry zone code is to provide for service industry and low impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.

Activities considered appropriate in this zone are defined as Low impact industry or Service industry in the schedule of definitions.

(2) The particular purpose of the code is to:

- (a) facilitate the safe, efficient and attractive use of land for smaller scale and lower impacting industries; and
- (b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

- (a) the zone primarily accommodates a range of generally smaller scale industrial uses which have low levels of potential impacts on surrounding areas and often provide services to the general public;
- (b) the zone also accommodates storage, wholesale and trade supplies, uses requiring significant outdoor sales areas and indoor sport and recreation uses which are difficult to locate elsewhere, where these have low levels of potential impacts on the surrounding area;
- (c) other non-industrial uses occur where they are ancillary to or directly support the industrial functions of the area, and are limited in extent;
- (d) the zone does not accommodate uses which are primarily oriented to retail sales and which are more appropriately located in centres, such as shops, shopping centres, showrooms or retail based hardware supplies;
- (e) the intrusion of incompatible uses, or uses which are more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;
- (f) any interface between industrial uses and sensitive land uses is designed and managed to minimise adverse impacts;
- (g) development makes a positive contribution to the public domain, particularly along major roads and near centres; and
- (h) development avoids significant adverse effects on water quality and the natural environment.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Nelly Bay low impact industry precinct:

(a) design of built form is of high quality and consistent with the low density Magnetic Island character.

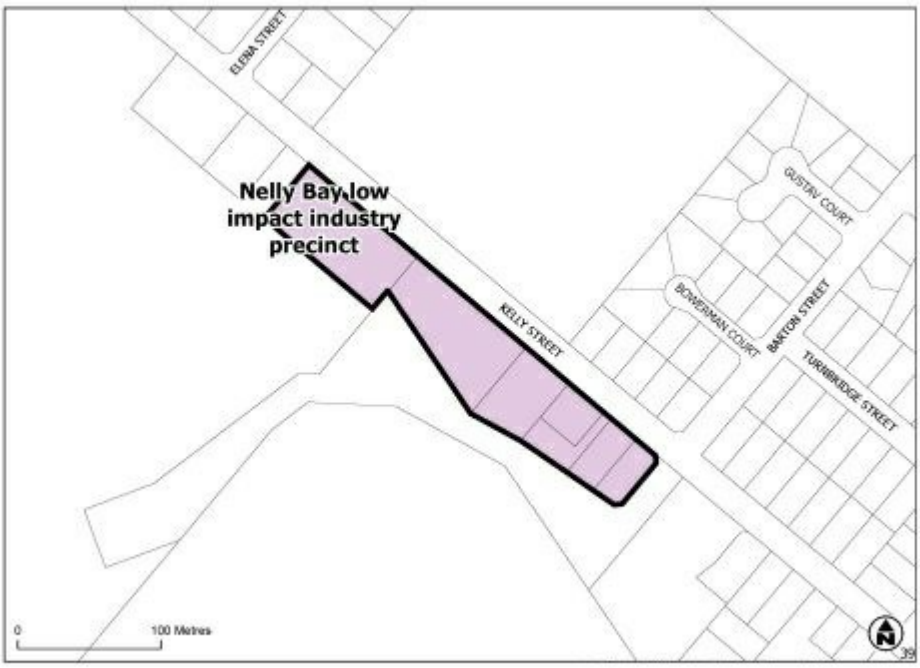

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Figure 6.153 – Nelly Bay low impact industry precinct

6.5.1.3 Assessment benchmarks

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the height and scale of surrounding buildings and includes features that contribute to an attractive streetscape.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Walls that have frontage to a street or road are articulated so that they do not exceed a length of 15m without a change in plane of at least 0.75m depth.
	AO1.3 New building and structure height does not exceed 12m.
	AO1.4 Buildings are set back from street and road frontages: (a) within 20% of the average front set back of adjoining buildings; or (b) where there are no adjoining buildings, 4m.
	AO1.5 Vehicle manoeuvring and loading and unloading areas are located to the side or behind of the building, and are not located in front of the building.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries to buildings are visible from the street and visitor parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Where adjoining a residential zone, development provides adequate buffering and screening so that adverse impacts on privacy and amenity are minimised.	**AO3.1** New buildings, plant and equipment, active outdoor use areas, site access and parking, servicing or outdoor storage areas are set back a minimum of 5m from any boundary adjoining a residential zone.
	AO3.2 Within the setback area adjoining a residential zone, the following are provided: (a) a minimum 1.8m high solid boundary fence; or (b) a densely planted landscape strip, having a minimum depth of 2m and the balance setback area turfed.
	AO3.3 Windows or openings that have direct views into adjoining residential buildings are provided with fixed screening that is a maximum of 50% transparent to obscure views into the adjoining residential building and maintain privacy for those residents.
PO4 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from the street and land within other zones.	**AO4** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.
PO5 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO5** Landscaping is provided along all road frontages of the site for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO6 Development minimises impacts on surrounding land having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO6.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO6.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO6.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO6.4 All external areas are sealed, turfed or landscaped.
	AO6.5 Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO6.6 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.
PO7 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off-site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO7.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO7.2 Roof water is piped away from areas of potential contamination.
PO8 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO8** Development does not involve earthworks involving more than $100m^3$.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one (1) caretaker's accommodation dwelling is established on the site.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Ancillary office uses	
PO10 Offices are accommodated within the zone where they are ancillary to the primary use.	**AO10** The area used for an office use does not exceed 250m^2 or 10% of the gross floor area, whichever is the lesser.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO11 Development within the zone is of a low impact nature and is either: (a) an industrial activity; or (b) trade related; or (c) difficult to locate in other zones due to land area or operational requirements (such as outdoor sales areas and indoor sport and recreation uses); or (d) small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 Development is not primarily oriented to retail sales, other than where involving an outdoor sales activity.	No acceptable outcome is nominated.
PO13 Development does not compromise the use of land for industrial purposes.	No acceptable outcome is nominated.
PO14 The zone does not accommodate uses that attract high volumes of heavy vehicle movement or generally involve 24-hour operation.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate signage and wayfinding; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO16 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO17 The site layout and design responds sensitively to on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay low impact industry precinct	
PO18 Building design and massing is consistent with the low density scale of the Magnetic Island character and articulates individual buildings.	No acceptable outcome is nominated.
PO19 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; and (b) natural setting of buildings within the landscape.	No acceptable outcome is nominated.
PO20 Streetscape and landscape treatments contribute to the creation of the local Magnetic Island character.	No acceptable outcome is nominated.

6.5.2 Medium impact industry zone code

6.5.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.2.2 Purpose

(1) The purpose of the Medium impact industry zone code is to provide for medium impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.
Activities considered appropriate in this zone are defined as Medium impact industry in the schedule of definitions.

(2) The particular purpose of the code is to:

(a) facilitate the safe and efficient use of land for a range of industrial activities; and

(b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone accommodates a wide range of industrial uses that are likely to have some potential for off-site impacts, including manufacturing, transport, storage, outdoor sales and other uses which require larger sites in locations separated from sensitive land uses;

(b) other non-industrial uses are those which are ancillary to or directly support the industrial functions of the area, and are limited in extent;

(c) the zone does not accommodate uses which are primarily oriented to retail sales and which are more appropriately located in centres, such as shops, shopping centres, showrooms, or retail based hardware supplies;

(d) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;

(e) the impacts of development are managed to ensure public health and safety and achieve acceptable levels of amenity for nearby sensitive land uses;

(f) development avoids significant adverse effects on water quality and the natural environment;

(g) development does not adversely affect the safe and efficient operation of nearby Department of Defence landholdings;

(h) development is safe and legible, and designed to establish safe and efficient movement systems;

(i) lot sizes provide for a range of large format industrial uses and discourage take up of land for smaller scale activities better suited to the Low impact industry zone; and

(j) development makes a positive contribution to the public domain, particularly along major roads.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Roseneath medium impact industry precinct:

(a) medium impact industries, including those with a transport and logistics focus, occurs in the precinct;

(b) development provides adequate new infrastructure to support new uses, including roads, stormwater, water and sewer infrastructure;

Editor's note—Conditions of approval or infrastructure agreements will be used (as appropriate) to ensure that infrastructure is provided.

(c) development minimises impacts on surrounding land uses, including existing residential uses as far as practicable; and

(d) development protects the hydraulic capacity and environmental qualities of waterways, including Stuart and Stoney Creeks, and unnamed tributaries.

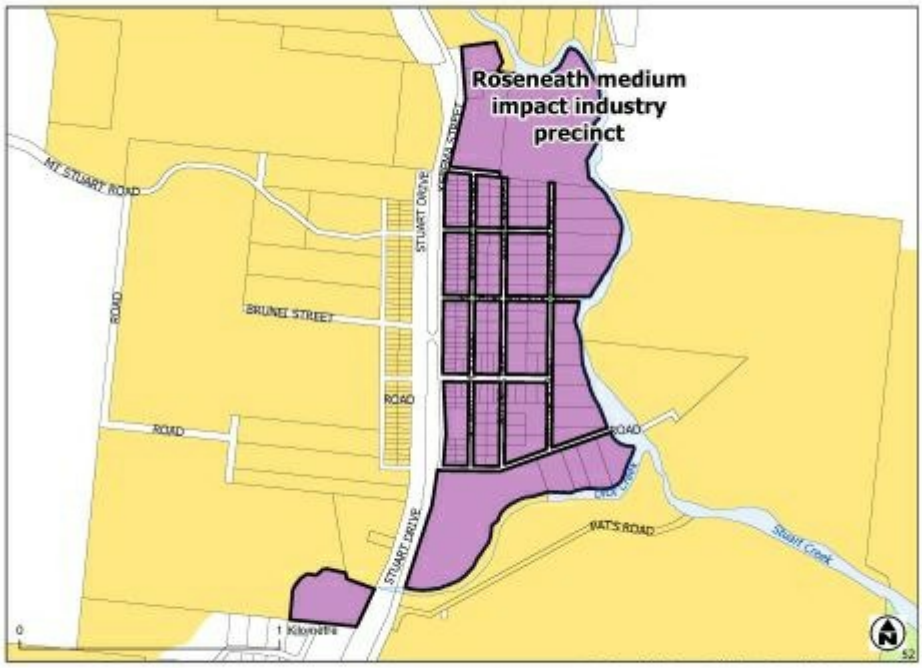

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Figure 6.154 – Roseneath medium impact industry precinct

6.5.2.3 Assessment benchmarks

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the scale of surrounding buildings.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Buildings are set back from street and road frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries are visible from the primary street frontage and visitor car parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from the street and sensitive land uses.	**AO3** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.
PO4 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO4** Landscaping is provided for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Development minimises impacts on sensitive land uses having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO5.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO5.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO5.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO5.4 All external areas are sealed, turfed or landscaped.
	AO5.5 Light emanating from any source complies with A*ustralian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO5.6 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.

PO6 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off-site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO6.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO6.2 Roof water is piped away from areas of potential contamination.
PO7 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO7** Development does not involve earthworks involving more than 100m^3.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Defence land	
PO8 Development does not adversely affect the safe and efficient operation of nearby Department of Defence land.	**AO8** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one (1) caretaker's accommodation dwelling is established on the site.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Ancillary office uses	
PO10 Offices are accommodated where they are ancillary to the primary industrial use on the site.	**AO10** The area used for an office use does not exceed 250m^2 or 10% of the gross floor area, whichever is the lesser.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO11 Development within the zone facilitates: (a) industrial activities whose impacts on sensitive land uses and the natural environment can be appropriately managed; or (b) uses which require larger sites in locations that are separated from sensitive land uses, and are not more appropriately accommodated in other zones; or (c) non-industrial uses which are small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 Development is not primarily oriented to retail sales, other than where involving an outdoor sales activity.	No acceptable outcome is nominated.
PO13 Development does not significantly detract from the availability or utility of land for industry purposes.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate signage and wayfinding; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO15 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO16 The site layout and design responds sensitively to on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts	
Roseneath medium impact industry precinct	
PO17 Development is supported by adequate infrastructure, including: (a) connection to reticulated water and sewage networks; (b) connection to a stormwater drainage system; and (c) constructed roads.	No acceptable outcome is nominated. **Editor's note—**In accordance with the Act, council may seek to secure the necessary infrastructure through conditions of approval or infrastructure agreements.
PO18 Development protects the environmental quality, existing riparian vegetation and hydraulic capacity of waterways including Stuart and Stoney Creeks.	No acceptable outcome is nominated.
PO19 Development does not compromise the safe use of the nearby magazine reserve.	**AO19** The development does not compromise the protective works safety distance from explosive storage stipulated in *AS2187-1 Explosives — Storage, transport and use* and is otherwise consistent with that standard. **Editor's note—**The magazine reserve is located on the following property descriptions, Lot 103 Plan EP2187 and Lot 220 Plan SP138418.
PO20 Impacts on nearby residential uses are minimised as far as practicable. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	No acceptable outcome is nominated.

6.5.3 High impact industry zone code

6.5.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.3.2 Purpose

(1) The purpose of the High impact industry zone code is to provide for high impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.

Activities considered appropriate in this zone are defined as High impact industry in the schedule of definitions.

(2) The particular purpose of the code is to:

(a) facilitate the safe and efficient use of land for a range of higher impacting industrial activities; and

(b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone accommodates industrial uses that are likely to have a higher potential for off-site impacts and other uses that are of a similar nature or scale and are compatible with the impacts and risks associated with the zone;

(b) the zone does not accommodate uses which attract visitation by members of the public.

(c) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;

(d) the impacts of development are managed to ensure public health and safety;

(e) development avoids significant adverse effects on water quality and the natural environment;

(f) development does not adversely affect the safe and efficient operation of Department of Defence landholdings;

(g) development is safe and legible and designed to facilitate large format industrial uses.

(h) development makes a positive contribution to the public domain, particularly along major roads.

6.5.3.3 Assessment benchmarks

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion of an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the scale of surrounding buildings.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries are visible from the primary street frontage and visitor parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion of an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from major roads.	**AO3** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.

PO4 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO4** Landscaping is provided along all road frontages of the site for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Development minimises impacts on sensitive land uses having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO5.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO5.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO5.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO5.4 All external areas are sealed, turfed or landscaped.
	AO5.5 Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO5.6 Outdoor lighting is provided in accordance with Australian Standard *AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.
PO6 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off- site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works Code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO6.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO6.2 Roof water is piped away from areas of potential contamination.
PO7 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO7** Development does not involve earthworks involving more than $100m^3$.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Defence land	
PO8 Development does not adversely affect the safe and efficient operation of Department of Defence land.	**AO8** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.5.3.3 - Self-assessable and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one caretaker's accommodation dwelling is established on the site.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO10 The zone predominantly accommodates industrial uses with potential for higher impacts.	No acceptable outcome is nominated.
PO11 Other uses are accommodated where they: (a) are uses which: (i) require larger sites in locations that are separated from sensitive land uses; (ii) are not more appropriately accommodated in other zones; and (iii) are compatible with the impacts and risks associated with the zone; or (b) are small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 The zone does not accommodate uses that attract members of the public who are not employed in the zone.	No acceptable outcome is nominated.
PO13 Development does not significantly detract from the availability or utility of land for industrial purposes.	No acceptable outcome is nominated.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate wayfinding mechanisms; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO15 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO16 The site layout and design minimises impacts of on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

6.6 Rural zones category

6.6.1 Rural zone code

6.6.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.6.1.2 Purpose

(1) The purpose of the Rural zone code is to:

(a) provide for a wide range of rural uses including cropping, intensive horticulture, intensive animal industries, animal husbandry, animal keeping and other primary production activities;

(b) provide opportunities for non-rural uses that are compatible with agriculture, the environment, and the landscape character of the rural area where they do not compromise the long-term use of the land for rural purposes; and

(c) protect or manage significant natural features, resources, and processes, including the capacity for primary production.

(2) The particular purpose of the code is to ensure:

(a) the productive capacity of all rural land and opportunities to diversify and add value to rural production are maximised, within the ecological constraints of the land;

(b) the character and landscape values of non-urban land are maintained; and

(c) urban or rural residential development does not expand into rural zoned land.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone primarily accommodates cropping or animal husbandry and ancillary detached houses;

(b) all rural land is protected from further fragmentation. A lack of viability for existing farm units and small holdings does not justify their further subdivision or use for non-rural purposes;

(c) housing in the rural zone only occurs to the extent that it supports the productive use of the land. Urban and rural residential development is contained within designated growth areas and does not expand into the rural zone;

(d) other new enterprises, including rural industries and tourism activities, are accommodated where:

(i) they are directly associated with rural production, a natural resource or the natural environment or need to be remote from urban uses as a result of their impacts;

(ii) the productive capacity of the land is not diminished and conflicts with existing and intended activities in the surrounding area are avoided;

(iii) the existing landscape and natural resource values of the land are maintained; and

(iv) the development is not more appropriately located in another zone;

(e) extractive resources and existing extractive operations on rural land are protected from encroachment by incompatible uses;

(f) the environmental, character and landscape values of all rural land are maintained; and

(g) adequate separation and buffering is provided by new development in nearby urban or rural residential zoned land to ensure the encroachment by more intensive residential and other sensitive uses is avoided.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Horticulture precinct:

(a) this precinct contains the most productive areas in the Townsville region, in which cropping is the predominant land use. The productive capacity of this land is maximised;

(b) rural industries which have a direct nexus with the rural production in the immediate locality and only small-scale farm stay or bed and breakfast accommodation are established in this precinct;

(c) forestry does not adversely affect horticultural production, natural or scenic values on nearby land;

(d) permanent plantations, animal keeping (being kennels and catteries), intensive animal industries and aquaculture are not established in this precinct; and

(e) subdivision of lots below 40ha generally does not occur.

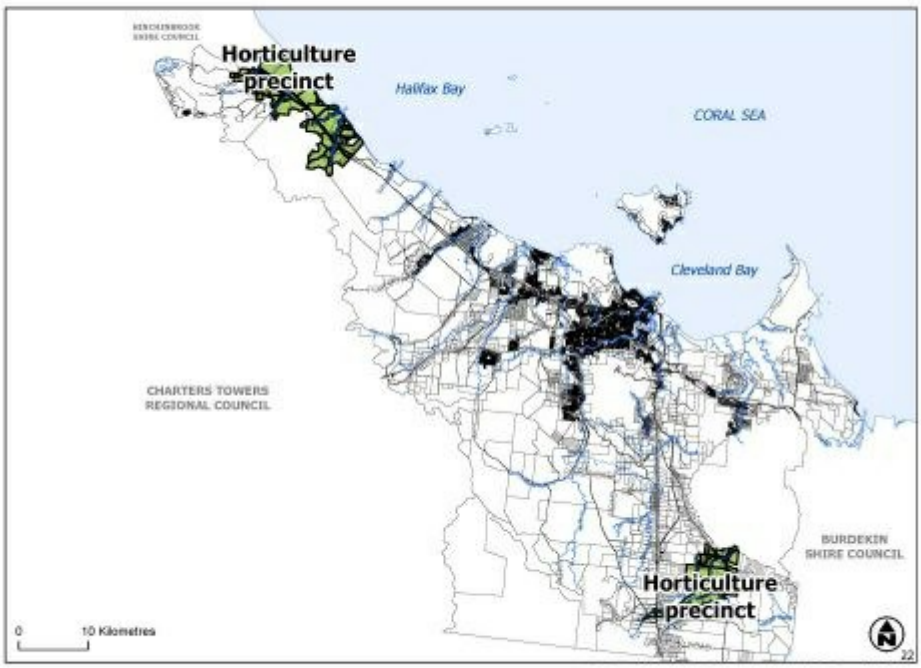

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Figure 6.155 – Horticulture precinct

Mixed farming precinct:

(a) this precinct contains low intensity animal husbandry with some potential for cropping.

(b) animal keeping (being kennels and catteries), intensive animal industries, aquaculture and rural industries establish where they:

  (i) are able to be located on less productive land within the precinct;

  (ii) are adequately separated from rural dwellings and other sensitive land uses;

  (iii) do not diminish the productive capacity of other land nearby; and

  (iv) do not diminish water quality, natural, scenic or environmental values, including remnant vegetation;

(c) subdivision of lots below 400ha in the Ross River Dam catchment and 40ha elsewhere generally does not occur.

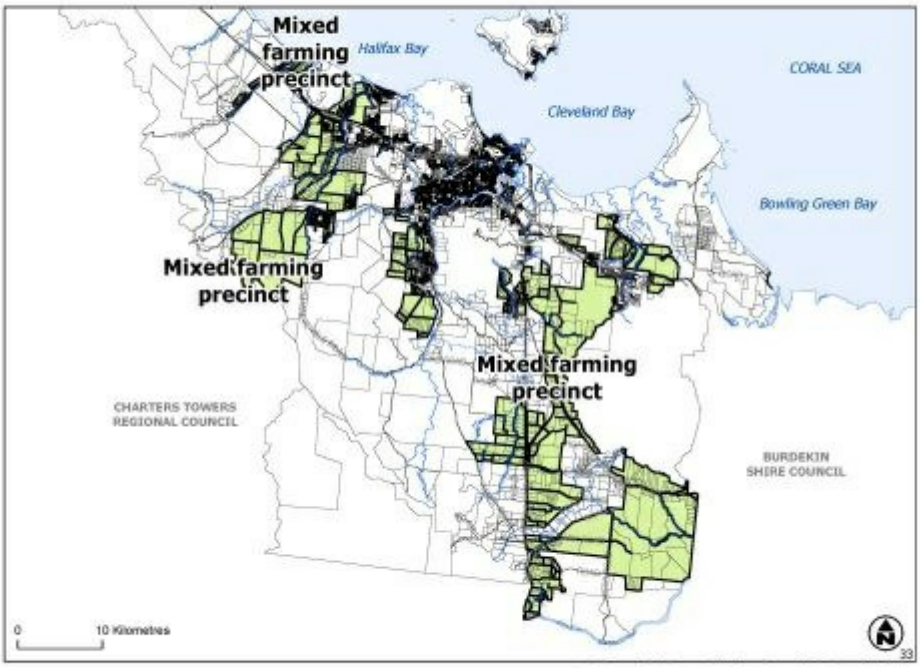

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Figure 6.156 – Mixed farming precinct

Grazing precinct:

(a) this precinct predominantly contains broad hectare grazing;

(b) the landscape character of elevated areas with high landscape significance is protected;

(c) animal keeping (being kennels and catteries), intensive animal industries, aquaculture and rural industries establish where they:

  (i) are able to be located on less productive land within the precinct;

  (ii) are adequately separated from rural dwellings and other sensitive land uses;

  (iii) do not diminish the productive capacity of other land nearby; and

  (iv) do not diminish water quality, natural, scenic or environmental values, including remnant vegetation;

(d) development does not prejudice the long-term potential of the Woodstock area for accommodating high impact, noxious or hazardous industries; and

(e) subdivision of lots below 400ha generally does not occur.

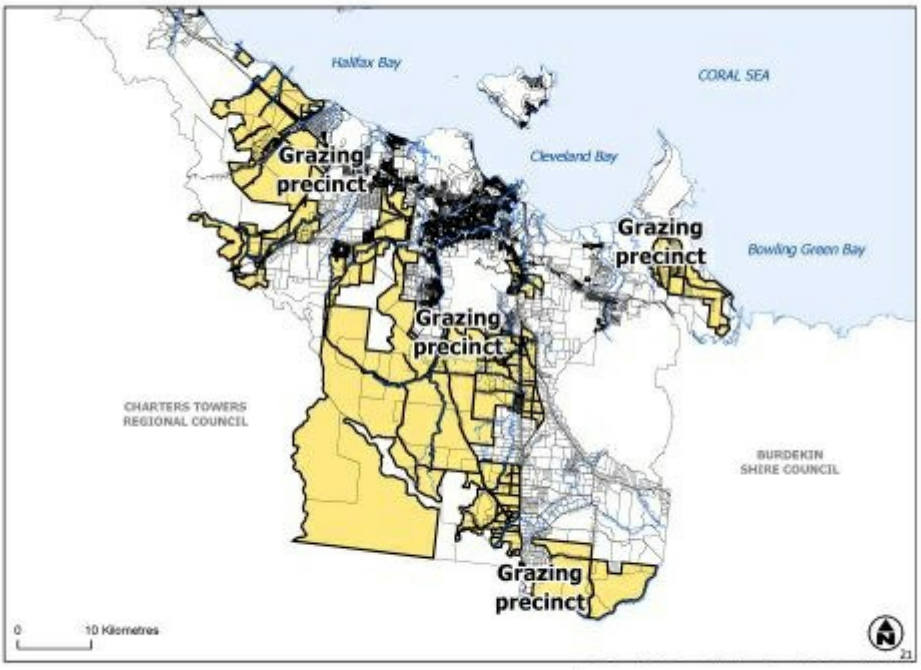

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Figure 6.157 – Grazing precinct

Cungulla precinct:

(a) rural land in the Cungulla precinct includes smaller lots used for primarily residential purposes. Agricultural uses are of lesser importance at Cungulla;

(b) houses are established on rural zoned land at Cungulla, providing that appropriate residential amenity and safety can be maintained, with particular regard to nearby extractive industry activities;

(c) houses are provided with adequate water supply and sewage treatment and disposal can be provided; and

(d) subdivision of lots below 10ha generally does not occur.

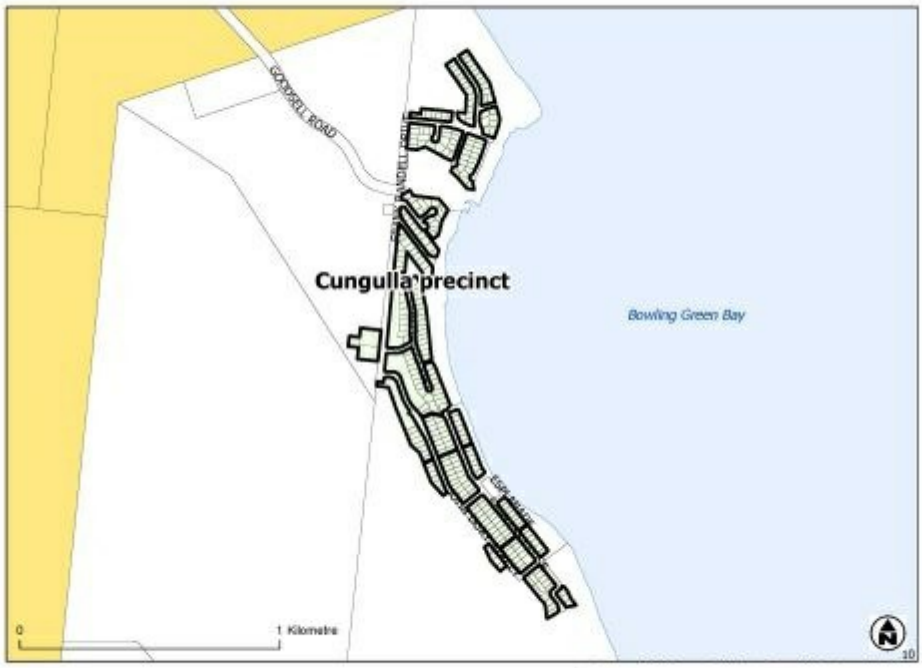

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Figure 6.158 – Cungulla precinct

Jensen precinct:

(a) this precinct contains smaller rural living lots with some potential for cropping;

(b) houses are provided with reticulated water supply, and on-site sewerage treatment and disposal; and

(c) subdivision of lots below 10ha generally does not occur.

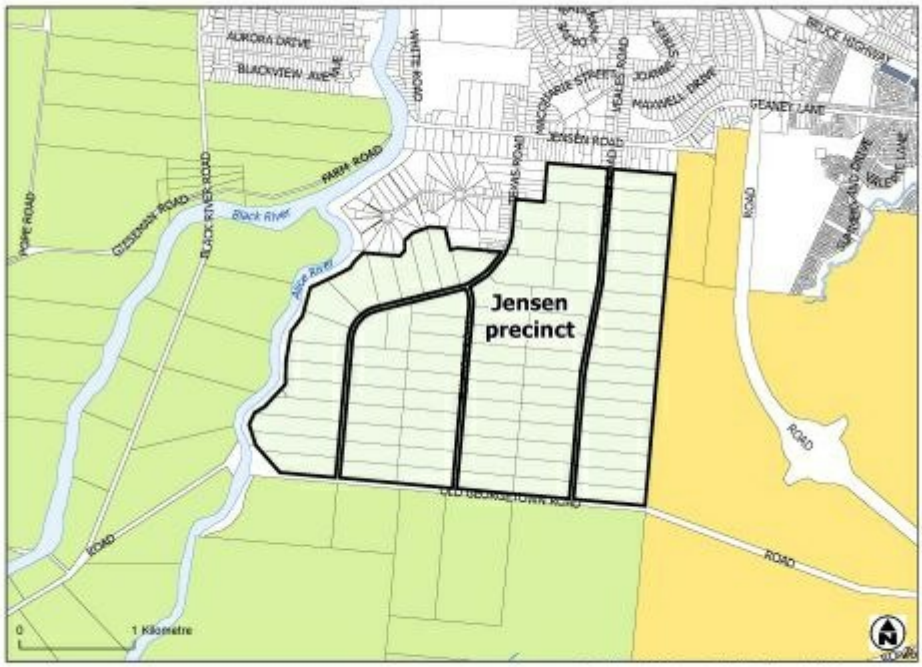

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Figure 6.159 – Jensen precinct

6.6.1.3 Assessment benchmarks

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Editor's note—Dwelling houses may also be accepted development subject to requirements against the Water resources catchment overlay code.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation, community residence or dwelling house	
PO1 Development does not detract from the effective operation of the primary use or the rural landscape character and amenity of site.	**AO1.1** Dwellings are not established on lots less than 1ha in size, other than in the Cungulla precinct.
	AO1.2.1 Where on a lot less than 1ha (in accordance with AO1.1), no more than 1 dwelling is established. OR **AO1.2.2** On lots greater than 1ha, no more than 2 dwellings are established.
PO2 Dwellings have adequate access to basic services to ensure the safety and wellbeing of residents and the protection of water quality and other environmental values.	**AO2** A dwelling: (a) has a legal access to a constructed road; (b) has a legal connection to either: (i) reticulated water supply; or (ii) a water tank with a minimum capacity of 45,000 liters; and (c) if in the Cungulla precinct, does not rely on bore water.
PO3 Dwellings are sufficiently separated from existing lawful activities in the locality in order to protect the safety and amenity of residents and to ensure the ongoing operation of those activities is not prejudiced.	**AO3.1** Dwellings are separated from: (a) an existing or approved intensive animal industry use by at least 1km; (b) an existing or approved extractive industry operation or a resource/processing area shown on overlay map OM-05 by: (i) 500m from a hard rock extractive industry; (ii) 200m from a sand and gravel extractive industry; and (iii) 100m from a haul route used by any existing operation.
	AO3.2 Dwellings are set back from all site boundaries by 20m, other than in the Cungulla precinct where dwellings and ancillary structures are set back a minimum of 6m from front boundaries, 3m from side boundaries where adjoining a road or 1.5m otherwise for side and rear boundaries.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO4 Development does not detract from the effective operation of the primary use or the rural landscape character and amenity of site. **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes GVM (gross vehicle mass), GCM (gross combination mass) or more than 2 tonnes ATM (aggregate trailer mass).	**AO4.1** The home based business does not: (a) require more than the owner and 2 employees on-site at any one time; (b) does not generate more than 14 visitor trips per day, where one trip includes arriving and departing the site. These trips are additional to normal trips associated with the dwelling or rural use; (c) include an area exceeding 20m^2 used for the sale of the goods made on the site; (d) involve hiring out of materials, goods, appliances or vehicles; and (e) involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business or rural use on the site.
	AO4.2 Bed and breakfast or farm stay accommodation does not exceed three bedrooms or three cabins.
PO5 Heavy vehicle parking: (a) has a direct nexus with a home based business or rural use carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO5.1** Not more than two heavy vehicles are parked on the site.
	AO5.2 While on-site, vehicles: (a) are not operated between the hours of 10pm and 6am; (b) are not left idling for more than 5 minutes at any one time; and (c) do not have a refrigeration unit running.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Roadside stall	
PO6 Roadside stalls are small in scale and do not impact negatively upon the amenity, character or safety of rural areas and the safety and efficiency of roads.	**AO6.1** Any structure used for the sale of goods or produce is limited to 20m^2 gross floor area.
	AO6.2 Access to the structure is via the primary property access point.
	AO6.3 Produce or goods sold is grown, made or produced on the land on which the road side stall is erected.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Rural industry, community use, wholesale nursery	
PO7 Development does not impact negatively upon the amenity, character or safety of surrounding areas.	**AO7.1** Non-residential buildings, animal enclosures storage facilities and waste disposal areas are set back: (a) 100m from the boundary of any land included in residential zone or the rural residential zone; or (b) 50m from other site boundaries.
	AO7.2 Buildings are set back 20m from any road frontage.
	AO7.3 Building height does not exceed 2 storeys.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General benchmarks	
PO8 Development: (a) is located on the least productive parts of a site; (b) does not restrict the ongoing safe and efficient use of nearby rural uses; and (c) is adequately separated or buffered where it is likely to be sensitive to the operational characteristics associated with rural uses, rural industries, extractive industries or other lawful use.	No acceptable outcome is nominated.
PO9 Tourism-related uses are established only where they are directly associated and compatible with rural production, natural resources or landscape amenity in the immediate vicinity.	No acceptable outcome is nominated.

PO10 Uses that require isolation from urban areas are accommodated only where: (a) they cannot be more appropriately located in an industrial or other relevant zone; (b) they can be adequately separated from sensitive uses (whether or not in the rural zone); (c) they can be adequately separated from land in the Horticulture precinct; and (d) potential impacts can be appropriately managed. **Editor's note—**Applicants seeking approval for intensive animal industries should refer to the *'National Guidelines for Beef Cattle Feedlots in Australia, National Beef Cattle Feedlot Environmental Code of Practice'*, 'Queensland Dairy Farming Environmental Code of Practice', *'National Environmental Guidelines for Piggeries'* and *'Queensland Guidelines Meat Chicken Farms* and that applicants consult with the relevant State government department prior to the lodgement of a development application. For other uses council may require a study that, amongst other matters, identifies how the development is in accordance with Environmental Protection (Air) Policy 1997 or Environmental Protection (Noise) Policy 1997.	No acceptable outcome is nominated.
PO11 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO12 Development does not adversely impact on the character, amenity or scenic values of the locality, having regard to: (a) the scale, siting and design of buildings; (b) the visibility of buildings, structures and infrastructure; (c) likely emissions including water-borne contaminants, noise, dust, lighting and odour; and (d) the nature or volume of traffic generated.	No acceptable outcome is nominated.
PO13 Ecological values, habitat corridors and soil and water quality are protected, having regard to: (a) maximisation of vegetation retention and protection of vegetation from the impacts of development; (b) avoidance of potential for erosion and minimisation of earthworks; (c) retention and protection of natural drainage lines and hydrological regimes; and (d) avoidance of leeching by nutrients, pesticides or other contaminants, or potential for salinity.	No acceptable outcome is nominated.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Horticulture precinct	
PO14 Productive land within this precinct is maintained.	No acceptable outcome is nominated.
PO15 Rural industries are established only where associated with rural production in the immediate vicinity.	No acceptable outcome is nominated.
PO16 Tourist related uses are limited to small-scale bed and breakfast and farm stay which do not detract from the ongoing productive use of the site.	No acceptable outcome is nominated.
PO17 Reconfiguration is limited to protect the ongoing viability of existing and potential horticulture.	**AO17** The minimum lot size in the precinct is 40ha.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Mixed farming precinct	
PO18 Reconfiguration is limited to protect the ongoing viability of existing and potential horticulture uses, water quality and ecological and landscape values.	**AO18** The minimum lot size in the precinct is 40ha, except in the Ross River Dam Catchment area where the minimum lot size is 400ha. **Editor's note—**The Ross River Dam catchment area is depicted on the Water resource catchment overlay map OM-09.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Grazing precinct	
PO19 Development in the vicinity of the Woodstock industry investigation area does not prejudice its future potential for industry.	No acceptable outcome is nominated.
PO20 Reconfiguration is limited to reflect the suitability of the land for primarily grazing purposes and to protect water quality and ecological and landscape values.	**AO20** The minimum lot size in the precinct is 400ha.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Cungulla precinct	
PO21 Development is compatible with the residential amenity of the locality and avoids adverse impacts on surrounding dwellings.	No acceptable outcome is nominated.

6.7 Other zones category

6.7.1 Emerging community zone code

6.7.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.7.1.2 Purpose

(1) The purpose of the Emerging community zone code is to:

- (a) identify land that is suitable for urban purposes and conserve land that may be suitable for urban development in the future;
- (b) manage the timely conversion of non-urban land to urban purposes; and
- (c) prevent or discourage development that is likely to compromise appropriate longer term land use.

(2) The particular purpose of the code is:

- (a) to ensure that future development:
  - (i) creates an integrated and compact urban form;
  - (ii) establishes safe, attractive and walkable communities;
  - (iii) provides for a wide choice of housing, employment and accessible community services; and
  - (iv) avoids areas within the Emerging community zone that are unsuited to urban development because of their natural, scenic or cultural values; and
- (b) to ensure that any development which occurs prior to urbanisation of an area maintains the suitability and capacity for future urban development.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) structure planning of areas within the zone is undertaken in advance of development of the land for urban purposes;
- (b) land is developed in a logical pattern that facilitates the efficient provision of infrastructure;
- (c) a high level of integration with existing and future urban development is achieved having regard to movement networks, open space and recreational facilities, centres and community infrastructure;
- (d) development facilitates the establishment of new residential communities together with an appropriate level of supporting land uses such as centres, industry and community activities;
- (e) residential development provides for a range of housing types and achieves a minimum dwelling yield of 15 dwellings per hectare net;
- (f) movement networks are established to promote active transport (walking and cycling) and public transport;
- (g) development retains and protects significant environmental, topographic, scenic and cultural features and values;
- (h) development provides for sufficient buffering to existing or intended non-urban or incompatible uses in surrounding areas; and
- (i) development which is, or has the potential to become, incompatible with future urban development of the area does not occur.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts.

Burdell precinct:

- (a) creates an identifiable community, which is developed through detailed subdivision design, focused land use provision and clear building requirements;
- (b) provides housing diversity to meet the evolving needs of various household types and lifestyles;

(c) development is integrated and respects the site's character and provides access to open space and community facilities;

(d) provides a defined open space system that protects wetland and riparian environmental values and provides various recreational opportunities;

(e) development facilitates safe and functional access within the precinct and to external connections;

(f) is designed to achieve tropical urban design outcomes;

(g) is developed for community and commercial facilities to:

(A) service the residents of the precinct, residents of the region, and the travelling public; and

(B) ensure that residential amenity is not detrimentally affected;

(h) provides for an integrated linear open space system along the major drainage paths with linkages to the Bohle River; and

(i) provides for innovative development over the life of the development of the precinct area, to account for technological development and changing patterns in the community.

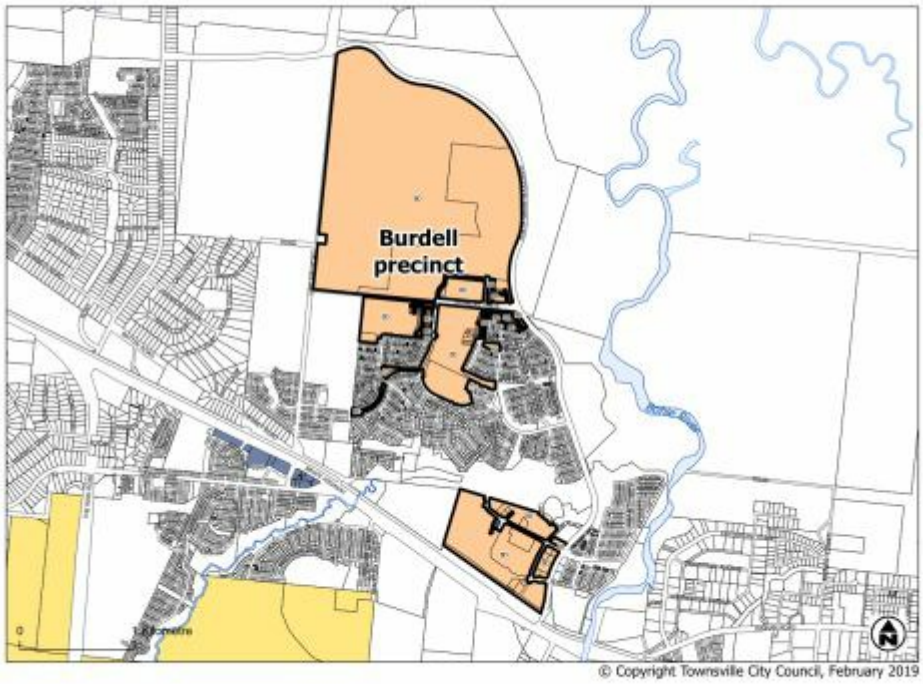

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Figure 6.160 - Burdell precinct

6.7.1.3 Assessment benchmarks

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast or farm stay accommodation does not exceed three bedrooms or cabins; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast, farm stay or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO2** Development of the sales office is in place for no more than five years.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Interim land uses	
PO3 Development does not reduce or preclude the long-term use of the site or nearby land for urban purposes, having regard to the scale and nature of the activity and its likely impacts, and would not compromise the implementation of a future structure plan over the site.	No acceptable outcome is nominated.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Creating new communities	
PO4 New development of an urban nature: (a) contributes to a logical pattern and sequence of development; (b) facilitates efficient use of land and infrastructure; (c) facilitates integration with existing and future urban development, having regard to movement networks, open space networks and accessibility to community infrastructure; (d) provides accessibility for all modes of transport including pedestrian, cyclist, public transport and private car; (e) creates clear, direct pedestrian and cycle access to centres, local parks and public transport stops; (f) achieves an average net residential density of at least 15 dwellings per hectare; (g) locates higher density residential development in and around centres, along connector streets and close to transit nodes; (h) locates community facilities requiring high levels of accessibility within or adjoining centres; (i) responds to constraints and natural values on the site and avoids or minimises any impacts on areas of environmental significance; (j) facilitates integrated water cycle management; (k) orients major streets and vistas to landmarks; (l) provides a road network with a capacity adequate for current and future demand; (m) does not increase hazard or risk to existing or future residents; and (n) provides an open space network suitable for current and future needs.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.
PO5 Emerging communities are provided with the range of supporting services and uses, including those that provide local employment opportunities, that: (a) are commensurate to the size of the relevant emerging community; (b) do not detract from planning scheme intentions for other parts of the city; and (c) are planned as an integrated and compatible component of the emerging community they serve.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.

PO6 New centres are designed to create: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; (e) active primary frontages with parking areas sleeved by buildings; (f) optimum energy efficiency; (g) a well-integrated mix of uses; (h) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; (i) connectivity to public transport services; and (j) sensitive transitioning to surrounding land and uses.	No acceptable outcome is nominated. **Editor's note—** Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.
PO7 Where centre development is proposed, development is consistent with the centres hierarchy and does not compromise the intended role or successful functioning of other centres in the network. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code. **Editor's note—** Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.7.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Crime prevention through environmental design	
PO8 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.7.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Burdell precinct	
PO9 A site is to be suitable in size and configuration for the intended use.	**AO9** A variety of lot sizes and configurations are provided to facilitate a well-connected master planned community.

6.7.2 Special purpose zone code

6.7.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.7.2.2 Purpose

(1) The purpose of the Special purpose zone code is to facilitate industrial development that is of regional, state and national significance.

(2) The particular purpose of the code is to:

- (a) recognise and facilitate reconfiguration of land in the Townsville State Development Area;
- (b) protect the area's suitability for industrial development and the expansion of existing industrial uses;
- (c) facilitate and maintain linkages to the Port of Townsville and major freight routes;
- (d) protect environmental values in the Townsville State Development Area; and
- (e) ensure development minimises impacts on the amenity of nearby sensitive land uses.

Editor's note—Material change of use applications in the Townsville State Development Area are administered by the Coordinator-General through the Development Scheme for the Townsville State Development Area. In this area, only development applications for reconfiguration of a lot and operational works will be assessed by Townsville City Council.

(3) The purpose of the code will be achieved through the following overall outcomes:

- (a) the Townsville State Development Area accommodates a wide range of large-scale industry uses, particularly those which support or have a nexus with the Port of Townsville and minerals processing;
- (b) other non-industrial uses are those which are ancillary to or directly support the industrial functions of the area, and are limited in extent;
- (c) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;
- (d) the impacts of development are managed to ensure public health and safety;
- (e) development avoids significant adverse effects on water quality and the natural environment;
- (f) development does not adversely affect the safe and efficient operation of Department of Defence landholdings;
- (g) development is safe and legible, and designed to establish safe and efficient movement systems;
- (h) lot sizes provide for a range of large format industrial uses and discourage take up of land for smaller scale activities better suited to other zones;
- (i) development makes a positive contribution to the public domain, particularly along major roads;
- (j) opportunities for energy efficiency through groupings and relationships between industries are accommodated where possible; and
- (k) development is adequately serviced by infrastructure and maximises the efficient use of existing and planned infrastructure.

6.7.2.3 Assessment benchmarks

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General	
PO1 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO1** Development does not involve: (a) earthworks involving more than 100m^3; and (b) any changes to existing drainage lines and wetlands.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Defence land	
PO2 Development does not adversely affect the safe and efficient operation of nearby Department of Defence land.	**AO2** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO3 Development does not significantly detract from the availability or utility of land for industrial purposes.	No acceptable outcome is nominated.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO4 Development is designed and managed so that it provides protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO5 The site layout and design minimises impacts of on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Part 6 Zones

6.1 Preliminary

(1) Zones organise the planning scheme area in a way that facilitates the location of preferred or acceptable land uses.

(2) Zones are mapped and included in Schedule 2.

(3) The categories of development and assessment for development in a zone are in Part 5.

(4) Assessment benchmarks for zones are contained in a zone code.

(5) A precinct may be identified for part of a zone.

(6) Precinct provisions are contained in the zone code.

(7) Each zone code identifies the following:

- (a) the purpose of the code;
- (b) the overall outcomes that achieve the purpose of the code;
- (c) the performance outcomes that achieve the overall outcomes and the purpose of the code;
- (d) the acceptable outcomes that achieve the performance and overall outcomes and the purpose of the code; and
- (e) the performance and acceptable outcomes for the precinct.

(8) The following are the zone codes for the planning scheme:

- (a) Residential zones category:
  - (i) Low density residential zone code;
  - (ii) Medium density residential zone code;
  - (iii) High density residential zone code;
  - (iv) Rural residential zone code;
  - (v) Character residential zone code;
- (b) Centres zones category:
  - (i) Neighbourhood centre zone code;
  - (ii) Local centre zone code;
  - (iii) District centre zone code;
  - (iv) Major centre zone code;
  - (v) Principal centre (CBD) zone code;
  - (vi) Specialised centre zone code;
  - (vii) Mixed use zone code;
- (c) Community facilities and open space zones category:
  - (i) Sport and recreation zone code;
  - (ii) Open space zone code;
  - (iii) Community facilities zone code;
  - (iv) Environmental management and conservation zone code;
- (d) Industry zones category:
  - (i) Low impact industry zone code;
  - (ii) Medium impact industry zone code;
  - (iii) High impact industry zone code;
- (e) Rural zones category:
  - (i) Rural zone code;
- (f) Other zones category:

(i) Emerging community zone code;

(ii) Special purpose zone code.

6.2 Residential zones category

6.2.1 Low density residential zone code

6.2.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.1.2 Purpose

(1) The purpose of the Low density residential zone code is to provide for predominately dwelling houses.

(2) The particular purpose of the code is to:

- (a) primarily accommodate dwelling houses and dual occupancy dwellings;
- (b) provide for housing choice and affordability by allowing for a range of lot sizes;
- (c) maintain the low-rise and lower density character of Townsville's suburbs;
- (d) maintain a high level of residential amenity; and
- (e) achieve accessible, well-serviced and well-designed communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) built form is of a house compatible scale and consistent with the local streetscape character;
- (b) reconfiguration facilitates a range of lot sizes to accommodate dwelling houses and dual occupancy dwellings, typically on lots 400m^2 or greater (unless otherwise intended in a precinct);
- (c) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (d) residential development is protected from the impacts of any nearby industrial activities, transport corridors, infrastructure, installations and major facilities such as the port, airport and Department of Defence landholdings;
- (e) the design of development promotes accessibility by walking, cycling and public transport;
- (f) the design of development is responsive to the city's climate and promotes sustainable practices including energy efficiency and water conservation;
- (g) low-rise multiple dwellings, residential care or retirement facilities may be acceptable within this zone where provided in locations that are within a convenient walkable distance to centres, public transport and community activities, and where of a scale that is consistent with the local character;
- (h) non-residential uses only occur within the zone where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centre zones;
- (i) development minimises impacts on remaining areas of ecological significance within the zone; and
- (j) the natural bushland setting and village character of the northern beaches and Magnetic Island townships are maintained. Tourism accommodation in these communities is of a house compatible scale.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Ross River Road corridor precinct:

(a) existing non-residential uses continue operation without significantly expanding;

(b) no additional non-residential development is established within the precinct to avoid the continuation of strip commercial development; and

(c) redevelopment of sites within this precinct may occur for the purposes of low-rise multiple dwellings, residential care or retirement facilities.

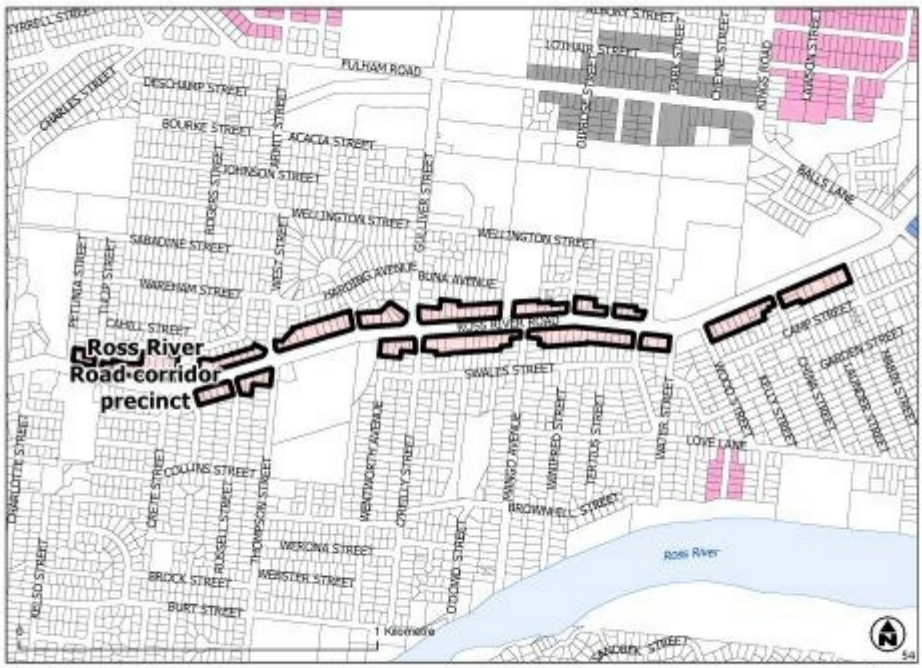

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Figure 6.1 Ross River Road corridor precinct

Stables precinct:

(a) stables are established in a manner that minimises impacts on residential amenity; and

(b) residential uses in the precinct do not intensify.

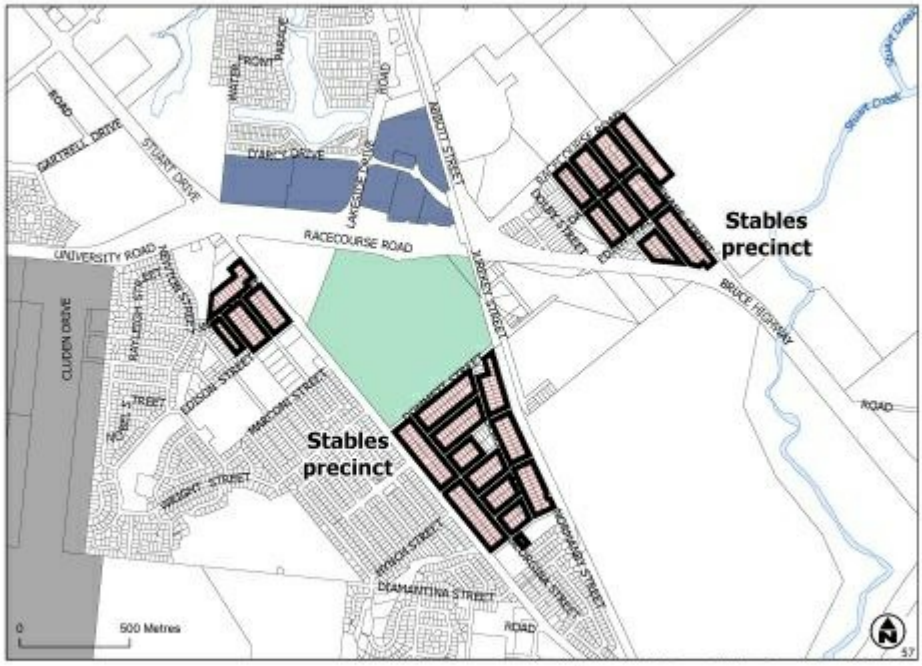

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Figure 6.2 Stables precinct

Marlow Street precinct:

(a) residential development occurs primarily in the form of dwelling houses on large lots with a limited site cover;

(b) lots are not smaller than 750m^2 and the minimum average lot size across the whole of the precinct is not less than 1,700m^2;

(c) development facilities viable wildlife corridors through the precinct; and

(d) built form and infrastructure is sub-ordinate to the vegetation and the natural landform.

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Figure 6.3 — Marlow Street precinct

6.2.1.3 Assessment benchmarks

Table 6.2.1.3 Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation, does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**a heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home based business on the site. **Editor's note—**home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

PO2 Commercial vehicle parking: (a) has a direct nexus with a home based business carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO2.1** Not more than one commercial vehicle is parked on the site.
	AO2.2 While on-site, vehicles: (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.
	AO2.3 Any commercial vehicle does not exceed 4.5 tonnes gross vehicle mass and is housed behind the building line.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For accepted development subject to requirements and assessable development	
Sales office	
PO3 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO3** Development of the sales office is in place for no more than two years.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for accepted development subject to requirements and assessable development in precincts **Note—**Townsville City Council has an animal keeping local law that also sets out requirements for stables. These must also be complied with.	
For accepted development subject to requirements and assessable development	
Stables precinct	
PO4 Only dwelling houses or caretaker's accommodation are established in the precinct.	**AO4** The development does not involve a dual occupancy, rooming accommodation, multiple dwelling, retirement facility, residential care facility, short-term accommodation or tourist park.
PO5 Reconfiguration does not result in additional lots being created.	**AO5** Lot size is no less than 1,000m^2.
PO6 The site is of a size to accommodate stables and associated service areas and allows for setback of stables from adjacent houses.	**AO6** Where stables are proposed, the site has a minimum area of 1,000m^2.
PO7 Stables are established where provision is made for a manager living on-site.	**AO7** Stables are established on the same site as a dwelling house or caretaker's accommodation.
PO8 Residential uses in the precinct do not intensify.	**AO8** Not more than one dwelling house or caretaker's accommodation unit is established on each lot.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO9 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO10 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.
PO11 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO12 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General	
PO13 Development minimises impacts on remaining areas of ecological significance within the zone.	No acceptable outcome is nominated.
PO14 On elevated or steeply sloping sites: (a) development is sympathetic to the natural landform through the use of terraced or split level building forms; (b) the understoreys of buildings are screened to maintain the quality of views from public vantage points below; and (c) buildings avoid highly reflective finishes.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO15 Parking facilities are located to be concealed from public view to ensure an attractive streetscape.	**AO15** Vehicle parking structures are located: (a) behind the building setback; or (b) behind the building; or (c) at basement level. Figure 6.4 – Concealment of parking structure illustrates.

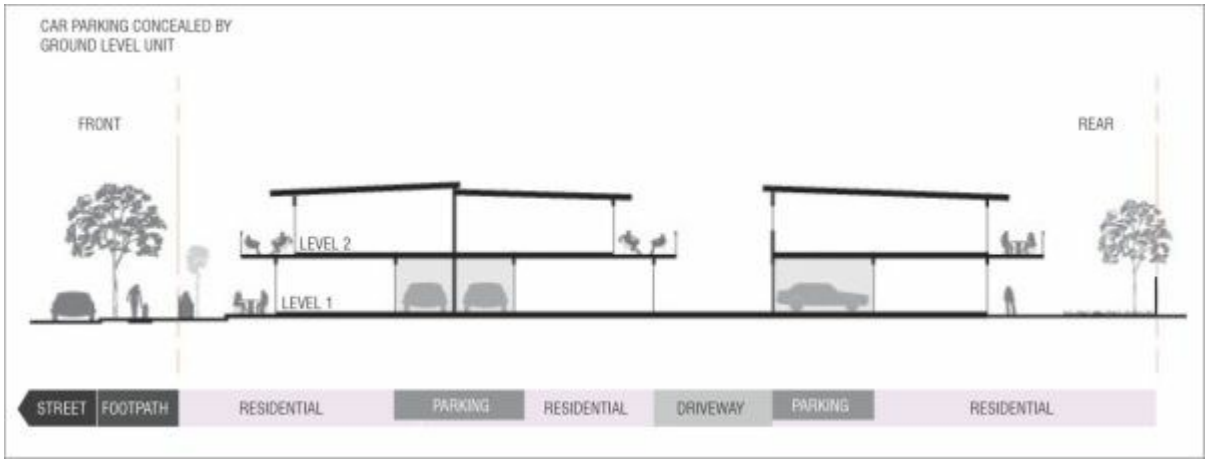

Figure 6.4 Concealment of parking structure

PO16 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development — where a non-residential or tourist accommodation use	
PO17 Non-residential uses are established only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO18 Tourist accommodation occurs only within the townships of Paluma, Balgal Beach, Toomulla, Toolakea and Saunders Beach and the Magnetic Island townships, and is compatible with the village character of these communities.	No acceptable outcome is nominated.
PO19 Development is of a house compatible scale.	**AO19.1** The use does not involve any building work or only minor building work. OR
	AO19.2 Where a new building is proposed: (a) buildings and other structures do not exceed 8.5m or 2 storeys, whichever is the lesser; (b) the building does not exceed 250m^2 in gross floor area; (c) site cover does not exceed 60%; and (d) the maximum length of any wall is 12m.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility or retirement facility development	
Location	
PO20 Multiple dwelling, residential care facility or retirement facility development occur only in locations where: (a) they can be designed to be compatible with local character and low density scale of development; (b) having convenient walkable access to the city's network of centres; (c) having convenient walkable access to public transport; and (d) having convenient walkable access to recreational facilities.	**AO20** The premises: (a) is located within 400m of a centre zone or public transport stop on a major road; (b) has a minimum site area of 1,000m² and 20m frontage where for a multiple dwelling; (c) has a minimum site area of 3,000m² and 20m frontage where for a residential care facility or retirement facility; and (d) is located within 400m of a park.
PO21 Buildings are low-rise and of a house compatible scale.	**AO21** Building design achieves: (a) a site cover that does not exceed 65% of site area; (b) a building height that does not exceed 2 storeys and 8.5m if it is within 10m of a site boundary, and 3 storeys if it is 10m or more from a site boundary; and (c) the maximum length of any wall is 12m.
PO22 Building setbacks and landscaping: (a) create an attractive, consistent and cohesive streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; and (c) do not prejudice the development or amenity of adjoining sites.	**AO22.1** Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 3m. Figure 6.5 – Appropriate front setbacks illustrates.
	AO22.2 A landscape area with a minimum dimension of 1m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access only). Figure 6.6 – Appropriate front and rear setbacks illustrates.
	AO22.3 The side boundary setback is a minimum of: (a) 1.5m for a wall up to 4.5m high; (b) 2m for a wall up to 7.5m high; and (c) 2.5m for any part of a wall over 7.5m high. **Editor's note—**Development should also comply with the requirements of AO21 (b), such that any part of the building that is 3 storeys is 10m or more from a site boundary.
	AO22.4 The rear boundary setback is a minimum of 6m. Figure 6.6 - Appropriate front and rear setbacks illustrates.

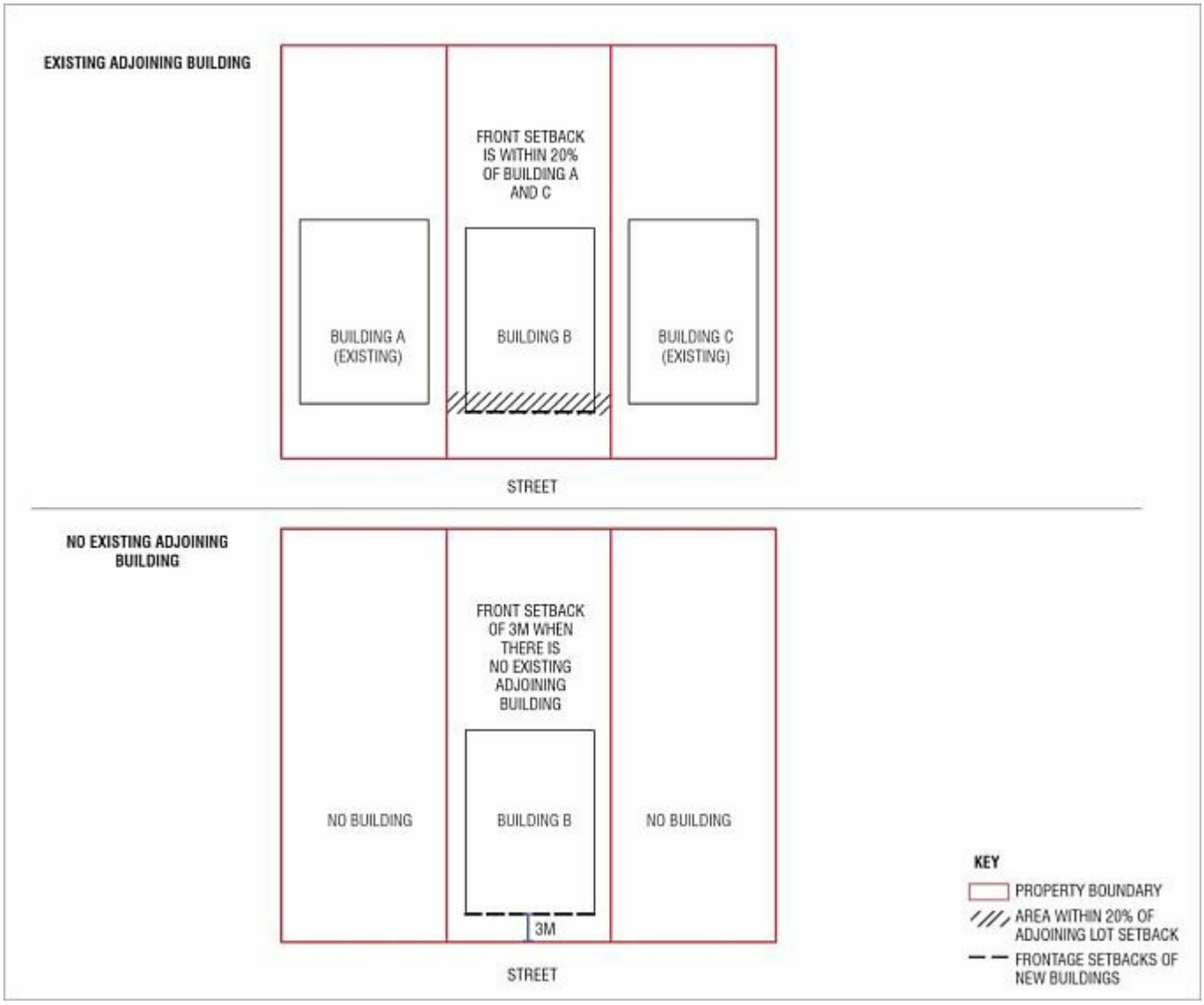

Figure 6.5 Appropriate front setbacks

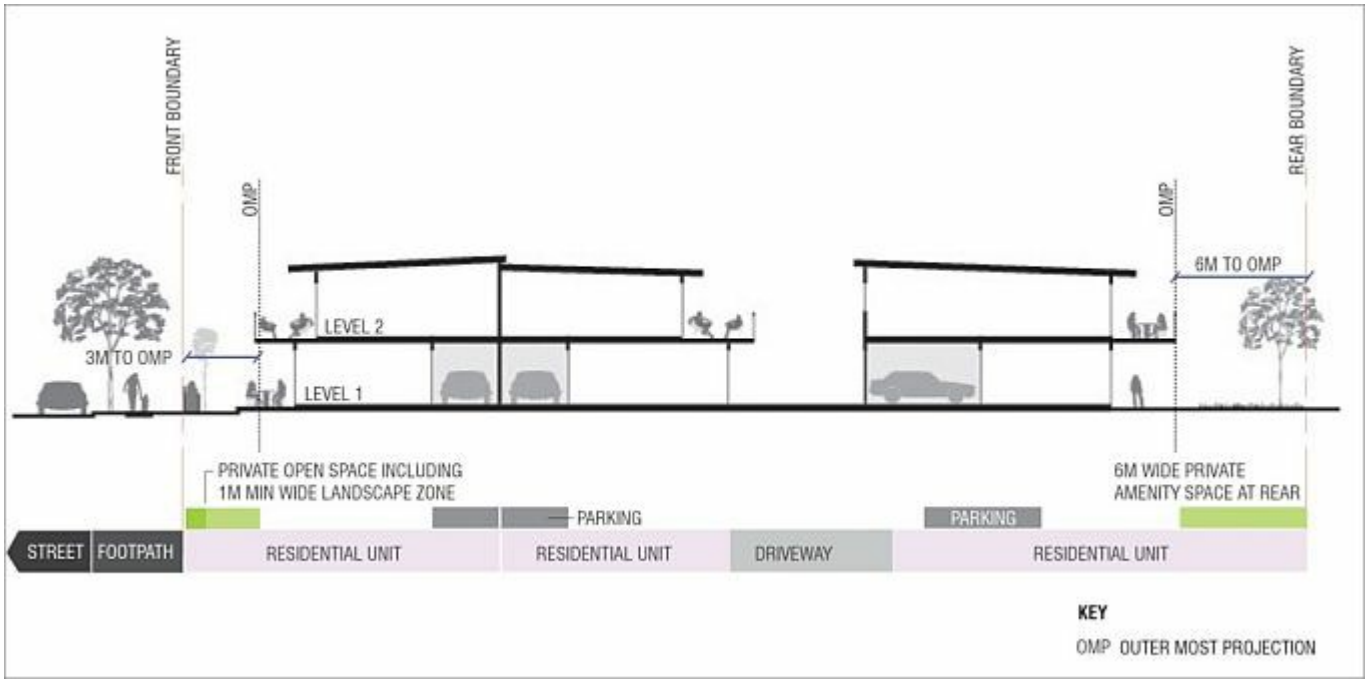

Figure 6.6 Appropriate front and rear setbacks

PO23 Built to boundary walls do not impact on the amenity or privacy of adjoining premises.	**AO23** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within the front or rear setback; (c) are not located within 1.5m of a habitable room or house on an adjoining lot; (d) have a maximum height of 3m; and (e) have a maximum length of 9m.
PO24 Buildings are designed to achieve good solar access by: (a) minimising the extent of shadows on usable private open space or public spaces; and (b) providing adequate sunlight to habitable rooms.	No acceptable outcome is nominated.
PO25 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings, including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages; (f) elements which assist in wayfinding and legibility; and (g) elements which relate to the context including surrounding buildings, parks, streets and open spaces. Figure 6.7 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.
PO26 Roof form assists in reducing the appearance of building bulk by: (a) articulating individual dwellings; and (b) incorporating variety in design through use of roof pitch, height, gables and skillions. Figure 6.7 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.

Figure 6.7 Building design elements

PO27 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO27.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other public spaces. Figure 6.8 – Design for casual surveillance illustrates.
	AO27.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

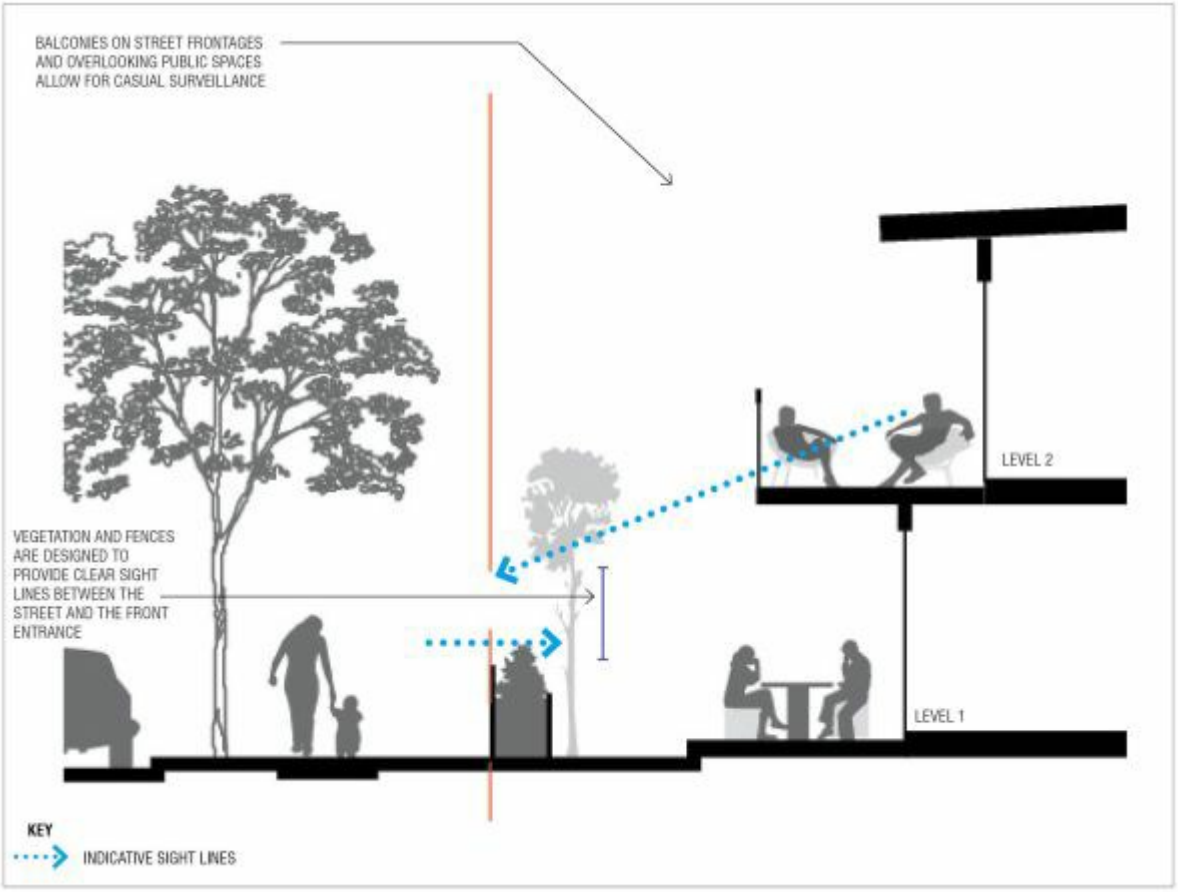

Figure 6.8 Design for casual surveillance

PO28 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO28.1** For a ground floor dwelling (where a multiple dwelling), ground floor private open space is provided with: (a) a minimum area of 35m²; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air-conditioning units.
	AO28.2 For a dwelling above ground storey, private open space is provided as a balcony with: (a) a minimum area of 9m² for a 1 bedroom unit or 16m² for a 2 or more bedroom unit; (b) a minimum dimension of 3m; and (c) clear of any utilities such as air conditioning units or drying space.
	AO28.3 Where clothes drying areas are provided on private balconies they are screened from public view and do not take up more than 10% of the balcony area.
	AO28.4 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings. Where screening is used, it is at least 50% translucent.
PO29 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO30 Communal open space provides facilities including seating, landscaping and shade. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.
PO31 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Ross River Road corridor precinct	
PO32 No new non-residential development is established within the precinct.	No acceptable outcome is nominated.
PO33 Expansion of existing non-residential development is minor in nature and does not significantly increase the intensity of non-residential activity.	**AO33** New gross floor area is only added through internal building work to an existing building.

Table 6.2.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Marlow Street precinct	
PO34 Reconfiguration creates large residential lots which support the protection of environmental values.	**AO34** Lots are not smaller than 750m^2 and the minimum average lot size across the whole of the precinct is not less than 1,700m^2.
PO35 Residential development occurs primarily in the form of dwelling houses on large lots with a limited site cover.	No acceptable outcome is nominated.
PO36 Built form and infrastructure is subordinate to vegetation and the natural landform.	No acceptable outcome is nominated.

6.2.2 Medium density residential zone code

6.2.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.2.2 Purpose

(1) The purpose of the Medium density residential zone code is to provide for a range and mix of dwelling types including dwelling houses and multiple dwellings.

(2) The particular purpose of the code is to:

- (a) provide opportunities for medium density living close to centres and other community nodes in a generally low to medium-rise built form;
- (b) maintain a high level of residential amenity; and
- (c) achieve accessible, well-serviced and well-designed communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) residential development consists primarily of low-rise (up to 3 storeys in building height) apartments or town house style dwellings, together with a mix of lot sizes or duplex housing types. Taller, more intensive built form will generally be limited to key infill locations near the city's major centres, as specifically intended in particular precincts;
- (b) built form creates an attractive and pedestrian oriented streetscape which integrates with nearby centres, public transport and community activities;
- (c) reconfiguration creates lots which facilitate the location of dwellings which address the street and allow for climate-responsive building orientation;
- (d) residential uses may also include residential care facilities, retirement facilities, rooming accommodation and short-term accommodation;
- (e) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (f) residential development is protected from the impacts of nearby centres, industrial activities, transport corridors and infrastructure installations and major facilities such as the port, airport and Department of Defence landholdings;
- (g) the design of development promotes accessibility by walking, cycling and public transport;
- (h) the design of development is responsive to the city's climate by taking into account prevailing breezes, slope and solar orientation, provision of awnings and promotes sustainable practices including energy efficiency and water conservation; and
- (i) non-residential uses only occur where they are specifically intended in particular precincts or where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centres.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Thuringowa South precinct:

(a) medium density housing reinforces the role and vibrancy of Thuringowa Central major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) development facilitates improved accessibility to the major centre for pedestrians and cyclists and promotes access to public transport facilities;

(c) a new east-west road link is created through the precinct providing an alternative route to High Range Drive;

(d) built form creates a medium-rise environment (up to 5 storeys in building height) along Riverway Drive;

(e) otherwise, built form within the precinct is generally low-rise (up to 3 storeys in building height); and

(f) Riverway Drive becomes a tropical boulevard providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

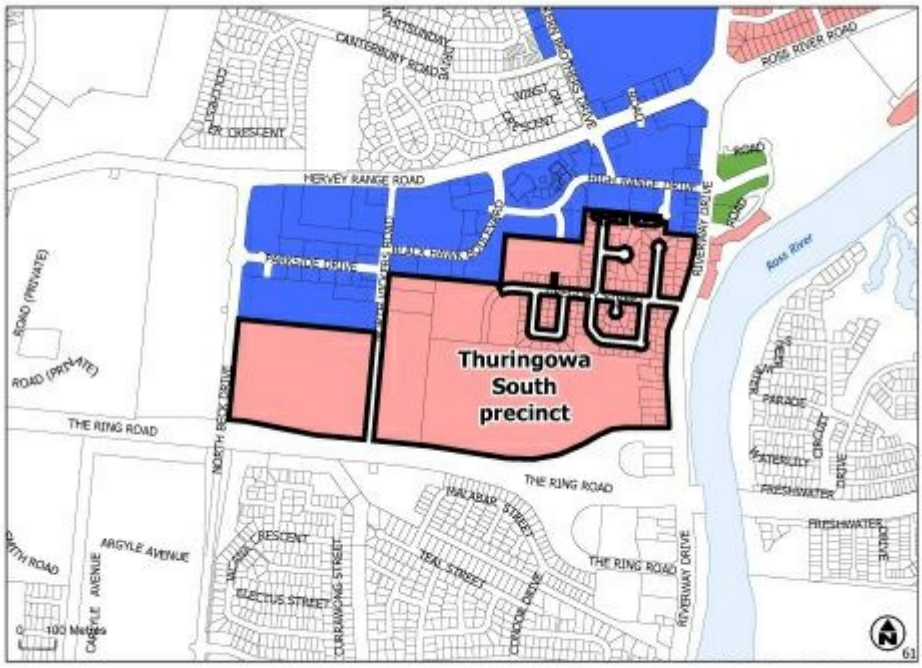

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Figure 6.9 Thuringowa South precinct

Thuringowa East precinct:

(a) medium density housing reinforces the role and vibrancy of Thuringowa Central major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) along Thuringowa Drive and Ross River Road and transitions down to surrounding low-rise residential areas;

(c) development facilitates improved accessibility to the major centre for pedestrians and cyclists, provides for safer and shadier pedestrian routes and road crossings and promotes access to public transport facilities;

(d) Thuringowa Drive, Riverway Drive and Ross River Road become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and reduction in vehicular access points and screening of parking areas; and

(e) existing non-residential uses do not significantly expand and no additional non-residential development is established within the precinct.

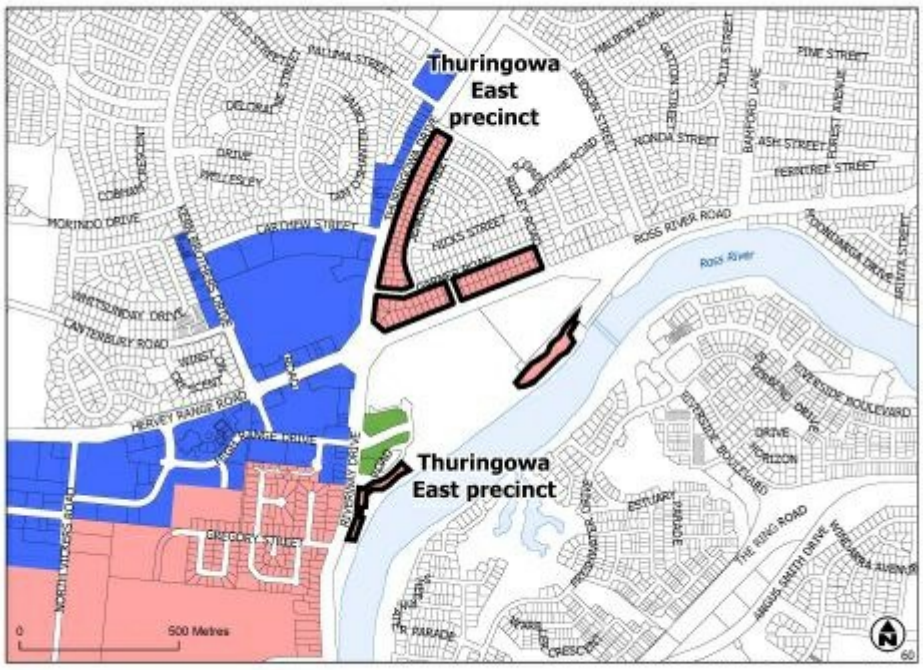

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Figure 6.10 Thuringowa East precinct

Rossiter Park precinct:

(a) the precinct redevelops into a medium density residential community, through amalgamation of existing lots into larger sites that provide the opportunity for better designed medium density residential development;

(b) built form creates a medium-rise environment (up to 6 storeys in building height) fronting Rossiter Park and transitions down (up to 3 storeys in building height) to surrounding low-rise residential areas;

(c) development creates a strong orientation to the street and to Rossiter Park; and

(d) the redevelopment of this precinct aligns new streets with the existing street grid alignment to the north to integrate the emerging precinct into the surrounding Aitkenvale locality and re-establishes direct travel connections between the Aitkenvale major centre and Ross River and its parkland via Elizabeth Street.

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Figure 6.11 Rossiter Park precinct

Aitkenvale medium density precinct:

(a) medium density housing reinforces the role and vibrancy of the Aitkenvale major centre, and includes student and visitor accommodation to reinforce economic links with James Cook University and Townsville Hospital;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) throughout the precinct; and

(c) new development facilitates improved accessibility for pedestrians and cyclists, provides for safer and shadier pedestrian routes and road crossings and promotes access to public transport facilities.

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Figure 6.12 Aitkenvale medium density precinct

Aitkenvale village precinct:

(a) non-residential uses occur in this precinct but are limited to small-scale retail, dining and entertainment activities accommodated on the ground floor of a residential development, and having direct frontage to Patrick Street or Elizabeth Street;

(b) built form creates a medium-rise environment (up to 5 storeys in building height);

(c) Patrick Street and Elizabeth Street are activated by small-scale shop fronts and kerbside activities at the ground storey with awnings providing protection from the elements;

(d) non-residential activities within the precinct do not impact on the role and function of the Aitkenvale major centre;

(e) large format retail and showroom uses do not establish within this precinct;

(f) development creates a safe environment, balancing vibrant street activity and the protection of visual amenity;

(g) linkages between the Aitkenvale centre and centre core sub-precinct, the Aitkenvale centre frame precinct and the Aitkenvale medium density precinct are improved through the strengthening of primary pedestrian linkages along Elizabeth Street and Patrick Street;

(h) streetscaping along Elizabeth Street and Patrick Street frontages occurs to improve the interface between the site and the street whilst also improving the pedestrian environment and experience; and

(i) Elizabeth Street is the focus for the creation of an active main street environment.

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Figure 6.13 Aitkenvale village precinct

Hyde Park medium density precinct:

(a) land adjoining the open space corridor through Hyde Park provides for the emergence of a new residential community which complements the Hyde Park major centre;

(b) development provides for the improvement of access to the adjoining open space corridor for recreational use, whilst preserving its drainage function;

(c) a mix of housing types is provided within the precinct in generally low to medium-rise built form (up to 5 storeys in building height) which is oriented to the open space and assists in activating this interface;

(d) provision of a new road off Woolcock Street defines the precinct from adjoining commercial activities and connects it to the existing local street network via Dillane Street;

(e) the precinct connects with Virgil Street and development facilitates this becoming the major east-west pedestrian thoroughfare through the locality;

(f) non-residential uses may be established in the precinct where fronting Woolcock Street. Non-residential uses are generally small-scale and accommodated on the ground storey of a residential development; and

(g) non-residential activities within the precinct do not impact on the role and function of the Hyde Park major centre.

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Figure 6.14 Hyde Park medium density precinct

Kings Road medium density precinct:

(a) development creates a medium-rise built form (up to 5 storeys in building height), with variation in built form to create visual interest across the precinct;

(b) the interface with the showgrounds is enhanced; and

(c) impacts on residential amenity from the rail corridor are minimised.

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Figure 6.15 Kings Road medium density precinct

The Strand precinct:

(a) this precinct enhances its role as Townsville's pre-eminent residential and tourist destination built on the amenity offered by The Strand parklands;

(b) The Strand forms the central focus of activity and concentration of medium density accommodation for tourists and residents;

(c) development creates a safe environment balancing vibrant street activity and the protection of residential amenity;

(d) The Strand plays a secondary role to nearby centres in accommodating non-residential uses. Non-residential uses are generally limited to small-scale cafes and restaurants accommodated on the ground storey of a residential development, to activate the street frontage and parkland;

(e) non-residential activities within the precinct do not impact on the role and function of the North Ward local centre;

(f) buildings within this precinct are designed to address The Strand parklands; and

(g) built form creates a medium-rise environment (up to 5 storeys in building height).

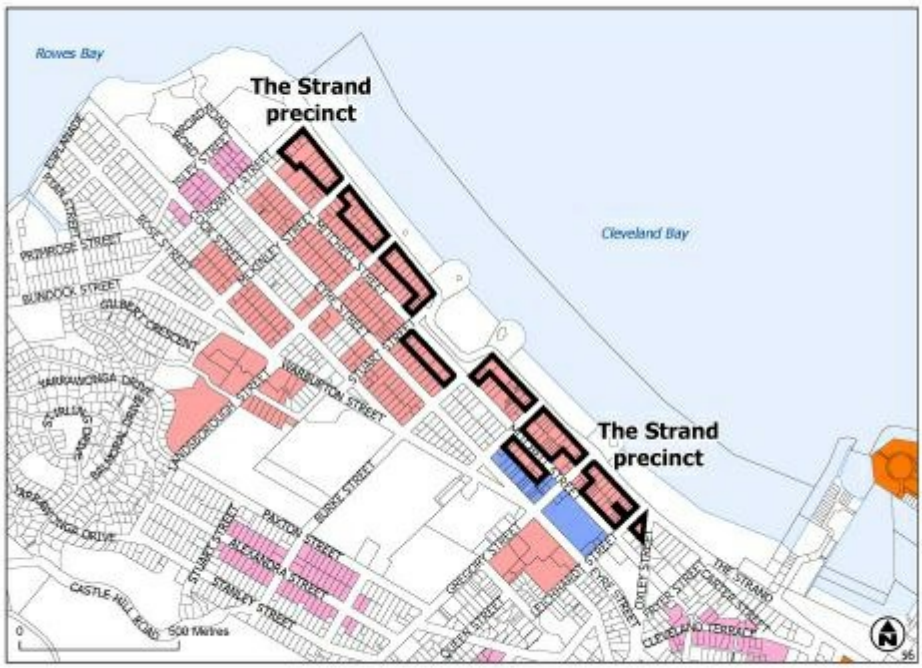

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Figure 6.16 The Strand precinct

North Ward gateway precinct:

(a) the precinct provides a key connectivity route between The Strand and Warburton Street by creating a distinctive built form along Landsborough Street;

(b) development reinforces the gateway role of the routes, creating a view corridor to The Strand and contributing to a sense of arrival and assisting in wayfinding to The Strand;

(c) built form creates a higher-medium rise environment (up to 8 storeys in building height); and

(d) an attractive tropical streetscape is created.

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Figure 6.17 North Ward gateway precinct

North Ward villages precinct:

(a) the North Ward villages are envisaged to contain the highest levels of activity and residential density in North Ward;

(b) the precinct plays a secondary role to nearby centres in accommodating non-residential uses. Non-residential uses are generally limited to small-scale cafes and restaurants accommodated on the ground floor of a residential development;

(c) Gregory Street village will expand its existing role and function as a destination for street dining and entertainment;

(d) non-residential activities within the precinct do not impact on the primacy of the principal centre or the role and function of the North Ward local centre;

(e) Landsborough Street village will develop into a secondary lifestyle focus of activity in North Ward. The role of Landsborough Street village will be to complement (not compete) with Gregory Street; and

(f) built form creates a higher-medium rise environment (up to 8 storeys in building height) along Gregory and Landsborough Streets.

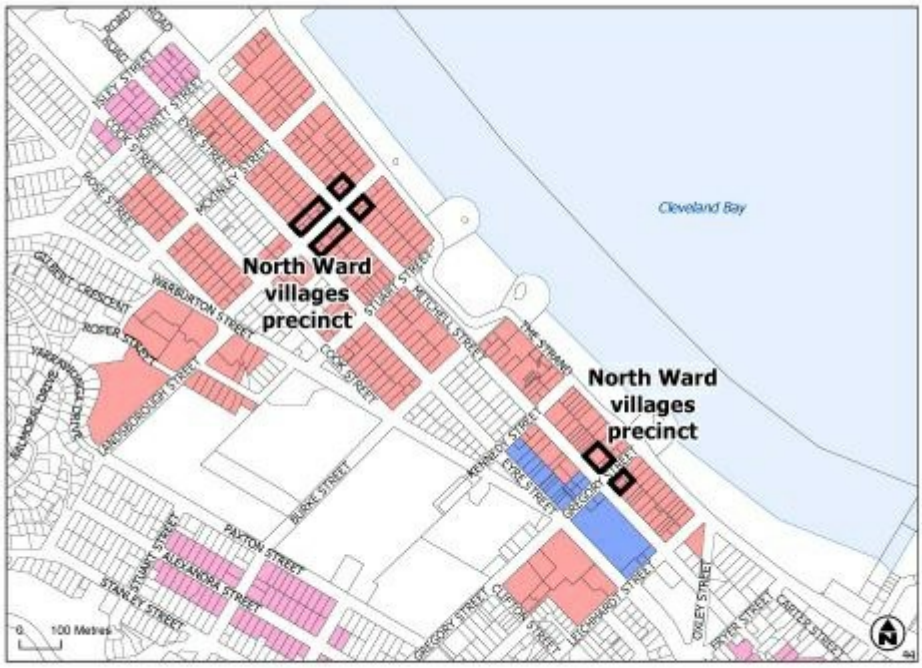

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Figure 6.18 North Ward villages precinct

North Ward medium density precinct:

(a) medium density housing reinforces the role and vibrancy of North Ward;

(b) built form creates a medium-rise environment (up to 5 storeys in building height) throughout the precinct;

(c) development of the former hospital site facilitates reuse of the hospital building for residential purposes and provides for improved accessibility for pedestrians and cyclists; and

(d) development creates a strong orientation to the street and to The Strand wherever possible.

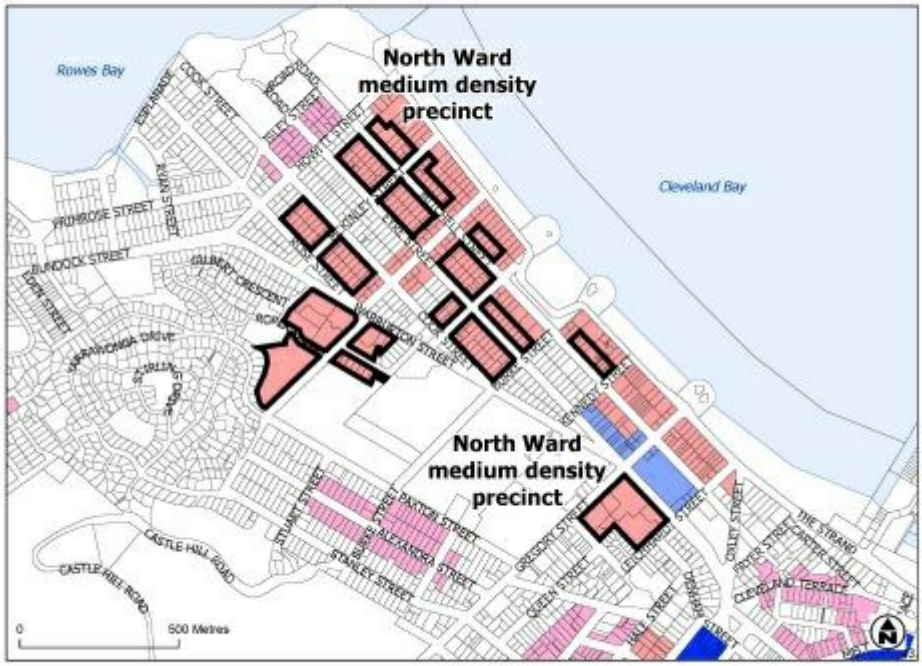

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Figure 6.19 North Ward medium density precinct

Magnetic Island medium density precinct:

(a) the precinct allows for the growth of short-term accommodation which minimises visual impact on the local natural setting, whilst providing opportunity for new investment in tourism;

(b) buildings within the precinct are low-rise (up to 2 storeys in building height) and are located to capitalise on views and beachfront settings;

(c) building scale and massing limits the impact on the natural character of Magnetic Island when viewed from the ocean and foreshore; and

(d) new buildings are in a design style that builds local character by articulation of individual units, incorporating extensive planting and climatically responsive design elements.

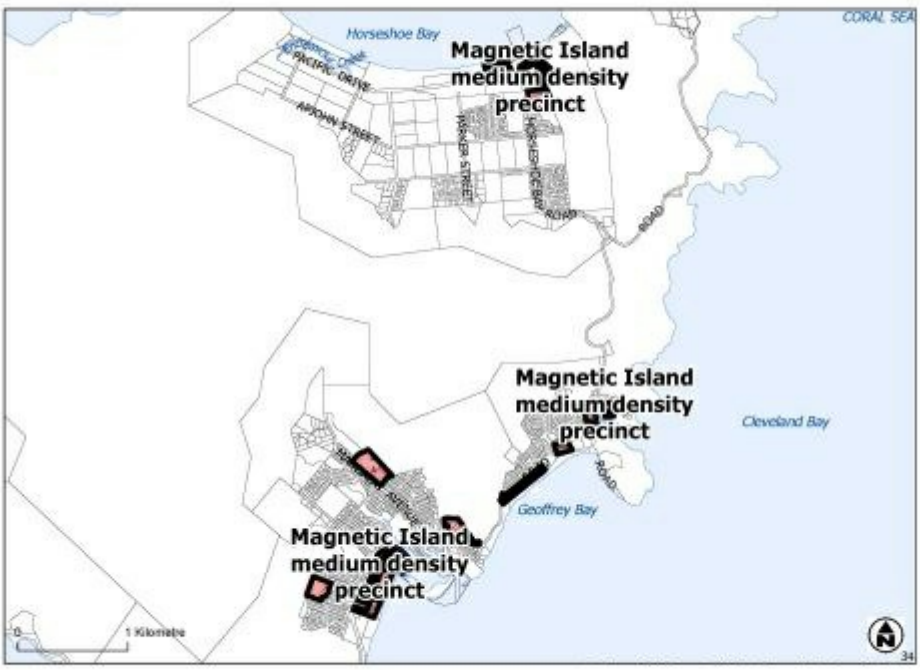

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Figure 6.20 Magnetic Island medium density precinct

Picnic Bay precinct:

(a) family oriented short-term accommodation is the predominant use established within the precinct with some non-residential uses on the ground floor;

(b) built form within the precinct consists of detached dwellings and multiple dwellings up to 2 storeys in building height; and

(c) new buildings are in a design style that builds local character by articulation of individual units, incorporating extensive planting and climatically responsive design elements.

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Figure 6.21 Picnic Bay precinct

Nelly Bay tourist precinct:

(a) the role of this precinct is to provide an attractive arrival place for the entire island, whilst also providing an accessible and convenient tourist hub, including accommodation and supporting tourist information and service facilities;

(b) built form accommodates the highest density short-term tourist accommodation on the island, with building heights up to 4 storeys;

(c) the ground floor of buildings within this precinct is activated by small scale café and restaurant uses where addressing the bay to create a waterfront promenade;

(d) tourist based businesses and services are located along Harbour Drive to support tourist needs for the island; and

(e) new buildings and streetscape improvements are in a design style that builds local character by articulation of buildings, incorporating extensive planting, use of a variety of materials and finishes and climatically responsive design elements.

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Figure 6.22 Nelly Bay tourist precinct

Wills Street precinct:

(a) built form creates a medium-rise environment (up to 4 storeys in building height) throughout the precinct and provides for a sensitive transition in scale to nearby Character residential zoned land.

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Figure 6.23 Wills Street precinct

6.2.2.3 Assessment benchmarks

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based childcare the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO2** Development of the sales office is in place for no more than two years.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO4 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note–**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO6.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other areas which are accessible to the public. Figure 6.24 – Design for casual surveillance illustrates.
	AO6.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high at least 50% transparent.

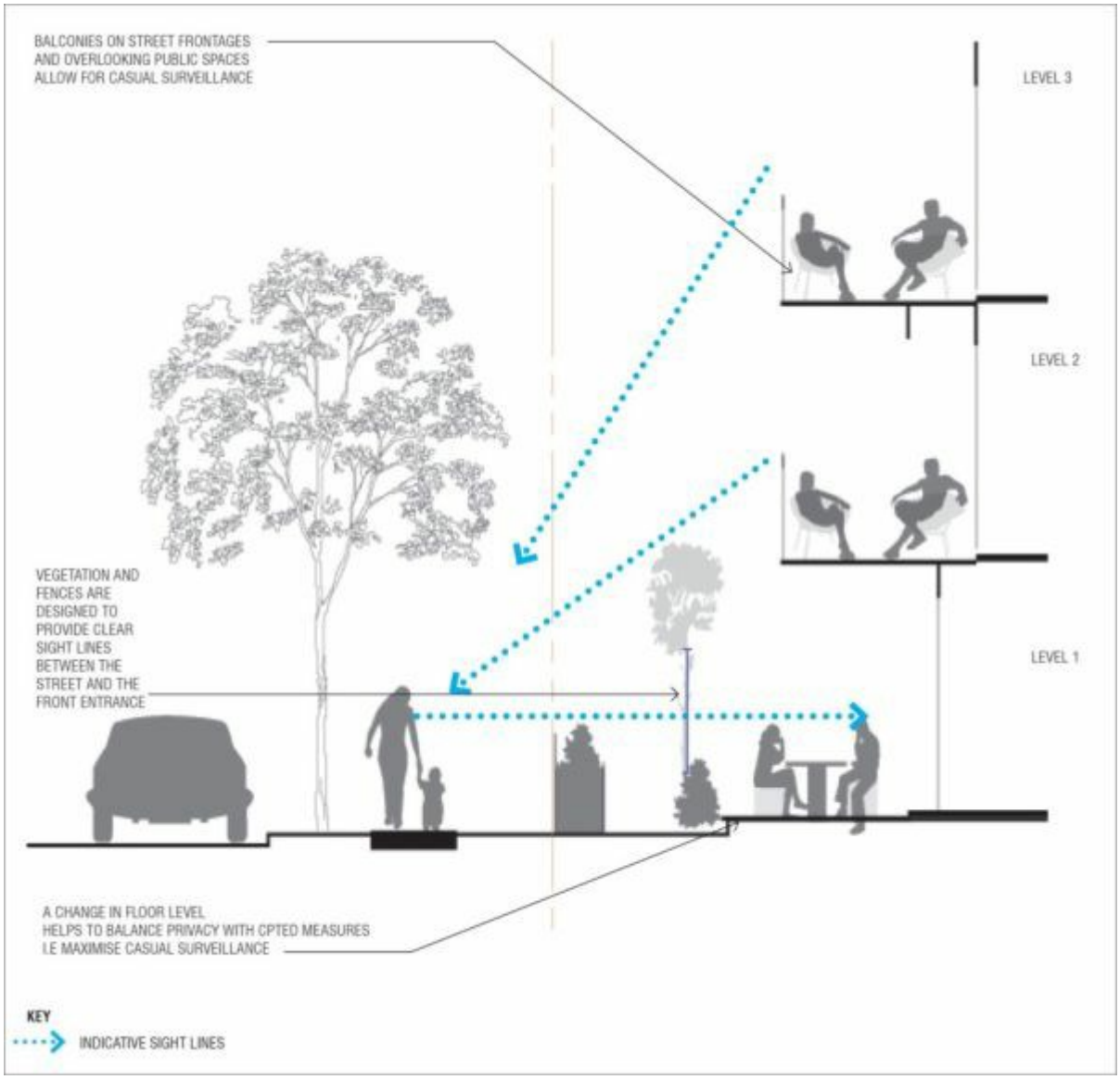
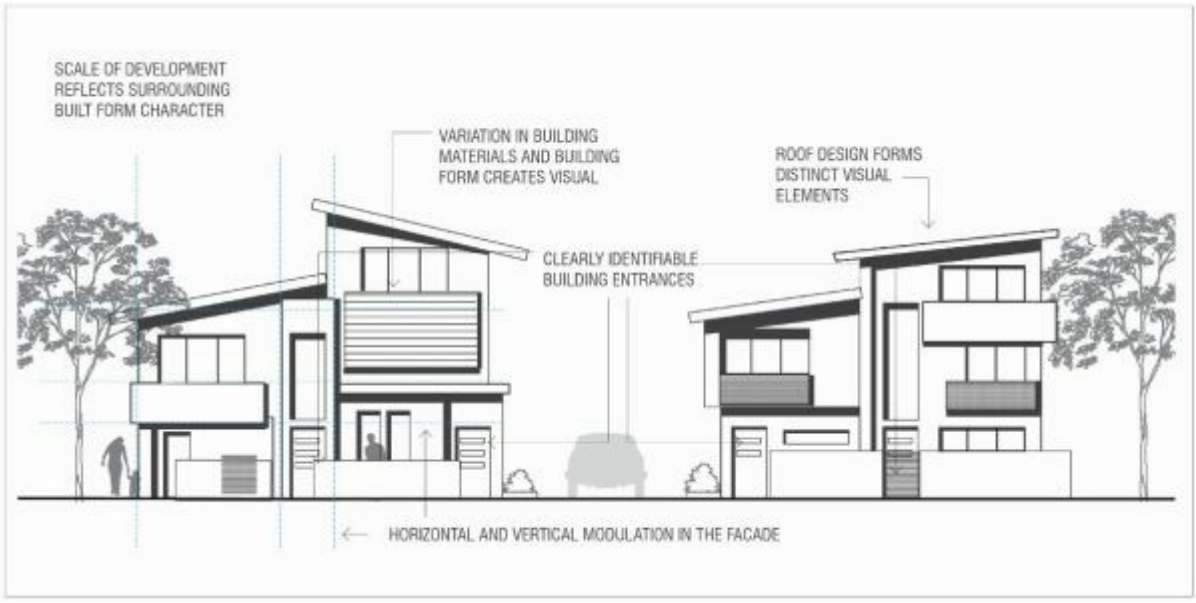


Figure 6.24 – Design for casual surveillance

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO7 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages for a premises on a corner; (f) elements which assist in wayfinding and legibility; and (g) elements which relates to the context including surrounding buildings, parks, streets and open spaces. Figure 6.25 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.



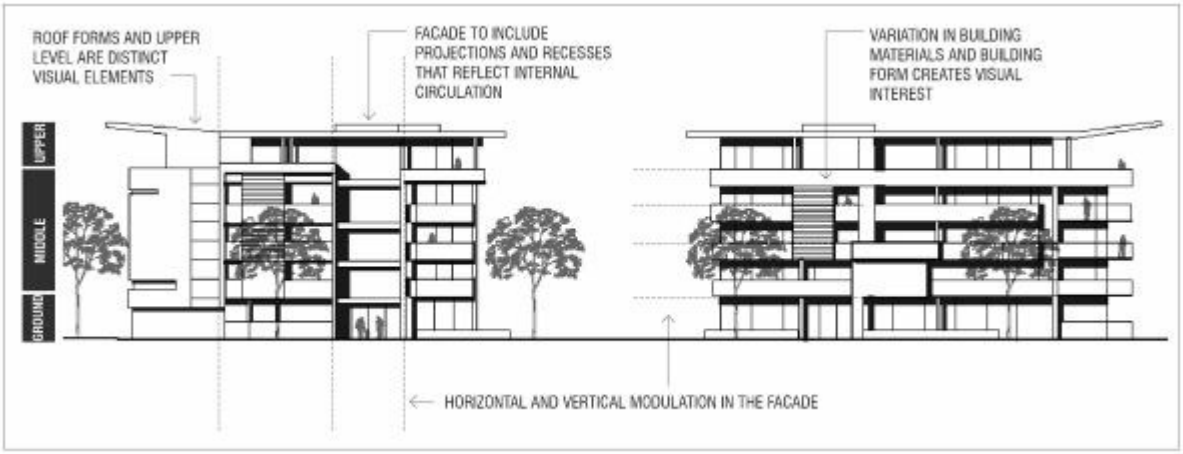


Figure 6.25 – Building design elements

PO8 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO9 Parking facilities are located to be concealed from public view to ensure an attractive streetscape.	**AO9** Vehicle parking structures are located: (a) behind the building setback; or (b) behind the building; or (c) at basement level. Figure 6.26 – Concealment of parking structures illustrates.

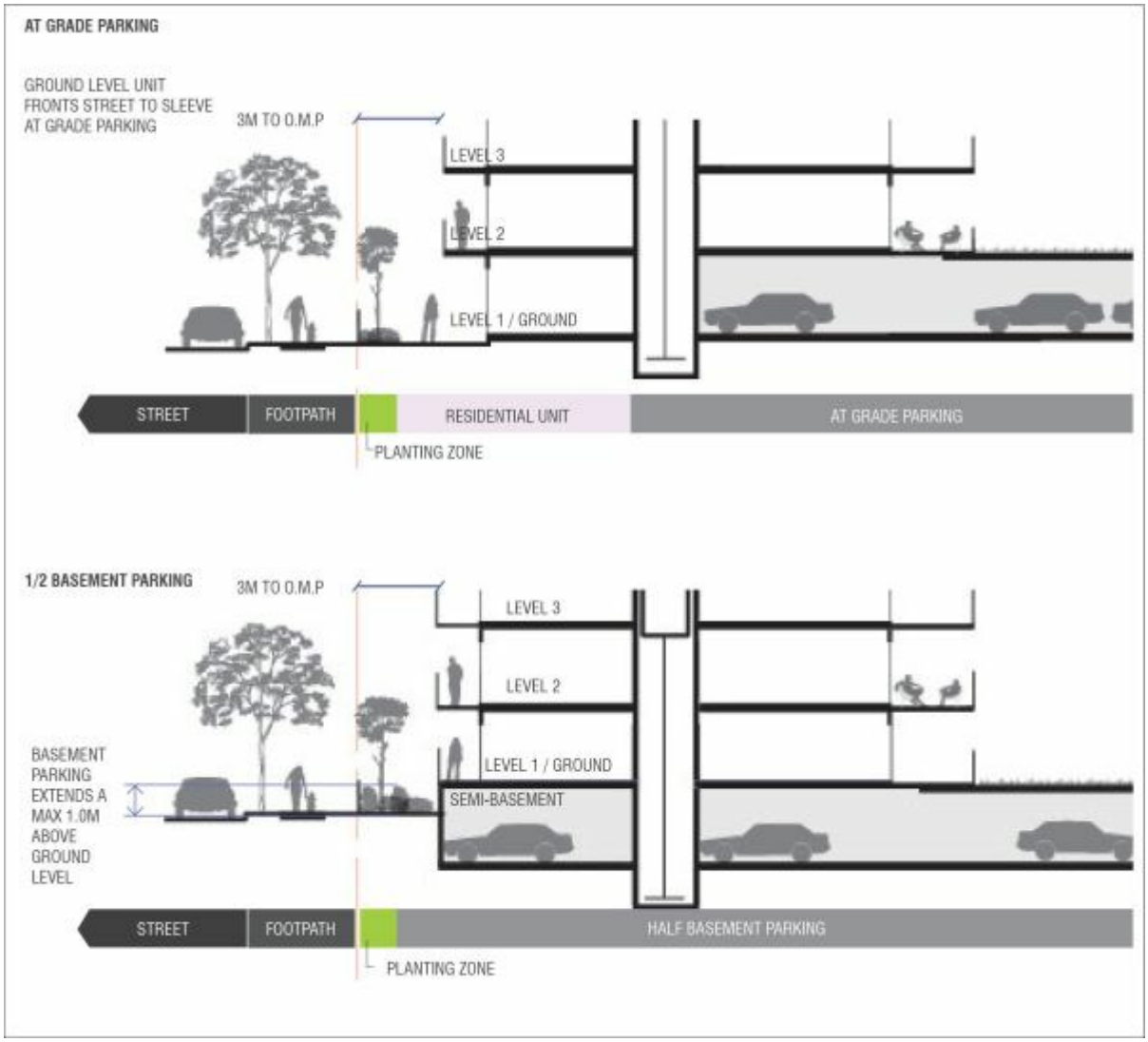


Figure 6.26 – Concealment of parking structures

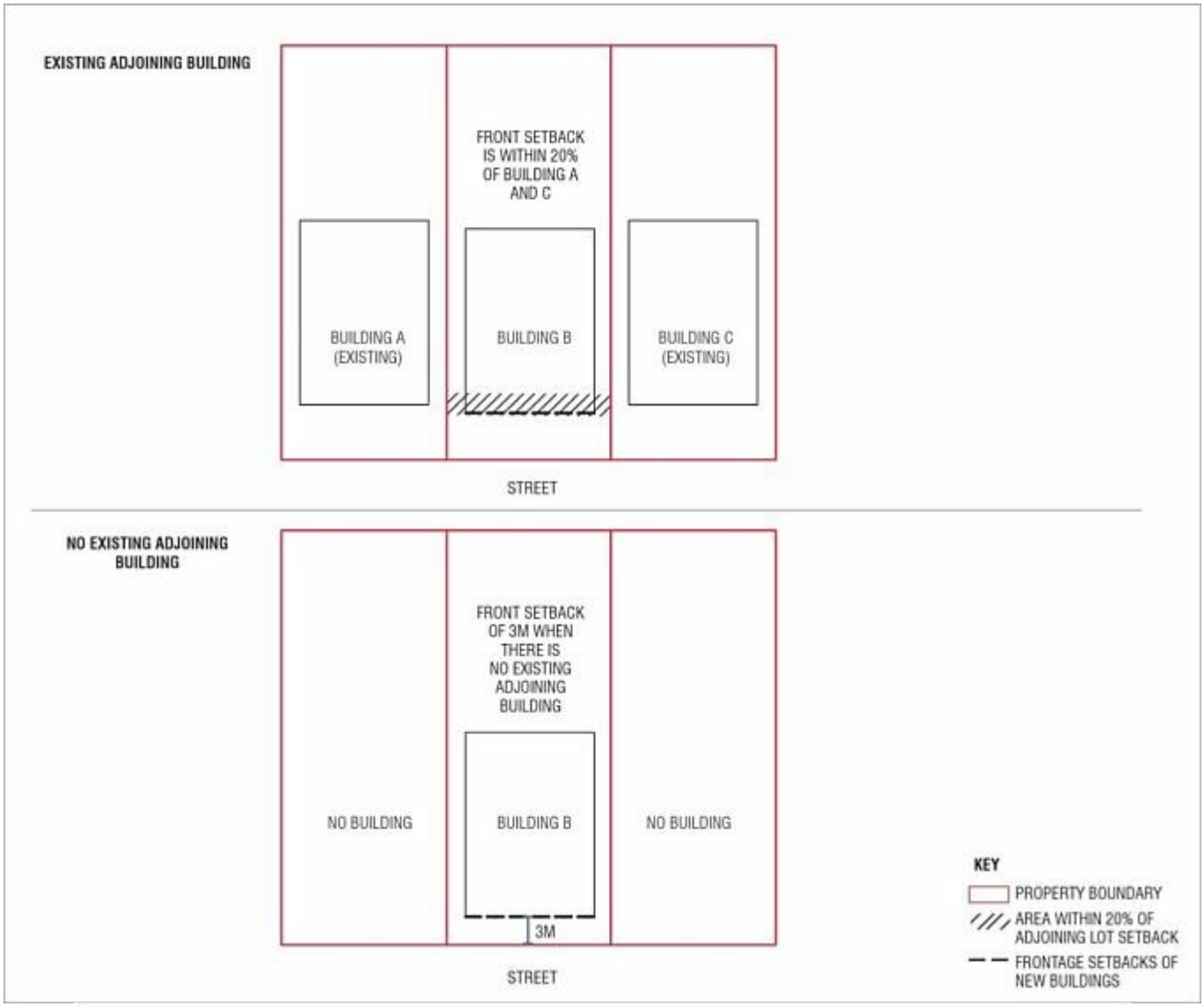
PO10 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a non-residential use	
PO11 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community or as specifically intended for a particular precinct; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with the performance outcome.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility, retirement facility or short-term accommodation with a building height of 3 storeys or less	
Built form	
PO12 Building height and scale is proportionate to the size of the premises and the desired low-rise character of the area.	**AO12** Building design achieves: (a) a site cover that does not exceed 65%; and (b) a building height that does not exceed 3 storeys.
PO13 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; and (c) do not prejudice the development of adjoining sites.	**AO13.1** Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 3m. Figure 6.27 – Building setbacks illustrates.
	AO13.2 The side boundary setback, except for a wall built to the boundary, is a minimum of: (a) 1.5m for a wall up to 4.5m high; (b) 2m for a wall up to 7.5m high; and (c) 2.5m for any part of a wall over 7.5m high. Figure 6.27 – Building setbacks illustrates.
	AO13.3 The rear boundary setback is a minimum of 6m. Figure 6.27 – Building setbacks illustrates.
	AO13.4 A landscape area with a minimum dimension of 1.5m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access only).



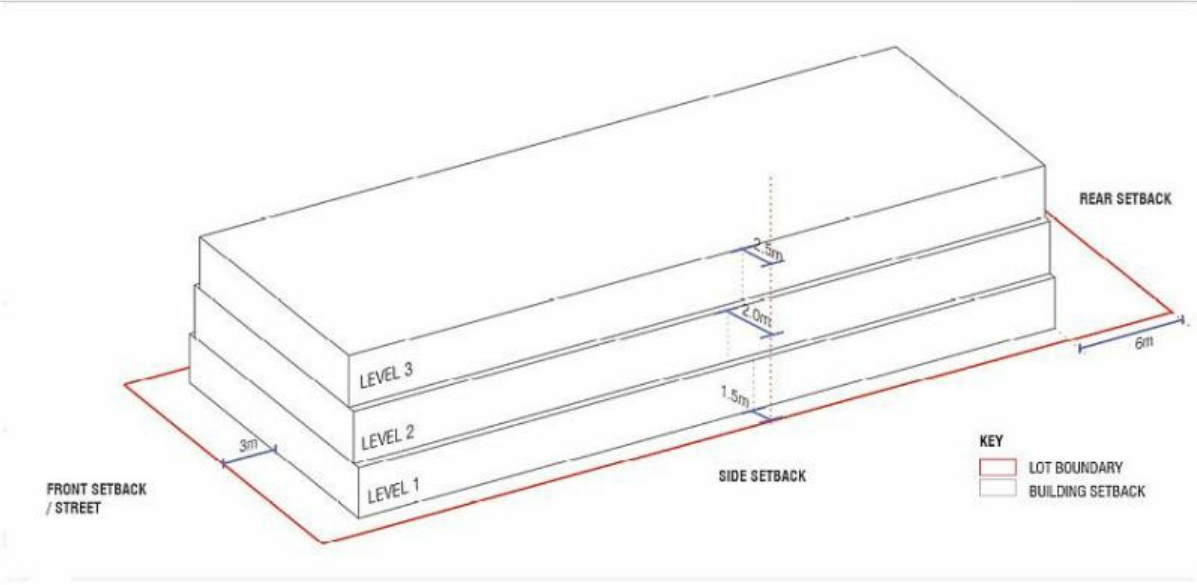


Figure 6.27 – Building setbacks

PO14 Built to boundary walls do not impact on the amenity or privacy of adjoining premises. **Editor's note–**Built to boundary wall heights and lengths may be increased where abutting an existing or proposed built to boundary wall on an adjoining property.	**AO14** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within 1.5m of a habitable room or house on an adjoining site; (c) are not located within the front or rear setback; (d) have a maximum height of 3m; and (e) have a maximum length of 15m.
PO15 Roof form assists in reducing the appearance of building bulk by: (a) articulating individual dwellings; and (b) incorporating variety in design through use of roof pitch, height, gables and skillions.	No acceptable outcome is nominated.
PO16 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO16.1** For a ground floor dwelling, ground floor private open space is provided with: (a) a minimum area of 25m²; (b) a minimum dimension of 4m; and (c) clear of any utilities such as gas, water tanks or air-conditioning units
	AO16.2 Balconies are provided with a minimum area of 9m² for a 1 bedroom unit or 16m² for a 2 or more bedroom unit, with a minimum dimension of 4m and clear of any air conditioning unit or drying space.
	AO16.3 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO16.4 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO17 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO18 Communal open space provides facilities including landscaping and shade treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development – where a multiple dwelling, residential care facility, retirement facility or short-term accommodation within a precinct intended for building heights of 4 storeys or more	
Built form	
PO19 Building design creates an enjoyable pedestrian environment and experience through the use of: (a) design elements that promote a sense of human scale at the street level, including use of awnings where appropriate; (b) design that breaks up the ground floor elevation on the principle street frontage into distinct elements; and (c) articulation of the built form above ground floor through use of balconies, recesses and changes in material.	No acceptable outcome is nominated.
PO20 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy, landscaping and amenity for existing and future buildings; and (c) do not prejudice the development of adjoining land.	**AO20.1** The design meets the setback requirements outlined by Table 6.2.2.3(b) — Building setbacks Medium density residential zone. Figure 6.28 – Building setbacks illustrates.
	AO20.2 A deep planting landscape area with a minimum width of 1.5m is provided along the full frontage of any road frontage (excluding crossover and pedestrian access). Figure 6.28 – Building setbacks illustrates.
	AO20.3 A deep planting landscape area with a minimum width of 1.5m is provided along the rear site boundary. Figure 6.28 – Building setbacks illustrates.

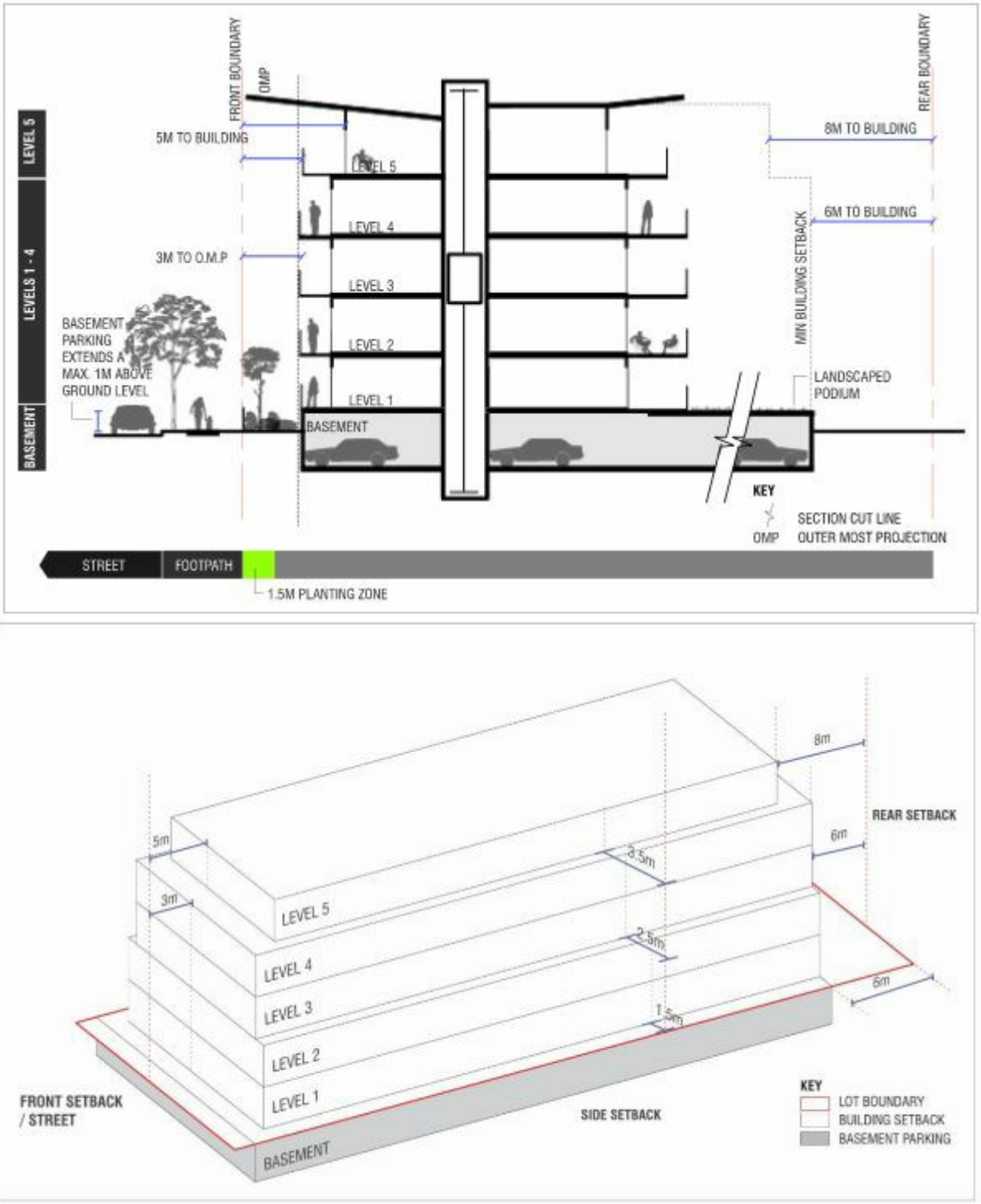


Figure 6.28 – Building setbacks

PO21 Roof forms assist in articulating the facade as a combination of distinct elements integrated with the facade design.	No acceptable outcome is nominated.
PO22 Roof top plant and equipment are contained within roof forms and are screened from the street and from adjoining buildings using a consistent range of non-reflective materials to provide a cohesive design element.	No acceptable outcome is nominated.

PO23 Development provides private open space that is: (a) well-proportioned, appealing and functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO23.1** Balconies are provided with a minimum area of 9m² for a 1 bedroom unit or 16m² for 2 or more bedroom unit, with a minimum dimension of 4m and clear of any air conditioning unit or drying space.
	AO23.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO23.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO24 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities and to mitigate the intensity of the built form.	No acceptable outcome is nominated.
PO25 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa South precinct	
PO26 New road linkages are created in accordance with Figure 6.29 – Thuringowa South precinct concept plan, including an alternative east west link from Riverway Drive to North Beck Drive and to provide a direct link into the Thuringowa Central major centre precinct.	No acceptable outcome is nominated.
PO27 Development creates a compatible interface with the centre activities and facilitates pedestrian and cyclist access to the Thuringowa Central major centre precinct in accordance with Figure 6.29 – Thuringowa South precinct concept plan.	No acceptable outcome is nominated.
PO28 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO28.1** Building height does not exceed 5 storeys where fronting Riverway Drive in the area shown on Figure 6.29 – Thuringowa South precinct concept plan, and 3 storeys otherwise.
	AO28.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m2.

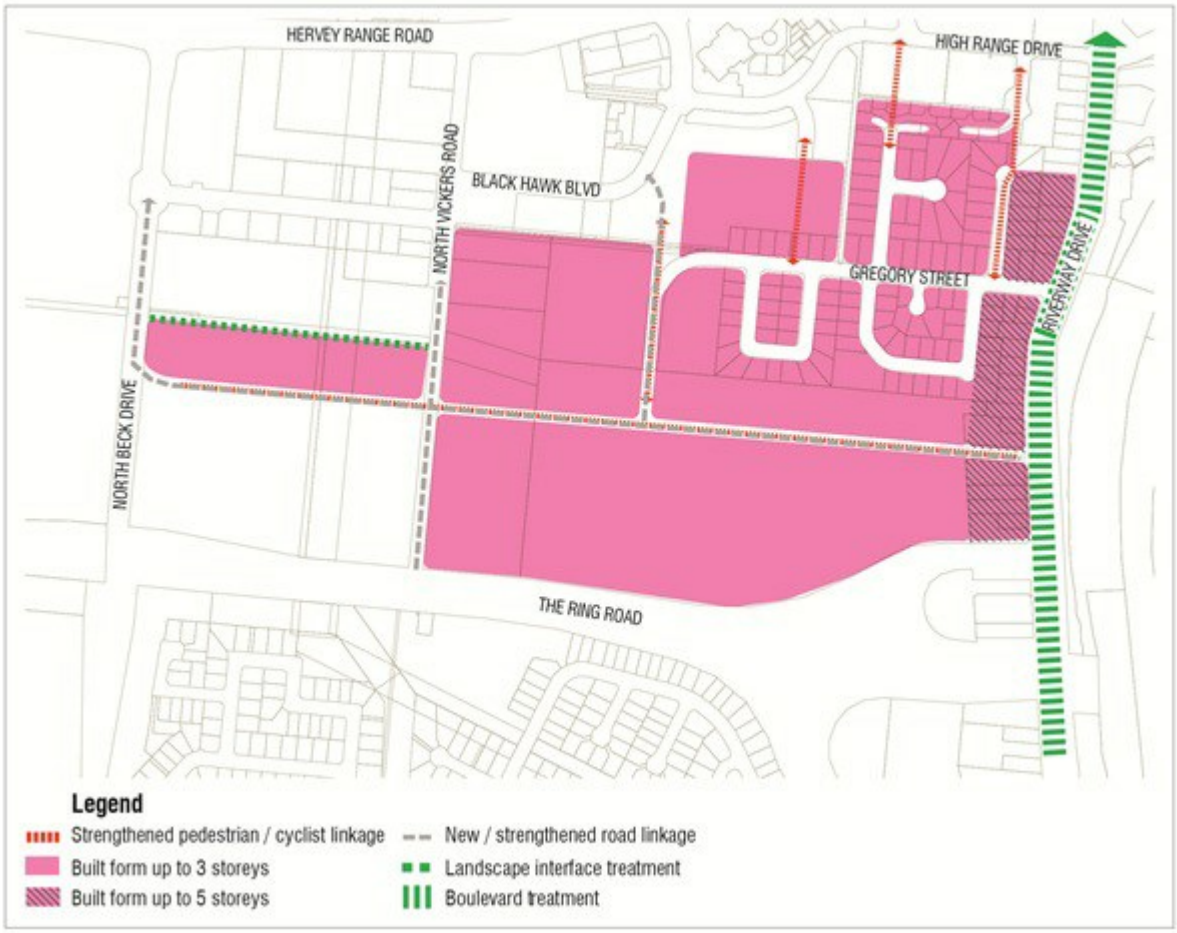


Figure 6.29 – Thuringowa South precinct concept plan

PO29 Development contributes to the boulevard treatment of Riverway Drive, through landscaping and streetscape treatments along the road frontage.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa East precinct	
PO30 Development contributes, through street improvements, to the boulevard treatment of Thuringowa Drive, Riverway Drive and Ross River Road.	No acceptable outcome is nominated.
PO31 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Built form provides for sensitive transitioning in height and scale to nearby Low density residential zoned land.	**AO31.1** Building height does not exceed 5 storeys in the areas shown on Figure 6.30 – Thuringowa East precinct concept plan, and 3 storeys otherwise.
	AO31.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.

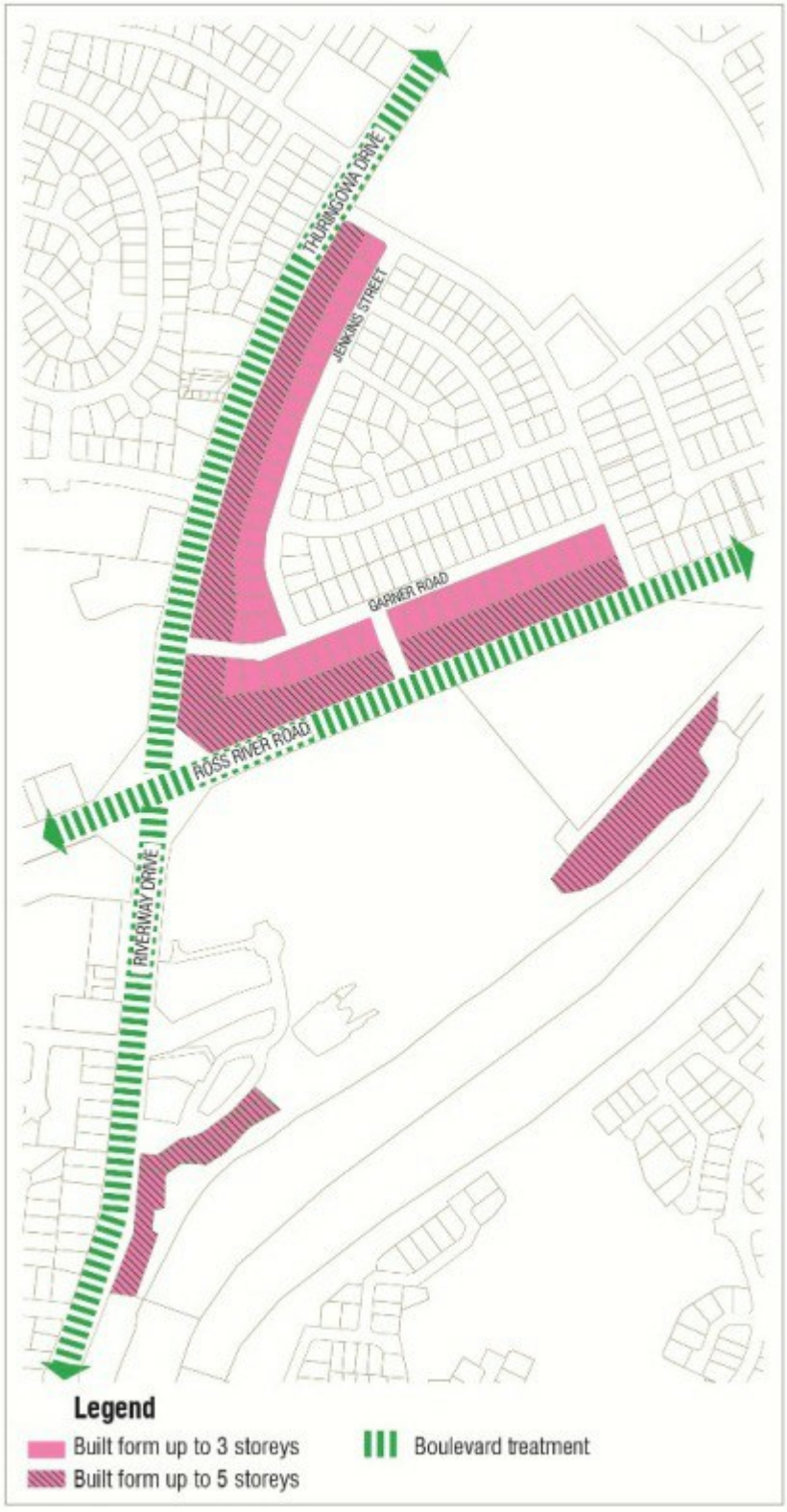


Figure 6.30 – Thuringowa East precinct concept plan

PO32 Access to Ross River Road, Thuringowa Drive and Riverway Drive is consolidated.	**AO32.1** Development sites have a minimum size of 1,000m2 and contain no more than 1 access driveway.
	AO32.2 Access driveways are provided from rear or side streets rather than Thuringowa Drive or Riverway Drive.
PO33 No new non-residential development is established within the precinct.	No acceptable outcome is nominated.
PO34 Expansion of existing non-residential development is minor in nature and does not significantly increase the intensity of non-residential activity.	**AO34** New gross floor area is only added through internal building work to an existing building.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Rossiter Park precinct	
PO35 Development achieves a coordinated redevelopment of this precinct into a high quality medium density urban environment which is highly responsive to the amenity offered by Ross River and its parklands through building orientation, intensity of built form and landscaping treatment. Development site planning is undertaken in accordance with Figure 6.31 – Rossiter Park precinct concept plan.	No acceptable outcome is nominated.
PO36 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for primary orientation of buildings to the street, the provision of building setbacks, on-site services and circulation and open space at ground storey. Development over 3 storeys occurs only on large, amalgamated sites that facilitate well-proportioned buildings permitting primary orientation to the park.	**AO36.1** Building height does not exceed 6 storeys in the area shown on Figure 6.31 – Rossiter Park precinct concept plan, and 3 storeys otherwise.
	AO36.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m2.
PO37 Development facilitates new street connections and promotes visual and pedestrian connectivity through the precinct to Rossiter Park to the south and Aitkenvale major centre precinct to the north, in accordance with Figure 6.31 – Rossiter Park precinct concept plan.	No acceptable outcome is nominated.

PO38 On frontages shown on Figure 6.31 – Rossiter Park precinct concept plan as having a responsive edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) having a primary orientation overlooking the street and Rossiter Park; and (b) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.

Figure 6.31 – Rossiter Park precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale medium density precinct	
PO39 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO39.1** Building height does not exceed 5 storeys.
	AO39.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO40 Pedestrian routes are defined by building streetscape improvements that provide shade and improve pedestrian comfort.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Aitkenvale village precinct **Note**-Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale village precinct	
PO41 Supermarket and showroom retail uses do not occur in this precinct.	No acceptable outcome is nominated.
PO42 Food and drink outlets are established where they are (a) orientated to the street; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above.	No acceptable outcome is nominated.
PO43 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian friendly and visually interesting frontages.	**AO43.1** Front setbacks at the ground floor do not exceed 3m.
	AO43.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO43.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.

PO44 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at the ground storey.	**AO44.1** Building height does not exceed 5 storeys.
	AO44.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO45 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO45** Awnings are provided over outdoor spaces.
PO46 On the frontage shown on Figure 6.32 - Aitkenvale village precinct concept plan as having built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) creating a generally continuous building alignment; (b) having facades which contain windows, doors, materials and features which generate visual interest at the street level; and (c) incorporating an attractive streetscape and planting theme.	No acceptable outcome is nominated.

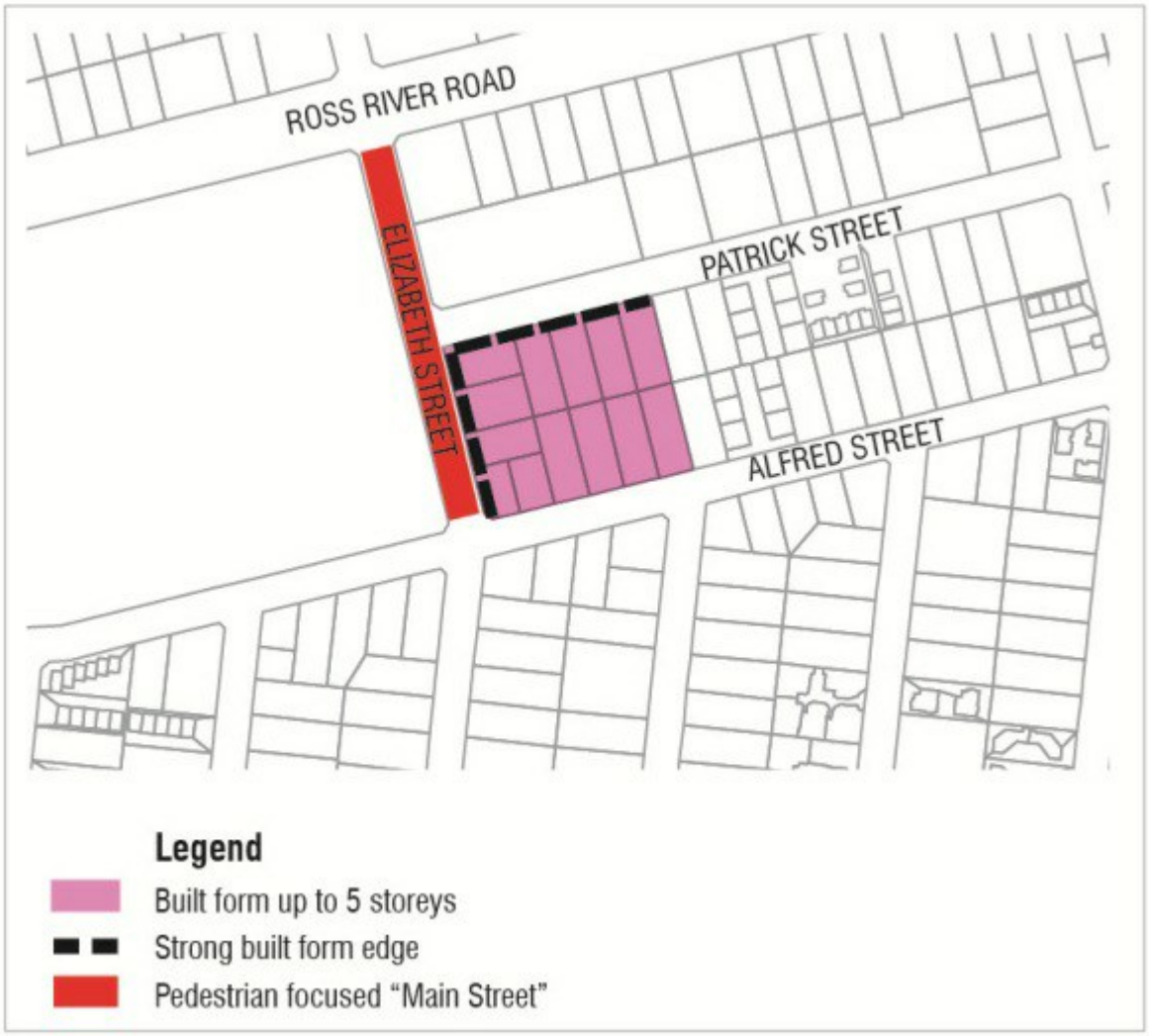


Figure 6.32 Aitkenvale village precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Hyde Park medium density precinct	
PO47 Building height creates a low to medium-rise environment, and transitions to nearby Low density residential zoned land.	**AO47** Building height does not exceed 3 storeys in the area shown on Figure 6.33 – Hyde Park medium density precinct concept plan, and 5 storeys otherwise.
PO48 Development provides for improvements to the open space corridor such that it provides a major recreational node for the precinct and surrounding area, in a manner generally consistent with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO49 Development adjacent to the open space corridor incorporates pedestrian access along the interface, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.

PO50 Development overlooks and provides for casual surveillance of the open space corridor.	No acceptable outcome is nominated.
PO51 Development facilitates the establishment of a new road linkage connecting Woolcock Street to Dillane Street, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan. This new road assists in creating an active and attractive interface between the major centre and the Hyde Park medium density precinct.	No acceptable outcome is nominated.
PO52 Development facilitates the establishment of Virgil Street as the major east-west pedestrian thoroughfare connecting across into the Hyde Park major centre and the open space corridor, in accordance with Figure 6.33 – Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO53 Non-residential uses may establish on the ground floor where fronting Woolcock street and where integrated with residential development in accordance with Figure 6.33 - Hyde Park medium density precinct concept plan.	No acceptable outcome is nominated.
PO54 Where incorporating ground floor non-residential uses, the design of buildings provides for pedestrian-friendly and visually interesting frontages.	**AO54** Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum of 0.5m for any length of facade exceeding 10m.
PO55 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO55** Awnings are provided over outdoor spaces.

Figure 6.33 – Hyde Park medium density precinct concept plan

PO56 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of the pedestrian environment along Woolcock Street.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kings Road medium density precinct	
PO57 Building height creates a medium-rise environment.	**AO57** Building height does not exceed 5 storeys.
PO58 Residential uses are appropriately buffered from the railway corridor.	No acceptable outcome is nominated.
PO59 Development provides for enhanced public realm and pedestrian connectivity throughout the precinct and connecting to the showground.	No acceptable outcome is nominated.
PO60 Safe pedestrian access is provided for across Kings Road.	No acceptable outcome is nominated.
PO61 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of the pedestrian environment along Kings Road, in accordance with Figure 6.34 – Kings Road medium density precinct concept plan.	No acceptable outcome is nominated.

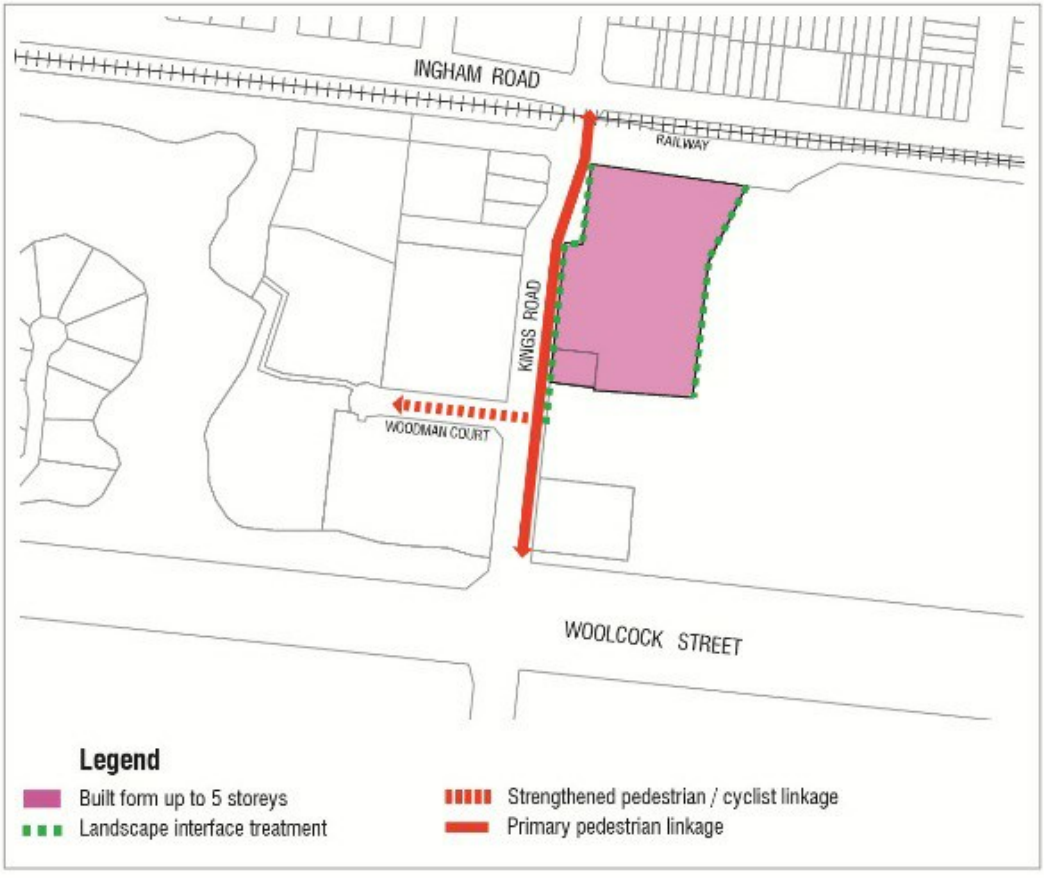


Figure 6.34 – Kings Road medium density precinct concept plan

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
The Strand precinct	
PO62 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street and parkland, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO62.1** Building height does not exceed 5 storeys. Figure 6.35 – The Strand conceptual built form illustrates the desired built form.
	AO62.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO63 Food and drink outlets are established where they are: (a) oriented to the street and parkland; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above. Figure 6.35 – The Strand conceptual built form illustrates the desired design principles.	No acceptable outcome is nominated.
PO64 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian friendly and visually interesting frontages.	**AO64.1** Front setbacks at the ground floor do not exceed 3m.
	AO64.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO64.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO65 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage. Figure 6.35 – The Strand conceptual built form illustrates the desired design principles.	**AO65** Awnings are provided over outdoor spaces.

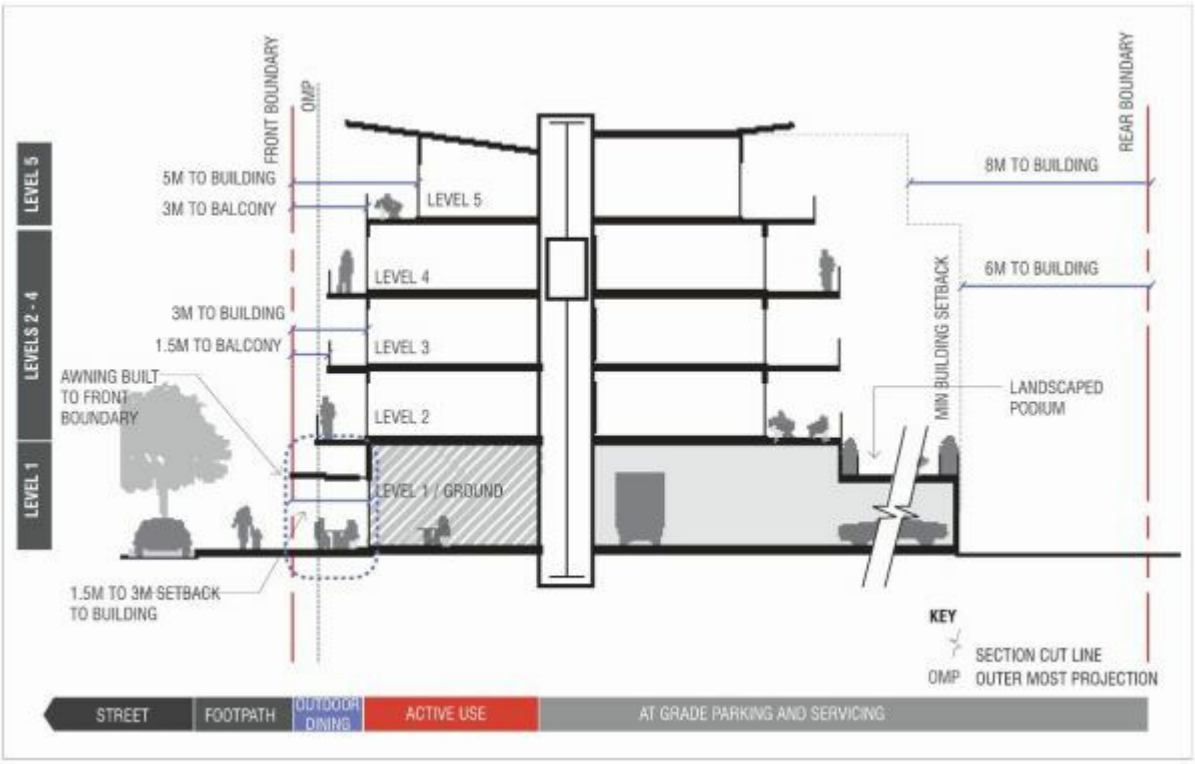


Figure 6.35 – The Strand conceptual built form

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward gateway precinct	
PO66 Building height and scale is consistent with the character desired for the precinct and reinforces Landsborough Street as a primary gateway to The Strand. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Figure 6.36 – North Ward gateway and villages conceptual built form illustrates.	**AO66.1** Building height does not exceed 8 storeys. **AO66.2** Development sites have a minimum size of 1,000m^2 where buildings of 5 storeys or above are proposed.
PO67 The design of buildings in this precinct provides for an arrival and wayfinding statement by: (a) addressing the street and are located to frame the edge of the street and focus view lines to The Strand; (b) creating an entry aesthetic by defining the street edge with a medium density built form; and (c) incorporating a streetscape and planting theme that creates a boulevard treatment of the street.	No acceptable outcome is nominated.

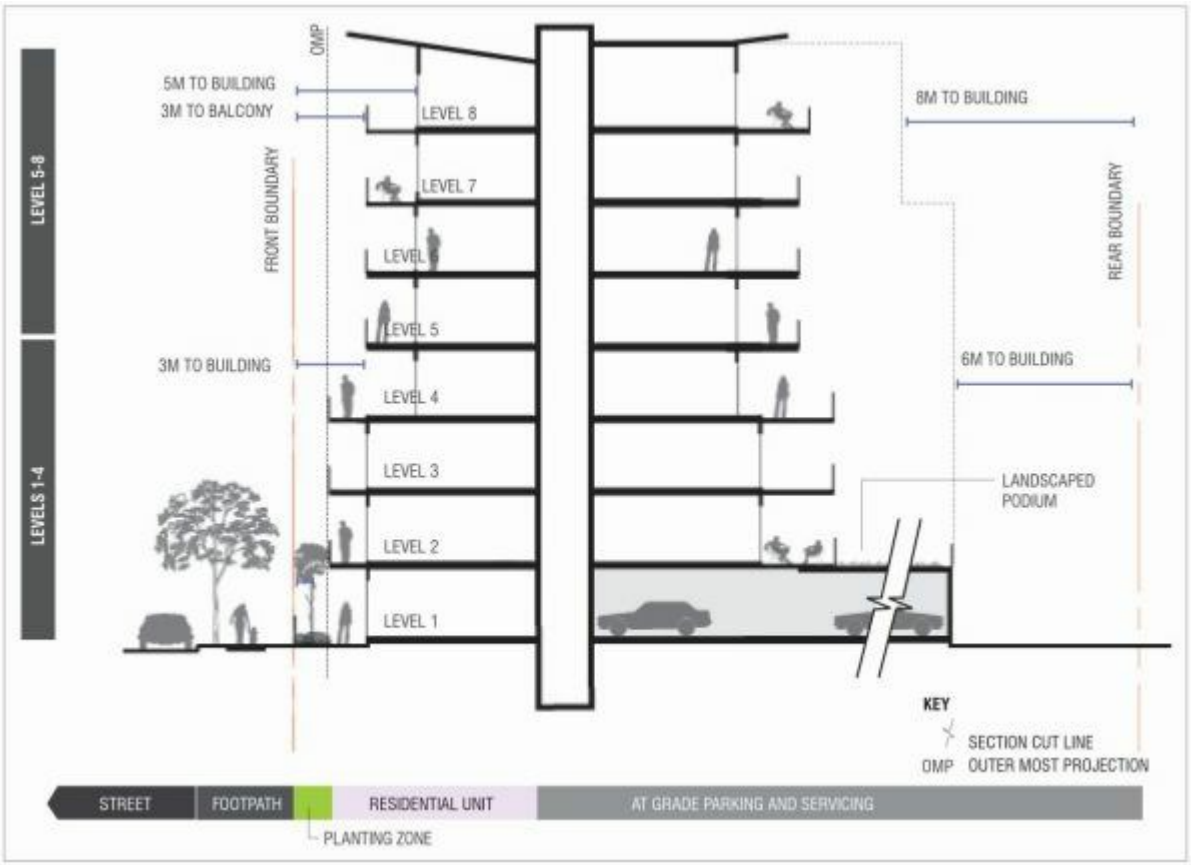


Figure 6.36 – North Ward gateway and villages conceptual built form

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward villages precinct	
PO68 Building height and scale is consistent with the character desired for the precinct and reinforces Gregory and Landsborough Streets as the primary activity spines and gateways to The Strand. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey. Figure 6.36 – North Ward gateway and villages conceptual built form.	**AO68.1** Building height does not exceed 8 storeys. **AO68.2** Development sites have a minimum size of 1,000m^2 where buildings of 5 storeys or above are proposed.
PO69 Non-residential uses are established where they are: (a) oriented to the street; (b) incorporate outdoor dining; and (c) are located on the ground floor with accommodation above.	No acceptable outcome is nominated.

PO70 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages.	**AO70.1** Front setbacks at the ground floor do not exceed 3m.
	AO70.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO70.3 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO71 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO71** Awnings are provided over outdoor spaces.
PO72 The design of buildings in this precinct provides for an arrival and wayfinding statement by: (a) focussing view lines to The Strand; (b) creating an entry aesthetic by defining the street edge with a medium density built form; and (c) incorporating a streetscape and planting theme that creates a boulevard treatment of the street. Figure 6.36 – North Ward gateway and villages conceptual built form.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward medium density precinct	
PO73 Building height and scale is consistent with the character desired for the precinct. The former hospital building remains as the most significant building in the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, onsite services and circulation and open space at ground storey.	**AO73.1** Building height does not exceed 5 storeys other than the existing hospital building which is retained at its present height.
	AO73.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m^2.
PO74 Building layout and design on the former hospital site facilitates a high level of pedestrian and cyclist permeability through the site.	No acceptable outcome is nominated.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Magnetic Island medium density precinct	
PO75 Building design and massing is consistent with the low density scale of the locality and articulates individual dwellings.	**AO75** Building height does not exceed 2 storeys and is predominately in the form of single, single unit or multiple pavilions. Figure 6.37 – Magnetic Island indicative built form outcomes illustrates.

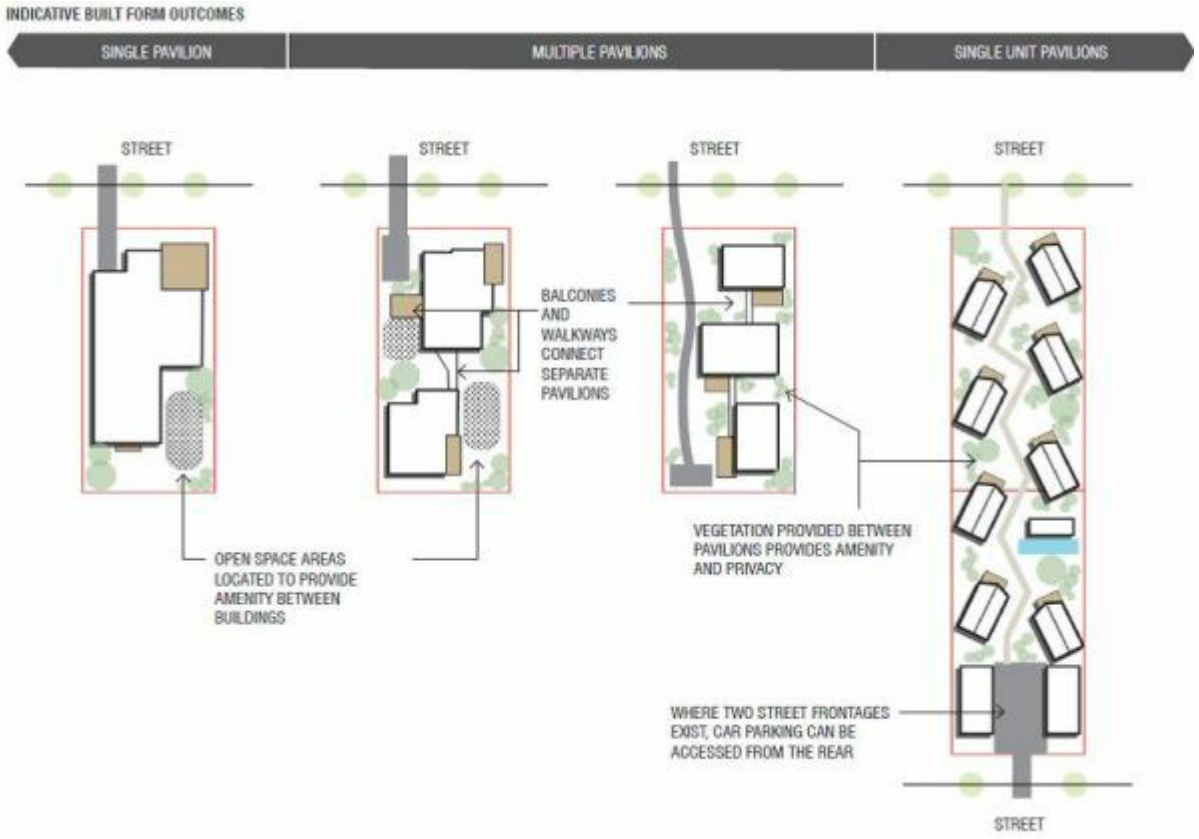


Figure 6.37 – Magnetic Island indicative built form outcomes

PO76 Design and articulation of buildings contribute to the creation of the local tropical character through: (a) use of tropical building design typologies; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay. Figure 6.38 – Examples of the desired tropical building design typologies.	No acceptable outcome is nominated.

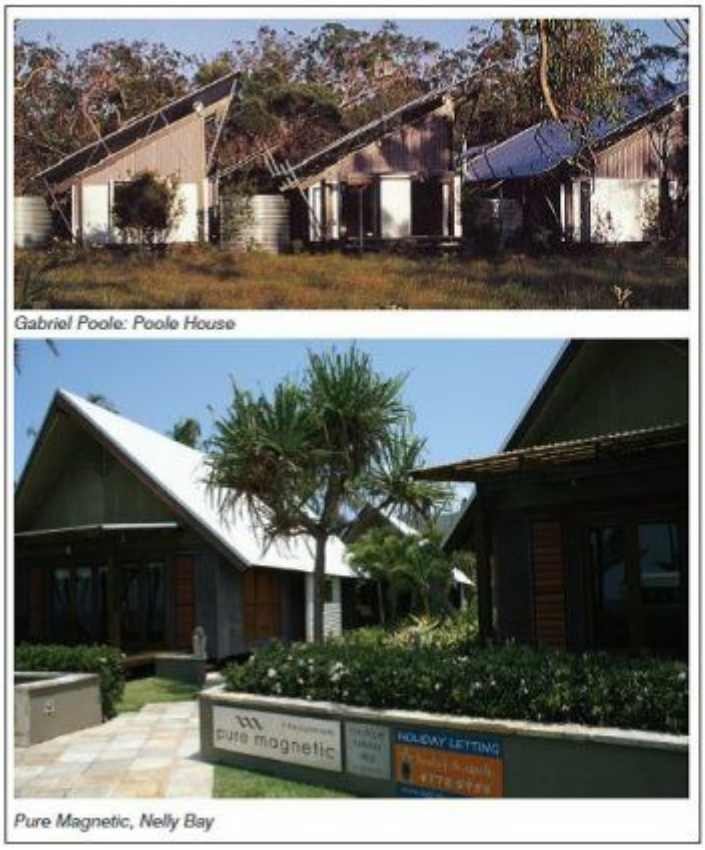


Figure 6.38 – Examples of the desired tropical building design typologies

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Picnic Bay precinct	
PO77 Non-residential uses are provided on the ground floor as part of a mixed use development along Granite Street and along the water frontage.	No acceptable outcome is nominated.
PO78 Building design and massing is consistent with the low density scale of the bay and articulates individual dwellings.	**AO78** Building height does not exceed 2 storeys and is predominately in the form of single, single unit or multiple pavilions. Figure 6.37 – Magnetic Island indicative built form outcomes illustrates.

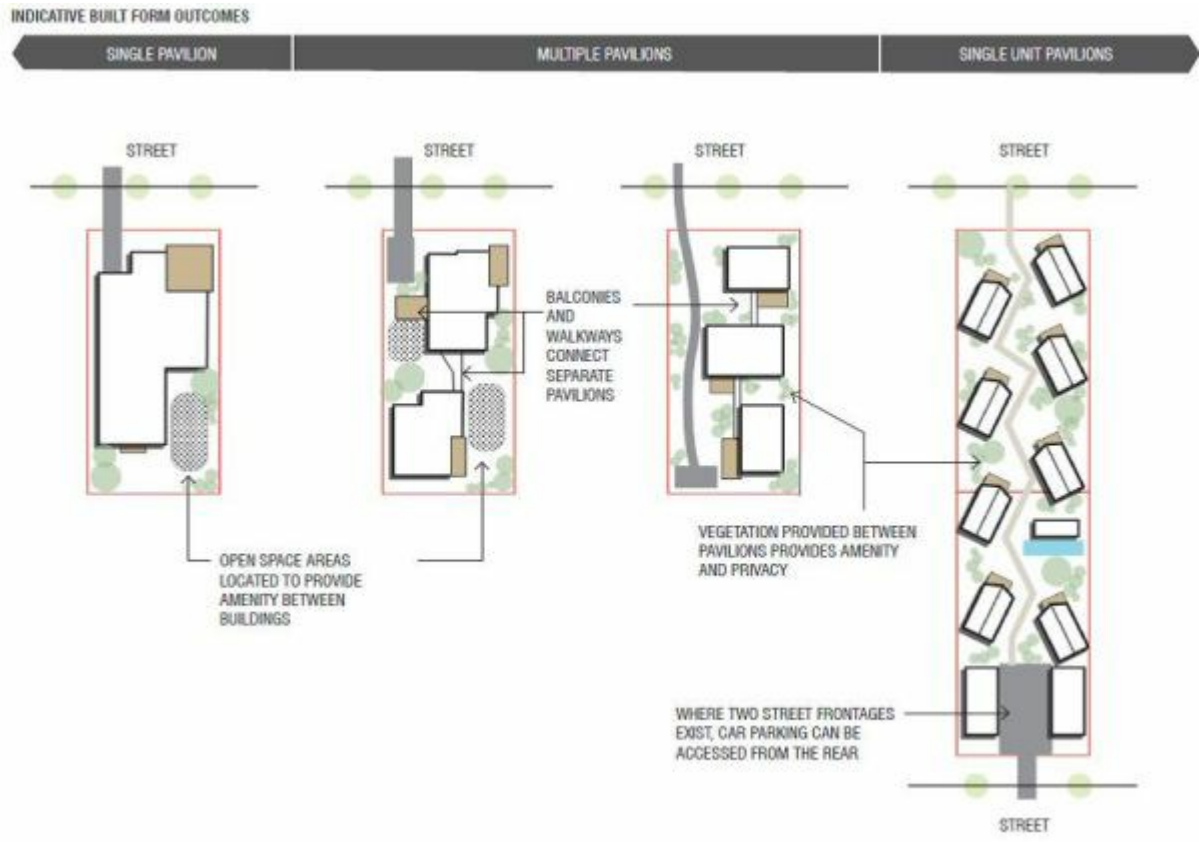
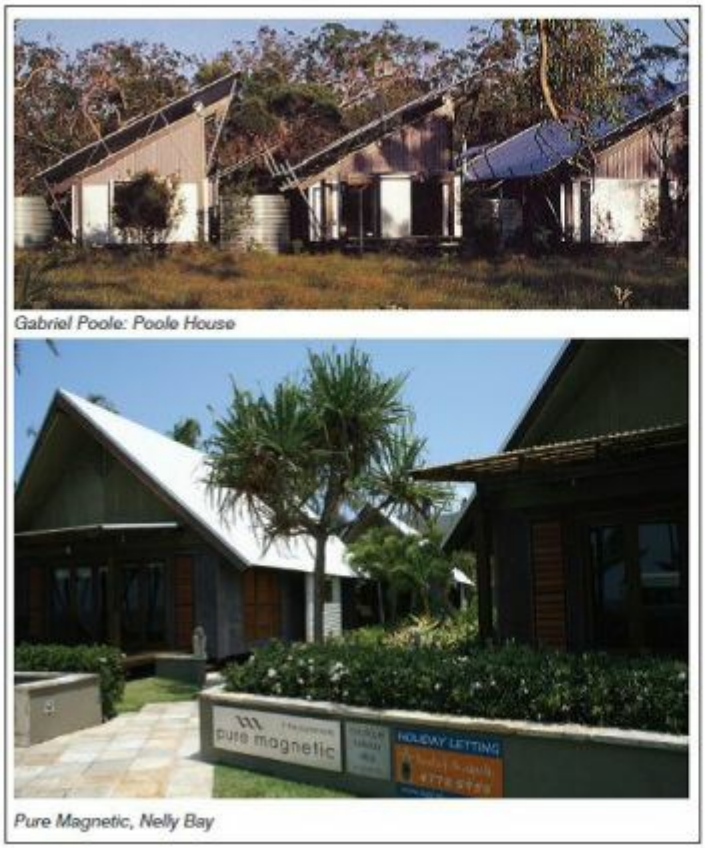


Figure 6.37 – Magnetic Island indicative built form outcomes

PO79 Design and articulation of buildings contribute to the creation of the local tropical character through: (a) use of tropical building design typologies; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay. Figure 6.38 – Examples of the desired tropical building design typologies illustrates.	No acceptable outcome is nominated.



Gabriel Poole: Poole House

Pure Magnetic, Nelly Bay

Troppo Architects: Thiel House, Cullen Bay

Balconies and walkways connect individual pavilions and create transition between indoor and outdoor spaces

Figure 6.38 – Examples of the desired tropical building design typologies

PO80 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages.	**AO80.1** Front setbacks at the ground floor do not exceed 3m.
	AO80.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO80.3 Ground floor dining tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO81 Where incorporating ground floor non-residential uses, weather protection via permanent or operable awnings is provided to usable outdoor spaces at the street frontage.	**AO81** Awnings are provided over outdoor spaces.

Table 6.2.2.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note–**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay tourist precinct	
PO82 Non-residential uses are provided on the ground floor as part of a mixed use development and contribute to the creation of a waterfront promenade. Figure 6.39 – Nelly Bay waterfront promenade illustrates	No acceptable outcome is nominated.

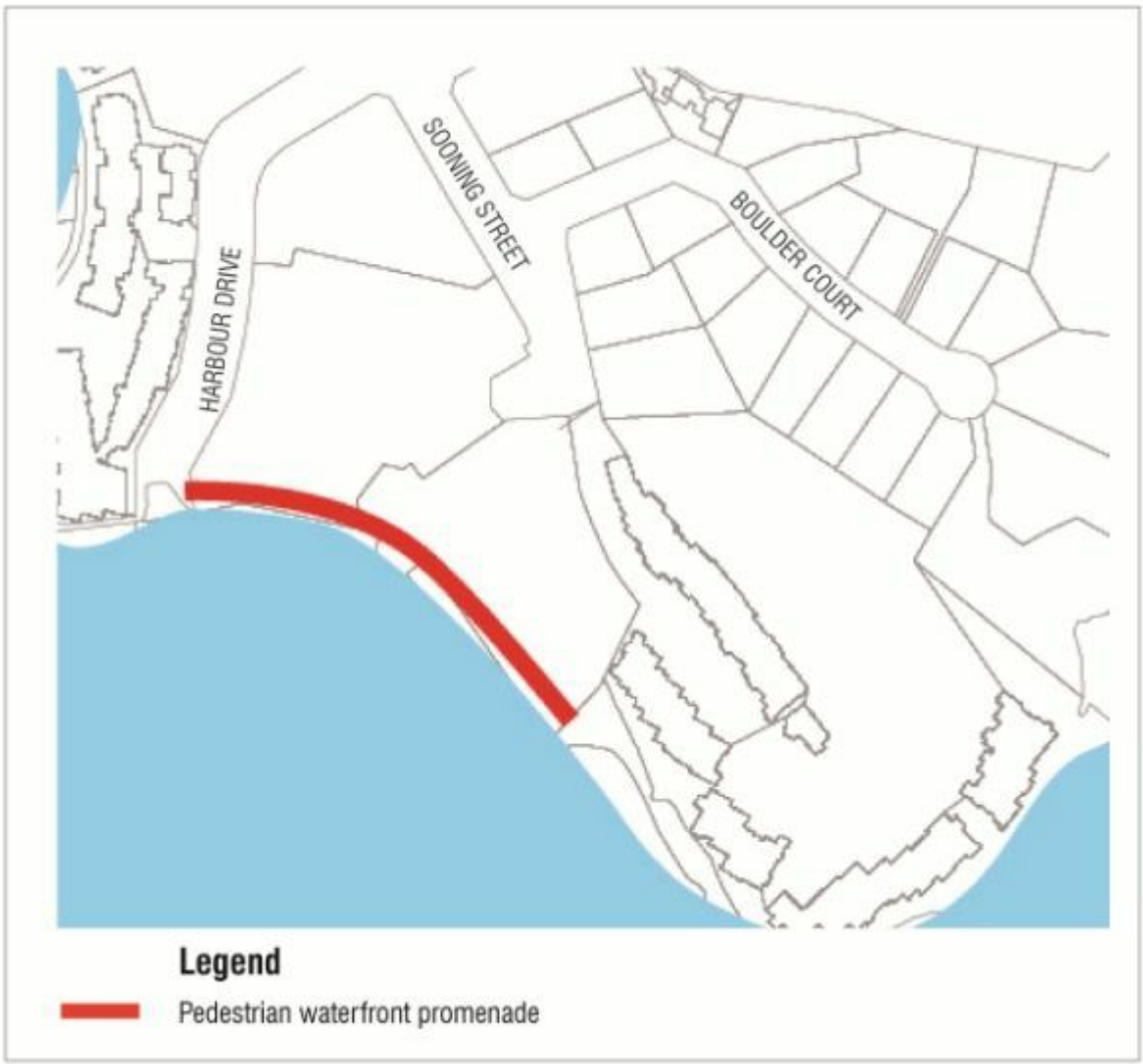


Figure 6.39 – Nelly Bay waterfront promenade

Performance outcomes	Acceptable outcomes
PO83 Tourist based services are located along Harbour Drive.	No acceptable outcome is nominated.
PO84 Building height is of a low to medium-rise scale and building massing is consistent with the low density character of the island.	**AO84.1** Building height does not exceed 4 storeys.
	AO84.2 Development consists of a number of distinct buildings where site frontage exceeds 20m. Figure 6.40 – Indicative building massing illustrates

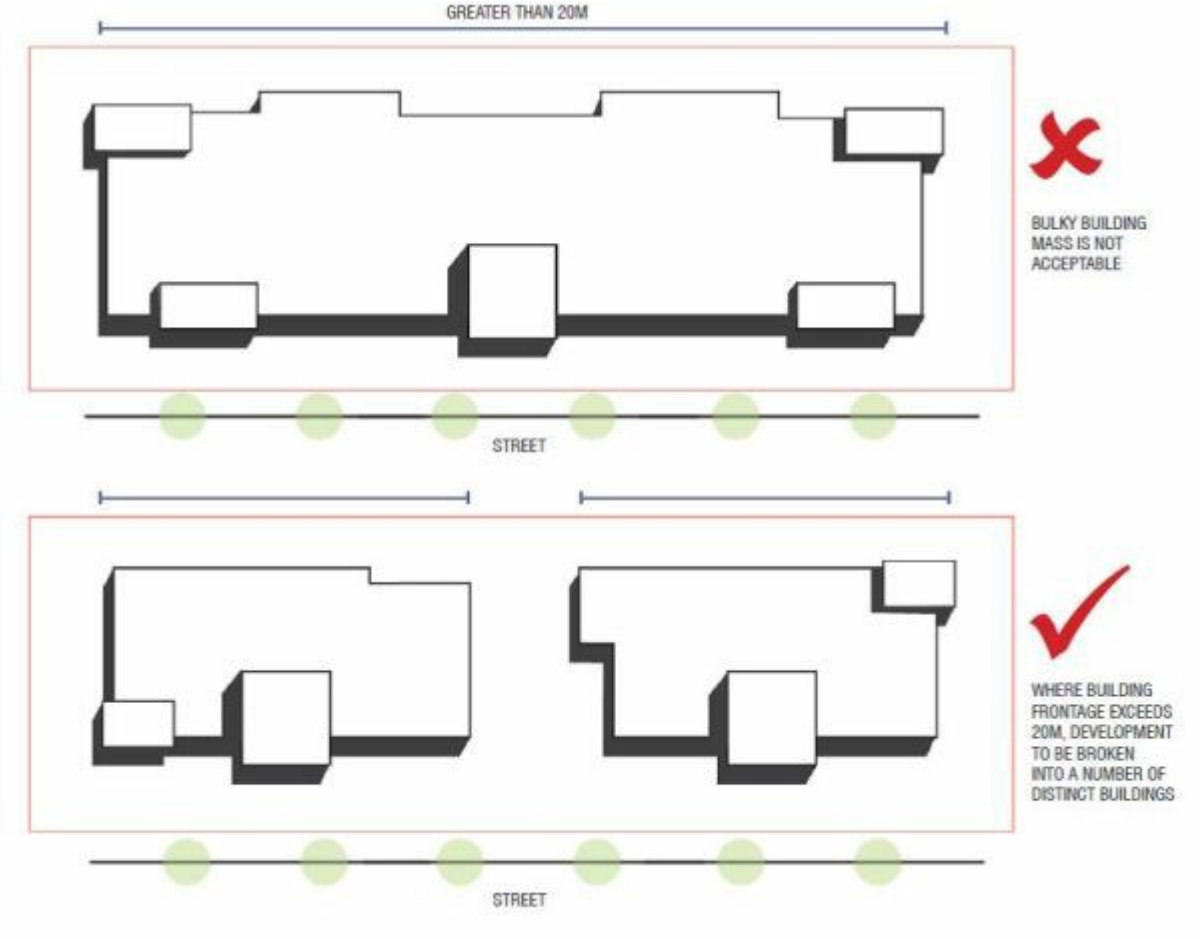


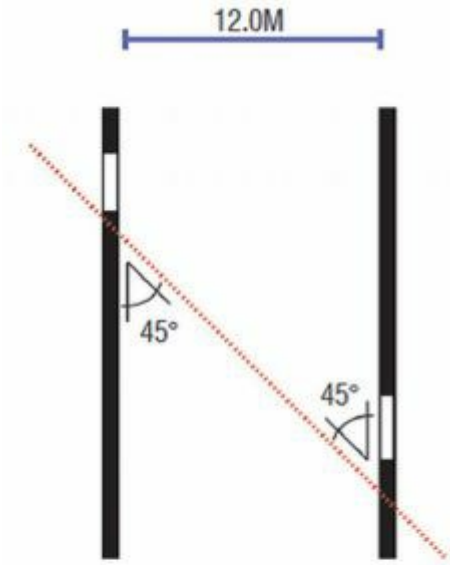
Figure 6.40 – Indicative building massing

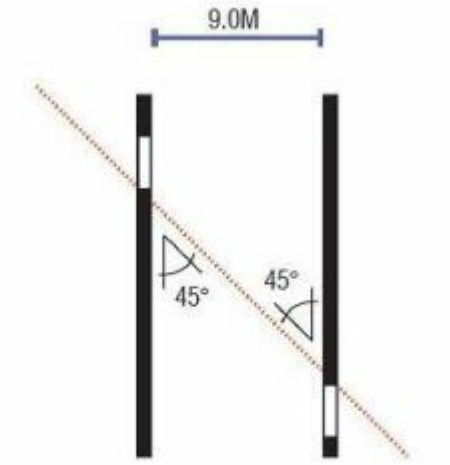
PO85 Design of buildings contribute to the creation of an attractive and safe arrival through maximising views to the bay through use of: (a) balconies, verandas or windows overlooking the bay; and (b) opportunities for indoor and outdoor living spaces.	No acceptable outcome is nominated.
PO86 Where incorporating non-residential uses, the design of buildings in this precinct provides for pedestrian friendly and visually interesting frontages with active ground floors where feasible.	**AO86.1** Front setbacks at the ground floor do not exceed 3m.
	AO86.2 Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum 0.5m for any length of the facade exceeding 10m.
	AO86.3 Ground floor dining tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO87 Where incorporating ground floor non-residential uses, weather protection is provided to usable outdoor spaces at the street frontage.	**AO87** Awnings are provided over outdoor spaces.

Table 6.2.2.3(a) - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcome takes precedence.	
Wills Street precinct	
PO88 Building height and scale is consistent with the character desired for the precinct. The size of the development site allows for the primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation, and open space at ground storey.	**AO88.1** Building height does not exceed 4 storeys.
	AO88.2 Where accommodating a building of more than 3 storeys, development sites have a minimum size of 1,000m².
PO89 Built form provides for sensitive transitioning in height and scale to nearby Character residential zoned land.	No acceptable outcome is nominated.

Table 6.2.2.3(b)-Building setbacks Medium density residential zone

<table>
<tr><th>Level</th><th>Building</th><th>Balconies or outermost projection</th><th>Privacy setbacks for balconies/terraces/windows of habitable rooms</th></tr>
<tr><td colspan="3">Front setbacks</td><td rowspan="15">Development provides a minimum separation distance of:
(a) 12.0m between windows or balconies that are offset by less than 45 degrees; or
 

12.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY LESS THEN 45°
(b) 9.0m between windows or balconies that are offset by 45 degrees or more.
 

9.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY 45° OR MORE</td></tr>
<tr><td>Basement</td><td>1.5m (providing a deep planting zone)</td><td>1.5m</td></tr>
<tr><td>Level 1-4</td><td>3.0m</td><td>1.5m</td></tr>
<tr><td>Level 5 and above</td><td>5.0m</td><td>3.0m</td></tr>
<tr><td colspan="3">Side setbacks</td></tr>
<tr><td>Levels 1-2</td><td colspan="2">1.5m</td></tr>
<tr><td>Levels 3-4</td><td colspan="2">2.5m</td></tr>
<tr><td>Level 5 and above</td><td colspan="2">3.5m</td></tr>
<tr><td colspan="3">Rear setbacks</td></tr>
<tr><td>Basement</td><td rowspan="4">6.0m</td><td>n/a</td></tr>
<tr><td>Level 1</td><td>n/a</td></tr>
<tr><td>Levels 2-4</td><td>4.0m</td></tr>
<tr><td>Level 5 and above</td><td>8.0m</td><td>6.0m</td></tr>
</table>

6.2.3 High density residential zone code

6.2.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.3.2 Purpose

(1) The purpose of the High density residential zone is to provide for higher density multiple dwellings.

(2) The particular purpose of the code is to:

- (a) optimise opportunities for higher density living close to the city's principal centre, in order to maximise accessibility to services, employment and public transport, promote affordable living and maximise day and night-time vibrancy of the centres;
- (b) maintain a level of residential amenity that is consistent with an inner urban and near centre lifestyle; and
- (c) create well-designed built form and public spaces that are pedestrian friendly and provide opportunities for community interaction.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) development provides for high-rise and high density multiple dwellings and short-term accommodation in locations clustered around or near the principal centre (CBD);
- (b) building height steps down from taller buildings in the Principal centre (CBD) zone, and is generally up to 12 storeys;
- (c) development maintains a high level of residential amenity on the site and in the neighbourhood;
- (d) development is designed to incorporate sustainable practices including maximising energy efficiency, water conservation and public and active transport use;
- (e) development is supported by transport infrastructure which is designed to provide and promote safe and efficient public transport use, walking and cycling; and
- (f) non-residential uses occur where they directly support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity of the area and are not better located in nearby centres.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Palmer Street precinct:

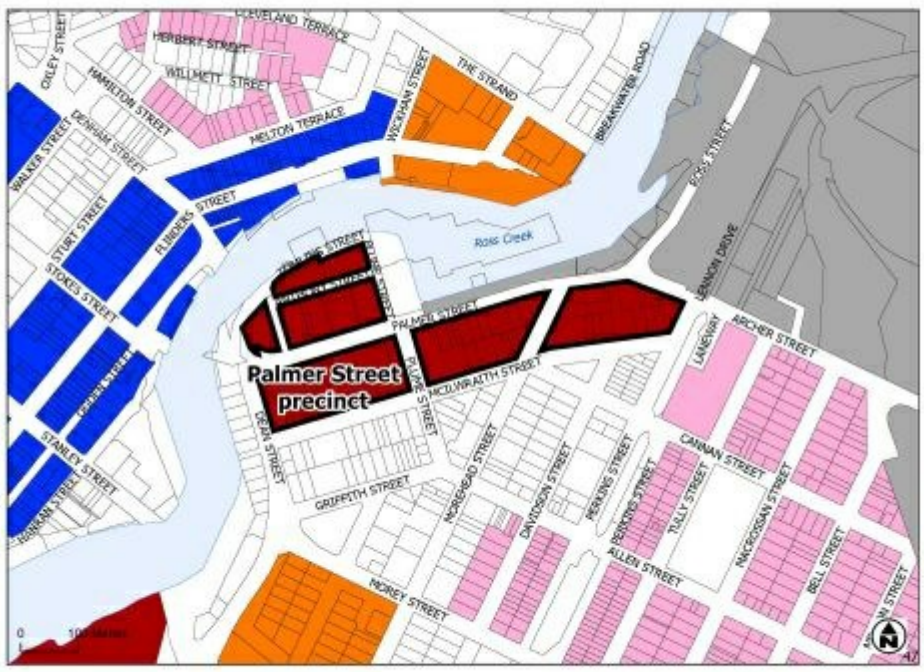
(a) this precinct continues to grow as Townville's primary contemporary entertainment and accommodation destination;

(b) Palmer Street is the continued focus for the establishment of restaurants, cafes and retail at the ground floor within a high quality streetscape;

(c) permanent residential accommodation occurs within this precinct where it does not compromise the function of Palmer Street as an entertainment destination;

(d) the public realm along the Ross Creek waterfront is of a high quality and provides continuous pedestrian access including the linking of the north and south banks by a new pedestrian bridge; and

(e) large-scale offices and other commercial activities are not established within the precinct.



Click here to view high resolution PDF.

Figure 6.41 – Palmer Street precinct

Flinders Street West precinct:

(a) this precinct grows to accommodate high density residential living;

(b) residential accommodation is provided in slender towers and takes advantage of the amenity of Ross Creek and views of Castle Hill, whilst protecting the heritage values of the historic railyards area;

(c) a hub of cultural activities is established within the historic railyards area, including a mix of education and entertainment activities;

(d) high quality public realm in and around the rail buildings is created and utilised for informal and formal performance spaces or events. Dining and local convenience retail may be located at ground storey; and

(e) new pedestrian connections are established within the precinct to:

(i) provide a linear connection along the edge of Ross Creek;

(ii) provide new connections to the Railway Estate precinct;

(iii) enhance the connectivity provided by the east west heritage rail path; and

(iv) provide connectivity within the precinct.

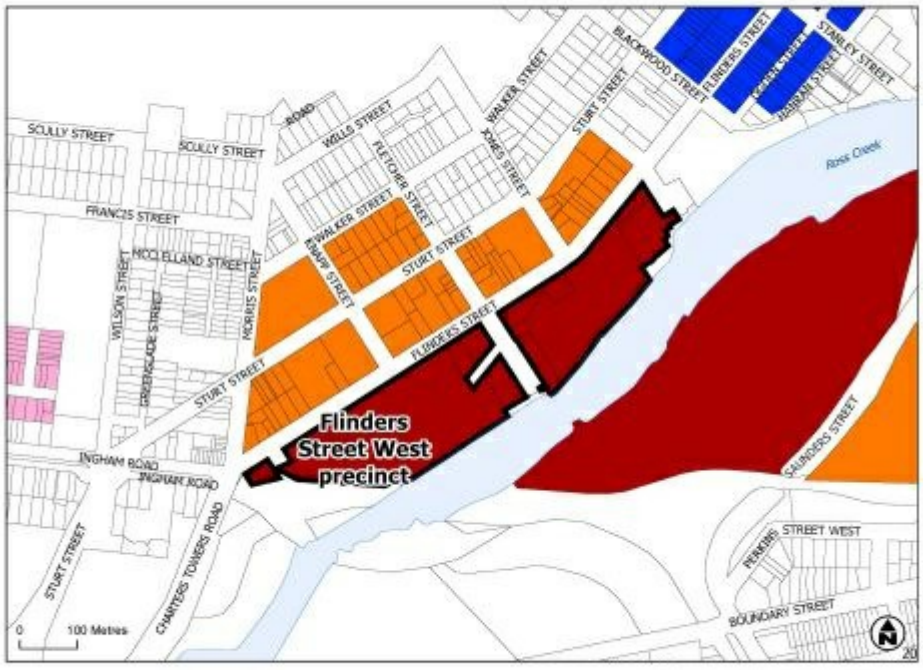


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Figure 6.42 – Flinders Street West precinct

Railway Estate precinct:

(a) development provides a high quality residential environment which capitalises on the precinct's proximity to the principal centre (CBD) and Ross Creek;

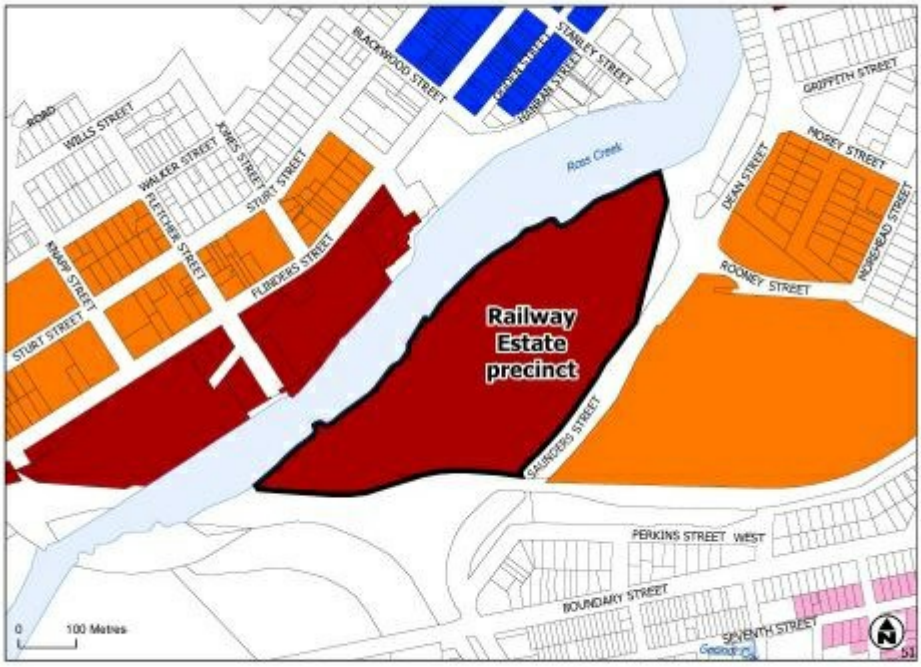
(b) development is predominantly residential in nature set in an attractive urban setting;

(c) a new neighbourhood centre is envisaged within this precinct to service the needs of residents;

(d) a high level of integration with existing and future development in surrounding areas is achieved, having regard to movement networks, open space and recreational facilities and community infrastructure;

(e) movement networks are established to promote walking and cycling and public transport; and

(f) development which is, or has the potential to become, incompatible with future urban development of the area does not occur.



Click here to view high resolution PDF.

Figure 6.43 – Railway Estate precinct

6.2.3.3 Assessment benchmarks

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast or home based child care, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO2** Development of the sales office is in place for no more than two years.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.
PO4 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development promotes the safety of residents and visitors, particularly through casual surveillance of the street and public spaces.	**AO6.1** Buildings are designed to have balconies, windows and building openings overlooking streets and other areas which are accessible to the public. Figure 6.44 — Design for casual surveillance illustrates
	AO6.2 Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

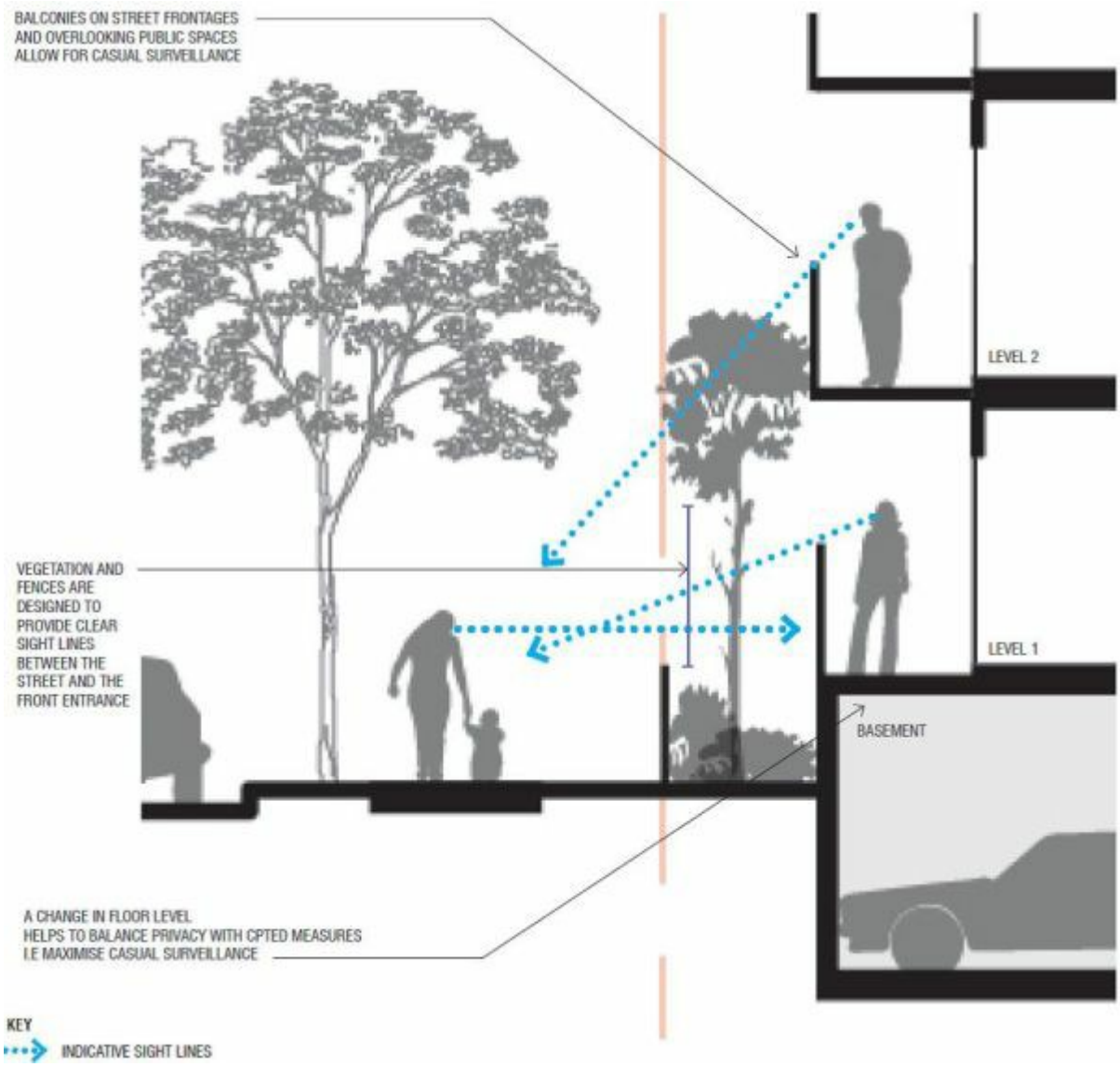


Figure 6.44 – Design for casual surveillance

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO7 Design elements contribute to an interesting and attractive streetscape and building through: (a) the provision of projections and recesses in the façade which reflect changes in internal functions of buildings including circulation; (b) variations in material and building form; (c) modulation in the façade, horizontally or vertically; (d) articulation of building entrances and openings; (e) corner treatments to address both street frontages for a premises on a corner; (f) at lower levels creates human/pedestrian scale experiences; (g) for upper levels, frames streets and public spaces; (h) elements which assist in wayfinding and legibility; and (i) elements which relates to the context including surrounding buildings, parks, streets and open spaces. Figure 6.45 – Building design elements provides indicative guidance.	No acceptable outcome is nominated.

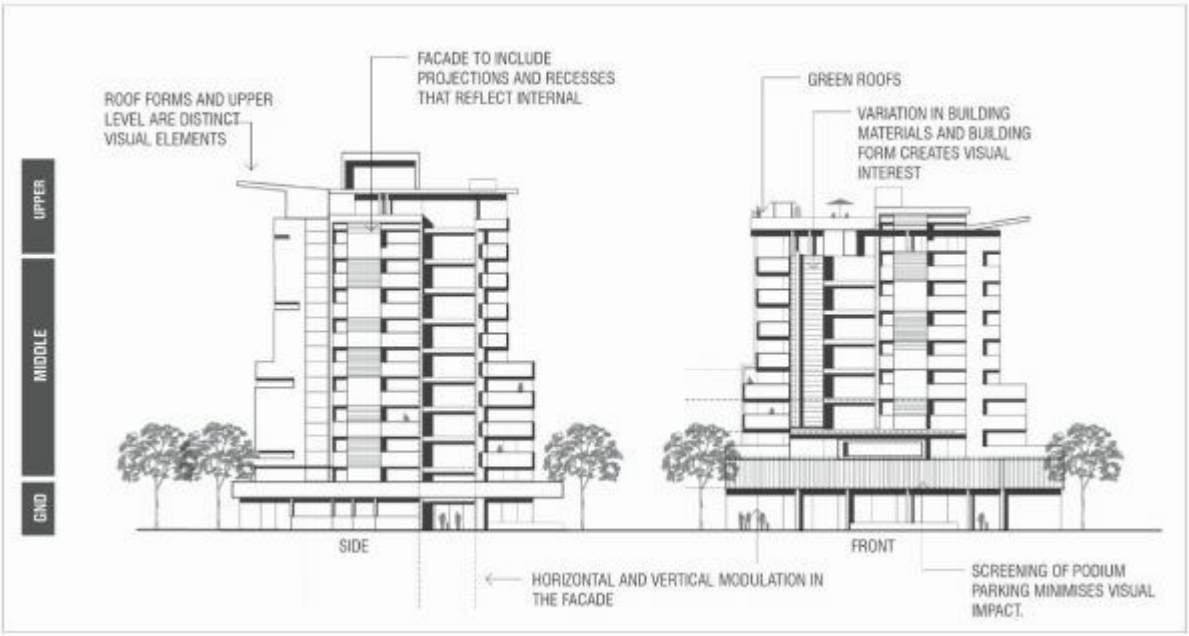


Figure 6.45 – Building design elements

PO8 Air conditioning units are insulated so that adjoining properties are not affected by the noise source, and are not significantly visible from the street.	No acceptable outcome is nominated.
PO9 The overall shape, configuration and placement of buildings create usable outdoor spaces.	No acceptable outcome is nominated.
PO10 Building height and scale, maintains the primacy of the principal centre (CBD) and is consistent with the character desired for the precinct.	**AO10** Building height does not exceed 12 storeys.
PO11 The size of the development site allows for primary orientation of buildings to the street, and the provision of building setbacks, on-site services and circulation and open space at ground storey.	**AO11** Where accommodating a building of 5 storeys or more, development sites have a minimum size of 1,000m^2.
PO12 Building design and setbacks: (a) create an attractive, consistent and cohesive scale along the streetscape; (b) maintain appropriate levels of light and solar penetration, air circulation, privacy and amenity for existing and future buildings; (c) do not prejudice the development or amenity of adjoining land; (d) retain the openness of street vistas, including to the sky, along major elements of the city grid; and (e) transition to lower scale heritage places and precincts.	**AO12** The design meets the setback requirements outlined by Table 6.2.3.3(b) - Building setbacks High density residential zone unless varied by a relevant precinct.
PO13 Built to boundary walls do not impact on the amenity or privacy of adjoining premises. **Editor's note—**Built to boundary wall heights and lengths may be increased where abutting an existing or proposed built to boundary wall on an adjoining property.	**AO13** Built to boundary walls: (a) are for non-habitable rooms or spaces only; (b) are not located within 1.5m of a habitable room on an adjoining site; (c) have a maximum height of 3m; and (d) have a maximum length of 15m.
PO14 Buildings are designed to achieve good solar access by: (a) minimising the extent of shadows on usable private open space or public spaces; and (b) maintaining access to sunlight for habitable rooms within adjoining premises.	No acceptable outcome is nominated.
PO15 Building caps and rooftops contribute to the: (a) architectural design of the building; and (b) the creation of an attractive roofscape.	No acceptable outcome is nominated.

PO16 Roof top levels incorporate open space or recreational spaces for the users of the building or are significantly dedicated to 'green roof' vegetation.	No acceptable outcome is nominated.
PO17 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO17.1** Balconies are provided with a minimum area of 9m² for 1 bedroom unit or 16m² for 2 or more bedroom unit, with a minimum dimension 4m and clear of any air conditioning unit or drying space.
	AO17.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO17.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO18 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	**AO18** No acceptable outcome is nominated.
PO19 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.
PO20 Where incorporating ground floor non-residential use, the design of buildings provides for pedestrian-friendly and visually interesting frontages.	**AO20.1** Ground floor tenancies where including a non-residential use are articulated through: (a) variation in use of materials (glass, timber, steel, masonry); and (b) a change in plane of a minimum of 0.5m for any length of the facade exceeding 10m.
	AO20.2 Ground floor tenancies are designed to be adaptable and flexible in configuration allowing for creation of indoor and outdoor spaces through use of large openings.
PO21 Where incorporating ground floor non-residential use, weather protection is provided to usable outdoor spaces at the street frontage.	**AO21** Awnings are provided over outdoor spaces.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Parking and servicing	
PO22 Parking facilities are located to be concealed from public view to ensure an attractive streetscape. Figure 6.46 — Concealment of parking structures.	No acceptable outcome is nominated.

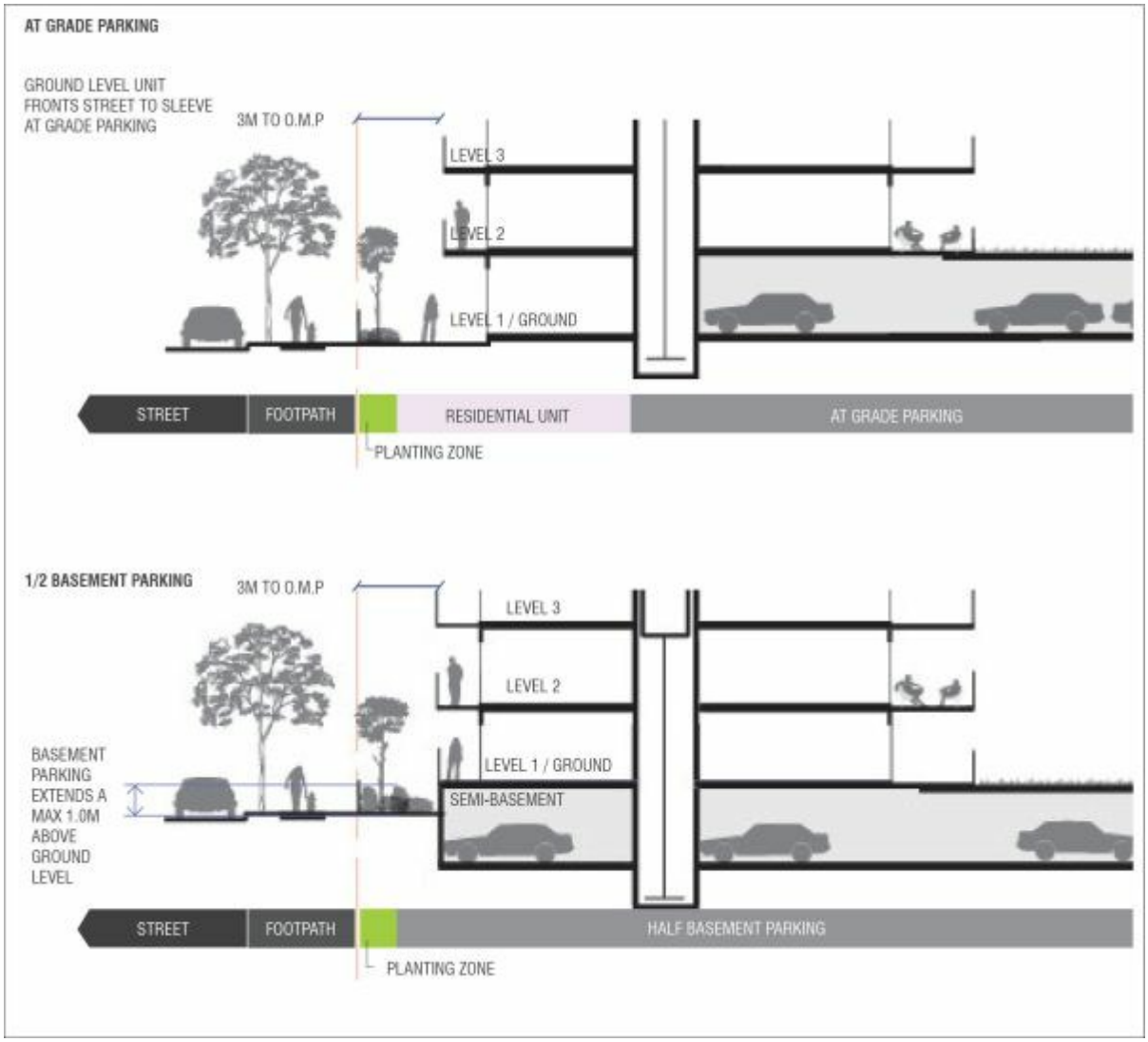


Figure 6.46 – Concealment of parking structures

PO23 Waste disposal and servicing areas are screened from public view and do not have adverse amenity impacts on adjoining properties.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development — where a non-residential use	
PO24 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community or as specifically intended for a particular precinct; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Palmer Street precinct	
PO25 Building height transitions down to create a low-rise interface with the Ross Creek Marina.	**AO25** Building height is in accordance with Figure 6.47 — Palmer Street precinct concept plan.
PO26 The design of buildings contributes to the creation of an interesting and attractive streetscape along Palmer Street by: (a) creating an entry aesthetic which defines the street edge with a high density built form; and (b) incorporating a streetscape and planting theme that creates a boulevard treatment of the street.	No acceptable outcome is nominated.
PO27 Development facilitates or supports primarily high density short-term or permanent accommodation uses.	No acceptable outcome is nominated.
PO28 An open space and pedestrian network is provided in accordance with Figure 6.47 — Palmer Street precinct concept plan which: (a) opens up opportunities for residents and visitors to view Ross Creek; and (b) creates quality walkable pathways along the creek edge in an attractive landscaped environment.	No acceptable outcome is nominated.
PO29 A new public space is provided along the Ross Creek frontage in accordance with Figure 6.47 — Palmer Street precinct concept plan which: (a) reduces the impact of traffic or service areas on pedestrians; (b) furnishes the space to provide a range of opportunities for sitting and social interaction; (c) connects the open space in the west with the yacht club in the east; and (d) provides an attractive environment for buildings to front.	No acceptable outcome is nominated.

PO30 On frontages shown on Figure 6.47 — Palmer Street precinct concept plan as having a built form edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO31 Dining, entertainment and tourist oriented uses occur at ground storey within development identified on the Figure 6.47 — Palmer Street precinct concept plan as active frontage.	No acceptable outcome is nominated.

Figure 6.47 – Palmer Street precinct concept plan

PO32 Buildings contribute to the creation of an attractive and activated edge to Ross Creek by having facades which contain windows, doors, materials and features which generate visual interest.	No acceptable outcome is nominated.

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Flinders Street West precinct	
PO33 Building height transitions down from the principal centre (CBD) interface to lower rise buildings around the historic railyards and surrounding neighbourhoods.	**AO33** Building height is in accordance with Figure 6.48 — Flinders Street West precinct concept plan.
PO34 Development primarily facilitates or supports high density accommodation uses.	No acceptable outcome is nominated.
PO35 Non-residential uses occur at ground storey and may include small-scale offices, retail, community uses and dining where on an active frontage identified on the Figure 6.48 — Flinders Street West precinct concept plan.	No acceptable outcome is nominated.
PO36 Heritage buildings within the historic railyards are refurbished and reused for educational, cultural and community uses.	No acceptable outcome is nominated.
PO37 The ground floor of all non-heritage buildings within the historic railyards are used for educational, cultural and community uses or complementary activities.	No acceptable outcome is nominated.
PO38 An open space and pedestrian network is provided in accordance with Figure 6.48 — Flinders Street West precinct concept plan. Central access within the precinct is designed to be a pedestrian focused shared zone, ensuring that while vehicle access is available pedestrian accessibility is prioritised.	No acceptable outcome is nominated.
PO39 New development or redevelopment within the historic railyards protects heritage values and provides high quality public realm including: (a) informal and formal performance spaces; and (b) spaces for public events or gatherings.	No acceptable outcome is nominated.

PO40 New public spaces are provided in accordance with Figure 6.48 — Flinders Street West precinct concept plan which: (a) create quality walkable connections to public walkways on the river; (b) reduce the impact of traffic or service areas on pedestrians; (c) furnish the space to provide a range of opportunities for sitting and social interaction; and (d) provide an attractive environment for adjoining buildings to front.	No acceptable outcome is nominated.
PO41 On frontages shown on Figure 6.48 — Flinders Street West precinct concept plan as having a built frontage, buildings contribute to the creation of a strong and pedestrian oriented edge to Ross Creek and the street, by: (a) creating a generally continuous building alignment; (b) providing awnings over the footpaths; and (c) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO42 Where shown as “built frontage” on Figure 6.48 – Flinders Street West precinct concept plan buildings contribute to the creation of an attractive and activated edge to Ross Creek and road frontage by having facades which contain windows, doors, materials and features which generate visual interest.	No acceptable outcome is nominated.

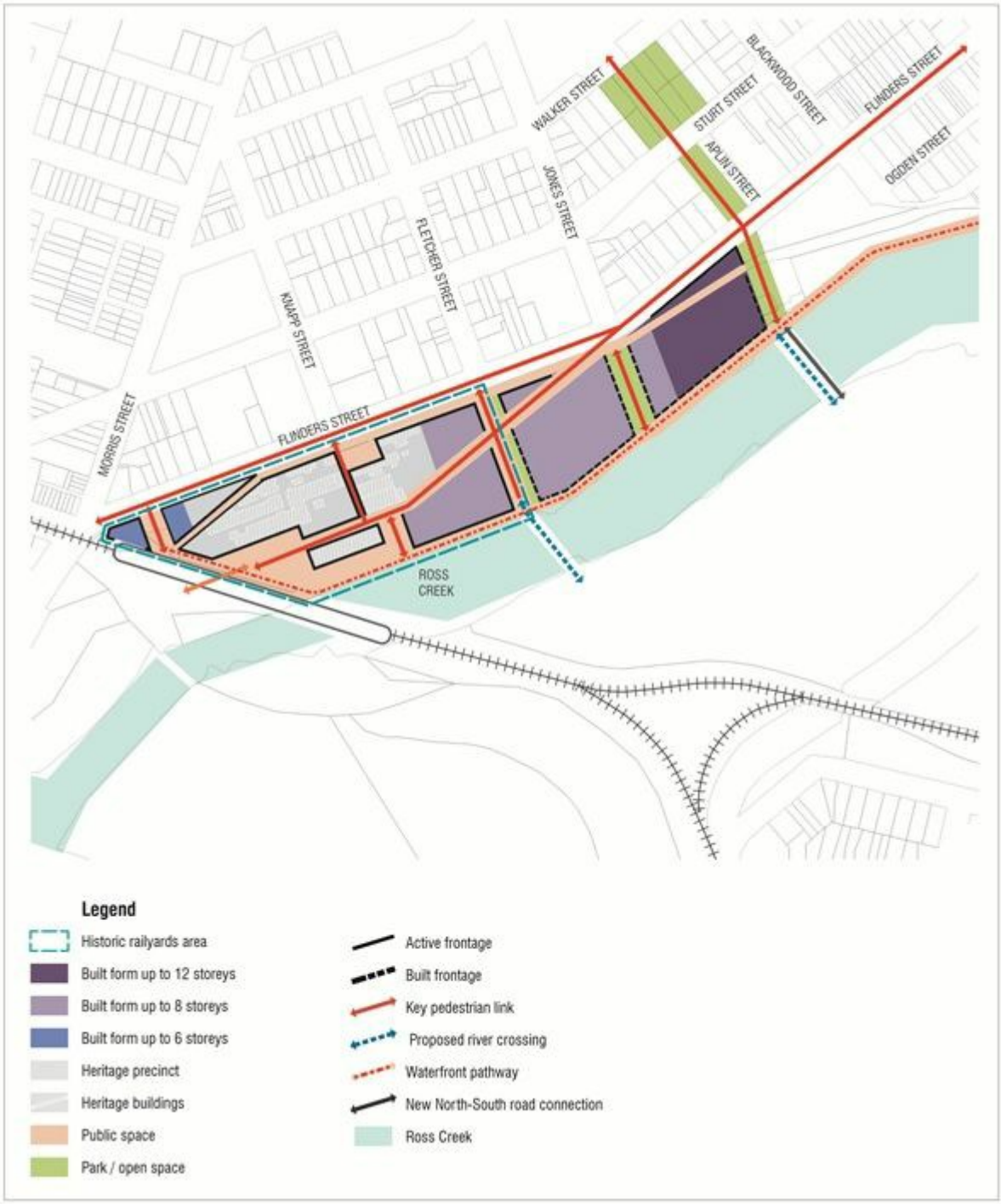


Figure 6.48 – Flinders Street West precinct concept plan

Table 6.2.3.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Railway Estate precinct	
PO43 Development primarily facilitates or supports high density accommodation uses.	No acceptable outcome is nominated.
PO44 A new neighbourhood level centre may establish within the precinct in accordance with Figure 6.49 — Railway Estate precinct concept plan. The new centre is designed to create: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; and (e) active primary frontages with car parking areas sleeved by buildings.	No acceptable outcome is nominated.
PO45 Development does not compromise or compete with the principal centre (CBD) or successful functioning of other centres in the network.	No acceptable outcome is nominated.
PO46 High level pedestrian and cyclist permeability is achieved, and primary elements of an open space, street and pedestrian network are provided in accordance with Figure 6.49 — Railway Estate precinct concept plan.	No acceptable outcome is nominated.

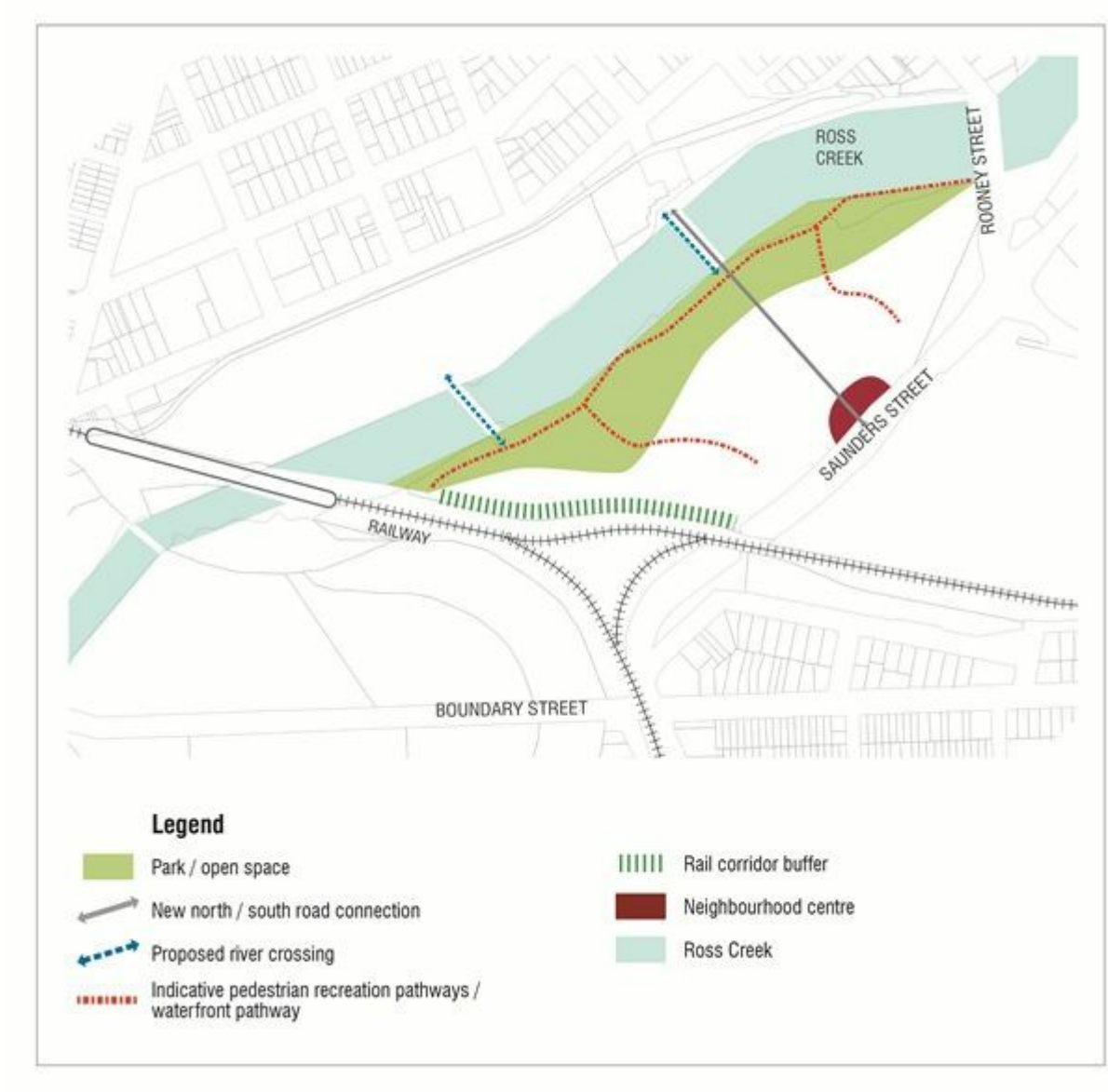
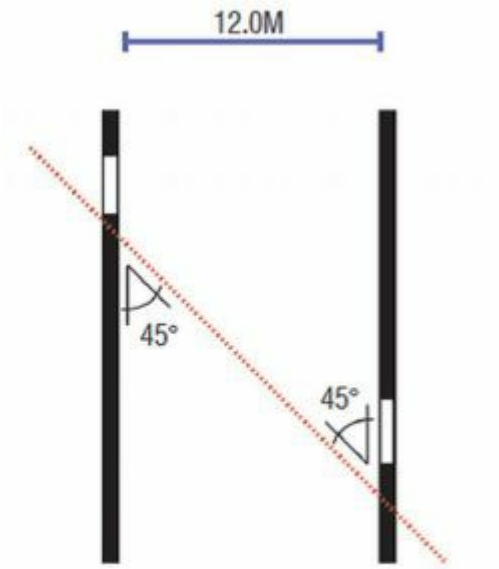
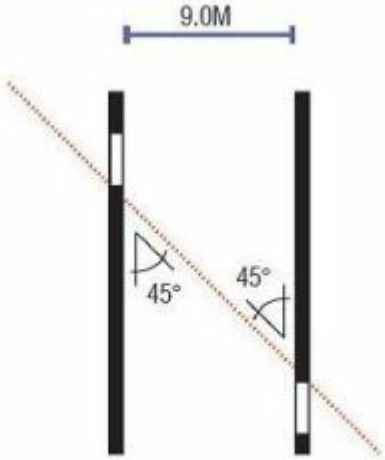


Figure 6.49 – Railway Estate precinct concept plan

PO47 New development provides high quality public realm including: (a) informal and formal performance spaces; (b) spaces for public events or gatherings; and (c) the creation of an attractive and activated edge to Ross Creek.	No acceptable outcome is nominated.
PO48 Development is attractively buffered from the railway, to achieve an acceptable level of residential amenity.	No acceptable outcome is nominated.

Table 6.2.3.3(b)—Building setbacks High density residential zone

<table>
<tr><th>Level</th><th>Building</th><th>Balconies or outermost projection</th><th>Privacy setbacks for balconies/terraces/windows of habitable rooms</th></tr>
<tr><td colspan="3">Front setbacks</td><td rowspan="12">Development provides a minimum separation distance of:
(a) 12.0m between windows or balconies that are offset by less than 45 degrees; or
 

12.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY LESS THEN 45°
(b) 9.0m between windows or balconies that are offset by 45 degrees or more.
 

9.0M SEPARATION BETWEEN WINDOWS AND/OR BALCONIES THAT ARE OFFSET BY 45° OR MORE</td></tr>
<tr><td>Basement</td><td>0m</td><td>n/a</td></tr>
<tr><td>Level 1-4</td><td>3.0m</td><td>1.5m</td></tr>
<tr><td>Level 5 and above</td><td>5.0m</td><td>3.0m</td></tr>
<tr><td colspan="3">Side setbacks</td></tr>
<tr><td>Levels 1-2</td><td colspan="2">1.5m or 0m where the adjoining building is built to boundary.</td></tr>
<tr><td>Levels 3-4</td><td colspan="2">2.5m or 0m where the adjoining building is built to boundary.</td></tr>
<tr><td>Level 5 and above</td><td colspan="2">3.5m</td></tr>
<tr><td colspan="3">Rear setbacks</td></tr>
<tr><td>Basement</td><td rowspan="3">6.0m or 0m where the adjoining building is built to boundary.</td><td>n/a</td></tr>
<tr><td>Level 1</td><td>n/a</td></tr>
<tr><td>Levels 2-4</td><td>4.0m</td></tr>
<tr><td>Level 5 and above</td><td>6.0m</td><td>6.0m</td></tr>
</table>

6.2.4 Rural residential zone code

6.2.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.4.2 Purpose

(1) The purpose of the Rural residential zone code is to provide for residential development on large lots where the intensity of residential development is dispersed.

(2) The particular purpose of the code is to:

- (a) provide for semi-rural lifestyles in which the primary use is dwelling houses on large lots which may have limited access to infrastructure and services;
- (b) provide for some subordinate, and generally domestic scale, rural activities and home based business to occur;
- (c) ensure development maintains the character and amenity of the rural residential locality; and
- (d) ensure any intensification of impacts on nearby ecological values or natural resources is avoided.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) residential development occurs in the form of dwelling houses, to the general exclusion of other more intensive residential uses;
- (b) reconfiguration creates large lots which support a semi-rural lifestyle and avoid intensification of impacts on on-site and on nearby ecological values, natural resources or rural activities;
- (c) lot sizes are sufficient to ensure the protection of environmental values and water quality objectives;
- (d) further expansion of existing rural residential areas does not occur beyond those areas zoned for this purpose;
- (e) home businesses occur to an extent that does not unduly diminish the semi-rural residential amenity, having regard to noise, odour, dust, traffic and other impacts;
- (f) roadside stalls and other sales of produce produced on the site are of a limited scale that is consistent with the semi-rural lifestyle;
- (g) non-residential uses occur within the zone where they primarily support the day-to-day needs of the immediate residential community and do not unreasonably detract from the residential amenity of the area;
- (h) development is buffered from nearby rural land such that the productive use of the rural land is not constrained;
- (i) residential development is protected from the impacts of nearby industrial activities, transport corridors and infrastructure installations and major facilities such as Department of Defence landholdings;
- (j) the natural bushland setting and village character of Balgal Beach and the Magnetic Island townships are maintained. Tourism accommodation in these communities is of a house compatible scale; and
- (k) development does not diminish water quality and does not intensify impacts on other environmental values including remaining areas of ecological significance within the zone.

6.2.4.3 Assessment benchmarks

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure (excluding truck parking); (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than two non-resident employees; (e) where bed and breakfast or farm stay accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 - Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast, farm stay or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

PO2 Heavy vehicle parking: (a) has a direct nexus with a home based business or rural use carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties. **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass.	**AO2.1** Not more than one heavy vehicle is parked on the site. **AO2.2** While on-site, vehicles: (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Roadside stall	
PO3 Roadside stalls are small in scale and do not impact negatively upon the amenity, character or safety of the locality and the safety and efficiency of roads.	**AO3.1** Any structure used for the sale of goods or produce is limited to 20m^2 gross floor area.
	AO3.2 Access to the structure is via the primary property access point.
	AO3.3 Produce or goods sold is grown, made or produced on the land on which the road side stall is erected.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO4 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO4** Development of the sales office is in place for no more than two years.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Animal keeping and cropping	
PO5 Animal keeping and cropping do not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO5.1** Non-residential buildings, animal enclosures, storage facilities and waste disposal areas are set back 50m from any dwelling on an adjoining or nearby site.
	AO5.2 The height of non-residential buildings or facilities does not exceed 2 storeys or 8.5m above ground level, whichever is the lesser.
	AO5.3 Cropping does not involve chemical spraying unless a 40m wide vegetated buffer is provided on the site between the crops which are being sprayed and adjoining land.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development - where a non-residential or tourist accommodation use	
PO6 Non-residential uses established only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO7 Tourism accommodation within Balgal Beach and the Magnetic Island townships is compatible with the village character of these communities.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO8 Development is consistent with the height and scale of surrounding buildings and includes features that contribute to an attractive streetscape.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO9 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) privacy; and (h) outlook.	No acceptable outcome is nominated.
PO10 Landscaping is provided to contribute positively to the city image, particularly along major roads.	No acceptable outcome is nominated.
PO11 Development does not compromise the ongoing productive use of nearby rural land.	No acceptable outcome is nominated.

PO12 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.4.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO13 The site layout, size and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention of existing vegetation; (e) providing buffers to protect the ecological functions of waterways; and (f) protecting environmental values and water quality objectives of receiving waters. **Editor's note—**The environmental values and water quality objectives are established under the Environmental Protection Policy (2009). For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated.

6.2.5 Character residential zone code

6.2.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.2.5.2 Purpose

(1) The purpose of the Character residential zone code is to provide for a particular character of a predominantly residential area.

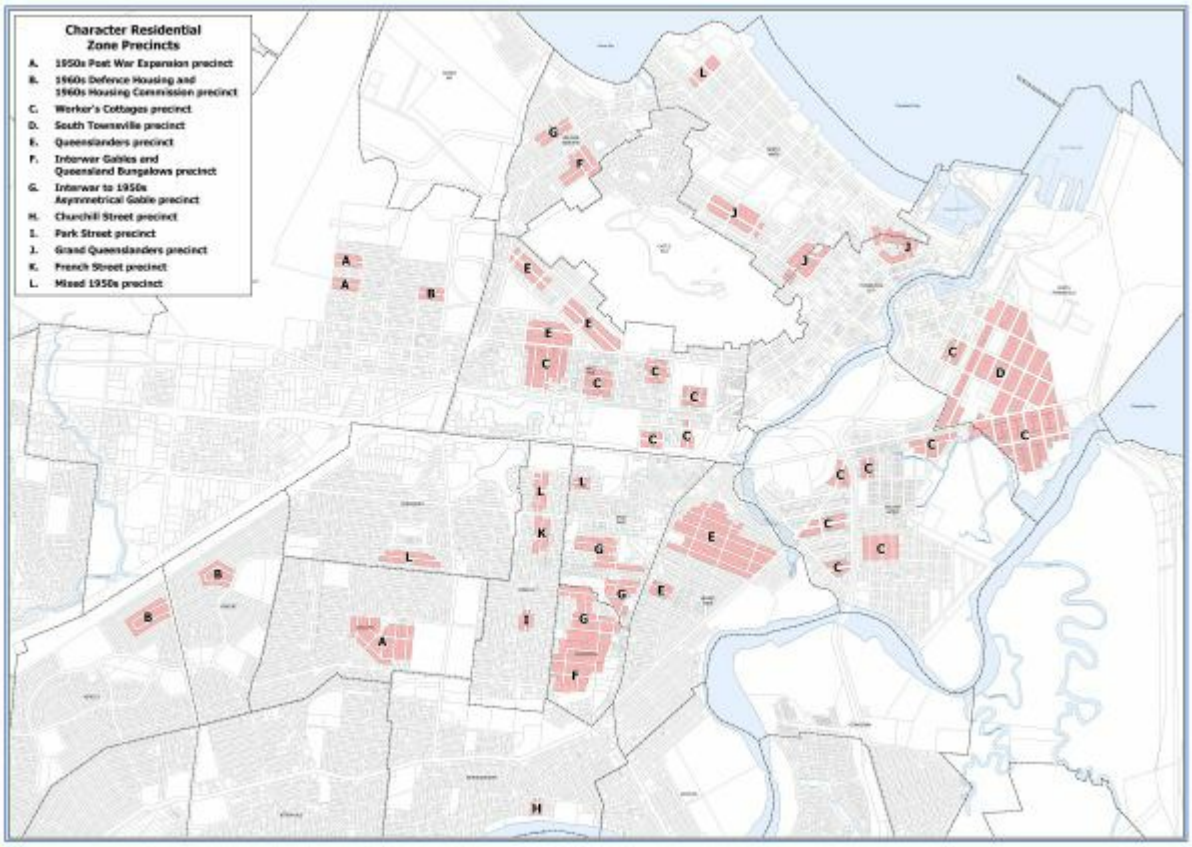
(2) The particular purpose of the code is to:

- (a) protect traditional character and streetscape values of the Character residential zone code by:
  - (i) preventing relocation off the site and demolition of contributing character buildings; and
  - (ii) ensuring the design of any new development is compatible with the places of character value within the zone.
- (b) primarily accommodate dwelling houses and ensure new development is sympathetic to the established character of the street or locality;
- (c) maintain a high level of residential amenity;
- (d) achieve accessible, well serviced and well-designed communities; and
- (e) maintain the low-rise and lower density character of Townsville's suburbs.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) contributing character buildings are protected and retained so they continue to contribute to the traditional character and amenity of the street and neighbourhood;
- (b) new development is limited to that which does not diminish the vernacular architectural character of houses or the traditional streetscape character;
- (c) new development incorporates design elements that are compatible with the established character;
- (d) reconfiguration of lots does not diminish the traditional streetscape character;
- (e) carports and garages do not dominate the frontage and are subservient to contributing character buildings;
- (f) dwelling houses are predominately low-rise, but may be low set or high set;
- (g) development maintains a high level of residential amenity on the site and in the precinct;
- (h) residential development is protected from the impacts of nearby industrial activities, transport corridors and infrastructure installations and major facilities such as the Port of Townsville, Townsville Airport and Department of Defence landholdings; and
- (i) non-residential uses only occur within the zone where they primarily support the day-to-day needs of the immediate residential community, do not unreasonably detract from the residential amenity, and are not better located in nearby centres.

Editor's note—The term "low set" refers to a building elevated 900mm or less. "High set" refers to buildings generally elevated 2,000mm above ground level.



Click here to view PDF high resolution map.

Figure 6.50 – Character residential zone precincts

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

1950s Post War Expansion precinct:

(a) this precinct consists mostly of compact, low set dwelling houses typical of the Queensland Housing Commission in the 1950s;

(b) buildings within this precinct have a low-set appearance and scale consistent with the predominant character of the precinct;

(c) built form maintains the existing setting and rhythm of the streetscape;

(d) the roof profile and overhang of buildings is consistent with that of contributing character buildings; and

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

1960s Defence Housing and 1960s Housing Commission precinct:

(a) this precinct consists mostly of intact Defence housing and Queensland Housing Commission design homes of the 1960s;

(b) buildings within this precinct are elevated, generally high set, and light weight, ventilated design features, and maintains regularity of form and street presentation;

(c) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(d) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(e) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building.

Worker's Cottages precinct:

(a) this precinct consists of low and high set Queensland worker's cottages and bungalows, constructed of lightweight materials;

(b) the consistent character of worker's cottages and interwar houses constructed of lightweight materials is maintained;

(c) buildings in this precinct have open facades which address the street and are consistent with the predominant front façade profile that contributes to the precinct's character;

(d) building floor level height in new development is consistent with adjoining contributing character buildings;

(e) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(f) the roof profile of buildings is consistent with that of contributing character buildings; and

(g) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

South Townsville precinct:

(a) this precinct contains predominantly low set Queensland worker's cottages and a large portion of non-residential facilities that are key attributes to the precinct's character;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) the front façade of buildings is consistent with the predominant front façade profiles of contributing character buildings and does not result in blank facades or facades with small openings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(g) additions, alterations and adaptive reuse of existing non-residential contributing character buildings maintains the legibility of the historic use and is sympathetic to the prevailing residential character of the precinct.

Queenslanders precinct:

(a) this precinct consists of low and high set Queensland workers' cottages and bungalows;

(b) the consistent character of Queensland workers' cottages and interwar houses constructed of lightweight materials is maintained;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) the roof profile of buildings is consistent with that of contributing character buildings;

(f) buildings have a verandah to the front façade which addresses the street and development does not result in blank facades or facades with small openings; and

(g) the subdivision pattern of the precinct is maintained.

Interwar Gables and Queensland Bungalows precinct:

(a) this precinct predominately consists of inter-war high-set dwelling houses and villa style residences with large workers' bungalows which have significant street presence;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

(g) the front facade of buildings addresses and retains street presence; and

(h) the subdivision pattern of the precinct is maintained.

Interwar to 1950s Asymmetrical Gable precinct:

(a) the precinct consists of a mix of Queensland bungalows and inter-war designs;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings;

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

(f) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings; and

(g) the subdivision pattern of the precinct is maintained.

Churchill Street precinct:

(a) this precinct contains predominantly older detached, lightweight, post-war dwelling houses, displaying pre-war design elements;

(b) dwelling houses in this precinct are elevated and generally high set;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) buildings within this precinct retain or enhance the setting and rhythm of the streetscape;

(f) the roof profile and overhang of buildings is consistent with that of contributing character buildings; and

(g) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

Park Street precinct:

(a) this precinct contains a mix of high and low set designs from the inter-war period;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) buildings in this precinct retain or enhance the setting and rhythm of the streetscape;

(e) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(f) window scale and proportions of buildings are sympathetic to the predominant character of the precinct; and

(g) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

Grand Queenslanders precinct:

(a) this precinct which contains Stanton Hill and Melton Hill, consists of large Queenslanders and other inter-war traditional timber buildings which have an iconic townscape appearance;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile of buildings is consistent with that of contributing character buildings; and

(e) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

French Street precinct:

(a) this precinct consists of large inter-war gabled Queenslander dwelling houses;

(b) dwelling houses in this precinct are elevated and generally high set;

(c) building floor level height in new development is consistent with adjoining contributing character buildings;

(d) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(e) development maintains the uniformity and consistency of dwelling design style, setting and the rhythm of the streetscape;

(f) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(g) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings; and

(h) window scale and proportions of buildings are sympathetic to the predominant character of the precinct.

Mixed 1950s precinct:

(a) the precinct contains older timber dwelling houses and gabled, inter-war and post-war designs;

(b) building floor level height in new development is consistent with adjoining contributing character buildings;

(c) enclosing the ground floor of a contributing character building does not have an adverse impact on the character of the building;

(d) the roof profile and overhang of buildings is consistent with that of contributing character buildings;

(e) window scale and proportions of buildings are sympathetic to the predominant character of the precinct;

and

(f) the front facade of buildings is consistent with the predominant front facade profiles of contributing character buildings.

6.2.5.3 Assessment benchmarks

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast accommodation does not exceed three bedrooms; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**Home based business operators should also refer to signage requirements under Table 5.8.2 - Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.

	AO1.3 Other than where a bed and breakfast or home based childcare the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.
PO2 Commercial vehicle parking: (a) has a direct nexus with a home based business carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO2.1** Not more than one commercial vehicle is parked on the site.
	AO2.2 While on-site, vehicles; (a) are not left idling for more than 5 minutes at any one time; and (b) do not have a refrigeration unit running.
	AO2.3 Any commercial vehicle does not exceed 4.5 tonnes gross vehicle mass and is housed behind the building line.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO3 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) odour and emissions; (f) lighting; (g) access to sunlight; (h) privacy; and (i) outlook.	No acceptable outcome is nominated.

PO4 Development for the purposes of a sensitive use within 500m of land included in the High impact industry zone or Special purpose zone, or within 250m of land in the Medium impact industry zone: (a) achieves indoor noise levels consistent with the objectives set out in the Environmental Protection (Noise) Policy 2008; (b) achieves air quality levels consistent with the objectives set out in the Environmental Protection (Air) Policy 2008 and the relevant national standard; and (c) does not experience offensive odours.	No acceptable outcome is nominated.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO5 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and way finding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note–**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.
PO6 Development minimises impacts on remaining areas of ecological significance within the zone.	No acceptable outcome is nominated.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Demolition and removal	
PO7 The removal, relocation or a partial or total demolition of a contributing character building only occurs if it can be demonstrated that the: (a) total or partial loss of the building will not contribute to the loss of the character values; (b) total or partial loss of the building will not impact on the rhythm of the streetscape; or (c) the building or part proposed for demolition is not capable of structural repair.	No acceptable outcome is nominated. **Editor's note–**An impact statement produced by a suitably qualified professional may be required to demonstrate that there is no adverse impact on the character of the precinct due to the loss of the place, or a suitably qualified professional provides a report on the buildings condition, demonstrating that the place is not capable of repair. **Editor's note–**Applicants should have regard to the Character Residential planning scheme policy no. SC6.2 for guidance on how to write an impact statement.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note–This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development	
Carports and garages	
PO8 When viewed from a street, ancillary buildings such as carports and garages: (a) do not visually dominate the streetscape character; (b) are subservient to existing buildings on the site; (c) do not detract from the character or appearance of the contributing character buildings; and (d) are consistent with the established rhythm of the streetscape.	**AO8** Class 10a structures such as carports, garages: (a) are set back an equal or greater distance from the street as the main building; (b) have a maximum width not exceeding 3m; (c) do not have a garage door or solid face presented to the street; (d) are detached or semi-detached structures with minimum carport roof gap to the building face of 0.6m (as shown in Figure 6.51 – Appropriate carport or garage type and roof gap); (e) have a roof pitch which matches the main building's predominant roof pitch or has a roof pitch no greater than 3 degrees (as shown in Figure 6.52 - Appropriate roof pitch of a carport or garage); (f) have their highest point lower or equal to the gutter/facia level of the main building (as shown in Figure 6.53 - Appropriate height relative to the main building); and (g) are built using materials that complement the existing dwelling (as shown in Figure 6.54 - Appropriate complementary building materials).

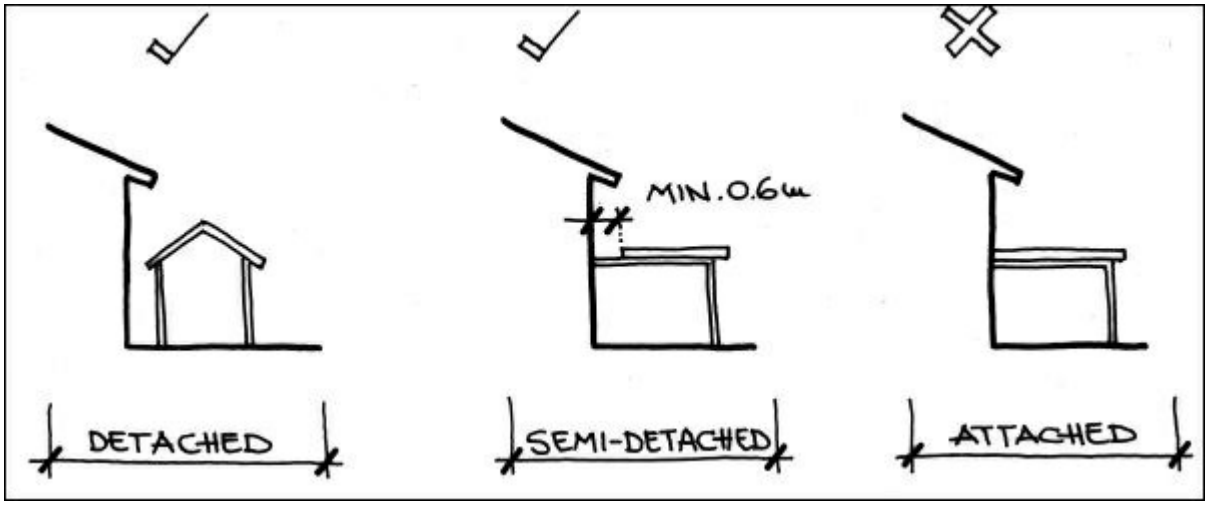


Figure 6.51 - Appropriate carport or garage type and roof gap

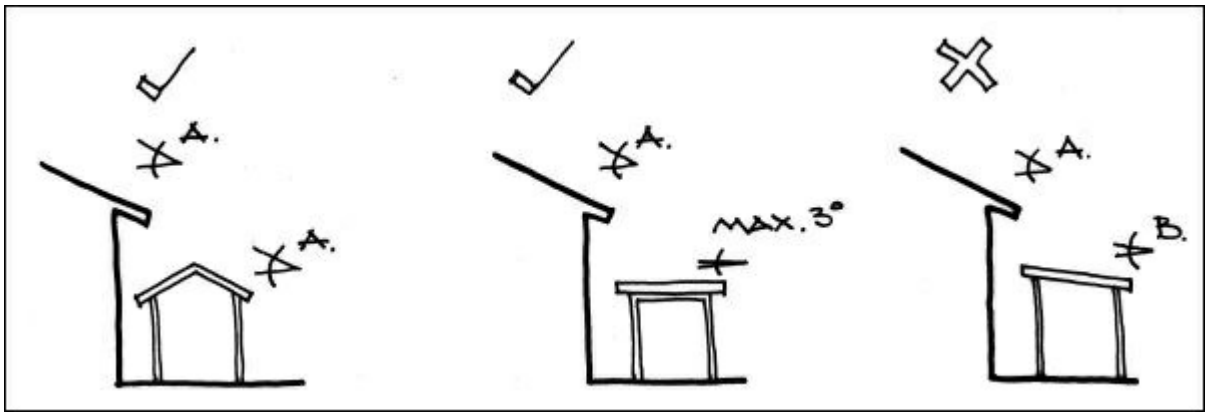


Figure 6.52 - Appropriate roof pitch of a carport or garage

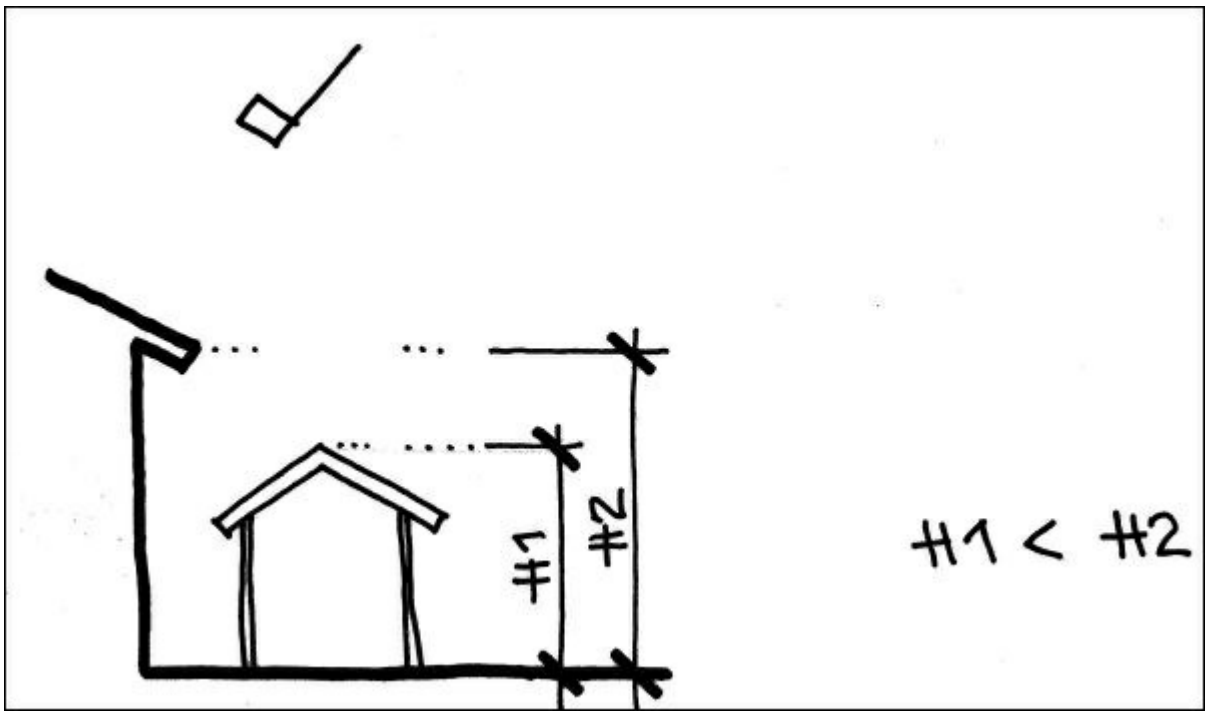


Figure 6.53 - Appropriate height relative to the main building

Figure 6.54 - Appropriate complementary building materials

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development - where a non-residential use	
PO9 Non-residential uses establish only where: (a) compatible with local character and amenity; (b) limited in scale and supporting the day-to-day needs of the local community; and (c) not impacting on the role and function of the city's network of centres or more appropriately located in another zone.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to the Economic impact assessment planning scheme policy no SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Development is of a house compatible scale.	**AO10.1** The use only involves minor building work. OR
	AO10.2 Where a new building is proposed: (a) buildings and other structures do not exceed 8.5m or 2 storeys in building height, whichever is the lesser; (b) the building does not exceed 250m² in gross floor area; (c) site cover does not exceed 60%; and (d) the maximum length of any wall is 12m.

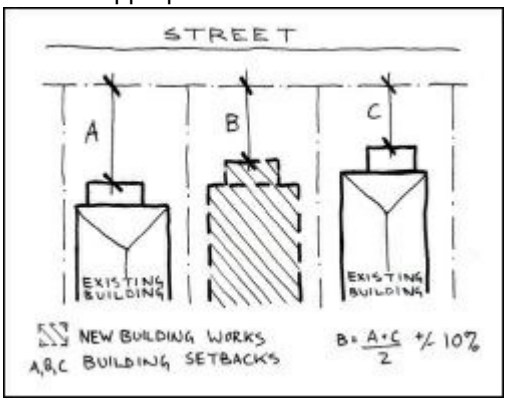
Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

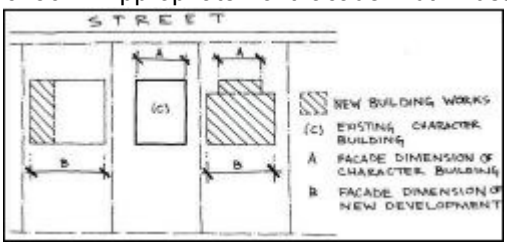
Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

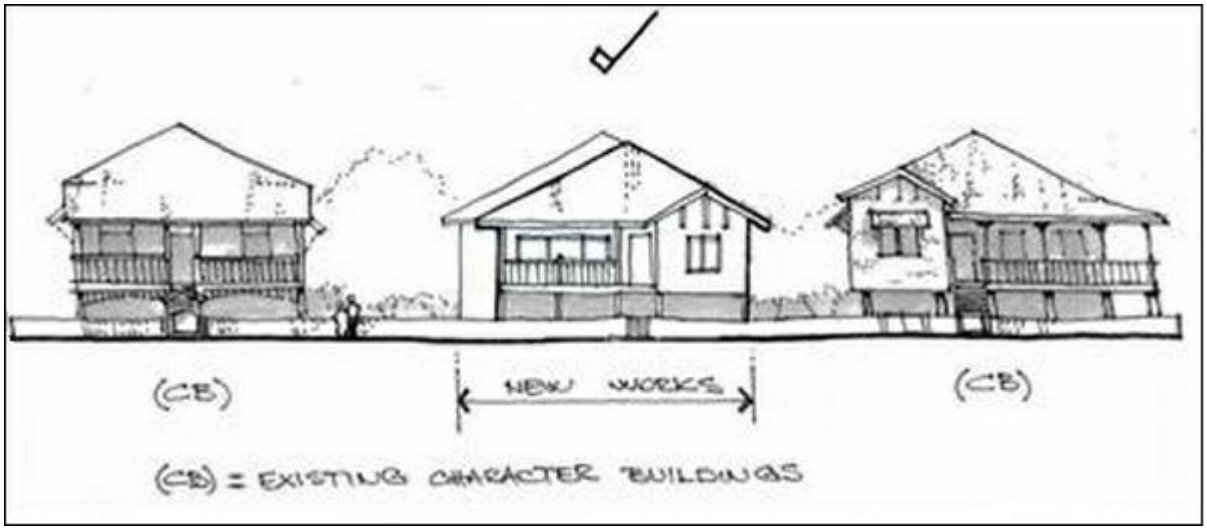
Performance outcomes	Acceptable outcomes
For assessable development	
Reconfiguring a lot	
PO11 Reconfiguration of lots is consistent with the predominant subdivision pattern of the precinct.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
For assessable development — where a new building, relocation of a contributing character building within the site or extension or alteration to an existing contributing character building	
PO12 Building height is consistent to adjoining contributing character buildings.	**AO12.1** Development does not involve raising or lowering a dwelling by more than 1m.
	AO12.2 Unless otherwise stated for a particular precinct, buildings and structures do not exceed 8.5m or 2 storeys in building height, whichever is the lesser.
PO13 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO13.1** Buildings and extensions are setback from street frontages within 10% of the average front setback of adjoining contributing character buildings. Figure 6.55 — Appropriate front setbacks illustrates.  **Figure 6.55 — Appropriate front setbacks**

	AO13.2 Unless otherwise stated for a particular precinct, the front facade width of the building is the same as the front facade width of the adjoining contributing character buildings, to a minimum depth of 3m. Figure 6. 56 — Appropriate front facade width illustrates.  **Figure 6.56 — Appropriate front facade width**
PO14 Buildings maintain the regularity of building form and street presentation. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome. Figure 6.57 — Street presentation provides indicative guidance.	No acceptable outcome is nominated.



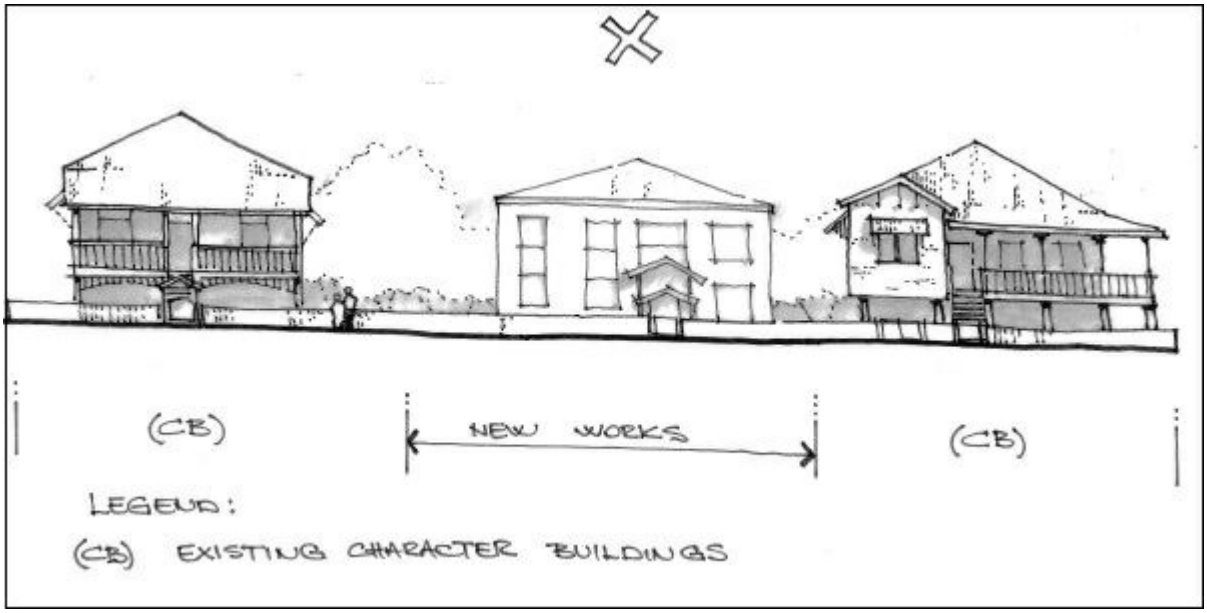


Figure 6.57 – Street presentation

PO15 Buildings use materials that have a lightweight appearance, and assist in reducing building bulk and form. **Editor's note—**Applicants should have regard to the Character planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO15.1** Walls are clad with lightweight materials with an expressed surface profile.
	AO15.2 Roofs are clad with corrugated iron.
	AO15.3 Windows are timber framed or have the appearance of being timber.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
1950s Post War Expansion precinct	
PO16 Buildings have a low-set appearance and scale consistent with the predominant character of the precinct.	**AO16.1** Building height does not exceed 1 storey.
	AO16.2 Dwelling houses have elevated floor levels between 600mm to 750mm above ground level.
PO17 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO17** The front facade width is 8m to 11m wide, to a minimum depth of 3m. Figure 6.58 - 1950s Post War Expansion precinct (Parsons street) illustrates. **Figure 6.58 - 1950s Post War Expansion precinct (Parsons Street)**
PO18 The roof profile is consistent with the predominant roof profile of dwellings that contribute to the precinct's character. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how todemonstrate compliance with this performance outcome.	**AO18** The roof profile is: (a) hipped with a 15 degree to 22.5 degree pitch; or (b) hipped with a 15 degree to 22.5 degree pitch incorporating a hipped or gabled projection towards the street.

PO19 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO19** Roof overhangs are: (a) 600mm wide; and (b) gable end overhangs are 300mm to 400mm wide.
PO20 Window scale and proportions are sympathetic to the predominant character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO20** Windows are half-height with 2, 3, or 4 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio. Figure 6.59 - Half-height vertically proportioned frames in the 1950s Post War Expansion precinct (Kent street) illustrates. **Figure 6.59 - Half-height vertically proportioned frames in the 1950s Post War Expansion precinct (Kent Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
1960s Defence Housing and 1960s Housing Commission precinct	
PO21 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO21** The roof profile is simple gabled or simple hipped with a 10 degree to 15 degree roof pitch.
PO22 The roof overhang is consistent with the predominant roof overhang of the contributing character buildings. **Editor' note—**Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO22** Roof overhangs are 750mm to 900mm wide.
PO23 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO24 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO24** Development on any ground floor storey is: (a) semi-enclosed with timber battens from view; and (b) aligned with the upper levels walls. Figure 6.60 - Appropriate enclosure to the ground floor in the 1960s Defence Housing and 1960s Housing Commission precinct (Pixley Street) illustrates. **Figure 6.60 — Appropriate enclosure to the ground floor in the 1960s Defence Housing and 1960s Housing Commission precinct (Pixley Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

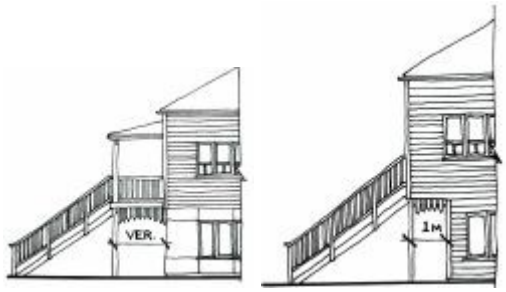
Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Worker's Cottages precinct	
PO25 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO25** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO26 The front facade includes a verandah consistent with the predominant front facade profile of the contributing character buildings.	**AO26.1** The front facade includes an open or semi-enclosed front verandah for a minimum 60% width of the front facade; OR **AO26.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across 60% or more of the front facade of the dwelling and wrap around one or both sides of the front facade for a minimum of 2m and the enclosure is capable of being reversed. Figure 6.61 - A front verandah in the Worker's Cottages precinct (Castling Street) illustrates. **Figure 6.61 — A front verandah in the Worker's Cottages precinct (Castling Street)**

PO27 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO27** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.62 - Appropriate enclosures to the ground floor illustrates. **Figure 6.62 — Appropriate enclosures to the ground floor**
PO28 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO28.1** The roof profile is simple hipped or pyramid with a 15 degree to 25 degree roof pitch.
	AO28.2 Verandahs are contained under the main roof form, or roofed separately with skillion or gently curved roofs.
PO29 Window scale and proportions, and window hoods and awnings are sympathetic to the predominant character of the precinct. **Editor' note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO29.1** The windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO29.2 Where windows are not sheltered by a verandah or roof overhang (which has a minimum overhang of 600mm), window hoods are provided.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
South Townsville precinct	
PO30 Building height and building floor level height are consistent to adjoining contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO30** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO31 The front facade is articulated with openings consistent with the predominant front facade profile of the contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO31.1** The front façade includes an open or semi-enclosed front verandah, at a minimum 60% width of the front facade. OR **AO31.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across 60% or more of the front facade of the dwelling and wrap around one or both sides of the front facade for a minimum of 2m and the enclosure is capable of being reversed.
	AO31.3 Where the front facade exceeds 8.5m in width, the front verandah wraps around one or both sides of the dwelling house.
PO32 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO32** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah; Figure 6.63 - appropriate enclosures to the ground floor illustrates.  **Figure 6.63 — Appropriate enclosures to the ground floor**

PO33 The roof profile is consistent with the predominant roof profile of the contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO33.1** The roof profile is: (a) simple hipped or pyramid with a 15 degree to 25 degree roof pitch; or (b) side gabled with a 15 degree to 25 degree roof pitch.
	AO33.2 Verandahs are contained under the main roof form, or roofed separately with skillion or gently curved roofs.
PO34 Window scale and proportions and window hoods or awnings are sympathetic to the dominant character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO34.1** The windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO34.2 Where windows are not sheltered by a verandah or roof overhang (which has a minimum overhang of 600mm), window hoods are provided. Figure 6.64 - vertically proportioned frames with window hoods in the South Townsville precinct (Bell Street) illustrates. **Figure 6.64 — Vertically proportioned frames with window hoods in the South Townsville precinct (Bell Street)**
PO35 Additions, alterations and adaptive reuse of existing contributing non-residential character buildings maintain the legibility of the historic use and are sympathetic to the prevailing residential character of the precinct.	No acceptable outcome is nominated. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Queenslanders precinct	
PO36 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO36** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO37 The front facade includes a verandah consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO37.1** The front facade includes an open or semi-enclosed front verandah across, at a minimum 60% width of the front facade.
	AO37.2 Where the front facade exceeds 9m in width the front verandah wraps around one or both sides of the dwelling house. Figure 6.65 - A front verandah that wraps around both sides in the Queenslanders precinct (Ackers Street) illustrates. **Figure 6.65 — A front verandah that wraps around both sides in the Queenslanders precinct (Ackers Street)**

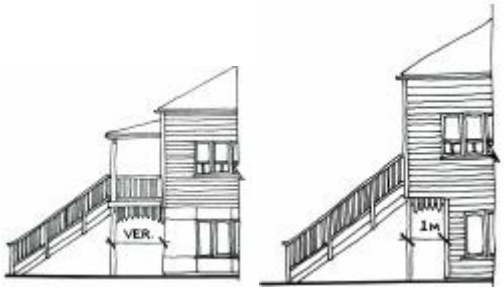
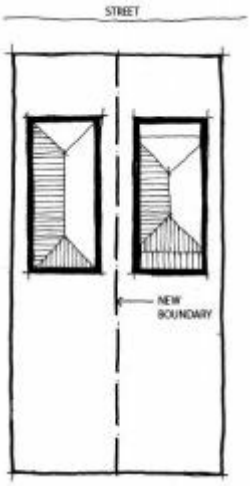
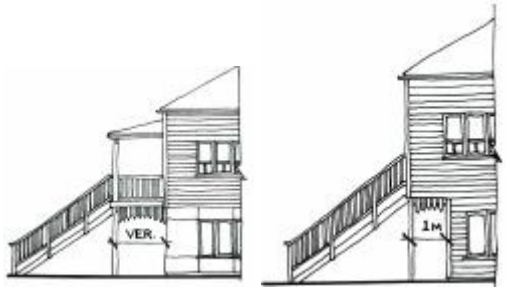
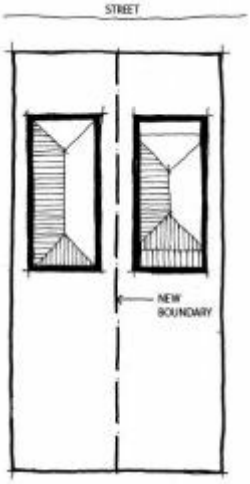
PO38 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO38** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.66 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.66 — Appropriate enclosures to the ground floor**
PO39 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO39** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.67 - Lot design illustrates.  **Figure 6.67 - Lot design**
PO40 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO40.1** The roof profile of new building works is a simple hipped or pyramid main roof with a 17.5 degree to 27.5 degree roof pitch. **AO40.2** Verandahs are contained under the main roof form, or roofed separately with a skillion roof.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Interwar Gables and Queensland Bungalows precinct	
PO41 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO41** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO42 The front facade is articulated with openings consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO42** The front facade includes: (a) an open front verandah; or (b) an enclosed or semi-enclosed front verandah with window, louvres or screens continuous across the front facade of the dwelling. Figure 6.68 - A front verandah in the Interwar Gables and Queensland Bungalows precinct (McKillop Street) illustrates. Figure 6.69 - An enclosed front verandah with continuous windows across the front facade in the Interwar Gables and Queensland Bungalows precinct (Chapman Street) illustrates. **Figure 6.68 — A front verandah in the Interwar Gables and Queensland Bungalows precinct (McKillop Street)** **Figure 6.69 — An enclosed front verandah with continuous windows across the front facade in the Interwar Gables and Queensland Bungalows precinct (Chapman Street)**

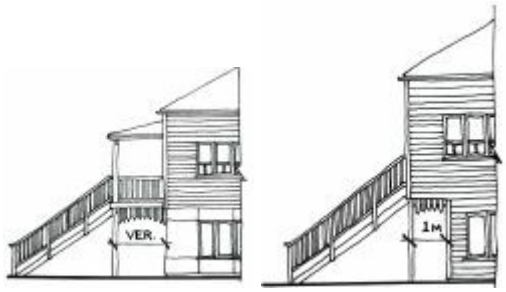
PO43 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO43** Development on any ground floor storey includes a valance and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.70 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.70 — Appropriate enclosures to the ground floor**
PO44 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO44** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.71 - Lot design illustrates.  **Figure 6.71 - Lot design**
PO45 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO45.1** The roof profile is: (a) simple hipped or pyramid, roofed with asymmetrical gable projections with a 22.5 degree to 27.5 degree roof pitch; or (b) gable fronted with asymmetrical gable projections with a 17.5 degree to 22.5 degree roof pitch.
	AO45.2 The primary roof form extends over the entire floor plan, including any front or side verandahs.

PO46 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO46.1** Windows are half-height with vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.
	AO46.2 Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of two vertically proportioned frames or have bay windows. Figure 6.72 - Half-height vertically proportioned window located symmetrically under gable in the Interwar Gables and Queensland Bungalows precinct (Lawson Street) illustrates. **Figure 6.72 — Half-height vertically proportioned window located symmetrically under gable in the Interwar Gables and Queensland Bungalows precinct (Lawson Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Interwar to 1950s Asymmetrical Gable precinct	
PO47 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO47** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.

PO48 The front facade profile is articulated consistent with the predominant front façade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO48** The front facade includes: (a) asymmetrical projecting building forms, or steps in plan, a minimum of 1.2m in depth; or (b) open or semi-enclosed front verandah across the full width of the building. Figure 6.73 — Asymmetrical projecting building forms for a minimum 1.2m in depth (Burton Street) illustrates. **Figure 6.73 — Asymmetrical projecting building forms for a minimum 1.2m in depth (Burton Street)**
PO49 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO49** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.74 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.74 - Appropriate enclosures to the ground floor**

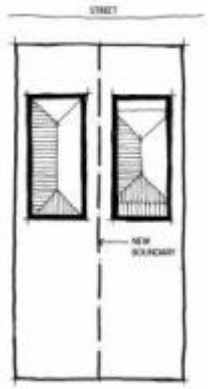
PO50 Reconfiguration of a lot maintains the existing layout, streetscape character and subdivision pattern of the precinct and is consistent with the established rhythm of the streetscape. **Editor's note—**This Performance outcome varies from Performance outcome 28 in Section 9.3.4 Reconfiguring a lot code and does take precedence.	**AO50** The side boundary of the new lot maintains the existing side boundary depth. Figure 6.75 - Lot design illustrates.  **Figure 6.75 - Lot design**
PO51 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO51.1** The roof form is: (a) simple hipped or pyramid with a 22.5 degree to 30 degree roof pitch with asymmetrical gable projections; or (b) gable fronted with a 17.5 degree to 22.5 degree roof pitch with asymmetrical gable projections. **AO51.2** Where front verandahs are included, they are contained under the main roof form.
PO52 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO52.1** Windows have a minimum of 3 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio. **AO52.2** Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of two vertically proportioned frames or have bay windows. Figure 6.76 - Symmetrically located bay windows under gable (Hooper Street) illustrates. **Figure 6.76 — Symmetrically located bay windows under gable (Hooper Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

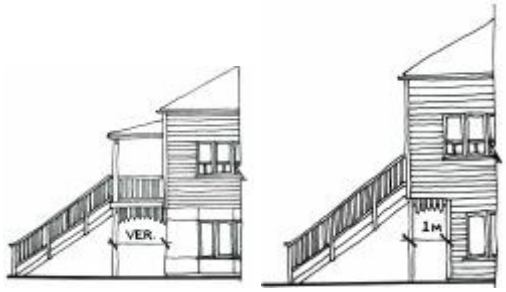
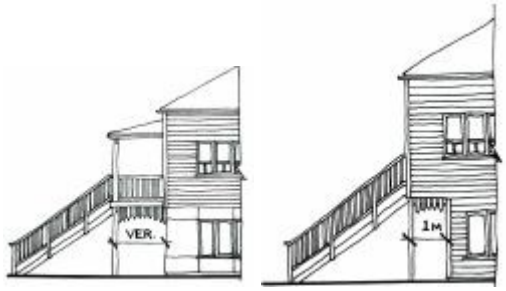
Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Churchill Street precinct	
PO53 Building height and building floor level height are consistent to adjoining contributing character buildings.	No acceptable outcome nominated.
PO54 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO54** The front facade width is 11.5m to 13.5m wide.
PO55 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO55** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.77 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.77 — Appropriate enclosures to the ground floor**
PO56 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO56** The roof pitch is between 15 degree to 20 degree.
PO57 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO57** Roof overhangs are 450mm to 750mm wide.
PO58 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO58** Windows are half height with a minimum of 3 vertically proportioned frames, where the frame height is greater than its width by a 3:1 ratio.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Park Street precinct	
PO59 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO59** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO60 The front facade openings are consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO60.1** The front facade includes: (a) a front verandah; or (b) a bay window.
	AO60.2 Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across the full width of the verandah.
PO61 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO61** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.78 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.78 — Appropriate enclosures to the ground floor**
PO62 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO62** The front facade width is 9m to 12.5m wide.
PO63 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO63** The roof pitch is between 15 degree to 30 degree.

PO64 The roof overhang is consistent with the dominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO64** Roof overhangs are 400mm to 600mm wide.
PO65 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO65** Windows are half height with a minimum of 3 vertically proportioned frames, where the window height is greater than its width by a 3:1 ratio.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—this code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Grand Queenslanders precinct	
PO66 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO66** Dwelling houses: (a) have a floor level a minimum of 700mm above ground level; or (b) are 2 storeys.
PO67 The front facade profile is articulated with openings consistent with the predominant front facade profile of contributing character buildings. **Editor's note—**applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO67.1** The front facade includes an open or semi-enclosed front verandah for the full width of the building and extends around at a minimum, down 2m one or both sides. OR **AO67.2** Enclosed verandahs are articulated with openings such as windows, louvers or screens, continuously across the full width of the verandah. Figure 6.79 - An open front verandah for the full width of the front facade; including removable blinds (Alexandra Street) illustrates. **Figure 6.79 — An open front verandah for the full width of the front facade; including removable blinds (Alexandra Street)**

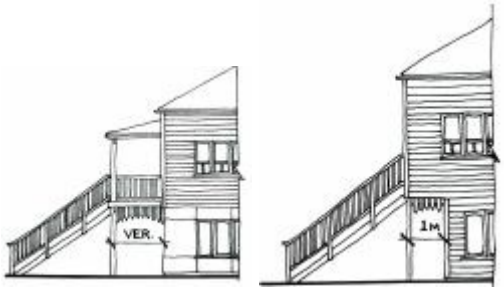
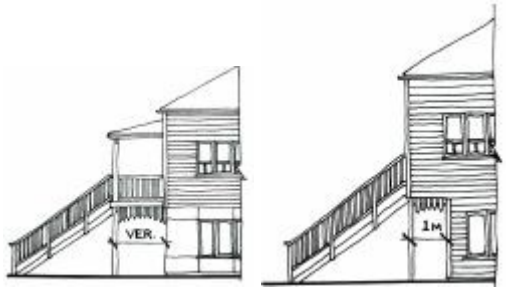
PO68 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO68** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.80 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.80 — Appropriate enclosures to the ground floor**
PO69 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO69.1** The roof profile is simple hipped or pyramid main roof, with a 17.5 degree to 27.5 degree roof pitch.
	AO69.2 Verandahs are contained under the main roof form, or roofed separately with a skillion roof.

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

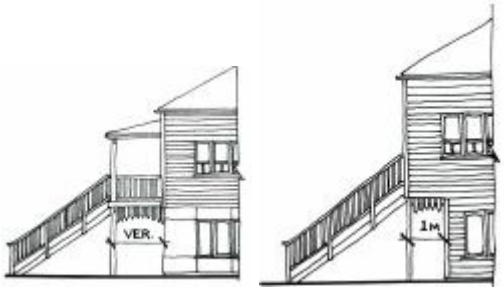
Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
French Street precinct	
PO70 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO70** Dwelling houses have a floor level minimum of 2m above ground level or is 2 storeys.
PO71 The front facade is articulated consistent with the predominant front facade of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO71** The front facade includes asymmetrical projecting building forms or steps in plan, a minimum of 1.2m in depth.
PO72 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO72** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.81 - Appropriate enclosures to the ground floor.  **Figure 6.81 — Appropriate enclosures to the ground floor**
PO73 The existing setting and rhythm of the streetscape is retained and enhanced.	**AO73** The front facade width is 10m to 12m wide.
PO74 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO74** Roof form is 17.5 degree in pitch and is simple hipped or pyramid and includes asymmetrical gable fronted projections.
PO75 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO75** Roof overhangs are: (a) a minimum of 400mm wide; and (b) with gable end overhangs a minimum of 200mm wide.

PO76 Window scale and proportions are sympathetic to the predominant contributing character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO76.1** Windows have a minimum of 3 vertically proportioned frames. Where the frame height is greater than its width by a 3:1 ratio.
	AO76.2 Windows below front gabled roofs: (a) are located symmetrically under the apex gable; and (b) have a minimum of 2 vertically proportioned frames or have bay windows. Figure 6.82 - Symmetrically located windows under gable (French Street) illustrates. **Figure 6.82 — Symmetrically located windows under gable (French Street)**

Table 6.2.5.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—This code contains alternative provisions for dwelling houses and dual occupancies to those set out in the Queensland Development Code (MP 1.1, MP 1.2 and MP 1.3), for the purposes of section 33 of the *Building Act 1975*.

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Mixed 1950s precinct	
PO77 Building height and building floor level height are consistent to adjoining contributing character buildings.	**AO77** Dwelling houses: (a) have a floor level minimum of 700mm above ground level; or (b) are 2 storeys.
PO78 The front facade is articulated consistent with the predominant front facade of contributing character buildings. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO78** The front facade includes asymmetrical projecting building forms; or steps in plan, a minimum of 1.2m in depth. Figure 6.83 - Asymmetrical projecting building forms a minimum 1.2m in depth (Goodwin Street) illustrates. **Figure 6.83 — Asymmetrical projecting building forms a minimum 1.2m in depth (Goodwin Street)**

PO79 Enclosing the ground floor storey of a building does not have an adverse impact on the character of the building and ensures the original fabric of the building is identifiable.	**AO79** Development on any ground floor storey includes a valance, and: (a) is set back the full depth of all open or enclosed verandahs; or (b) is set back 1m from the upper level of an exterior wall where there is no verandah. Figure 6.84 - Appropriate enclosures to the ground floor illustrates.  **Figure 6.84 —Appropriate enclosures to the ground floor**
PO80 The roof profile is consistent with the predominant roof profile of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO80** The roof profile is: (a) hipped with a 15 degree to 20 degree pitch; or (b) simple hipped or pyramid with asymmetrical gable projections with a 17.5 degree to 22.5 degree roof pitch.
PO81 The roof overhang is consistent with the predominant roof overhang of contributing character buildings. **Editor's note**—Applicants should have regard to the Character residential planning scheme policy no SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	**AO81** Roof overhangs are 400mm to 600mm wide.
PO82 Window scale and proportions are sympathetic to the predominant character of the precinct. **Editor's note—**Applicants should have regard to the Character residential planning scheme policy no. SC6.2 for guidance on how to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.

6.3 Centre zones category

6.3.1 Neighbourhood centre zone code

6.3.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.1.2 Purpose

(1) The purpose of the Neighbourhood centre zone code is to provide for a small mix of land uses to service residential neighbourhoods.

It includes small-scale convenience shopping, professional offices, community services and other uses that directly support the immediate community.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes the efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) neighbourhood centres contain a generally limited range of retail, commercial and community-related activities which are focused on meeting the basic, day-to-day convenience needs of a surrounding neighbourhood within a walkable catchment. Neighbourhood centre catchments are in the order of 1,500 households;
- (b) neighbourhood centres are located as an integral part of residential communities. Wherever possible they are co-located with other local facilities such as child care centres, parks or community uses;
- (c) centres do not compromise the intended role or successful functioning of higher order centres or each other;
- (d) residential development may occur within the centres, primarily where integrated in a mixed use development;
- (e) the built form and layout of a centre reinforces its integration with the local neighbourhood and creates a safe and pleasant community meeting place;
- (f) centres create a pedestrian-focussed frontage, activated by shop fronts, awnings and kerbside activities. Buildings are low-rise and smaller scale in nature;
- (g) the design of centres gives priority to improved accessibility by walking and cycling; and
- (h) centres are designed and operated to avoid adverse impacts on the amenity of surrounding residential neighbourhoods.

6.3.1.3 Assessment benchmarks

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Hours of operation are consistent with maintaining a reasonable level of amenity for nearby land in a residential zone.	**AO1** Hours of operation are limited to 6am to 10pm.
PO2 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO2.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO2.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirement*.
PO3 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO3** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO4 Residential uses within the centre are provided with a reasonable level of privacy.	**AO4.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO4.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO5 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO5** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Buildings are low-rise and are designed to break down the facade into finer-scaled components.	**AO6.1** All buildings and structures do not exceed 2 storeys or 8.5m in building height, whichever is the lesser.
	AO6.2 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m.
PO7 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO7.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO7.2 On-site car parking is provided to the side or the rear of buildings or below ground level, and is not located at the street frontage.
	AO7.3 Entrances to buildings face the street.
	AO7.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO7.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
	AO7.6 Clear windows are provided at ground storey and where provided, grille or translucent security screens are used rather than solid shutters, screens or roller-doors.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space is provided of at least 4m^2 for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO9 Development is consistent with the intended role, scale and character of the neighbourhood centre and does not compromise the intended role or successful functioning of other centres.	**AO9** The combined area of all existing and proposed shops, shopping centres, offices, service industries, health care services and food and drink outlets within the centre do not exceed a total gross leasable area of 1,000m^2. For other uses, no acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Showrooms are not established in the neighbourhood centre.	No acceptable outcome is nominated.
PO11 Development facilitates opportunities for appropriate co-location of community-related activities or facilities to the extent practical.	No acceptable outcome is nominated.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO12 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO13 Streetscape treatments are provided to enhance amenity and to contribute positively to the city image, particularly along major roads and streets.	No acceptable outcome is nominated.

PO14 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.
PO15 Development is designed and located so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO15.1** Buildings are set back 2m from any boundary shared with a residential zone, or half the height of that part of the building, whichever is the greater.
	AO15.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone, and **AO15.2.2** A landscaped buffer with a minimum width of 2m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO15.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO16 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO16** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO17 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO18 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

6.3.2 Local centre zone code

6.3.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Local centre zone.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.2.2 Purpose

(1) The purpose of the Local centre zone code is to provide for a limited range of land uses and activities to service local needs. It includes local shopping, local employment nodes, commercial, cafes and dining, entertainment, community services and residential development where it can integrate and enhance the fabric of the activity centre, but it is not the predominant use.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) local centres provide a range of retail, commercial and community activities that are focused on grocery shopping and local service needs of their surrounding catchments. They may include a single full-line supermarket and a small range of specialty shops, food and drink outlets, personal services and local offices;
- (b) local centres provide a significant focal point for the surrounding community. Wherever possible they are co-located with or include other local facilities such as child care centres, parks or community uses;
- (c) centres do not compromise the intended role or successful functioning of higher order centres or other local centres. Local centre catchments are in the order of 3,000 to 5,000 households;
- (d) residential development may occur within the centres, primarily where integrated in a mixed use development;
- (e) the built form and layout of a centre creates a safe and pleasant community meeting place. Centres create pedestrian-focussed public spaces and street frontages, activated by shop fronts, awnings and kerbside activities;
- (f) buildings are low-rise and create a sensitive transition in scale from the surrounding neighbourhood;
- (g) the design of centres gives priority to improved accessibility by walking and cycling;
- (h) centres are designed and operated to avoid adverse impacts on the amenity of surrounding residential neighbourhoods; and
- (i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Rising Sun local centre precinct:

(a) development facilitates the consolidation of local centre uses in the area bounded by Ross River Road, Cross Street, and Bowen Road;

(b) built form, public space and streetscape treatments in this area contribute to a distinct character for the local centre, in particular on the frontages of Ross River Road, Cross Street, and Bowen Road; and

(c) development of this precinct facilitates a consolidation of vehicular access points.

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Figure 6.85 — Rising Sun local centre precinct

North Ward local centre precinct:

(a) development reinforces the character of this centre as a mixed use café and dining hub, with residential or tourist accommodation uses, in addition to its local service role;

(b) built form, public space and streetscape treatments in this area contribute to an integrated character for the centre, with a focus on the frontage of Gregory Street; and

(c) built form creates a higher-medium rise environment (up to 8 storeys in building height) along Gregory Street, transitioning down to medium rise (up to 5 storeys) behind.

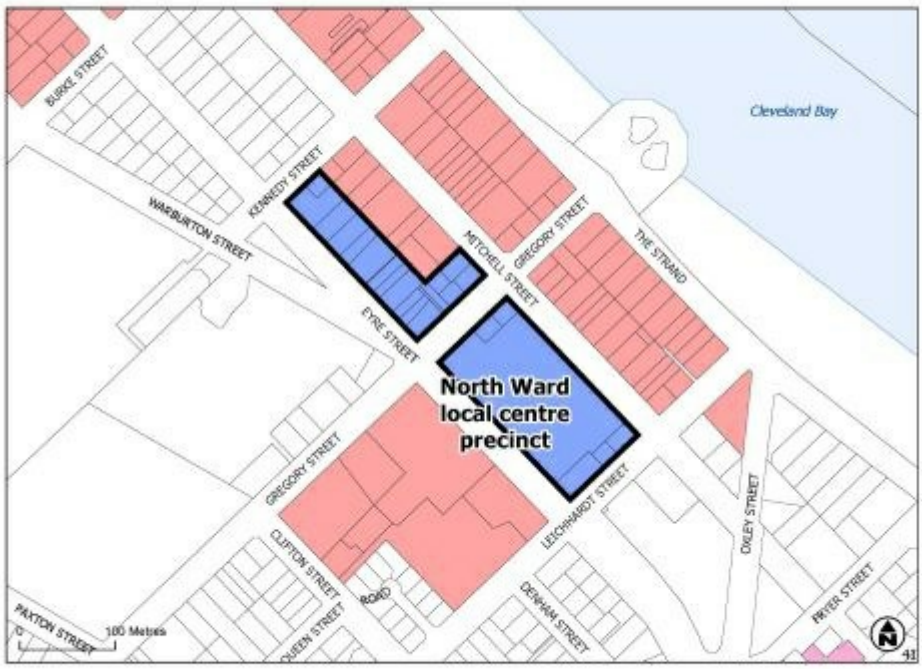

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Figure 6.86 - North Ward local centre precinct

6.3.2.3 Assessment benchmarks

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Hours of operation are consistent with maintaining a reasonable level of amenity for nearby land in a residential zone.	**AO1** Hours of operation are limited to 6am to 10pm.
PO2 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO2.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO2.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO3 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO3** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO4 Residential uses within the centre are provided with a reasonable level of privacy.	**AO4.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO4.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO5 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO5** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Buildings are low-rise and are designed to break down the facade into finer scaled components, avoiding large expanses of blank walls.	**AO6.1** All buildings and structures do not exceed 2 storeys or 8.5m in building height, whichever is the lesser.
	AO6.2 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m.

PO7 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO7.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO7.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO7.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO7.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO7.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Community uses, community care centres, clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Role and function	
PO9 Development is consistent with the intended role, scale and character of the local centre and does not compromise the intended role or successful functioning of other local or higher order centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO10 Showrooms are not established in the local centre.	No acceptable outcome is nominated.
PO11 Development facilitates opportunities for appropriate co-location of community-related activities or facilities to the extent practical.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Centre design and built form	
PO12 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for the people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian-friendly and visually interesting frontages to street and public spaces; (e) optimum energy efficiency; (f) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (g) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO13 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO14 Streetscape treatments are provided at the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO18.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO18.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO18.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO18.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.

PO19 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO19** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Rising Sun local centre precinct	
PO21 Development is consistent with Figure 6.87 — Rising Sun local centre precinct concept plan, including an internal public space and parking area that is framed by buildings with an active edge.	No acceptable outcome is nominated.
PO22 Frontages shown on Figure 6.87 — Rising Sun local centre precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO23 Frontages shown on Figure 6.87 — Rising Sun local centre precinct concept plan as having built form edge are well-defined by a continuous building façade built to the street edge, awnings and significant use of glazing.	No acceptable outcome is nominated.

Figure 6.87 – Rising Sun local centre precinct concept plan

PO24 Development contributes to the boulevard treatment of Ross River Road and Bowen Road through landscaping and streetscape treatments along the road frontage in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.
PO25 Vehicular access to the site is constrained to one single point of entry from Ross River Road and Bowen Road in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.
PO26 Development at the intersection of Ross River Road and Bowen Road creates a landmark gateway to the Rising Sun Local Centre. Built form, landscape and streetscape treatment at this intersection reinforces a gateway statement in accordance with Figure 6.87 - Rising Sun local centre precinct concept plan.	No acceptable outcome is nominated.

PO27 Built form, landscape and streetscape treatment at the corner of Ross River Road and Bowen Road, creates a gateway to the Rising Sun local centre.	No acceptable outcome is nominated.

Table 6.3.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
North Ward local centre precinct	
PO28 Building height and scale is consistent with the character desired for the precinct and reinforces Gregory Street as the primary activity spine and gateway to The Strand.	**AO28** Building height does not exceed 8 storeys where fronting Gregory Street or 5 storeys otherwise.
PO29 Development primarily consists of retail, commercial and dining activities at ground level and residential or tourist accommodation above.	No acceptable outcome is nominated.
PO30 Development is consistent with Figure 6.88 — North Ward local centre precinct concept plan.	No acceptable outcome is nominated.
PO31 Development provides for an internal public space and parking area that is framed by buildings with an active edge within the block bounded by Gregory, Mitchell, Leichardt and Eyre Streets, in accordance with Figure 6.88 — North Ward local centre precinct concept plan.	No acceptable outcome is nominated.
PO32 Development at the intersection of Gregory Street and Eyre Street creates a landmark gateway to the North Ward local centre. Built form, landscape and streetscape treatment at this intersection reinforces a gateway statement.	No acceptable outcome is nominated.
PO33 Frontages shown on Figure 6.88 — North Ward local centre precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO34 Frontages shown on Figure 6.88 — North Ward local centre precinct concept plan as having a built form edge are well-defined by a continuous building facade built to the street edge, awnings and significant use of glazing.	No acceptable outcome is nominated.

Figure 6.88 – North Ward local centre precinct concept plan

PO35 Development contributes to the boulevard treatment of Eyre Street and the integration of the Gregory Street village environment through landscaping and streetscape treatments.	No acceptable outcome is nominated.

6.3.3 District centre zone code

6.3.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.3.2 Purpose

(1) The purpose of the District centre zone code is to provide for a mix of uses and activities. It includes a concentration of land uses including retail, commercial, residential, offices, administrative and health services, community, entertainment and recreational facilities capable of servicing a district.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) district centres provide a community focus for weekly or fortnightly shopping trips and a range of services, and include Idalia, Deeragun, Rasmussen, Annandale and a future centre at Shaw. Retail functions are anchored by major supermarkets with a wide range of speciality shops; however, these centres operate as multifunctional community hubs. They contain a range of district level personal and community services such as community centres and health and fitness facilities;

Editor's note—the centre in Shaw is within the Emerging community zone. It is planned within the Greater Ascot area.

(b) centres do not compromise the intended role or successful functioning of higher order centres or other district centres. District centre catchments are in the order of 5,000 to 8,000 households. They do not contain discount department stores;

(c) the mix of uses promotes a vibrant centre which includes medium density residential development and active day and night-time uses;

(d) showrooms may occur within the district centres, but are generally located and designed so that they do not detract from the intended built form, pedestrian focus and accessibility of the district centres;

(e) district centres provide a major focal point for their catchment communities. The built form and layout of a centre creates a safe and pleasant community meeting place. Centres create pedestrian-focussed public spaces and street fronts, kerbside activities, awnings and landscape and streetscape treatments;

(f) buildings are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood;

(g) the design of district centres gives priority to improved accessibility to and within centres by walking, cycling and public transport;

(h) centres are designed and operated to minimise adverse impacts on the amenity of surrounding residential neighbourhoods; and

(i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Idalia district centre precinct:

(a) Idalia will develop to provide a focus for larger format showrooms for the southern parts of the city, and will complement, but not undermine the role of the Domain Central precinct on the northern side of Townsville. It will service a wider catchment than other district centres in this respect. Other retail functions of this centre do not expand substantively; and

(b) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.89 — Idalia district centre precinct

Annandale district centre precinct:

(a) no significant expansion of this centre for retail purposes occurs; and

(b) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.90 — Annandale district centre precinct

Deeragun district centre precinct:

(a) further outward expansion of the centre or the establishment of additional supermarkets does not occur;

(b) development assists in consolidating the centre, and facilitates improved integration and connectivity;

(c) showrooms servicing the district catchment may be accommodated; and

(d) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

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Figure 6.91 — Deeragun district centre precinct

Rasmussen district centre precinct:

(a) further outward expansion of the centre does not occur;

(b) showrooms servicing the district catchment may be accommodated in the longer term; and

(c) new floor space within the centre provides for a wider mix of non-retail uses including residential uses, community uses, commercial and medical offices and dining activities.

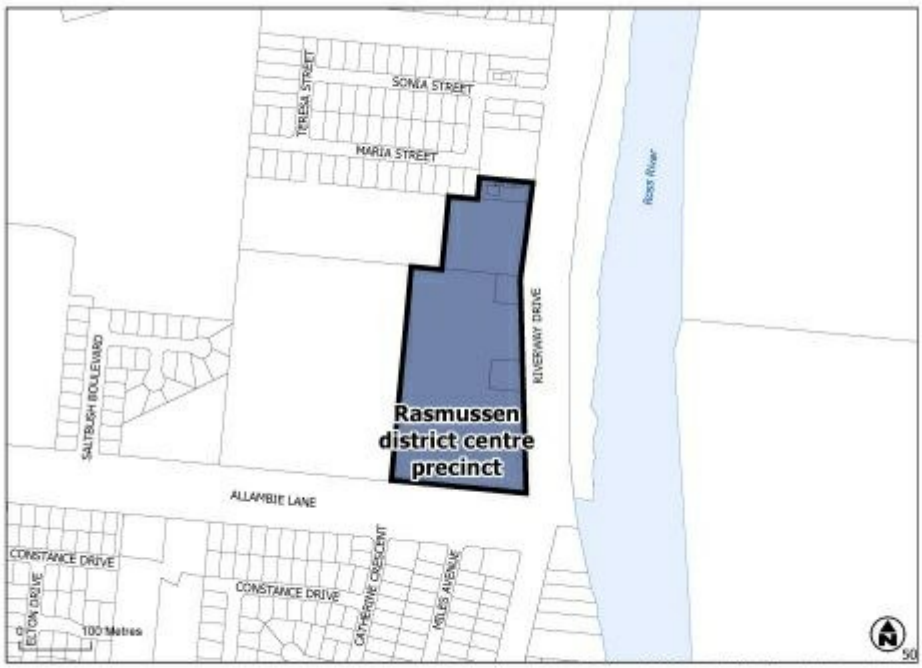

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Figure 6.92— Rasmussen district centre precinct

6.3.3.3 Assessment benchmarks

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of $9m^2$; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the district centre and does not compromise the intended role or successful functioning of other district or higher order centres. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO6 Development facilitates a range of uses that contributes to the vibrancy of the centre and provides for a compatible mix of active day and night-time uses.	No acceptable outcome is nominated.
PO7 Development facilitates opportunities for appropriate co-location of residential uses and community-related activities or facilities within the centre, to the extent practical.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Centre design and built form	
PO8 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian-friendly and visually interesting frontages to streets and public spaces; (e) optimum energy efficiency; (f) a well-integrated mix of uses; (g) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (h) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.

PO9 Buildings are low-rise and are designed to break down the facade into finer scaled components, avoiding large expanses of blank walls.	**AO9.1** Building height does not exceed 3 storeys.
	AO9.2.1 Buildings provide for tenancies fronting the street frontage which have a maximum width of 10m. or **AO9.2.2** Where showrooms are proposed, the maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
PO10 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	**AO10.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath.
	AO10.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO10.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO10.4 Where buildings are located on a corner site, the main entrance faces the principal street or the corner.
	AO10.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
PO11 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO12 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO13 Buildings housing residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO13** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO14 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO18.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO18.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO18.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO18.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO19 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO19** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO21 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO21** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Showrooms	
PO22 Showrooms are designed and located as an integrated part of the centre, having regard to the continuity of built form and streetscapes, active street frontages and pedestrian and cyclist accessibility and circulation.	No acceptable outcome is nominated.

Table 6.3.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Deeragun district centre precinct	
PO23 Development in the Deeragun district centre precinct contributes to the consolidation and integration of the centre.	No acceptable outcome is nominated.

6.3.4 Major centre zone code

6.3.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.4.2 Purpose

(1) The purpose of the Major centre zone code is to provide for a mix of uses and activities. It includes concentrations of higher order retail, commercial, offices, residential, administrative and health services, community, cultural and entertainment facilities and other uses capable of servicing a sub-region in the planning scheme area.

(2) The particular purpose of the code is to provide for a network of centres that are readily accessible, integrated and well-designed, form vibrant focal points for the community, and provide a mix and range of services and facilities that are appropriate to their respective function and catchments. This promotes efficient provision of services and contributes to the quality of life, character and identity of communities.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) Hyde Park, Aitkenvale, Thuringowa Central and the future Julago and Burdell major centres act as the most significant centres for the Townsville community after the principal centre (CBD). They service sub-regional catchments and do not compromise the intended role or successful functioning of other major centres or the CBD;

Editor's note—The Julago and Burdell areas are included in the Emerging community zone. The future major centre at Burdell is planned within the North Shore area.

(b) these centres operate as major multifunctional community hubs. They contain the highest order of community, retail and office based functions after the principal centre (CBD), including sub-regional level services such as theatres, major libraries and community centres and health and educational facilities. However, they do not contain any additional department stores;

(c) major centres evolve as vibrant mixed use places where people live, work and play in a high density environment which is active both during the day and night-time and includes residential uses;

(d) major centres are highly accessible by walking and cycling from surrounding medium density residential areas;

(e) major centres become a hub for major public transport routes providing frequent services to other parts of the city, and development facilitates convenient access to public transport facilities as a priority;

(f) showrooms occur within the major centres, but are generally located and designed so that they do not detract from the intended built form, pedestrian focus and accessibility;

(g) centre design and built form creates a walkable and legible pedestrian-focussed environment, with a range of connected, safe and pleasant public spaces forming community focal points. Public spaces and primary pedestrian circulation streets are activated by shop fronts, awnings and kerbside activities;

(h) the height and scale of buildings reinforce the character, legibility and accessibility of the centre. Centres predominantly contain medium-rise buildings. However, a human scale and attractive, pedestrian friendly environment is created at street level;

(i) centres are designed to create a desirable interface with surrounding neighbourhoods, providing for attractive streetscapes and transitioning of building form and scale and minimising potential land use conflicts; and

(j) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts and sub-precincts:

Aitkenvale major centre precinct:

(a) The Aitkenvale major centre builds on existing uses and underutilised land to become a diverse major activity centre;

(b) Aitkenvale leverages its location on the transport corridor to the principal centre (CBD) and James Cook University and Townsville Hospital;

(c) the existing department store at Aitkenvale is not significantly expanded and no additional department store is established;

(d) housing includes student and visitor accommodation to reinforce links with the James Cook University and Townsville Hospital; and

(e) Ross River Road and Nathan Street become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

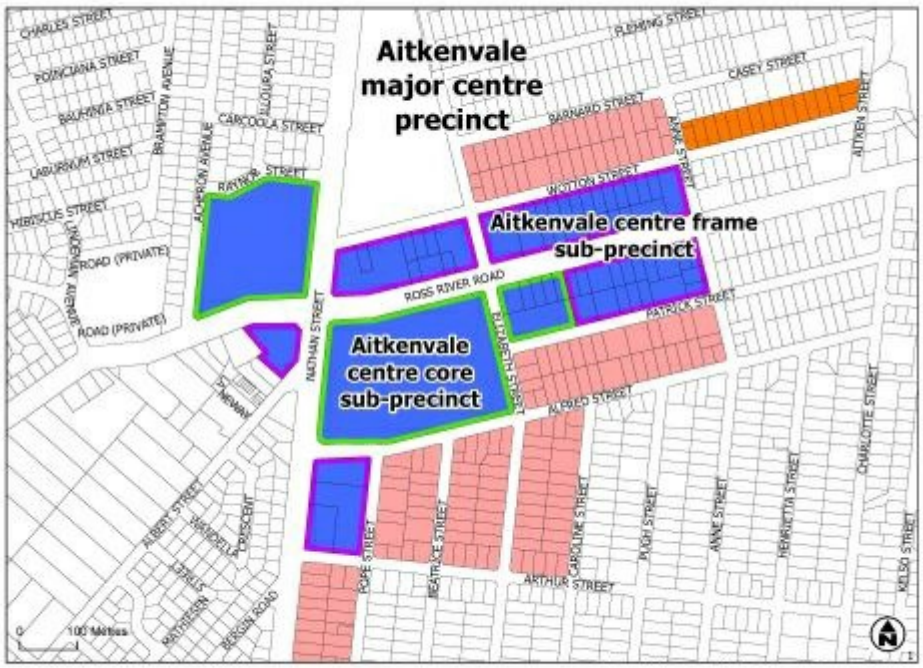

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Figure 6.93 – Aitkenvale major centre precinct

Aitkenvale centre core sub-precinct:

(i) the Aitkenvale centre core encompasses the retail focus of the centre;

(ii) the mix of uses within this sub-precinct is diversified as part of future redevelopment to include additional uses including shopping, office, higher density residential uses, community facilities and dining and entertainment uses;

(iii) residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(iv) a new town square is accommodated within the south-east corner of the sub-precinct. This space is sleeved by medium-rise built form fronting Alfred and Elizabeth Streets;

(v) Elizabeth Street is the focus for the creation of an active main street environment;

(vi) frontages to Nathan Street and Ross River Road are treated with a responsive built form that avoids unarticulated or 'back of house' design responses;

(vii) linkages between the Aitkenvale centre core sub-precinct (north and south sides of Ross River Road), the Aitkenvale centre frame sub-precinct and the surrounding Medium density residential zone are improved through the strengthening of primary pedestrian linkages along Nathan and Elizabeth Streets; and

(viii) streetscaping along Nathan and Elizabeth Street frontages also occurs to improve the interface between the site and the street whilst also improving the pedestrian streetscape environment and experience.

Aitkenvale centre frame sub-precinct:

(i) the centre frame sub-precinct complements the retail core with a mix of uses including additional shopping, offices, community and residential uses that reinforce the centre's role as a mixed use activity centre;

(ii) residential components are accommodated in mixed use developments, with retail or commercial uses at the ground storey; and

(iii) buildings have a strong relationship with their street frontage by contributing to streetscape improvements, passive surveillance, and creation of an identifiable major centre.

Thuringowa Central major centre precinct:

(a) development in the Thuringowa Central major centre continues to grow and diversify the range of activities within the centre. However, a department store is not established within this centre;

(b) higher density housing includes student and visitor accommodation to reinforce economic links with the James Cook University and Townsville Hospital;

(c) the centre is focussed on a new main street and town square along High Range Drive, which provides a strong connector between Riverway and the Willows sub-precinct;

(d) further outward expansion of the centre does not occur, with all new development contributing to the increasing consolidation of the centre and the clear definition of its edges;

(e) new development facilitates improved permeability within the centre for pedestrians and cyclists, provides for safer and shadier pedestrian routes and promotes access to public transport facilities;

(f) a bus interchange forms a focal point within the centre that is well-connected to the Thuringowa town centre heart sub-precinct, the Willows sub-precinct and the surrounding neighbourhoods;

(g) built form is highest and most intensive in the Thuringowa town centre heart sub-precinct, decreasing to the centre edges;

(h) visual and physical connections to Pioneer Park and Riverway are maximised wherever possible; and

(i) Thuringowa Drive, Riverway Drive and Hervey Range Road become tropical boulevards providing a sense of arrival at the centre and strong landscape amenity. This is achieved through street tree planting, stronger definition of road edges by buildings fronting the street and screening of parking areas.

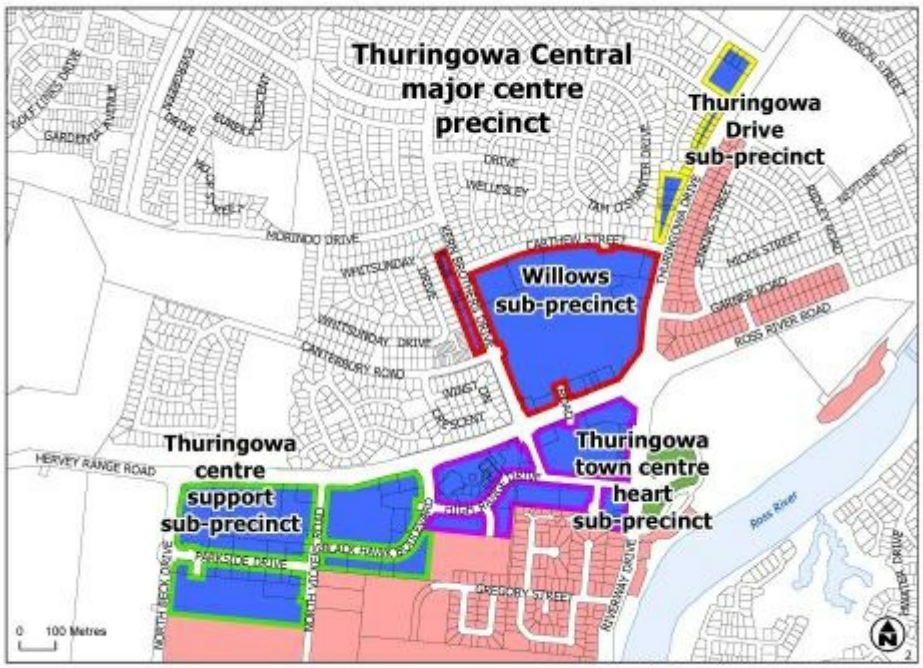

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Figure 6.94 – Thuringowa Central major centre precinct

Thuringowa town centre heart sub-precinct:

(i) a new main street and town square for Thuringowa Central are created along High Range and Pioneer Drive, and provides a community heart and a strong connection between Riverway and the Willows sub-precinct;

(ii) the sub-precinct contains a concentrated mix of uses, including shopping, office, higher density residential uses, community facilities and dining and entertainment uses. Residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(iii) the sub-precinct contains the highest and most concentrated built form within Thuringowa Central, with the most intensive built form along Riverway Drive and the main street sections of High Range and Pioneer Drives;

(iv) buildings along High Range and Pioneer Drive create a strong relationship with the street frontage and facilitate a highly activated environment, accommodating day and night-time activities, shop fronts, outdoor dining and other opportunities for community interaction;

(v) development creates a strong relationship with Hervey Range Road, Riverway Drive and Blackhawk Boulevard, by sleeving the sub-precinct with buildings that are oriented to the street and screen parking areas behind;

(vi) pedestrian spaces and pathways are provided with extensive shading;

(vii) parking is consolidated wherever practicable and is screened and separated from the street by buildings;

(viii) pedestrian and cyclist linkages are improved to the residential neighbourhood to the south and to the centre sub-precincts to the west and north. Additional and safe pedestrian crossings are provided across Hervey Range Road to the Willows sub-precinct; and

(ix) development minimises impacts on the amenity of adjoining residential land to the south of the sub-precinct.

Willows sub-precinct:

(i) this sub-precinct is the primary shopping destination for Thuringowa Central but may also contain a mix of other office, higher density residential uses, community facilities and dining and entertainment uses;

(ii) an improved relationship between built form and Thuringowa Drive, Hervey Range Road and Kern Brothers Drive is created by sleeving the sub-precinct with buildings oriented to the street and screening parking areas;

(iii) built form assists in reducing the internalised orientation of the shopping centre, creating a sense of external activity and reducing the visual dominance of the parking areas;

(iv) development facilitates pedestrian connections with the Thuringowa town centre heart sub-precinct and the surrounding residential neighbourhood; and

(v) development along Kern Brothers Drive and Carthew Street provides an attractive interface and minimises impacts on the amenity of nearby residential land.

Thuringowa Drive sub-precinct:

(i) a mix of office, shops, service industries and residential uses occur within this sub-precinct;

(ii) the corner of Thuringowa Drive and Hinchinbrook Drive creates a gateway to Thuringowa Central. Built form at this corner reinforces this gateway function;

(iii) development facilitates a more continuous building line along Thuringowa Drive, by providing a strong building edge along the street front and locating parking areas to the side or rear of buildings; and

(iv) access points and parking are consolidated wherever practicable.

Thuringowa centre support sub-precinct:

(i) larger format showroom uses, service industries and some low impact industries are accommodated in this sub-precinct. The sub-precinct may also contain office uses and community facilities, but does not contain shopping uses other than those of a convenience nature;

(ii) buildings are oriented to the street frontages, and streetscape is improved through the quality of the adjoining built form and landscaping;

(iii) built form is generally lower rise and less intensive than in the rest of the Thuringowa Central major centre;

(iv) convenient pedestrian connections are created to the Thuringowa town centre heart sub-precinct; and

(v) development along the edges of this sub-precinct provides an attractive interface and minimises impacts on the amenity of nearby residential land.

Hyde Park major centre precinct:

(a) the Hyde Park major centre contains an increasing diversity of business activities and community services. However, a department store is not located within this centre, and no significant expansion of showroom based floor space is intended;

(b) residential and office uses are accommodated in mixed use developments, with shopping or entertainment uses at the ground storey;

(c) development facilitates improved integration with surrounding residential and activity areas, including the showgrounds. Wherever possible, the interface with the lake is enhanced and opportunities for recreational use improved;

(d) Virgil and Dillane Streets are established as primary linkages to new infill residential development within the Hyde Park medium density precinct. Virgil Street becomes the major east-west pedestrian thoroughfare for the locality;

(e) development provides for appropriate immunity to flooding and drainage characteristics; and

(f) development facilitates improved public transport, pedestrian and cyclist connectivity to the principal centre (CBD), particularly along Woolcock Street.

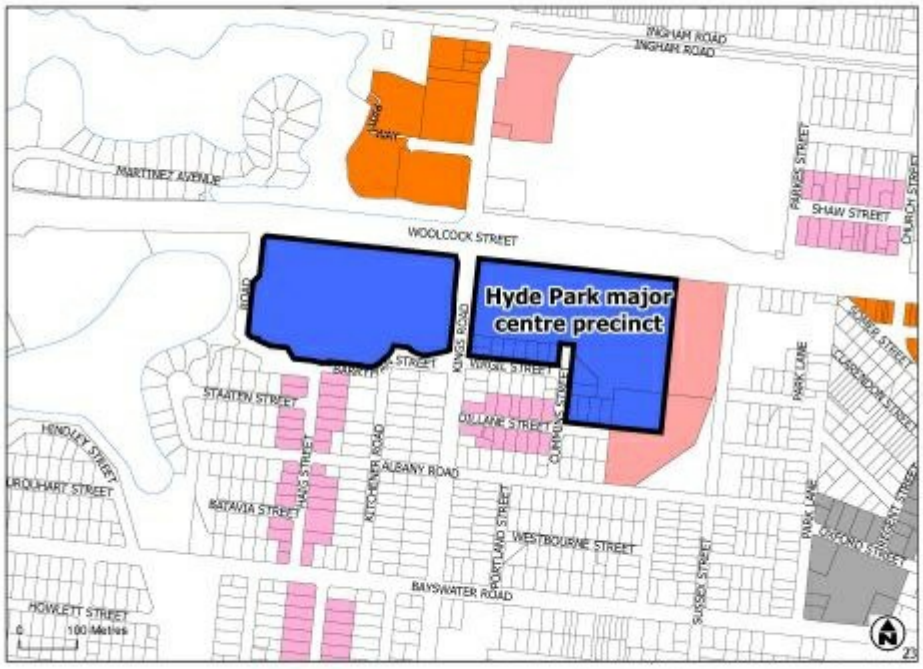

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Figure 6.95 – Hyde Park major centre precinct

6.3.4.3 Assessment benchmarks

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; and (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks or air conditioning units.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the major centre and does not compromise the intended role or successful functioning of the principal centre (CBD) or other major centres. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

PO6 Development facilitates a range of uses that contributes to the vibrancy of the centre and provides for a compatible mix of active day and night-time uses.	No acceptable outcome is nominated.
PO7 Development facilitates opportunities for appropriate co-location of residential uses and community-related activities or facilities with retail or commercial development within the centre, to the extent practical.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Centre design and built form	
PO8 The design of the centre provides for: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; (e) optimum energy efficiency; (f) a well-integrated mix of uses; (g) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (h) sensitive transitioning to surrounding land and uses. **Editor's note–**Applicants may be requested to prepare a centre design master plan to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO9 Buildings create a human scale at street level.	No acceptable outcome is nominated.
PO10 A strong sense of enclosure and definition of pedestrian space is created along street frontages, with buildings designed to provide visual interest, foster social interaction and create a safe and pleasant pedestrian-focussed environment.	No acceptable outcome is nominated.
PO11 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO12 Parking areas are not located along the street frontage.	No acceptable outcome is nominated.
PO13 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.

PO14 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO17 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO18 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO18** Refuse storage areas loading/unloading or other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO19 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO19.1** Buildings are set back 4m from any boundary shared with a residential zone.
	AO19.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO19.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO19.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO20 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community uses, community care centres, clubs	
PO21 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO21** At least one (1) lockable storage space of at least 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Showrooms	
PO22 Showrooms are designed and located as an integrated part of the centre, having regard to the continuity of built form and streetscapes, active street frontages and pedestrian and cyclist accessibility and circulation.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Aitkenvale major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Aitkenvale centre core sub-precinct	
PO23 Development facilitates a town square sleeved by medium-rise mixed use built form at the corner of Elizabeth and Alfred Streets, in accordance with Figure 6.96 — Aitkenvale major centre precinct concept plan.	No acceptable outcome is nominated.
PO24 Development assists in creating a main street environment along Elizabeth Street by facilitating an active edge incorporating externally oriented shops, dining and entertainment uses at the ground storey. Buildings contribute to the creation of this active edge by incorporating features such as: (a) primary building entrances; (b) awnings to provide shade for pedestrians; and (c) significant use of glazing or transparent materials.	No acceptable outcome is nominated.

PO25 On frontages shown on Figure 6.96 — Aitkenvale major centre precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the full width of footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO26 The visual dominance of the parking areas is reduced by buildings sleeving road frontages and by landscape screening.	No acceptable outcome is nominated.
PO27 Pedestrian connections between the centre core north and centre core south are improved wherever possible.	No acceptable outcome is nominated.
PO28 Development provides for pedestrian and cyclist connections to the Rossiter Park precinct and to surrounding areas.	No acceptable outcome is nominated.
PO29 Pedestrian routes are defined by buildings streetscape improvements that provide shade and improve pedestrian comfort.	No acceptable outcome is nominated.
PO30 Building height assists in identifying the centre core as the primary focus of activity within the centre and as a mixed use environment.	**AO30** Building height does not exceed: (a) 8 storeys where as part of a mixed use development and located in accordance with Figure 6.96 - Aitkenvale major centre precinct concept plan; and (b) 5 storeys otherwise.

Figure 6.96 – Aitkenvale major centre precinct concept plan

PO31 Development contributes to the boulevard treatment of Nathan Street and Ross River Road through streetscape and landscape treatments.	No acceptable outcome is nominated.
PO32 Development provides sufficient land and infrastructure to support a new bus interchange along Elizabeth Street.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Aitkenvale major centre sub-precincts **Note—**where acceptable outcomes in this section vary from those provided earlier in this code, the precinct- based acceptable outcomes take precedence.	
Aitkenvale centre frame sub-precinct	
PO33 On frontages shown on Figure 6.96 — Aitkenvale major centre precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian-oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the full width of footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.

Figure 6.96 – Aitkenvale major centre precinct concept plan

PO34 Development provides for pedestrian and cyclist connections to surrounding areas wherever practicable.	No acceptable outcome is nominated.
PO35 Development contributes to the boulevard treatment of Nathan Street and Ross River Road through streetscape and landscape treatments.	No acceptable outcome is nominated.
PO36 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO37 Parking areas are sleeved by buildings which screen them from street frontages.	No acceptable outcome is nominated.
PO38 Building height creates a medium-rise environment and assists in identifying the centre core as the primary focus of activity within the centre and as a mixed use environment.	**AO38** Building height does not exceed 5 storeys.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa town centre heart sub-precinct	
PO39 Development facilitates or supports a mix of uses and day and night-time activity throughout the sub-precinct.	No acceptable outcome is nominated.
PO40 Shops, dining and entertainment uses are predominant at the ground storey along the main street section of High Range Drive and Pioneer Drive, identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.
PO41 Residential and office uses are accommodated but do not interrupt ground storey activation by shopping and dining uses along the main street section of High Range Drive and Pioneer Drive, identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.
PO42 Development facilitates a town square at the corner of High Range and Pioneer Drive.	No acceptable outcome is nominated.

PO43 On frontages shown on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan as having a strong built form edge, buildings contribute to the creation of a strong and pedestrian oriented edge to the street, by: (a) being built to the street frontage at the ground storey; (b) creating a generally continuous building alignment; (c) providing awnings over the footpaths; and (d) having facades which contain windows, doors, materials and features which generate visual interest at the street level.	No acceptable outcome is nominated.
PO44 Building height reinforces the sub-precinct's role as the heart of Thuringowa Central, and is generally medium-rise. The tallest buildings in the sub-precinct occur along Riverway Drive and the main street section of High Range and Pioneer Drives.	**AO44** Building height does not exceed: (a) 8 storeys fronting Riverway Drive and the main street section of High Range and Pioneer Drives, consistent with Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan; and (b) 5 storeys otherwise.
PO45 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO46 Parking areas are sleeved by buildings which screen them from street frontages.	No acceptable outcome is nominated.
PO47 Development provides for pedestrian and cyclist connections from Riverway and Pioneer Park to the Willows sub-precinct and to surrounding areas in accordance with Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.

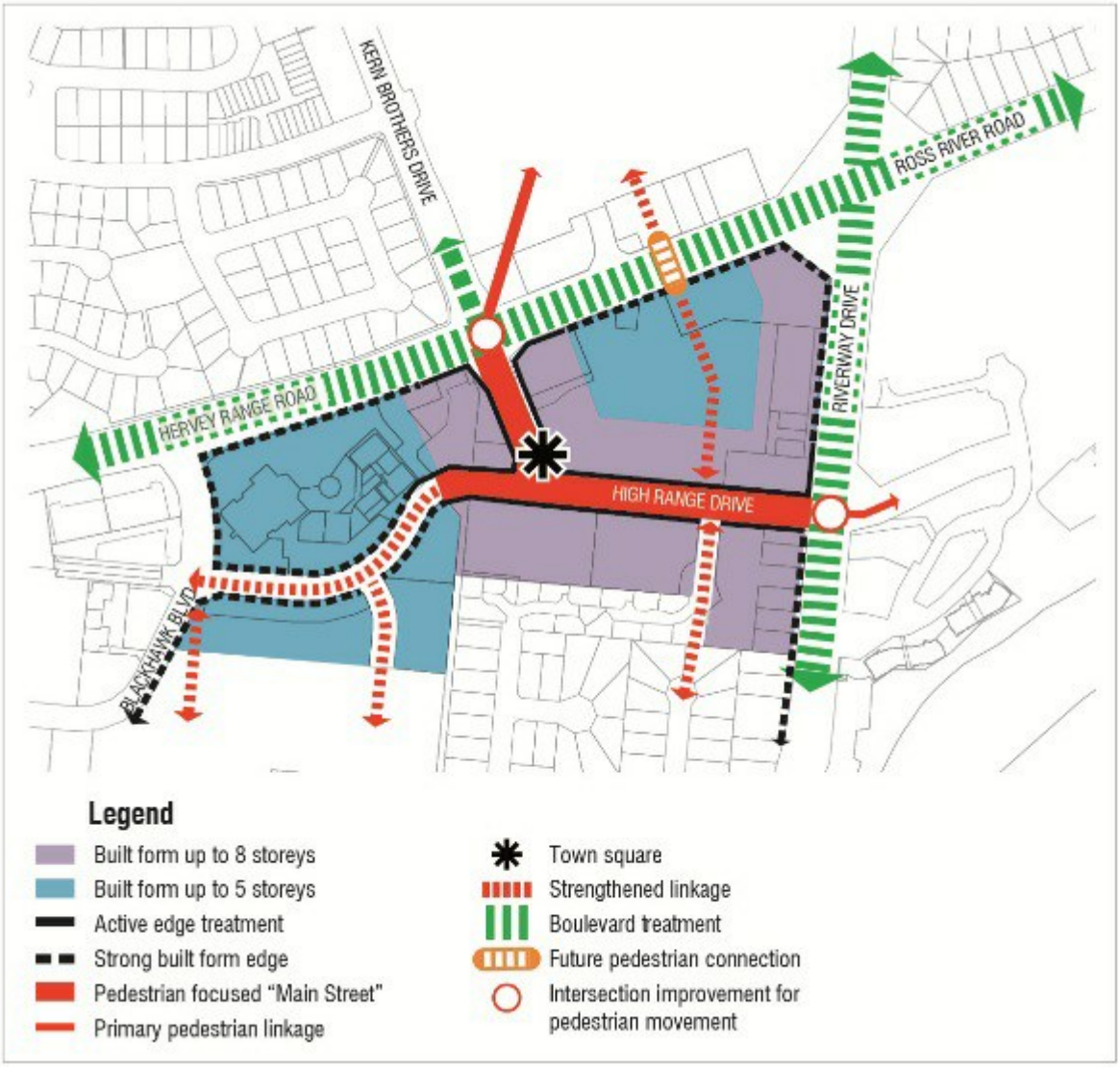

Figure 6.97 – Thuringowa town centre heart sub-precinct concept plan

PO48 Development contributes to the boulevard treatment of Riverway Drive and Hervey Range Road through streetscape and landscape treatments as identified on Figure 6.97 — Thuringowa town centre heart sub-precinct concept plan.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Willows sub-precinct	
PO49 Development assists in creating strong edges at the street by buildings that are oriented to the street frontages, identified on Figure 6.98 — Willows sub-precinct concept plan.	No acceptable outcome is nominated.

PO50 Development assists in reducing the internalised orientation of the shopping centre by facilitating externally oriented uses.	No acceptable outcome is nominated.
PO51 The visual dominance of the parking areas are reduced by buildings sleeving road frontages and by landscape screening.	No acceptable outcome is nominated.
PO52 Built form generates visual interest at the street level, having regard to the proportion of openings, windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO53 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO54 Visual connections to Pioneer Park and Riverway are maximised wherever possible.	No acceptable outcome is nominated.
PO55 Development provides for pedestrian and cyclist connections to the Town centre heart sub-precinct, Riverway and Pioneer Park and to surrounding areas in accordance with Figure 6.98 — Willows sub-precinct concept plan.	No acceptable outcome is nominated.

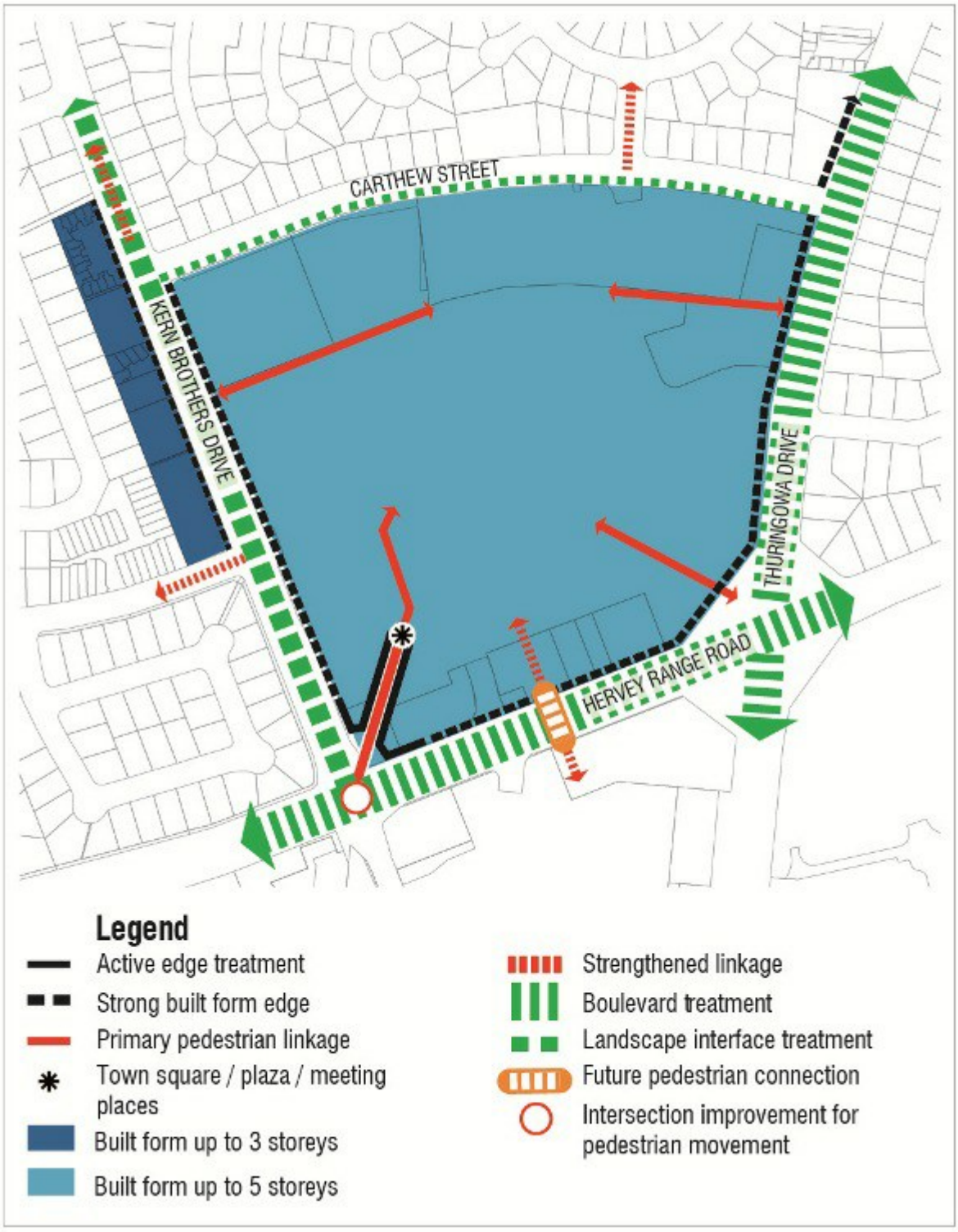

Figure 6.98 – Willows sub-precinct concept plan

PO56 The main pedestrian route connecting to the Town centre heart sub-precinct is defined by buildings and uses creating an active edge.	No acceptable outcome is nominated.
PO57 Building height is generally medium rise, but provides for a transition in building heights to the surrounding neighbourhood.	**AO57** Building height does not exceed 5 storeys within the block bounded by Thuringowa Drive, Hervey Range Road Kern Brothers Drive and Carthew Street, and 3 storeys otherwise, as identified on Figure 6.98 – Willows sub-precinct concept plan.
PO58 Landscaping and streetscape treatments are provided along Kern Brothers Drive and Carthew Street to enhance the outlook from the surrounding neighbourhood.	No acceptable outcome is nominated.
PO59 Development contributes to the boulevard treatment of Riverway Drive and Hervey Range Road through streetscape and landscape treatments.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa Drive sub-precinct	
PO60 Strong edges at the street are created by buildings that are oriented to the street frontages and forming a continuous building line, as identified on Figure 6.99 – Thuringowa sub-precinct concept plan.	No acceptable outcome is nominated.
PO61 Built form generates visual interest at the street level, having regard to the proportion of openings windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO62 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO63 Building height is generally low-rise.	**AO63** Building height does not exceed 3 storeys.
PO64 As identified on Figure 6.99 –Thuringowa sub-precinct concept plan, the corner of Thuringowa Drive and Hinchinbrook Drive creates a gateway to Thuringowa Central. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement, and landscape treatment along Hinchinbrook Drive assists in connecting and unifying the sub-precinct.	No acceptable outcome is nominated.

PO65 Development contributes to the boulevard treatment of Thuringowa Drive through streetscape and landscape treatments.	No acceptable outcome is nominated.

Figure 6.99 – Thuringowa Drive sub-precinct concept plan

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Thuringowa Central major centre sub-precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Thuringowa centre support sub-precinct	
PO66 Supermarket and discount department store retail uses do not occur in this sub-precinct.	No acceptable outcome is nominated.
PO67 Buildings are oriented to the street frontages along Hervey Range Road and Blackhawk Boulevard, and the streetscape is improved through the quality of the adjoining built form and landscaping, as identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO68 All building frontages to Hervey Range Road and Blackhawk Boulevard, are provided with large windows and clearly identifiable building entrances.	No acceptable outcome is nominated.
PO69 A pedestrian connection is provided between Blackhawk Boulevard and High Range Drive, in accordance with Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO70 Development facilitates new road linkages between Blackhawk Boulevard and the residential neighbourhood to the south in accordance with Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.

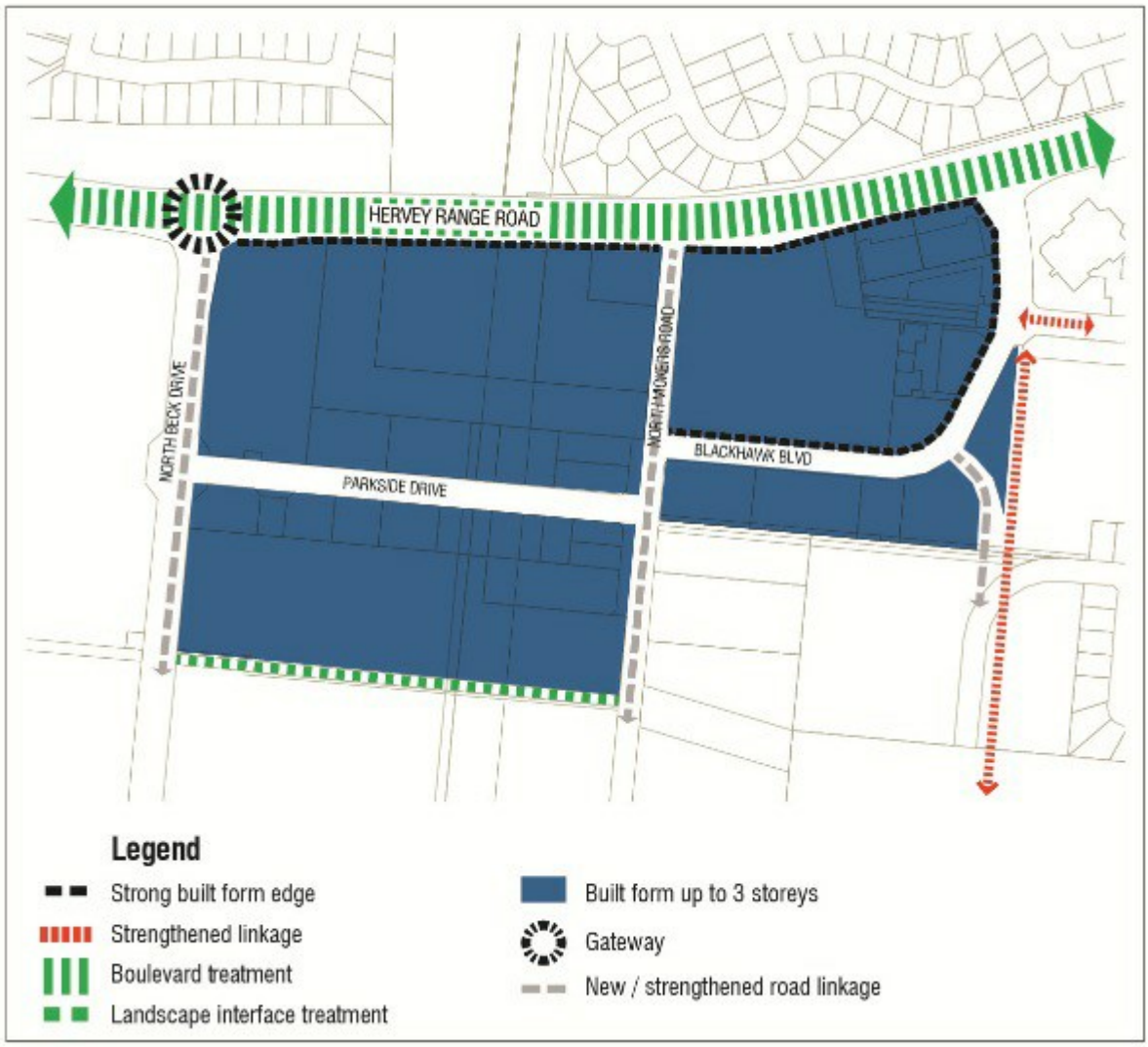

Figure 6.100 – Thuringowa centre support sub-precinct concept plan

PO71 Building height is generally low-rise.	**AO71** Building height does not exceed 3 storeys.
PO72 Landscaping and streetscape treatments are provided along North Beck Drive and Vickers Road North to enhance the outlook from the surrounding neighbourhood.	No acceptable outcome is nominated.
PO73 The appearance of development along the southern edge of this sub-precinct is enhanced through landscape treatment, as identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan.	No acceptable outcome is nominated.
PO74 As identified on Figure 6.100 — Thuringowa centre support sub-precinct concept plan, the corner of North Beck Drive and Hervey Range Road creates a gateway to Thuringowa Central. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement.	No acceptable outcome is nominated.

PO75 Development contributes to the boulevard treatment of Hervey Range Road through streetscape and landscape treatments.	No acceptable outcome is nominated.

Table 6.3.4.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in Hyde Park major centre precinct **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Hyde Park major centre precinct	
PO76 Strong edges at the street are created by buildings that are oriented to the street frontages and forming a continuous building line, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan.	No acceptable outcome is nominated.
PO77 Built form generates visual interest at the street level, having regard to the proportion of openings, windows, materials and features. Large expanses of blank walls are avoided.	No acceptable outcome is nominated.
PO78 Parking is provided in consolidated areas wherever practicable.	No acceptable outcome is nominated.
PO79 Building height is generally medium rise.	**AO79** Building height does not exceed 5 storeys.
PO80 Development facilitates the establishment of a new road linkage connecting Woolcock Street to Dillane Street, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan. This new road assists in creating an active and attractive interface between the major centre and the Hyde Park medium density precinct.	No acceptable outcome is nominated.
PO81 Development facilitates the establishment of Virgil Street as the major east-west pedestrian thoroughfare connecting across Kings Road and east into the Hyde Park medium density precinct and the nearby open space corridor, in accordance with Figure 6.101 — Hyde Park major centre precinct concept plan.	No acceptable outcome is nominated.

Figure 6.101 – Hyde Park major centre precinct concept plan

Table 6.3.4.3 - Accepted development subject to requirements and assessable development (Part)

PO82 Development assists in creating a primary pedestrian and cycle pathway and improving the quality of pedestrian environment along Woolcock Street and Kings Road.	No acceptable outcome is nominated.
PO83 Landscape treatment along Virgil Street, Dillane Street and the parkland assists in connecting and unifying the precinct.	No acceptable outcome is nominated.

6.3.5 Principal centre (CBD) zone code

6.3.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.5.2 Purpose

(1) The purpose of the Principal centre (CBD) zone code is to provide for the largest and most diverse mix of uses and activities in Townsville.

It includes key concentrations of high-order retail, commercial, employment, residential, health services, administrative, community, cultural, recreational and entertainment activities and other uses, capable of servicing the planning scheme area.

(2) The particular purpose of the code is to:

(a) re-enforce the Townsville central business district (CBD) as the economic heart of the region, and the primary location for business, government and administration uses;

(b) promote the principal centre (CBD) as the location for the highest order activities and facilities of the city including retail, commercial, cultural, civic, sporting, and recreational uses;

(c) consolidate Townsville as Queensland's second capital and be an exemplar city in tropical urban sustainability; and

(d) ensure the principal centre (CBD) contributes to the identity, character and life of the city.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the principal centre (CBD) is a vibrant mixed use place where people live, work and play in a high density environment which is active both during the day and night-time;

(b) the principal centre is the highest order centre in Townsville and services a regional catchment, supported by a network of centres;

(c) the principal centre is the focus for the highest intensity of retail, commercial, administrative, government and employment uses in the city and is the primary location for major office and commercial buildings;

(d) the principal centre offers a more distinctive and higher order retailing than the major centres in an outdoor, main street environment that is characterised by arcades, laneways and footpath dining. The preferred location for any new department store in Townsville is in the Flinders Street retail precinct;

(e) high density residential development, tourist and short-term accommodation are located within the principal centre (CBD);

(f) new, larger scale strategic facilities, such as sports arenas, stadiums, convention centres and entertainment centres are located in other zones outside the CBD. These facilities are intended to be located close to the fringe of and well-connected to the CBD. Shops and commercial uses associated with these facilities do not compromise the CBD;

(g) the scale and density of development creates a critical mass of people living and working in the principal centre, to support the provision of the highest order of public and active transport facilities and promotes sustainable transport choices including public transport, walking and cycling;

(h) the principal centre (CBD) is a major hub for most public transport routes providing a single interchange to access frequent services to other parts of the city. An on-street transport interchange for bus routes to and through the CBD is to be located immediately adjacent to the Flinders Street retail precinct;

(i) Flinders Street, Ogden Street and Hanran Street are slow-speed vehicle environments and provide the main pedestrian and cycle spines through the principal centre. Through traffic is diverted to the fringes, including Walker Street, Blackwood Street, Denham Street and Stanley Street;

(j) pedestrian and cycle access is complemented by a network of shared paths along the banks of Ross Creek and new pedestrian and cycle creek crossings;

(k) Stokes Street is intended to be the primary east-west pedestrian spine linking the Civic and administration precinct, public transport interchange, commercial office, retail heart, Flinders Street, Victoria Bridge and Palmer Street;

(l) public realm provides a platform for public life and is characterised by high quality streetscapes, landscape elements, planting and hardscape materials reflective of the climate and character of Townsville;

(m) a variety of public open space areas at different scales and forms are provided for event and gathering spaces throughout the city, including public plazas, parks and gardens. These are appropriate to the required use and include:

(i) Flinders Square forming the primary civic event and gathering space;

(ii) a new 'front door' to Castle Hill at 'The Cutting', incorporating an information and interpretive centre, viewing platform over the CBD and providing walking track access to Castle Hill;

(iii) Flinders Street East park and plaza, which create a waterfront park for passive recreation, taking advantage of views and amenity; and

(iv) Flinders Street spine, which forms a linear plaza street from Stanley Street to Wickham Street with wider footpaths and slow vehicle speeds.

(n) natural features are retained, enhanced and buffered from the impacts of adjacent uses. Impacts are minimised through location, design, operation and management requirements;

(o) public spaces and streets are activated by shop fronts and kerbside activities at the ground storey whilst awnings over the full width of the footpaths provide protection from the elements;

(p) development is designed to incorporate exemplar sustainable practices including new technologies in maximising energy efficiency, water conservation and climate-responsive design principles;

(q) the height and scale of buildings reinforce the principal role of the centre and contribute to character, legibility and accessibility of the centre. The principal centre predominantly contains high-rise buildings. However, a human scale and attractive, pedestrian friendly environment is created at street level; and

(r) buildings located to the north of Sturt Street do not extend above the maximum height of buildings to the south of Sturt Street.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Civic and administration precinct:

(a) the Civic and administration precinct anchors the top of the principal centre (CBD) and is focused around government, administration and civic functions, such as the library and courthouse, local and state government departments;

(b) high quality public and semi-public spaces are incorporated into development to support the community function of these buildings, particularly at the intersection of Stokes and Walker Streets;

(c) lower building forms are contained in this precinct in response to the local topography and the need to provide an appropriate interface with adjoining residential land uses to the north of Wills Street;

(d) building heights in the precinct do not exceed 8 storeys; and

(e) building forms reflect a 'building in plaza' form incorporating a tower design with side and rear setbacks. Recesses in the ground level accommodate plaza spaces which are particularly focussed on presentation to Walker Street.

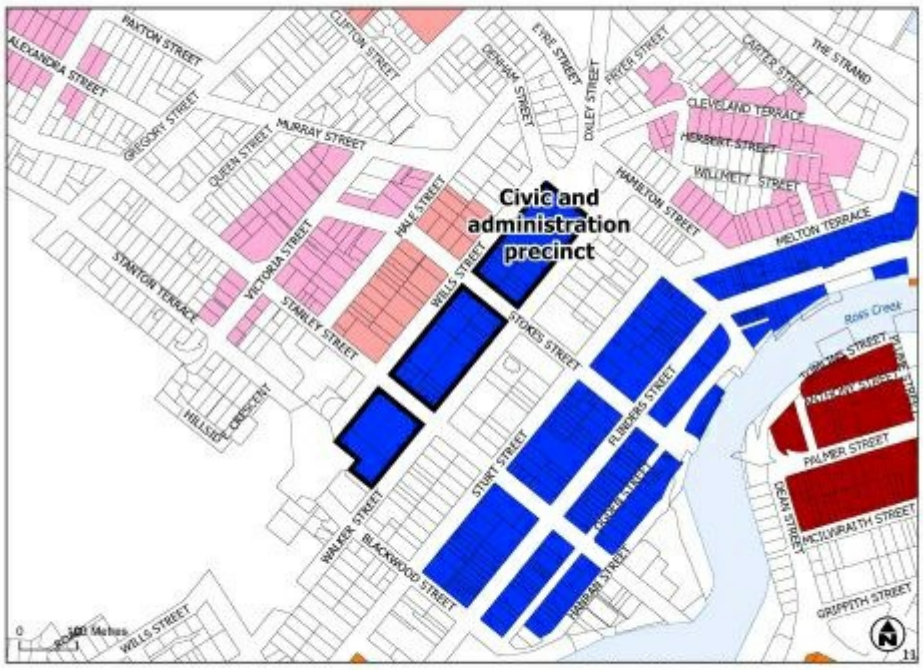

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Figure 6.102 – Civic and administration precinct

Flinders Street retail precinct:

(a) the Flinders Street retail precinct is the core focus for future retail activity and the provision of a new department store in this precinct is highly desired and actively encouraged;

(b) department stores, arcades and internal retail developments connect directly into Flinders Street, supporting the retail spine and do not detract from the attractiveness and activity on the street;

(c) highly attractive and permeable pedestrian-based built form is created with a highly active ground floor and cross block links available during operating hours;

(d) this precinct includes a large concentration of historic buildings. New buildings reflect and integrate with this built form with a low podium height and continuous frontages;

(e) taller building elements are set back from the street frontage to allow for light and air into the street and maintain the outdoor quality and human scale of the street;

(f) shop fronts, café and or restaurant premises are continuous along both sides of the street. Retail is the predominant use; and

(g) parking is not situated at the street frontage at the ground floor, and does not detract from the street activity or create blank walls. Parking structures are screened with green walls, planting, vines, creepers or public art. There are no blank facades along Flinders Street.

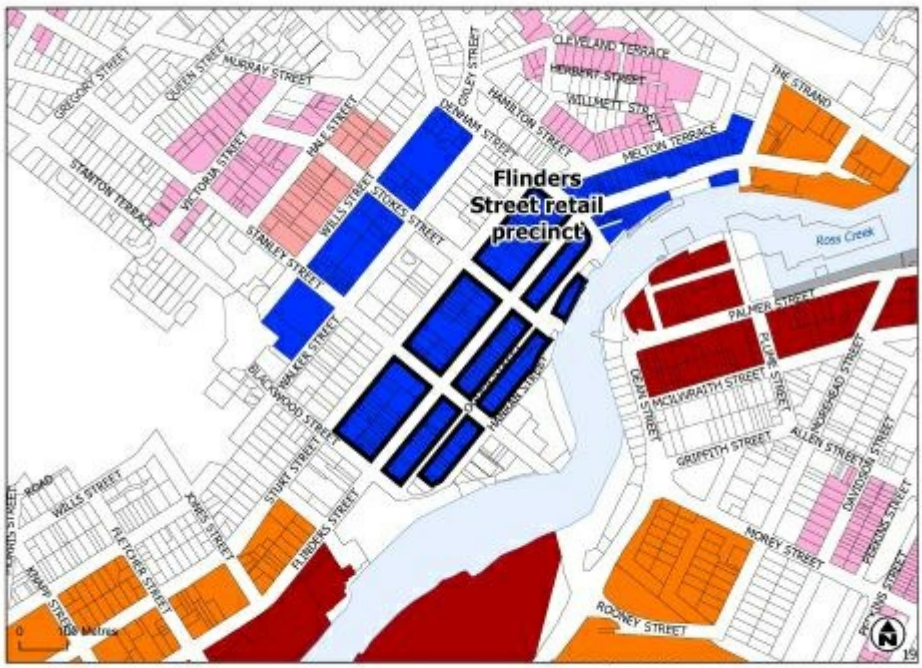

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Figure 6.103 – Flinders Street retail precinct

Flinders Street East precinct:

(a) the Flinders Street East precinct frames the eastern end of the principal centre (CBD). The precinct will continue to emerge as a vibrant entertainment and boutique shopping location, integrated with the principal centre (CBD) but with its own unique identity as a destination;

(b) the precinct will continue to develop at a lower scale than the rest of the principal centre (CBD);

(c) re-use of existing heritage buildings is actively encouraged, and new buildings are designed to respect the heritage attributes of the precinct;

(d) building height fronting Flinders Street East and Melton Terrace is low-rise and consistent with the scale of nearby character and heritage buildings;

(e) retail uses do not compete with the rest of the principal centre (CBD), and will generally be of a boutique shopping and convenience nature;

(f) active uses such as restaurants and pubs are located to the Flinders Street frontage, with new development to Melton Terrace to predominantly consist of residential uses; and

(g) new development contributes to a consistent pallet of local streetscape elements and designs, resulting in the continuing development of a local streetscape character for the precinct.

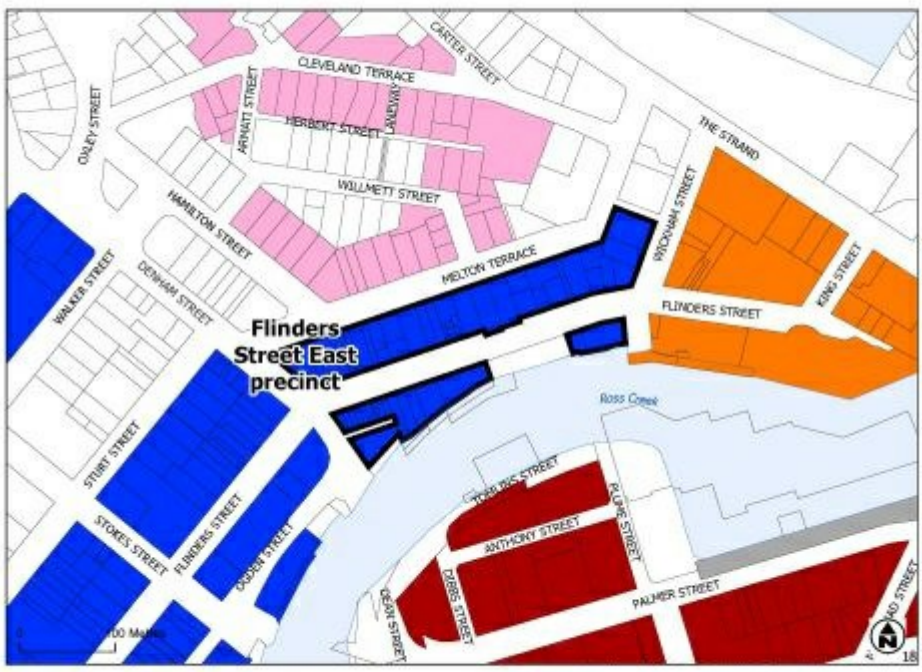

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Figure 6.104 – Flinders Street East precinct

6.3.5.3 Assessment benchmarks

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum of 9m^2; (b) a minimum dimension of 3m; and (c) clear of any utilities, water tanks and air conditioning units.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 Development is consistent with the intended role, scale and character of the principal centre. The growth of retail and office floor space and residential uses within this centre allow for it to expand into its intended role as the economic and administrative heart of the region.	No acceptable outcome is nominated.
PO6 Development is generally in accordance with the Figure 6.105 – Principal centre concept plan.	No acceptable outcome is nominated.

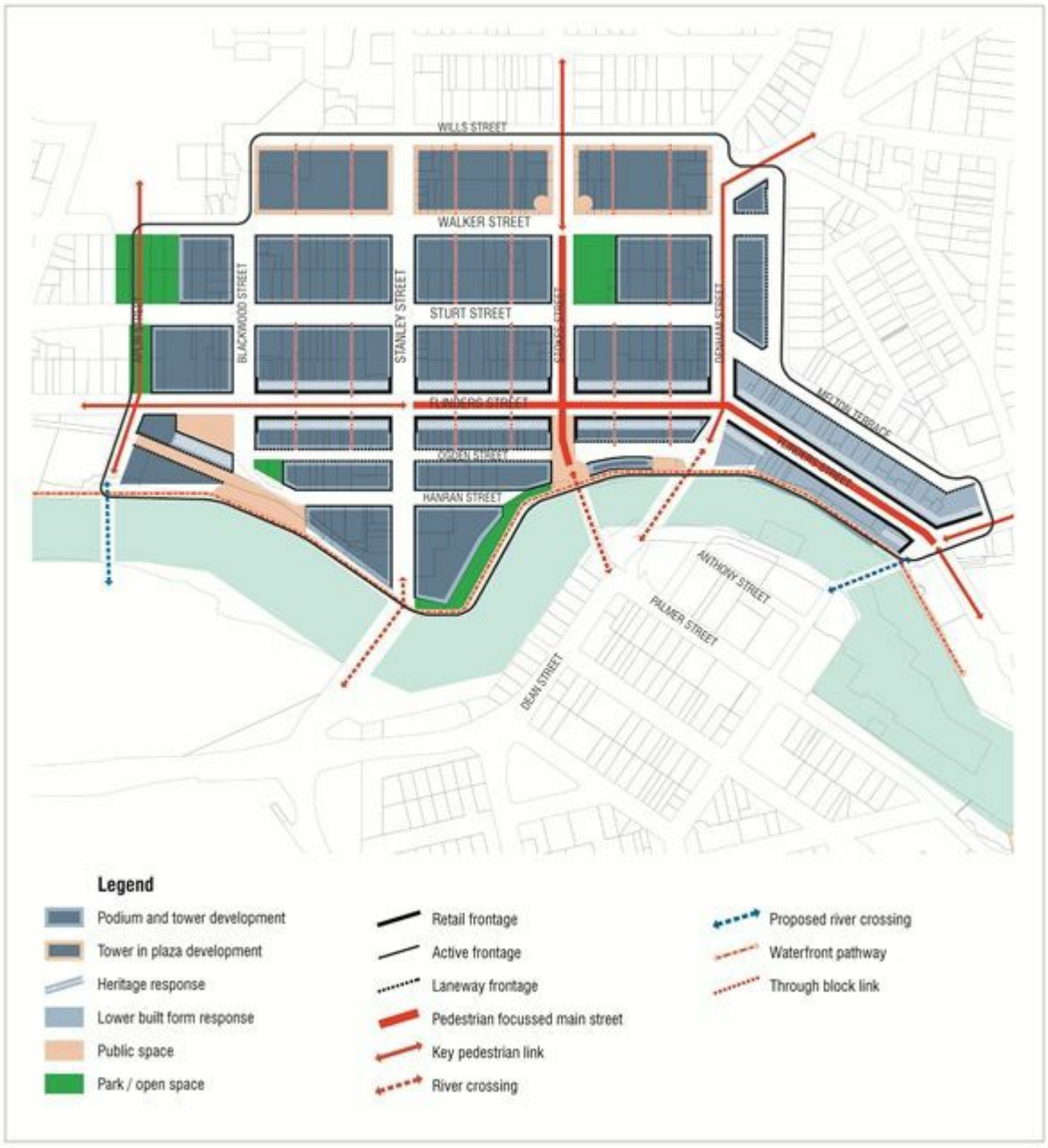

Figure 6.105 – Principal centre concept plan

PO7 Ground floor and podium level development is occupied with uses that contribute to: (a) the core economic, entertainment and cultural functions of the principal centre (CBD); (b) the vitality and vibrancy of the city's public domain; and (c) a compatible mix of active day and night-time uses.	**AO7.1** Podium level development accommodates non-residential uses.
	AO7.2 Uses at ground storey are active and include: (a) retail; or (b) cafes and restaurants incorporating outdoor dining; or (c) services and commercial offices which generate a high level of pedestrian traffic; or (d) recreational and entertainment; or (e) community and cultural uses; or (f) entrance foyers to commercial and residential uses above.

	AO7.3 Car parking is located in basements unless servicing significant citywide infrastructure or unresolvable geotechnical issues means basement parking is inappropriate or unachievable. In this case, parking is located above ground floor.
PO8 Tower development forms are occupied by uses that contribute to the accommodation of a critical mass of people (a resident or working population) within the principal centre (CBD).	**AO8** Uses within tower elements are predominantly: (a) residential accommodation either short or long-term; or (b) commercial offices; or (c) a combination of these.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO9 Building heights, site cover and setbacks contribute to the legibility, distinctiveness and place making of the city centre by creating an attractive skyline, and reinforcing the sense of primacy of the principal centre (CBD) core through built form outcomes.	**AO9.1** Unless otherwise stated for a particular precinct: (a) buildings greater than 8 storeys have a podium for a minimum of 2 storeys up to a maximum of 4 storeys, and a tower above, in accordance with Figure 6.106 – Tower and podium form; or (b) buildings of 8 storeys or less have a single tower form in accordance with Figure 6.107 – Single tower form.
	AO9.2 Unless otherwise stated for a particular precinct, setbacks and site cover are: (a) for buildings greater than 8 storeys incorporating tower and podium, in accordance with Figure 6.106 – Tower and podium form, and the following: Design Provisions - Zone & Precinct Codes Acceptable Outcome Building Form: > 8 Storey's: Tower & Podium Podium: Height: up to 4 storeys; Site Cover: 100%; SETBACKS Front: 0m; Side: 0m; Rear: 0m Tower: Height: 20 storeys + (including podium); Site Cover: 60%; SETBACKS Front: 4m; Side: 3m; Rear: 10m

	(b) for buildings 8 storeys or less and in a single tower form, in accordance with Figure 6.107 – Single tower form, and the following: **Design Provisions - Zone & Precinct Codes** **Acceptable Outcome** **Building Form**: Tower **Height**: Up to 8 storeys **Site Cover**: 70% **SETBACKS** – **Front:** 0m; **Side:** 3m; **Rear:** 6m
PO10 Building heights and massing: (a) contribute to the intended role, scale and character of the principal centre by: (i) accommodating sufficient floor space to provide critical mass and intensity of use to activate the city; (ii) concentrate major development in the CBD core and transition building height at the fringes to ensure appropriate interface with lower scale adjoining developments; and (iii) maximising active uses at lower levels to activate, interact with and overlook street frontages. (b) is appropriate to the character and climate of Townsville and: (i) retains the openness of street vistas, including to the sky, along major elements of the city grid; (ii) provides privacy, natural light penetration and air circulation; (iii) provide transition to and design compatibility with lower scale heritage places and precincts; and (iv) retains an appropriate relationship with established streetscapes. (c) contributes to safe, active streets and public domain, by: (i) defining the street space with human scale elements; (ii) retains the continuity of facades along the street; and (iii) addressing all streets and public spaces with active uses, windows, doors, openings and balconies.	No acceptable outcome is nominated.

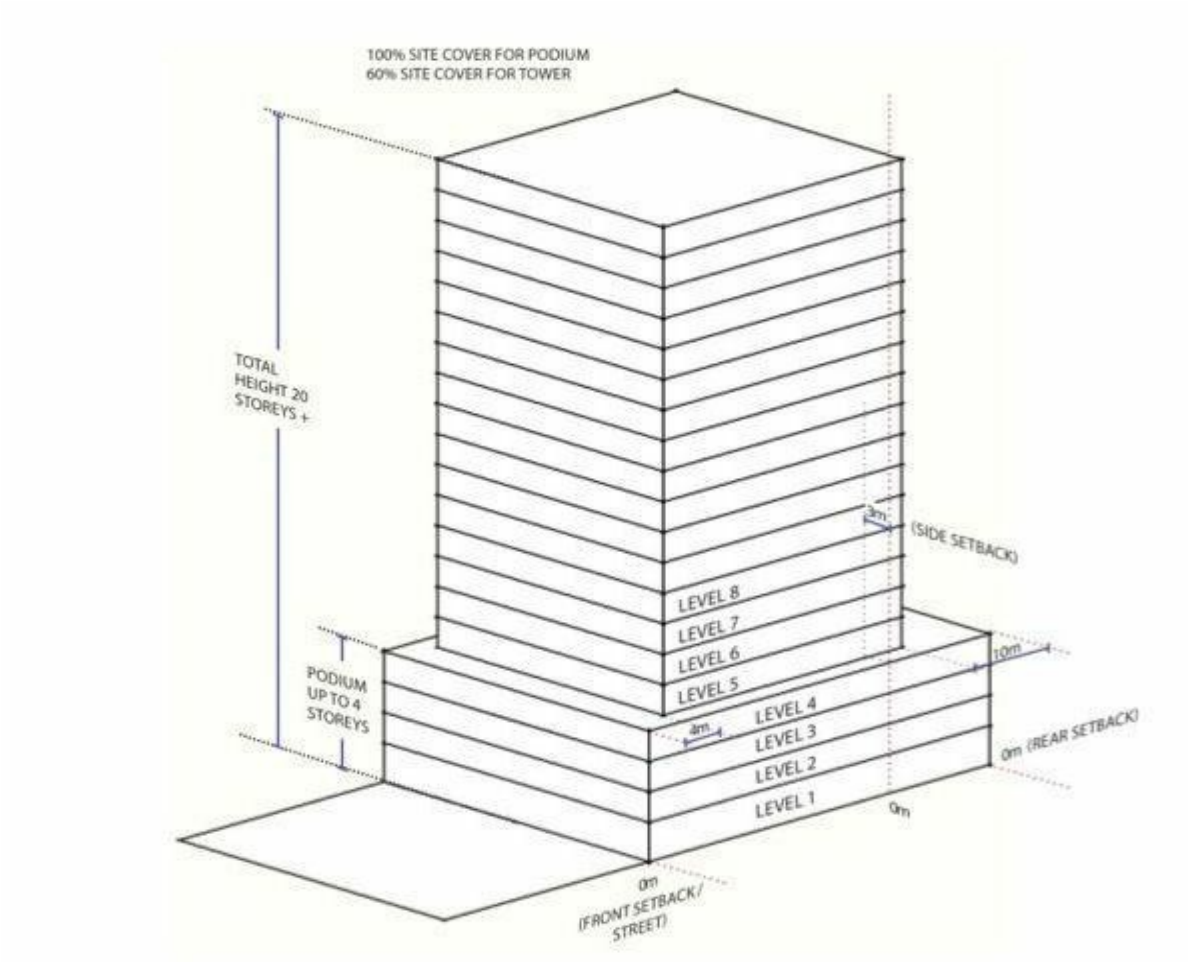

Figure 6.106 – Tower and podium form

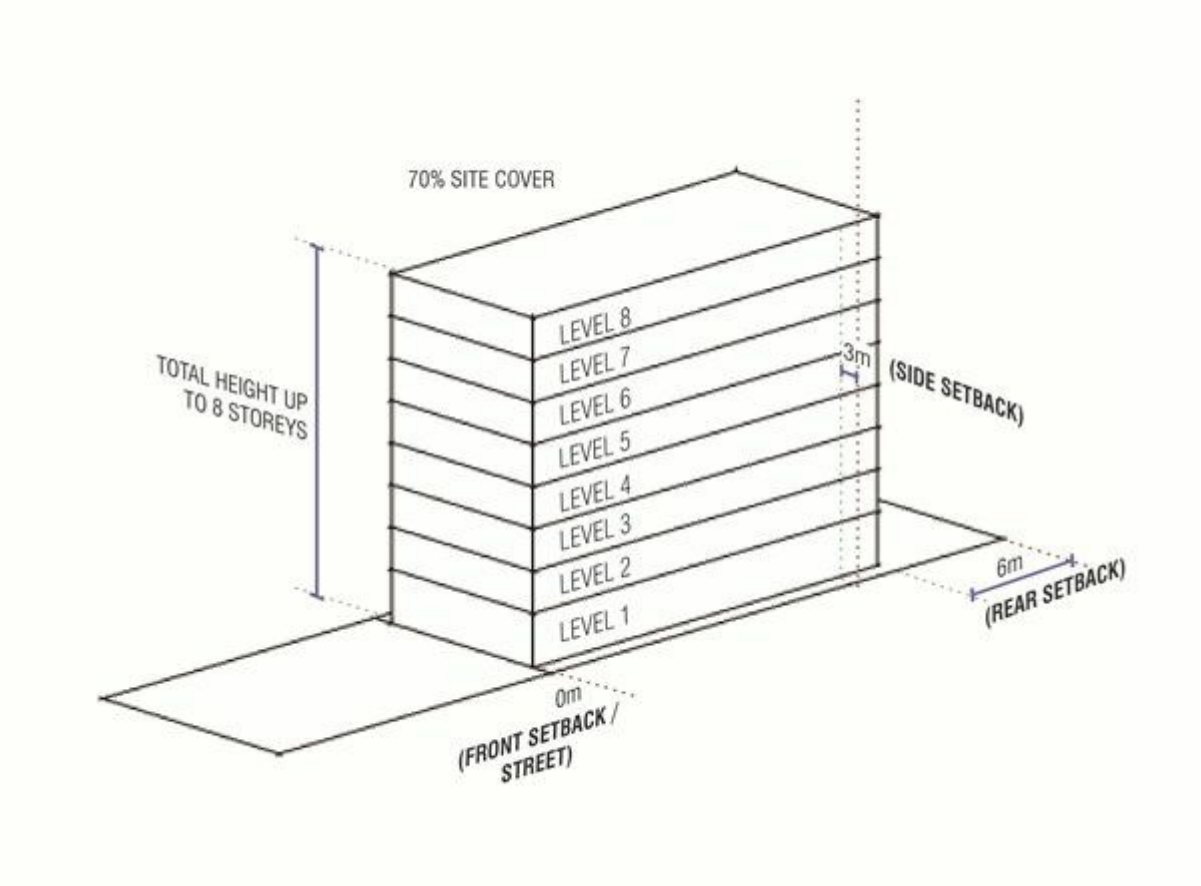

Figure 6.107 – Single tower form

PO11 Tower forms are clearly defined slender building elements with adequate spacing between them to provide for privacy, natural light penetration and air circulation.	**AO11.1** Maximum horizontal dimension for a tower on any side is 40m or 75% of the width of the site, whichever is the lesser.
	AO11.2 On a site greater than 3,000m^2, more than 1 tower is provided.
PO12 Ground floor and podium forms relate positively to streets and public spaces, and activate the public domain by incorporating: (a) operable elements within the building facade such as large window openings, sliding doors, window seating; (b) strong visual and physical connections between internal and external spaces; (c) usable outdoor/semi-outdoor spaces that support outdoor lifestyles and engage with the public realm; and (d) a gradual transition between the public domain and private outdoor or building spaces.	No acceptable outcome is nominated.
PO13 Through block connections are provided in accordance with Figure 6.105 – Principal centre concept plan which are publicly accessible during normal working/operating hours.	No acceptable outcome is nominated.

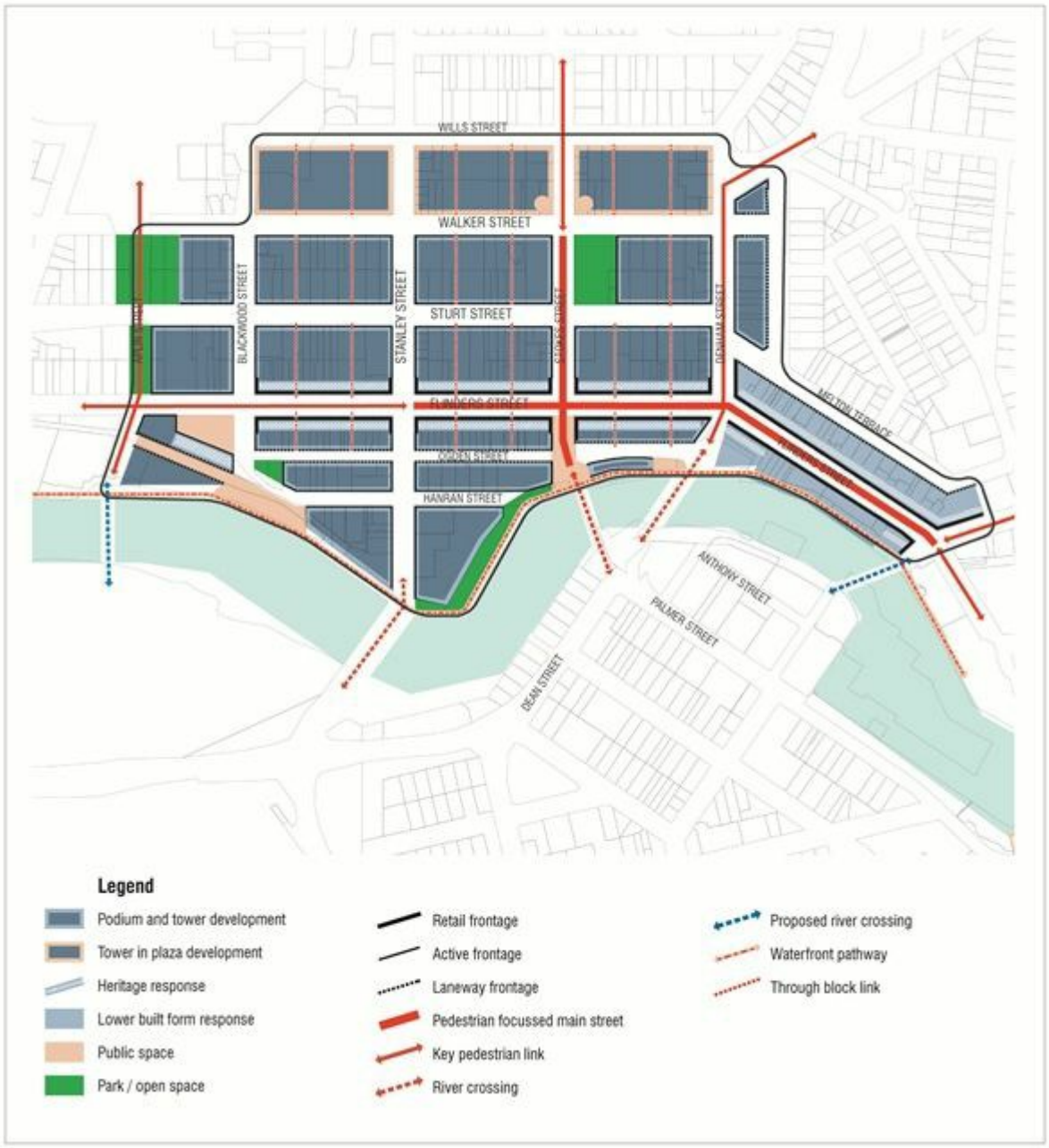

Figure 6.105 – Principal centre concept plan

PO14 Development provides continuity of building facades with adjoining buildings or provides appropriate transitions where a difference necessarily exists.	No acceptable outcome is nominated.
PO15 Ground floor and podium forms exhibit a human scale through: (a) the incorporation of detailed building elements; (b) articulation and definition of windows and openings including framing; (c) creation of a finer grain building rhythm, through design articulation such as variations in horizontal and vertical profiles, and variation in occupancy layouts within the overall building; and (d) where development sites are amalgamated, design of ground floor premises and facade to reflect the original lot widths.	No acceptable outcome is nominated.
PO16 Buildings or towers make a positive contribution to the skyline by: (a) exhibiting exceptional architectural design and quality; (b) utilising high quality materials that contribute to the tropical/Townsville character, are easily maintained and do not readily stain, discolour or deteriorate; and (c) articulating the building silhouette.	No acceptable outcome is nominated. **Editor's note–**where new buildings are proposed within the Principal centre (CBD) zone a design statement/response document is to be submitted with any development application demonstrating achievement of the relevant performance outcomes.
PO17 Roofscapes make a positive contribution to the attractiveness and function of the city through: (a) integrating them with the architectural design of the building; (b) service structures, lift motor rooms, externally mounted air conditioning units and mechanical plant designed as an architectural feature or with attractive screening; (c) creation of a coherent skyline for the city centre; and (d) creation of attractive and usable visual, open space, recreational or ecological spaces, including at podium level.	No acceptable outcome is nominated.
PO18 Buildings do not incorporate any type of glass or other surface that is likely to reflect solar rays that could create undue nuisance, discomfort or hazard to any part of the surrounding locality.	**AO18** Any reflective glass material has: (a) a level of light reflectivity of not greater than 20%; and (b) a level of heat transmission of not less than 20%.

PO19 Fenestration and sun control elements are used to: (a) minimise solar heat gain on building walls and windows; (b) reduce glare; (c) enrich the tropical character; and (d) provide texture to the building facades.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO20 Development facilitates the safety and security of people and property having regard to: (a) maximising opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) provision of adequate lighting; (d) appropriate signage and wayfinding mechanisms; (e) minimisation of entrapment locations; (f) building entrances, loading and storage areas that are well lit and lockable after hours; and (g) provision of direct movements along desire lines with clear unobscured sight lines. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO21 Ground storey pedestrian footpaths and access ways are the same level as, and connect without any lip or step to, the footpath and abutting pedestrian areas on neighbouring sites. Where the footpath is sloping, entries to the building are at the same level as the footpath.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO22 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO23 Development provides private open space that is: (a) well-proportioned, appealing, functional and easily accessible, and promotes outdoor living as an extension of the dwelling; (b) provides a high level of privacy for residents and neighbours; and (c) has sufficient size and shape to meet the needs of a diversity of potential residents.	**AO23.1** Private open space is provided as a balcony with: (a) a minimum area of 9m^2 for a 1 bedroom unit or 16m^2 for a 2 or more bedroom unit; and (b) a minimum dimension of 3m, clear of any utilities such as gas, water tanks or air-conditioning units.
	AO23.2 Where clothes drying areas are provided on private balconies they are screened from public view.
	AO23.3 Private open space is located or screened so it does not directly overlook main living areas or private open space of adjoining dwellings.
PO24 Sufficient communal open space is provided to create flexible spaces suitable for a range of activities.	No acceptable outcome is nominated.
PO25 Communal open space provides facilities including seating, shade, flexible spaces suitable for a range of activities. Treatments such as green roofs, green walls or community gardens contribute to the attractiveness of these spaces.	No acceptable outcome is nominated.

PO26 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and public spaces; (b) contribute to pedestrian comfort through shade; (c) create green rooves, walls or other sustainable building elements; and (d) screen unsightly components.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Loading and servicing	
PO27 The design and location of parking areas, refuse storage areas, loading/unloading and servicing areas, plant and building control on-site: (a) minimise disruption or breaks in building frontages; and (b) are screened from view from the street and adjoining uses.	**AO27.1** Non-active frontage (vehicle access, fire egress, control room, plant, building services etc.) occupies a maximum 8m or 25% of the primary frontage, whichever is the lesser.
	AO27.2 Refuse storage areas, loading and services bays are: (a) contained within the ground floor or podium built form; and (b) screened from the street by active uses/occupied building space.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Public domain	
PO28 Footpaths and pathways provide all weather protection within a safe, unobstructed and attractive environment. Awnings are: (a) continuous and compatible with existing awnings; (b) allow for street trees and landscaping; (c) visually safe and amenable; (d) located along key pedestrian routes and connects key destinations; (e) contributes to legibility and wayfinding; (f) do not impede the normal flow of pedestrians; and (g) constructed of materials that reflect the tropical climate and character of Townsville.	**AO28.1** Awnings are provided in accordance with Figure 6.108 – Awning location.
	AO28.2 Awnings: (a) are located above ground floor and is a minimum of 3.2m and generally not more than 4.2m above pavement height; (b) extend from the face of the building and is set back from the inside of the kerb line: 1.5m; (c) are continuous across all street frontages of the site; (d) are contiguous with adjoining buildings and awnings; (e) are cantilevered from the building and does not include posts within the footpath (except within the Flinders Street East precinct); (f) are provided with under awning lighting; and (g) are constructed of lightweight materials.
	AO28.3 Additional pedestrian shelter is provided as free-standing shade structures (such as umbrellas) which: (a) are constructed of lightweight materials; (b) have a minimum number of posts; (c) are a minimum 2.5m above pavement height; and (d) maintain the normal flow of pedestrians.

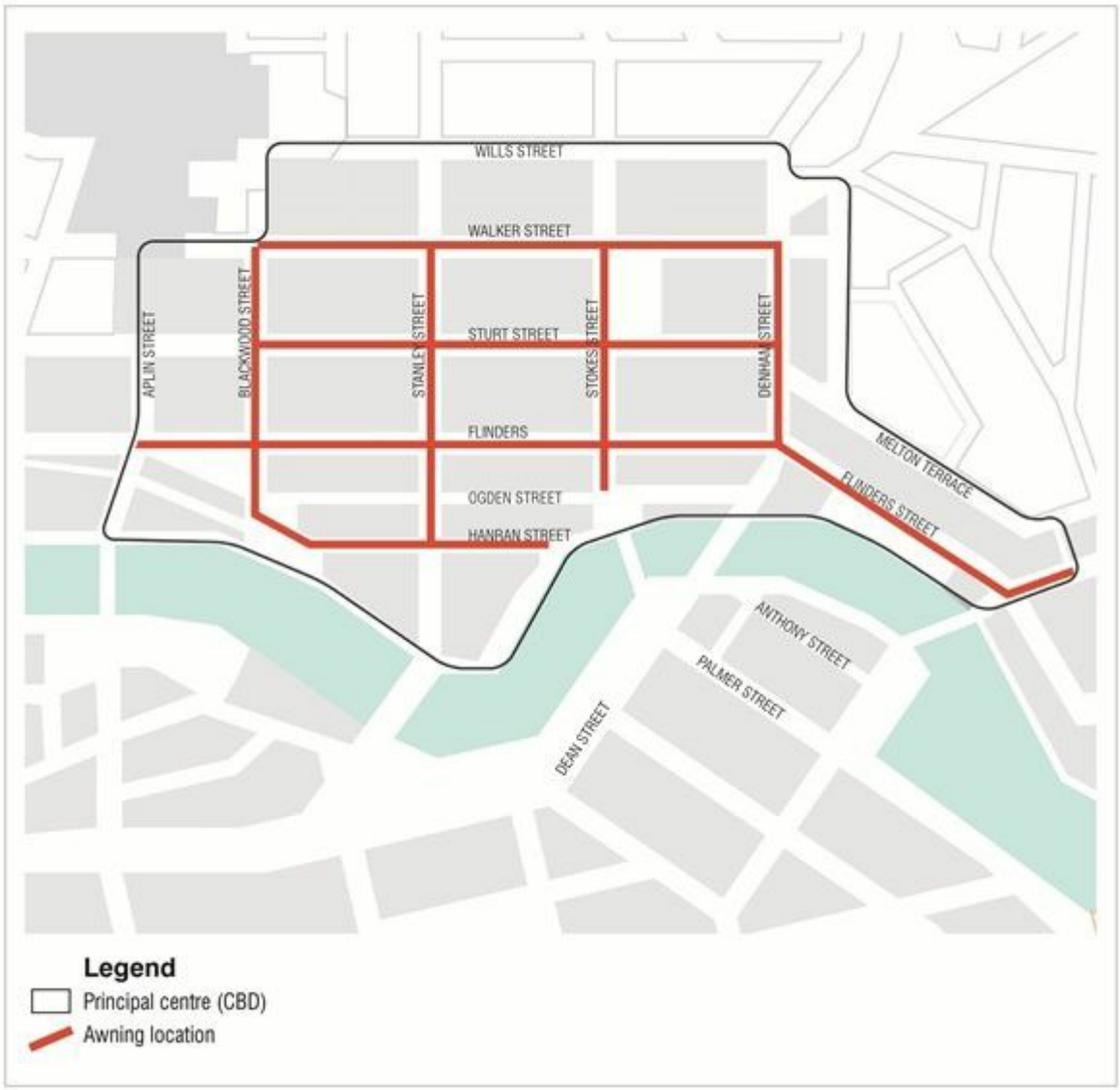

Figure 6.108 – Awning location

PO29 Where the ground floor is setback and upper podium levels overhang, or awnings are provided, these are cantilevered to avoid columns, ensuring no visual or physical obstruction occurs between the footpath and ground floor premises.	No acceptable outcome is nominated.
PO30 The location and placement of steps, escalators, ramps, lifts, automatic teller machines and other facilities which require queuing, standing areas or waiting such as bus stops and taxi ranks: (a) do not impede the normal flow of pedestrians; (b) maintain visibility and good sight lines; and (c) provide adequate space for queuing, standing areas.	**AO30** Any steps, escalators, ramps, lifts and automatic teller machines are set back 1.5m from the building facade at ground floor to allow for adequate waiting space in a manner that does not create concealment spots.
PO31 Pedestrian movement is continuous, convenient, safe and comfortable. Development: (a) provides pathways at street level and not provided via overhead bridges; (b) provides additional through block connections; (c) provides direct connections between key destinations; and (d) priorities pedestrian movement throughout the CBD.	No acceptable outcome is nominated.
PO32 Footpath and public realm design delivers pedestrian spaces that: (a) accommodate the requirements of the adjacent land use and the likely pedestrian traffic; (b) provide all weather protection; (c) provide vegetation that contributes to the city's tropical character; and (d) are constructed and maintained to a consistent standard.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Provision of public spaces	
PO33 A variety of public spaces are provided throughout the principal centre (CBD) and include: (a) small-scale spaces; (b) laneways; (c) public promenades; (d) public squares; (e) urban boulevards; (f) parks and gardens; (g) performance spaces; and (h) arcades and through block links.	**AO33** New public spaces, corridors, pathways and through block connections are provided in accordance with Figure 6.105 – Principal centre concept plan.
PO34 Development adjoining Ross Creek contributes to the provision of a continuous riverside bikeway/walkway linking Reid Park to The Strand and extending out to the Breakwater precinct. The pathway system: (a) provides a shared path for pedestrians and cyclists; (b) is safe and attractive providing opportunities for pausing and weather protection along the route; and (c) provides direct connections between the pathway and the adjoining street network.	**AO34** Any development on premises adjoining Ross Creek provides: (a) a fully publicly accessible riverside walkway/bikeway that is dedicated to council and has a minimum unobstructed pavement width of 4.5m and a minimum overall width of 6m; (b) tree planting, lighting, balustrading, and pavement treatment are provided along the full length and within the pathway; and (c) furniture, including seating, awnings and public art for weather protection are provided at the intersection of the pathway and key streets.

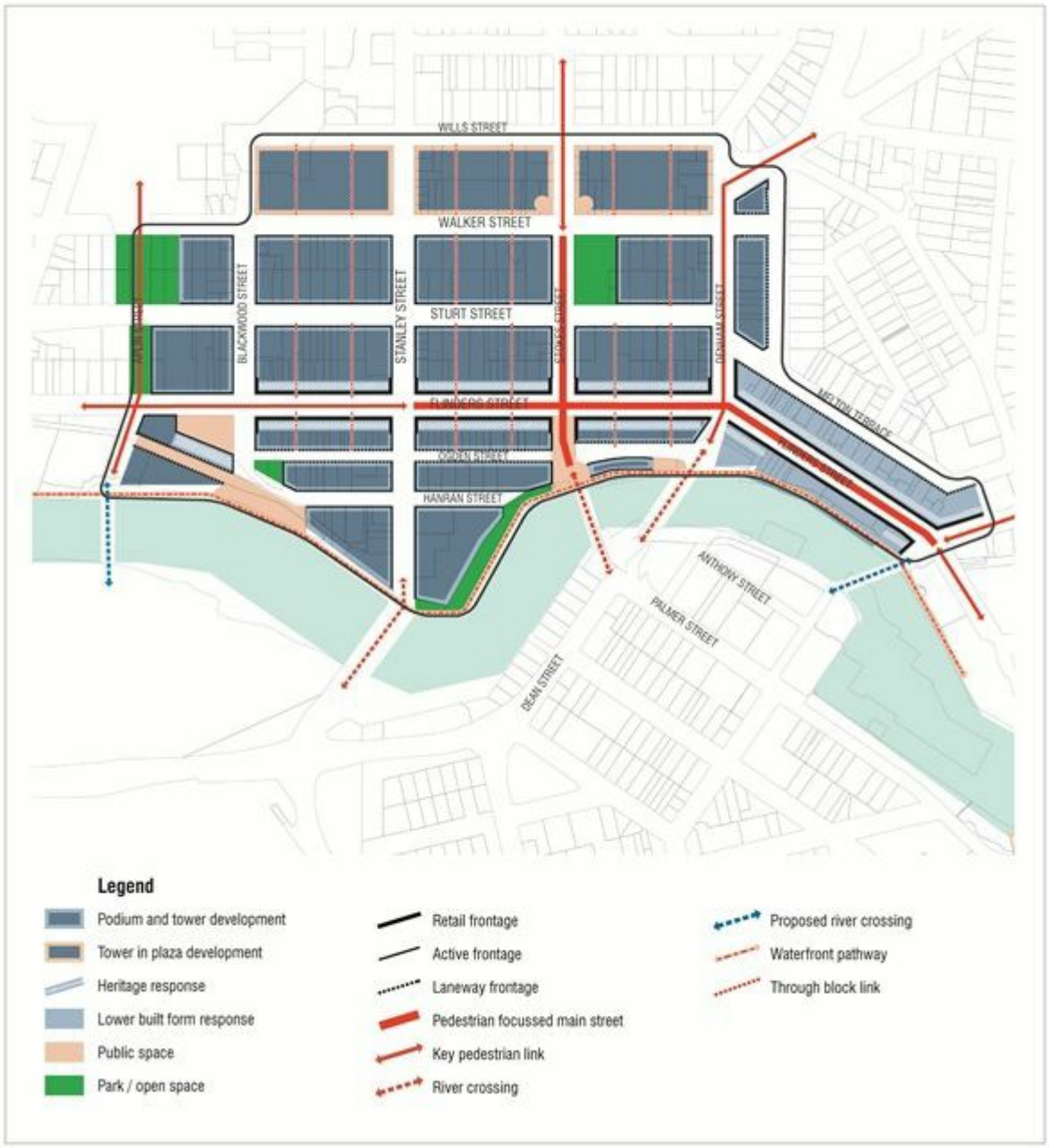

Figure 6.105 – Principal centre concept plan

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Civic and administration precinct	
PO35 Development facilitates or supports a mix of uses and day and night-time activity throughout the precinct including: (a) civic, administration, government, education and commercial office buildings are the predominant uses; and (b) shops, dining, café and restaurant uses may occur at the ground storey along street frontages and adjoining public entrances and forecourts.	No acceptable outcome is nominated.
PO36 Building form and massing reflect a distinctive 'building in plaza' setting to contribute to the civic character and identity of the precinct including: (a) substantial areas of the ground plane given over to public access; (b) a high quality public realm including both hard and soft-scape materials; (c) creation of stand-alone pavilions; and (d) consistent single, uniform building elements.	**AO36.1** Buildings: (a) do not have a site cover exceeding 60% of the site; and (b) incorporate a significant space as an entrance plaza/waiting or meeting area. Figure 6.109 — Civic and administration precinct built form illustrates the desired outcome. **AO36.2** Building setbacks are: (a) a minimum of 5m from street and side boundaries; (b) a minimum of 6m from the rear boundary; and (c) are generally consistent for the full height of the building on a single side, with only minor (less than 1m) indents or projections in the facade. Figure 6.109 — Civic and administration precinct built form illustrates the desired outcome.

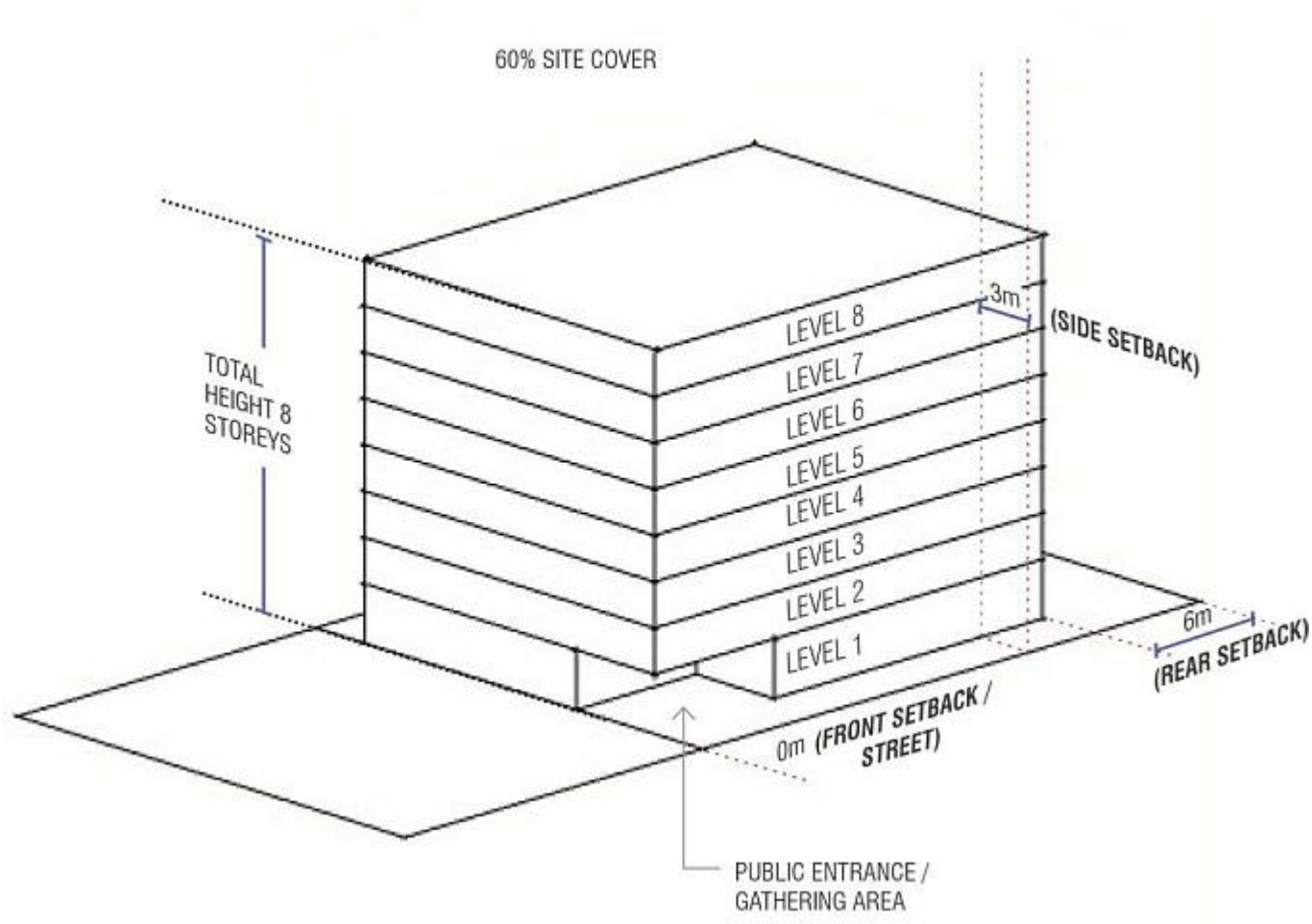

Figure 6.109 – Civic and administration precinct built form

PO37 Building heights and setbacks contribute to the legibility, distinctiveness and place making of the city centre by contributing to an attractive skyline, and reinforce the sense of primacy of the principal centre (CBD) core through built form outcomes. Buildings in the Civic and administration precinct provide a transition from the built form intensity and scale to the central parts of the CBD to adjoining residential development generally at a lower scale.	**AO37** Building height does not exceed 8 storeys.
PO38 Overall building siting and location on the site: (a) provides glimpses of Castle Hill between buildings as a constant reference point, wherever possible; and (b) creates spaces in and around the building which are proportionate to the overall dimensions of the building.	No acceptable outcome is nominated.
PO39 At the ground floor, design is to incorporate innovative responses to public realm interface, including the use of additional corner setbacks integrated with public entrances and gathering areas.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street retail precinct	
Role and function	
PO40 Ground floors of buildings on Flinders Street frontage are occupied by uses that have a visible presence on and interaction with the street and public domain. Predominant uses reflect the role of this precinct as the focus for retail uses within the principal centre (CBD) and the highest order retailing in the city by: (a) retail and other active uses at ground floor along Flinders Street and Odgen Street in this precinct; (b) accommodating specialist retailing; and (c) accommodating a department store.	**AO40** New development provides at least the same amount of retail floor space as existed prior to that development, ensuring there is no net loss.
PO41 Active uses including retail, shops, banks, active commercial tenancies and café uses are located: (a) at ground floor along Flinders Street and Odgen Street; (b) along the ground floor of any through block links, arcades or indoor retail developments; and (c) at upper levels where indoor retail developments.	No acceptable outcome is nominated.
PO42 Any department or discount department store has a frontage to Flinders Street and is incorporated into larger retail and entertainment development where possible.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street retail precinct	
Building form and massing	
PO43 Building heights and massing: (a) reflect and respond to the scale of adjoining historic building forms; (b) facilitate a high degree of pedestrian amenity by: (i) minimising overshadowing and adverse wind effects; (ii) providing for good light penetration and air circulation with visibility to the sky; and (c) ensure the scale and character of the heritage buildings is the prevailing built form.	**AO43.1** Along the Flinders Street frontage and Sturt Street frontage: (a) podium height is a maximum of 4 storeys; (b) where adjoining a heritage or character building, podium height is a maximum of 2 storeys, or is within 20% of the height of the adjoining building height; (c) podium development is built to boundary on all site boundaries; (d) towers are set back from Flinders Street a minimum of 10m; (e) towers are set back from Sturt Street a minimum of 4m; and (f) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.110 – Flinders Street retail precinct building massing, and the following: Design Provisions - Zone & Precinct Codes Acceptable Outcome Building Form: Heritage Frontage and Tower set back from street Podium / Tower Height: 2-3 storey's Flinders Street; 4 storeys Sturt St & Ogden St / 20 storeys + (including podium) Site Cover: 100% / 60% SETBACKS Front/ Street: 0m / 20m Flinders St, 4m Sturt & Ogden St SETBACKS Side: 0m / 3m SETBACKS Rear: 0m / 10m or between tower elements

AO43.2

Along the Ogden Street frontage:

(a) podium height is maximum of 4 storeys;

(b) podium development is built to boundary on all site boundaries;

(c) the tower are setback a minimum of 5m from the street frontage; and

(d) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.106 – Tower and podium form, and the following:

Design Provisions - Zone & Precinct Codes

Acceptable Outcome

Building Form		> 8 Storey's:	Tower & Podium
		Podium	**Tower**
Height		up to 4 storeys	20 storeys + (including podium)
Site Cover		100%	60%
SETBACKS	**Front:**	0m	4m
	Side:	0m	3m
	Rear:	0m	10m

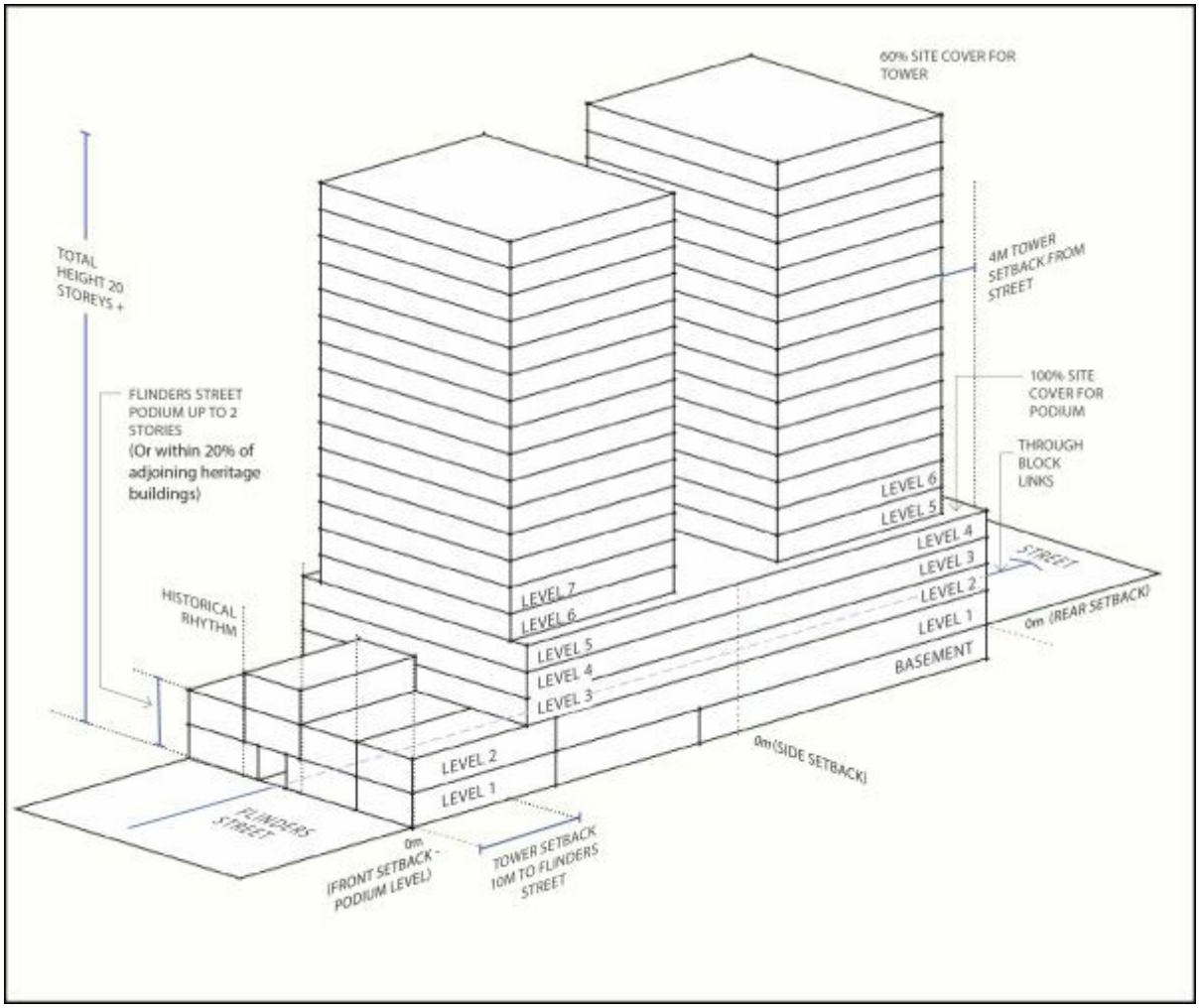

Figure 6.110 – Flinders Street retail precinct building massing

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street East precinct	
Role and function	
PO44 Development is consistent with the role of this precinct as the focus for entertainment and late night-time economy.	No acceptable outcome is nominated.
PO45 Development contributes to a mix of day and night-time activity on Flinders Street (East) which enhances the safety of the precinct, including some retail uses and nightclub entertainment facilities with extended operating hours for daytime dining.	No acceptable outcome is nominated.
PO46 Retail uses are not established to a level that would undermine the Flinders Street retail precinct as the primary shopping area in the principal centre (CBD).	**AO46** Where retail uses are provided these are located at ground floor and do not contribute to the overall retail frontage on the street exceeding 40% of the entire length of the street frontage at ground floor.
PO47 Where short-term accommodation is located within this precinct it is accommodated above ground floor.	No acceptable outcome is nominated.

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

<table>
<tr><th>Performance outcomes</th><th>Acceptable outcomes</th></tr>
<tr><td colspan="2">Flinders Street East precinct</td></tr>
<tr><td colspan="2">Building form and massing</td></tr>
<tr><td>PO48
Building heights and massing:
(a) reflect and respond to the scale of adjoining heritage building forms;
(b) create a predominantly continuous built edge to the street at the ground storey; and
(c) retain views to and from Melton Hill to South Townsville (Tomlins Street).</td><td>AO48
In the Flinders Street East precinct:
(a) building height along Flinders Street (East) is 3 storeys or within 20% of the adjoining heritage buildings;
(b) no towers are established;
(c) buildings are set back 0m from Flinders Street (East);
(d) side setbacks do not exceed 1.5m;
(e) building height along Melton Terrace is a maximum of 2 storeys above the level of the adjoining road; and
(f) unless otherwise stated building form, setbacks, heights, and site cover are as illustrated in Figure 6.111 – Flinders Street East building massing, and the following:
Design Provisions - Zone & Precinct Codes
Acceptable Outcome
<table><tr><td colspan="2">Building Form</td><td>Heritage frontage with development behind</td></tr><tr><td colspan="2">Height</td><td>Flinders Street East: 2-3 storeys
Melton Terrace: 2 storeys</td></tr><tr><td colspan="2">Site Cover</td><td>100%</td></tr><tr><td rowspan="3">SETBACKS</td><td>Front/ Street:</td><td>Flinders Street East:
0m for levels 1-3
20m for levels 3+
Melton Terrace: 3m</td></tr><tr><td>Side:</td><td>0m</td></tr><tr><td>Rear:</td><td>N/A</td></tr></table></td></tr>
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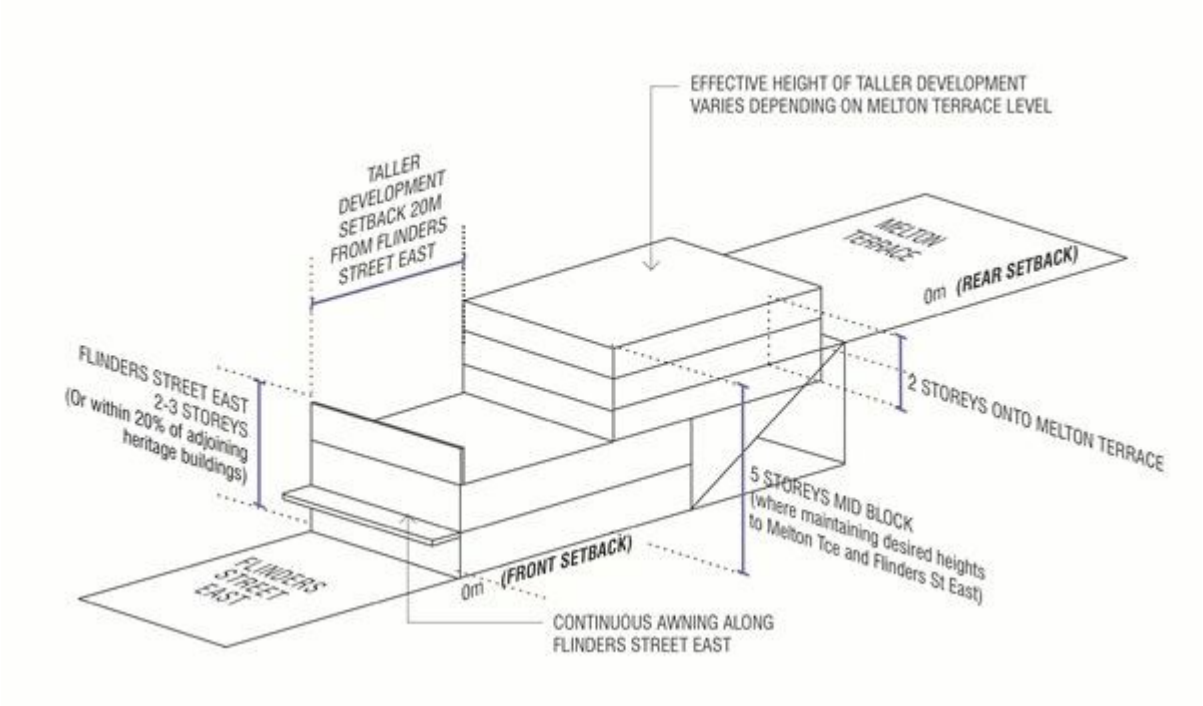

Figure 6.111 – Flinders Street East building massing

Table 6.3.5.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Flinders Street East precinct	
Roof form and awnings	
PO49 Roof form is contemporary and contributes to tropical design character, complementing but not mimicking heritage building elements.	No acceptable outcome is nominated.

6.3.6 Specialised centre zone code

6.3.6.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.6.2 Purpose

(1) The purpose of the Specialised centre zone code is to provide for one or more specialised uses.

(2) The particular purpose of the code is to:

(a) recognise the role and function of each of the specialised centres and guide development within each centre; and

(b) protect each centre from encroachment by development which may impact on that role and function.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the zone accommodates large public, commercial or institutional facilities which are significant to the economic and social well-being of Townsville but are not appropriately included in other zones. These centres include Domain Central, the James Cook University-Townsville Hospital precinct, Lavarack Barracks, Townsville Airport, Port of Townsville and major medical precincts;

Editor's note—While the planning scheme does not regulate land within some of these sites, this code is intended to give direction to development within or in the vicinity of these sites, to the extent possible.

(b) the centres perform a specific function for the Townsville and wider North Queensland community, and are major nodes of business activity, services or employment;

(c) these centres generally have strong relationships with the other multifunctional activity centres in Townsville, but do not incorporate the breadth and depth of activities of these other centres and do not compete with or undermine the retail and commercial functions of these other centres;

(d) development supports and is compatible with the primary focus for the centre. The specialised centre retains its dominant function and new development does not prejudice its ongoing operation or significantly impact on the amenity of nearby sensitive uses;

(e) shops and shopping centres within these centres are limited to convenience retail, food and drink outlets servicing on-site businesses, workers and, where they exist, residents. Offices are limited to those directly related to the primary focus of the centre;

(f) specialised centres grow in a consolidated way that makes efficient use of the zoned area. Development near the boundaries of specialised centres is located and designed to minimise impacts on sensitive land uses in other zones;

(g) development surrounding a specialised centre does not impact on the continued functioning and expansion of the centre for its intended primary purpose;

(h) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour; and

(i) opportunities for energy efficiency through built form are maximised.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts and sub-precincts:

Townsville Airport precinct:

(a) the long-term operation and expansion of the Townsville Airport is supported for both Department of Defence purposes, and to satisfy the primary air transport needs of the Townsville and North Queensland regions;

(b) the timely and cost-effective provision of aeronautical infrastructure is facilitated;

(c) aviation-related related businesses, research and technology industries and low impact industries are accommodated;

(d) development is not of a type or scale that undermines the successful operation of the principal centre (CBD) or major centres in Townsville; and

(e) residential development is limited to short-term accommodation.

Editor's note—The Townsville Airport does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important joint defence and civil functions through this zoning and acknowledges the intentions of Townsville Airport's master planning document.

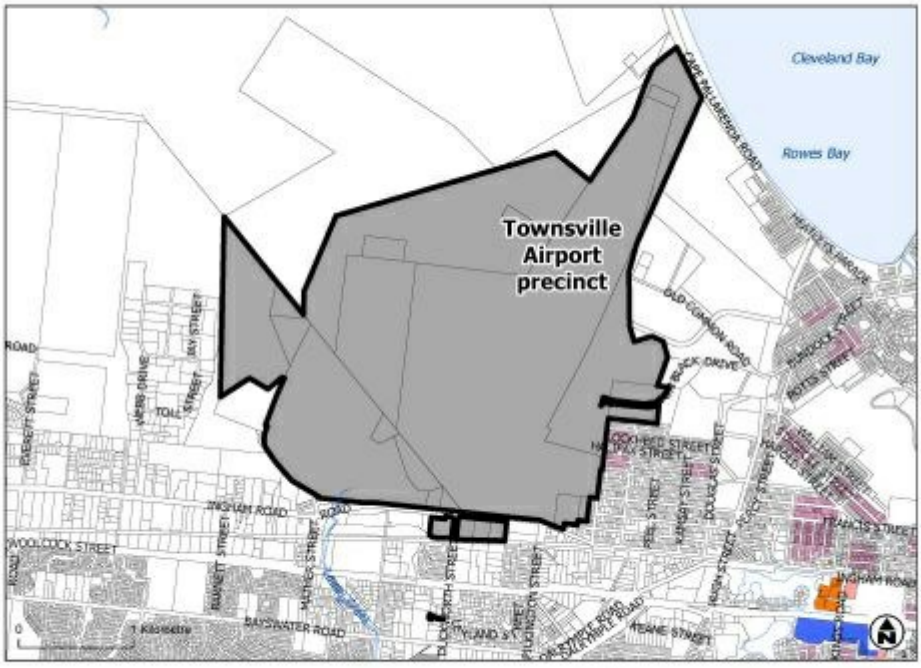

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Figure 6.112 – Townville Airport precinct

Port of Townsville precinct:

(a) the long-term operation of the Port of Townsville is protected for the benefit of the local and regional economy;

(b) the operations of the port are protected from incompatible land uses and activities on nearby land; and

(c) waterfront development within the port is integrated with the Palmer Street and The Strand areas where possible, to maximise community access to and use of waterfront areas.

Editor's note—The Port of Townsville does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning and the acknowledges the intentions of Port of Townsville's master planning documents.

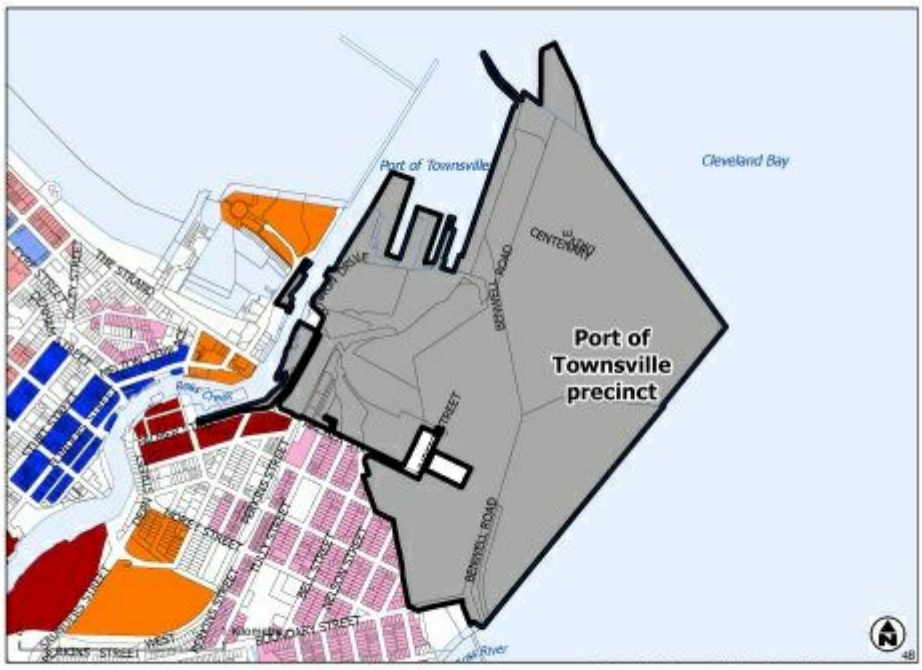

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Figure 6.113 – Port of Townsville precinct

Lavarack Barracks precinct:

(a) the ongoing use and development of the barracks area for Department of Defence-related purposes, including aviation, communications, logistics, administration, training, and accommodation and recreation facilities for defence personnel is protected; and

(b) to the extent practicable, development is encouraged to create an attractive frontage to University Road.

Editor's note—Lavarack Barracks does not fall within the regulatory jurisdiction of the Townsville City Plan. However, council recognises its important function through this zoning.

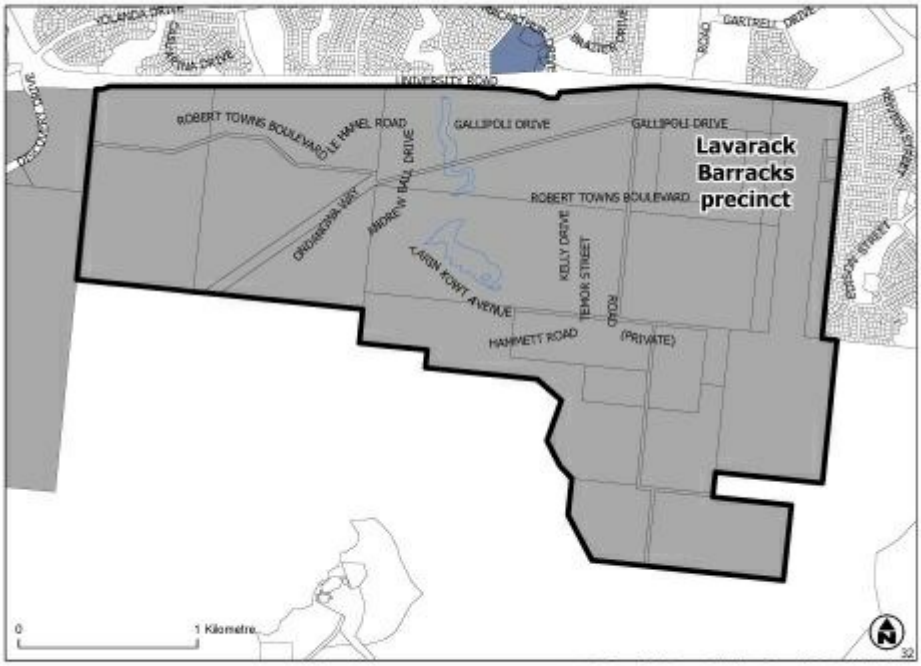

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Figure 6.114 – Lavarack Barracks precinct

Domain Central precinct:

(a) this centre accommodates showrooms primarily servicing the northern Townsville community;

(b) apart from small-scale food and drink outlets, Domain Central is not substantially expanded to include further shops or shopping centres; and

(c) the integration of this centre is strengthened through built form and layout, and pedestrian-based accessibility is improved.

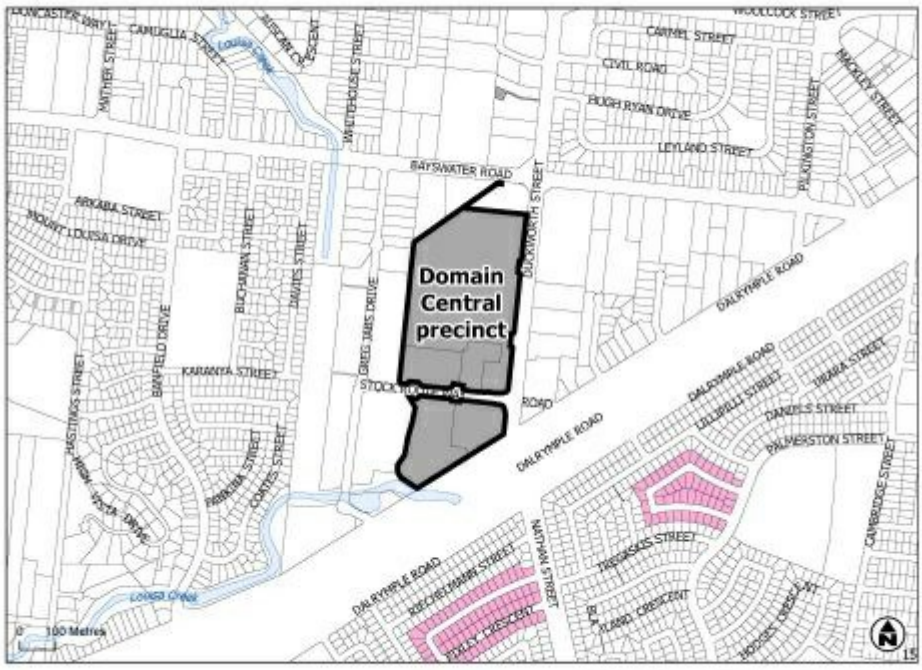

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Figure 6.115 – Domain Central precinct

Fulham Road medical precinct:

(a) the precinct continues to be the focus for private acute medical services in the Townsville region;

(b) the continued efficient and effective operation of the hospital is protected;

(c) the precinct accommodates medical centres, medical offices and health care services, research and technology industries, accommodation and other activities that support or are otherwise allied to the hospital activities;

(d) the hospital has the highest scale and intensity of any use within the precinct; and

(e) development facilitates an active pedestrian environment along Fulham Road which promotes connectivity to adjoining areas including Anderson Park.

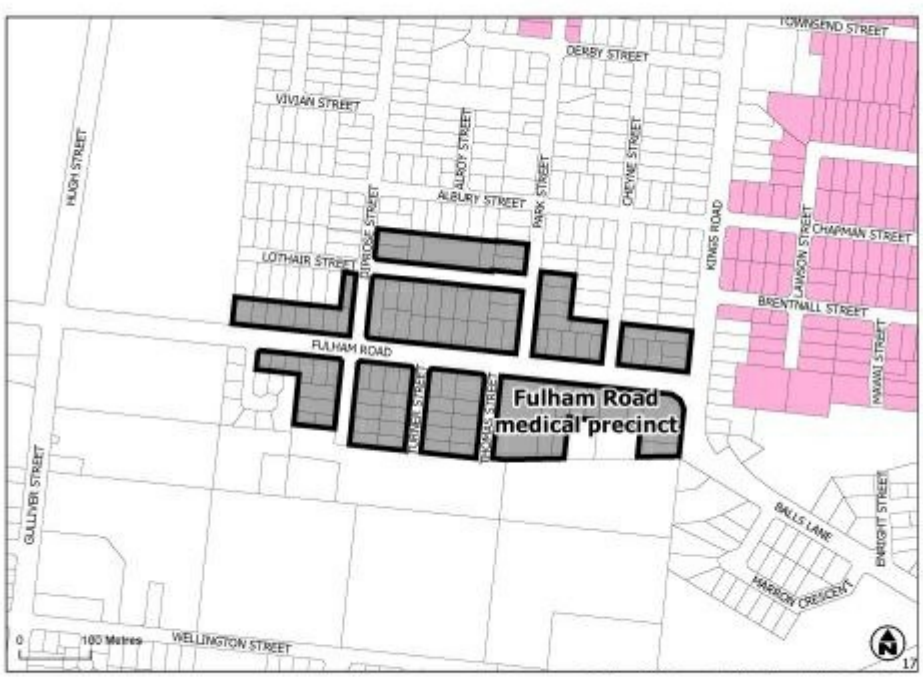

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Figure 6.116 – Fulham Road medical precinct

Bayswater Road medical precinct:

(a) the continued efficient and effective operation of the hospital is protected;

(b) the hospital has the highest scale and intensity of any use within the precinct;

(c) the precinct accommodates medical centres, medical offices and health care services, research and technology industries, accommodation and other activities that support or are otherwise related to the hospital activities;

(d) the primary hospital entry and pedestrian activity within the precinct is focused around the Oxford Street and Regent Street intersection;

(e) Oxford and Regent Street are active pedestrian environments and direct pedestrian connections are provided through the hospital site; and

(f) parking associated with the hospital and other allied health uses is provided in consolidated areas.

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Figure 6.117 – Bayswater Road medical precinct

James Cook University-Townsville Hospital precinct:

(a) the James Cook University-Townsville hospital precinct is evolving into a 'world-class knowledge community' with a focus on the tropics and on sustainability. Prominent land uses include health and education services and a range of research and technology industries;

(b) the land use mix and scale of development reflects the role of the precinct in the city and the tropics. Land uses which benefit and enhance the knowledge community are accommodated. Development not related to the focus of the precinct, and that would adversely affect other centres, is not established;

(c) the precinct changes from a collection of single use campuses into a mixed use urban centre. The precinct integrates existing institutions and is integrated into the wider city including strong links to the CBD and the Aitkenvale and Thuringowa Central major centres;

(d) the James Cook University-Townsville Hospital precinct takes on a specific role in leadership in sustainability. Development provides exemplar and culture changing projects in areas like public transport, housing, public spaces and community development as well in its traditional academic and healthcare focus;

(e) the James Cook University-Townsville Hospital precinct exhibits increased self-containment compared to normal practice, with people living and working within the centre. Development minimises the use of finite resources like land, energy, water and wastewater. An overall test for all development at the centre, including residential development, is that it exemplifies sustainable development in all its realms;

(f) an emerging and sustainable resident community is well-connected to the wider city by active and public transport;

(g) car dominance within the precinct is redressed, with walking and cycling given priority in all development components;

(h) development does not extend into areas of landslip or bushfire risk, high scenic amenity or local, regional or state ecological significance; and

(i) development is well-designed at the centre, precinct, street, public space and building scales.

Editor's note—Development of James Cook University (Douglas Campus), which is undertaken in terms of a Ministerial Designation, does not fall within the regulatory jurisdiction of the Townsville City Plan.

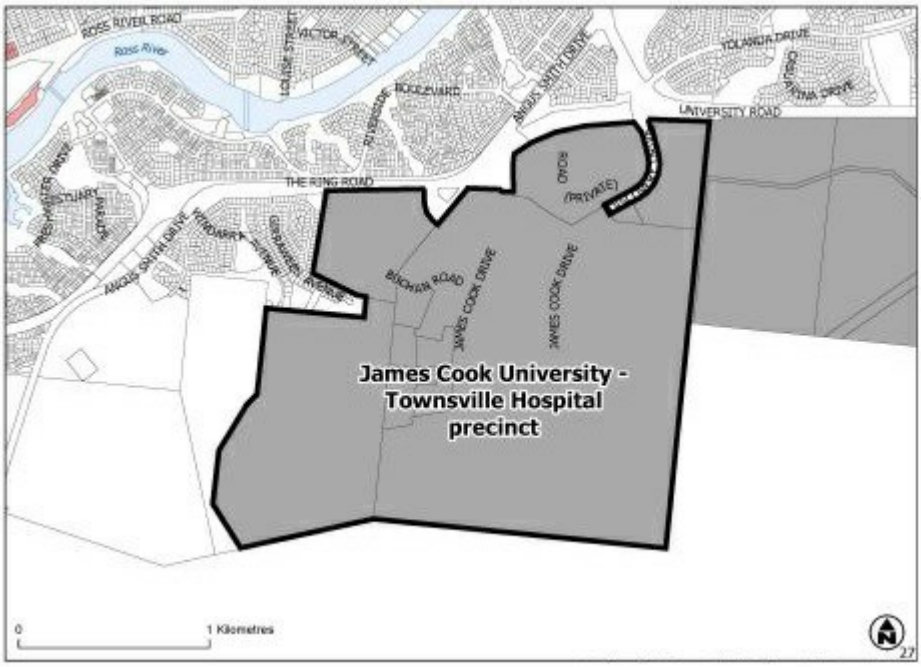

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Figure 6.118 – James Cook University-Townsville Hospital precinct

Discovery Central sub-precinct:

(i) at the heart of the precinct, development at Discovery Central exhibits the most intensive mix of uses and is busy with people throughout the day, week and year;

(ii) Discovery Central provides a strong focus for the hospital and university communities. Significant uses include research institutions and teaching facilities. Student and short-term accommodation is also present;

(iii) at street level, shops, cafes and bars are part of the mix;

(iv) Discovery Central is focussed on the 'ideas market', a significant public space located on the axis between the hospital and university library, and Mt Stuart Street, a new urban street connecting east-west through the centre. Pocket parks and small-scale spaces punctuate the area;

(v) buildings are 4 to 6 storeys and frame the street with no setbacks. Many buildings are mixed use;

(vi) footpaths and public spaces are well shaded. Walking is the best way to get around Discovery Central;

(vii) retail, including a supermarket, and other business uses support the daily needs of the knowledge community and are only established when need is demonstrated. Comparison shopping is not found here; and

(viii) buildings, streets and spaces are well-designed. The image and identity speaks strongly of Townsville's climate and place in the 21st century.

Discovery village sub-precinct:

(i) dwelling density within the precinct achieves a minimum net residential density of 30 dwellings per hectare through a mix of housing types including a range of townhouses, apartments and small lot homes. A focus on traditional dwelling houses does not occur;

(ii) buildings and neighbourhood design exhibit exemplar sustainable and social principles;

(iii) development does not alter the natural topography and maximises the retention of vegetation through street and housing design;

(iv) housing areas are well-connected to the central parts of the campus via pedestrian paths;

(v) a high quality public realm is created with passive recreation areas overlooked by verandahs and other living spaces in residences, shaded footpaths along all streets and a high level of permeability for pedestrians and bicycles; and

(vi) housing design provides exemplar responses to the Dry Tropics climate having regard to building massing and depth, solar orientation and shading and use of cooling and water sensitive landscape elements.

Editor's note—Sub-precincts are shown in Figure 6.123 — James Cook University-Townsville Hospital centre strategy plan.

6.3.6.3 Assessment benchmarks

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO1 Development does not prejudice or detract from the primary function of the specialised centre.	No acceptable outcome is nominated.
PO2 Other uses occur on a site where they: (a) directly support or are directly allied with the primary function of the particular centre; and (b) are subordinate to that primary function.	No acceptable outcome is nominated.
PO3 Development is consistent with the intended role, scale and character of the centre and does not compromise the intended role or successful functioning of the other specialised centres, the Principal centre (CBD) or major centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy no. SC6.5 for guidance on how to demonstrate compliance with this performance outcome.
PO4 Shops and shopping centres accommodate convenience retail, food and drink outlets, service industries and other services providing for the day-to-day needs of on-site businesses, workers, visitors or residents.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Design and built form	
PO5 The design of the precinct provides for: (a) efficient use of the available land; (b) a coherent and integrated built form, public realm and circulation networks; (c) central, accessible and attractive public spaces for people to congregate and interact; (d) continuity and complementarity of streetscape and landscape characteristics; (e) pedestrian friendly and visually interesting frontages to streets and public spaces; (f) optimum energy efficiency; (g) a compatible mix of uses; (h) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; and (i) sensitive transitioning of built form and uses to surrounding land. **Editor's note—**Applicants may be requested to prepare centre design master plans to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO6 Building setbacks and orientation provide for an attractive streetscape that is sympathetic to existing characteristics of the local area.	No acceptable outcome is nominated.
PO7 Development is sympathetic to the scale of surrounding buildings, avoids expanses of blank walls and includes features that contribute to an attractive streetscape.	**AO7.1** The maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
	AO7.2 Landscaping is provided along the street frontage, including substantive planting along at least 50% of the length of the frontage.
PO8 Streetscape treatments and street trees are provided along the street frontage to create a visually cohesive precinct and enhance pedestrian amenity.	No acceptable outcome is nominated.
PO9 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO10 Built form maximises use of natural ventilation, solar heating/cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO11 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO12 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO13 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the centre, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO14 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO14.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO14.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO15 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO15** The open area used for the storage of refuse, vehicles, machinery, goods and materials used on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.
PO16 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) to contribute to pedestrian comfort through shade; and (c) to screen servicing components.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout, size and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention of existing vegetation; and (e) providing buffers to protect the ecological functions of waterways; and protects environmental values and water quality objectives of receiving waters. **Editor's note—**The environmental values and water quality objectives are established under the Environmental Protection (Water) Policy (2009). For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Domain Central precinct	
PO18 Domain Central is not substantially expanded to include further shops or shopping centres.	No acceptable outcome is nominated.
PO19 Development is consistent with the height of existing buildings in the area.	**AO19** Building height does not exceed 3 storeys.
PO20 Buildings create an attractive, safe and pleasant pedestrian-focussed environment along street frontages.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Fulham Road medical precinct	
PO21 Development creates a medium-rise environment with the highest built form, scale and intensity centred on the hospital, and built form stepping down to a low-rise environment at the eastern and western edges of the precinct.	**AO21** Development occurs in accordance with building heights shown on Figure 6.119 — Fulham Road medical precinct concept plan.
PO22 Development has a direct nexus with the hospital or other medical uses within the precinct. The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of the CBD, district or major centres.	No acceptable outcome is nominated.
PO23 Development provides an active interface at the street level.	**AO23.1** Buildings are oriented to all street frontages and have points of entry visible to each street frontage.
	AO23.2 Non-residential uses occur at the street level where shown as a primary or secondary active frontage on Figure 6.119 — Fulham Road medical precinct concept plan.
	AO23.3 Development provides outdoor seating and dining along the primary active frontage.
	AO23.4 Development involving the expansion of the Mater Hospital provides a formal entrance along Park Street.
PO24 Building setbacks: (a) assist in defining key activity areas; (b) create a well-defined edge to the street; and (c) provide a soft edge to the adjoining parkland.	**AO24.1** Buildings setbacks at ground level are in accordance with Figure 6.119 — Fulham Road medical precinct concept plan.
	AO24.2 Buildings built to 6 storeys are setback 20m from any property boundary.
PO25 Development provides protection from the weather for pedestrians along the frontage of the site.	**AO25** Development provides a 3m wide awning along the frontage of the site where identified on Figure 6.119 — Fulham Road medical precinct concept plan as having either a primary or secondary active frontage.
PO26 Private open space is located and oriented to allow passive surveillance of the street.	**AO26** Residential uses above the street level incorporate balconies and are setback 3m to the building wall. Figure 6.120 — Residential uses above street level illustrates.

Figure 6.119 – Fulham Road medical precinct concept plan

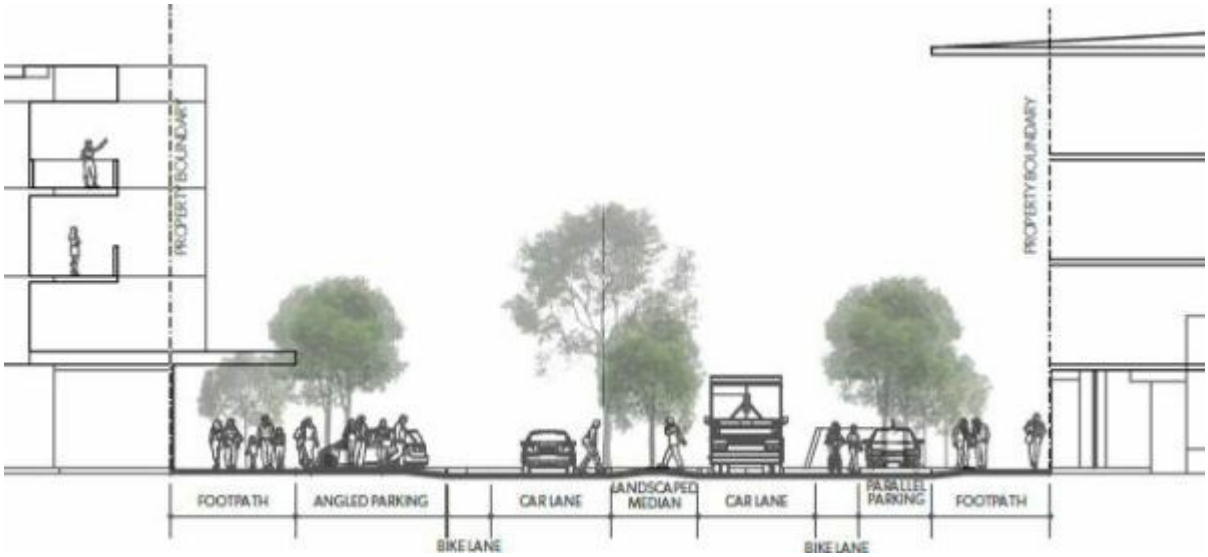


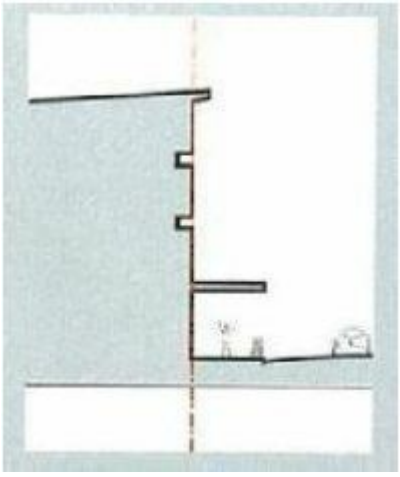
Figure 6.120 – Residential uses above street level

PO27 Development facilitates clear and safe pedestrian links between Anderson Park and Fulham Road.	No acceptable outcome is nominated.
PO28 Parking and access are consolidated and do not dominate the street frontage.	**AO28.1** Parking is provided within or behind buildings and is screened so that it is not visible from the street.
	AO28.2 Development does not obtain access to Fulham Road between Diprose Street and Thomas Street.
PO29 Where possible, development provides shared access and parking with adjoining uses.	No acceptable outcome is nominated.
PO30 Where development has a common boundary with Anderson Park, opportunities for overlooking and casual surveillance to the Park are created through the orientation of buildings and private open space.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Bayswater Road medical precinct	
PO31 Development creates a medium-rise environment with the highest built form, scale and intensity centred on the hospital.	**AO31** The maximum building height is in accordance with Figure 6.121 — Bayswater Road medical precinct concept plan.
PO32 Development has a direct nexus with the hospital or other medical uses within the precinct. The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of the CBD, district or major centres.	No acceptable outcome is nominated.
PO33 Buildings are oriented to the street frontages and have points of entry visible to each street frontage.	No acceptable outcome is nominated.
PO34 Development provides an active and pedestrian-friendly interface at the street level.	**AO34.1** Non-residential uses occur at the street level.
	AO34.2 Where development has an active frontage identified in Figure 6.121 — Bayswater Road medical precinct concept plan: (a) buildings are built to the street boundary; and (b) development provides a 3m wide awning over the footpath. Figure 6.122 — Buildings built to the frontage illustrates.

Figure 6.121 – Bayswater Road medical precinct concept plan



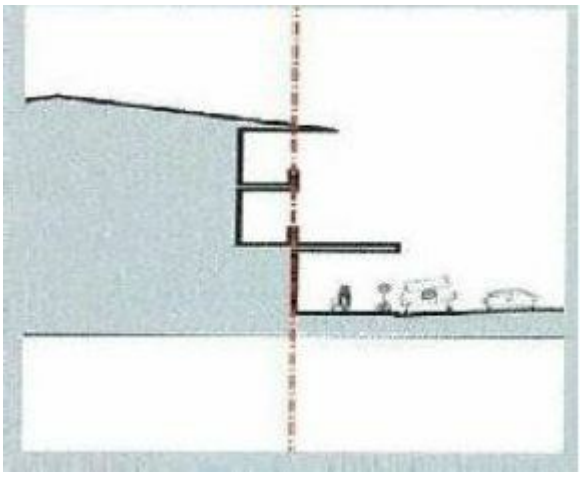


Figure 6.122 – Buildings built to the frontage

PO35 The primary pedestrian entrance to the Mater hospital is oriented to Oxford Street and the Oxford Street/Regent Street intersection.	No acceptable outcome is nominated.
PO36 Development facilitates a direct pedestrian connection from Bayswater Road through the Mater hospital site to the Oxford and Regent Street intersection.	No acceptable outcome is nominated.
PO37 Development on the hospital site facilitates the consolidation of parking within a centralised parking facility.	No acceptable outcome is nominated.

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
James Cook University-Townsville Hospital precinct	
PO38 Development is generally in accordance with the land use allocations shown in Figure 6.123 — James Cook University- Townsville Hospital centre strategy plan and is consistent with the following intentions: (a) Townsville Hospital sub-precinct — development facilitates the efficient operation of Townsville's major hospital and ensures integration of the hospital and university campuses into a seamless urban centre; (b) Discovery Central sub-precinct — development creates a vibrant community heart containing the most intensive mix of uses; (c) Enterprise Village sub-precinct— development facilitates the establishment of knowledge businesses and industries; (d) Academic Core sub-precinct — development facilitates continued operation and expansion of educational purposes; (e) University Village sub-precinct and College sub-precinct — development facilitates student accommodation; (f) Discovery School sub-precinct — development facilitates the establishment of a new high school; (g) Discovery Village sub-precinct — development creates a mixed density residential community which has strong links to the university and hospital; and (h) Green Space sub-precinct — accommodates natural areas within the centre including watercourses, environmental areas and corridors, parks and sport and recreation area.	No acceptable outcome is nominated. **Editor's note—**The first stage of Discovery Village may develop as a pioneer project to demonstrate the sustainability principles sought.
PO39 The land use mix and scale of development have a direct nexus with, and enhance, the knowledge community focus.	No acceptable outcome is nominated.
PO40 The community is well-connected internally and to the wider city by active and public transport.	No acceptable outcome is nominated. **Editor's note -** Future growth of the precinct will increase transport demand. In order to support development in this precinct, and the preferred pattern of development in Townsville as a whole, improved public transport to this precinct will be necessary. Planning has identified the need to preserve a potential route for a rapid bus transit corridor and identify potential sites for Townsville Hospital and James Cook University Bus Stations.

PO41 Development exemplifies leadership in economic, social and environmental sustainability.	No acceptable outcome is nominated. **Editor's note—**For guidance, refer to Discovery Rise Design Guidelines adopted by the place making panel established for James Cook University (JCU).
PO42 Development is well-designed at the precinct, street, public space and building scales.	No acceptable outcome is nominated. **Editor's note—**For guidance, refer to Discovery Rise Design Guidelines adopted by the place making panel established for James Cook University (JCU).
PO43 Development is well planned and orderly, and within the capacity of available infrastructure.	No acceptable outcome is nominated. **Editor's note—**Council will request that an area/precinct scale structure plan — comprising land use, infrastructure, staging, urban design and implementation - is prepared and agreed to by the place making panel established for JCU before development takes place.
PO44 Development does not extend in to areas of landslip or bushfire risk, high scenic amenity or local, regional or state ecological significance.	No acceptable outcome is nominated.

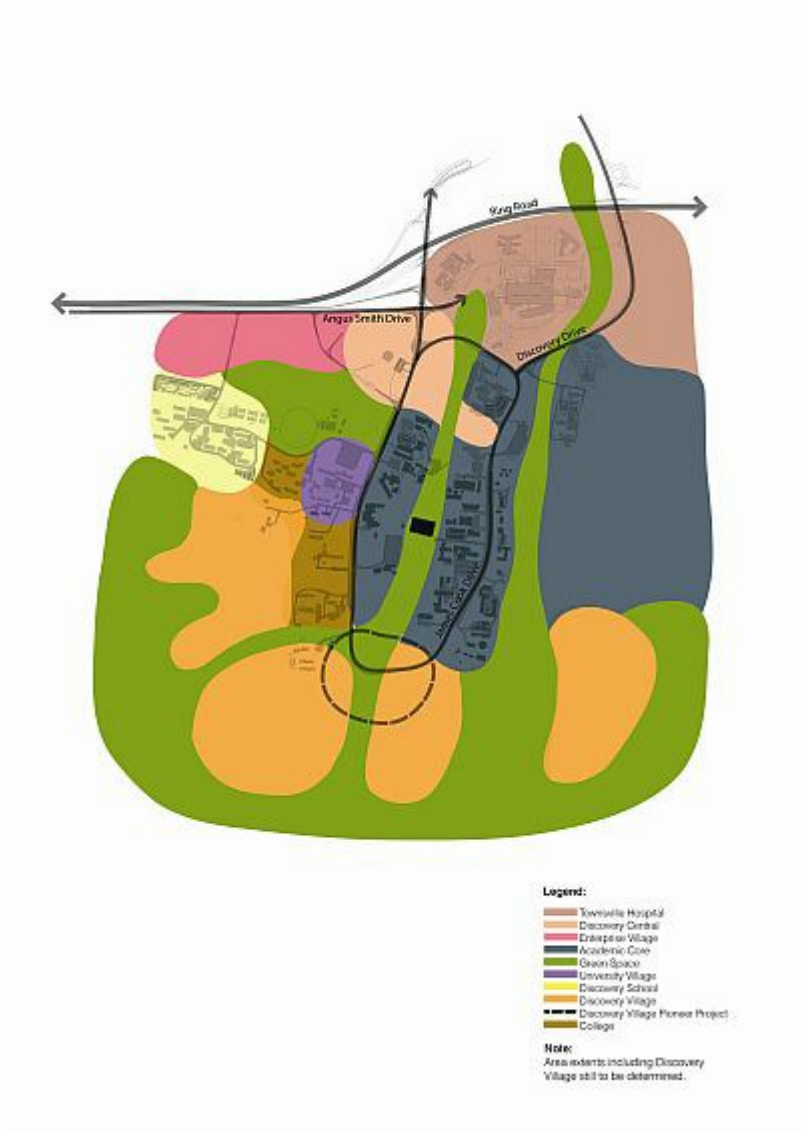


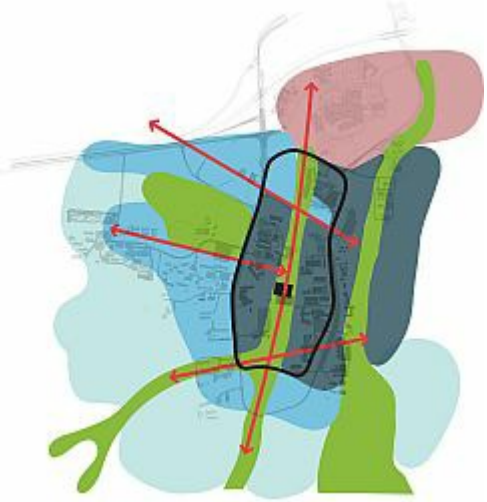
Figure 6.123 – James Cook University-Townsville Hospital centre strategy plan

PO45 Development complies with and advances the design concepts set out in Figure 6.124 – James Cook University-Townsville Hospital precinct development concepts.	No acceptable outcome is nominated.

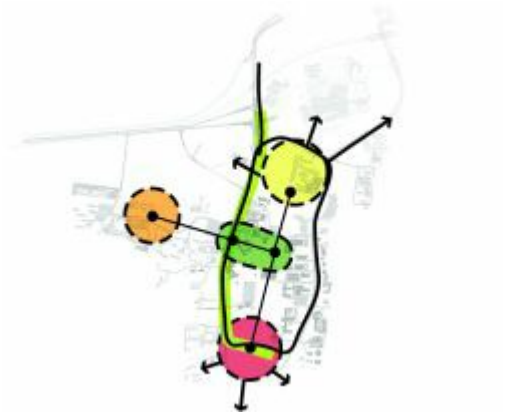
1. **Axes**
Original axes/view lines from Birell's 1964 Master Plan.

2. **Academic Core**
This needs to be retained as the heart of Discovery Rise.

3. **Connect Academic Core to New Uses:**
Existing campus axes from 'key connectors' linking new development around academic core into the heart of the campus.
Denser development closer to the academic core.

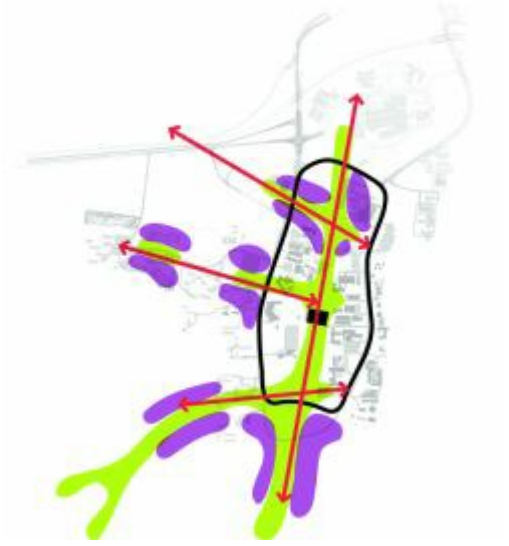


4. **Hubs Interconnected**
Create 'hubs' of mixed academic and new uses.



5. **Public Spaces**
Public spaces are located along 'key connectors', in the centre of significant hubs.

6. **Density**
Create greatest density along 'key connectors' streets, pedestrian pathways and public spaces.



7. **Pedestrian and Cycle Paths**
Create an interconnected network of paths and bike routes emphasising linkages into the campus heart and academic core. These paths are cool, shaded and green.

8. **Road Network**
James Cook Drive as primary circulating street, slower speed, shady street environments for east-west connecting streets. New street to link to existing neighbouring suburban development to the west.

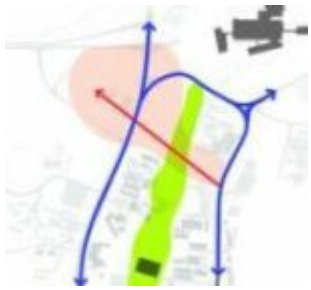
9. **Public Transport**
Existing bus and taxi set down areas on Mt Stuart Street, at Discovery Village and at Discovery School. Approximately 10-20m wide corridor to be reserved for a future rapid bus transit corridor and associated Townsville Hospital and James Cook University Bus Stations, to be determined through collaborative planning between Townsville Hospital, James Cook University, Department of Transport and Main Roads and Townsville City Council.

Figure 6.124 - James Cook University-Townsville Hospital precinct development concepts

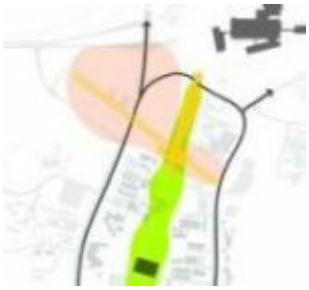
Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Discovery Central sub-precinct	
PO46 Development accommodates the primary structural elements shown in Figure 6.125 — Discovery Central primary elements.	No acceptable outcome is nominated.

1. Pedestrian Paths



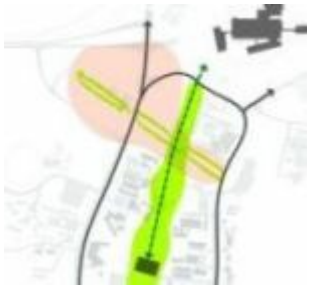
2. Road Linkages



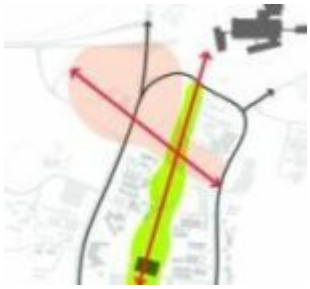
3. Public Spaces

4. Frontage Treatment

5. Shading



6. Greenspace Corridors

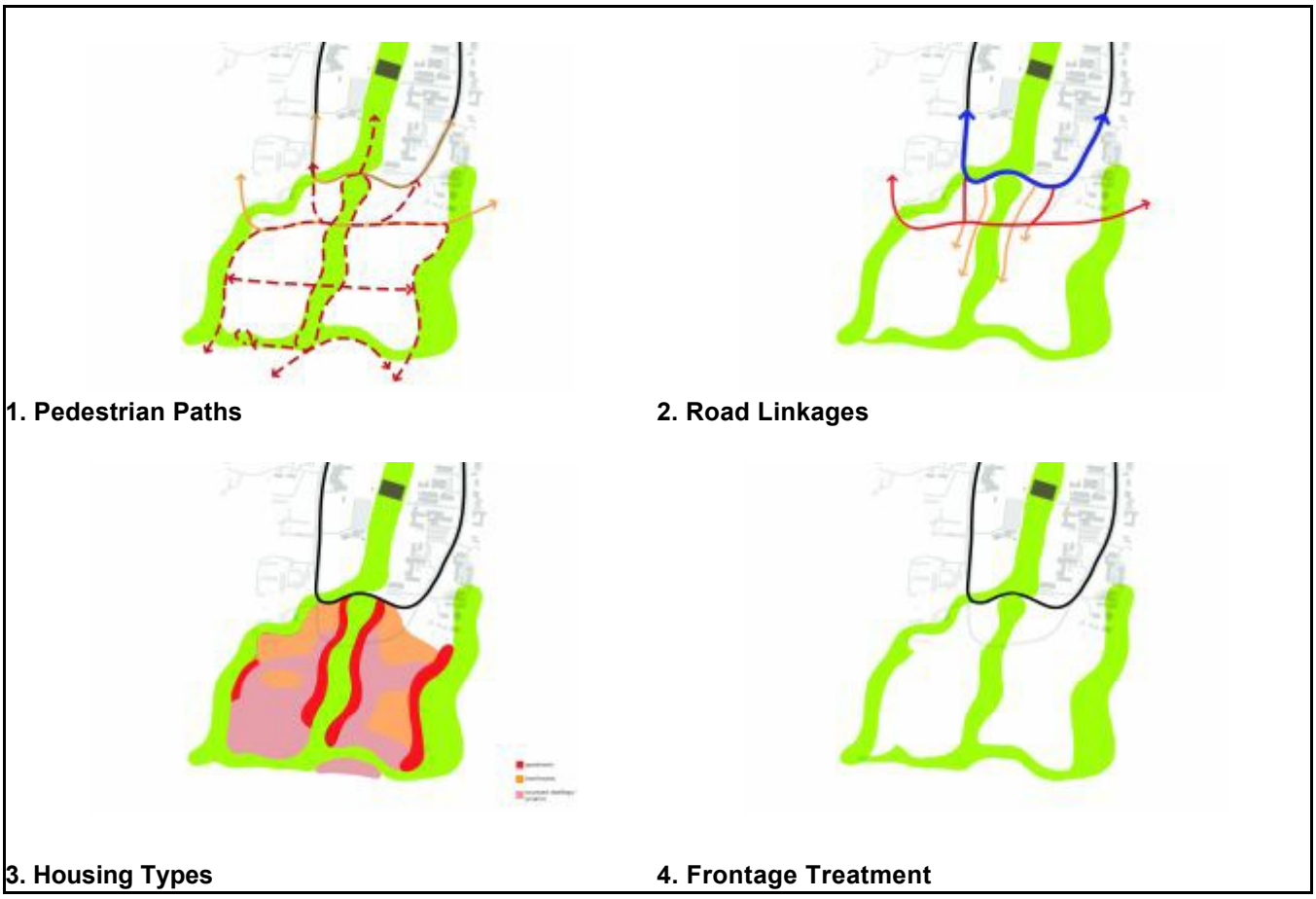


7. View and Connection Axes

Figure 6.125 – Discovery Central primary elements

Table 6.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Discovery Village sub-precinct	
PO47 Development accommodates the primary structural elements shown in Figure 6.126 — Discovery Village primary elements.	No acceptable outcome is nominated.



1. Pedestrian Paths

2. Road Linkages

3. Housing Types

4. Frontage Treatment

Figure 6.126 – Discovery Village primary elements

PO48 Development occurs at medium densities that optimise public transport and walkability, and sustainable living.	**AO48** Dwelling density within the precinct achieves a minimum net residential density of 30 dwellings per hectare.

6.3.7 Mixed use zone code

6.3.7.1 Application

This code applies to assessing a development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.3.7.2 Purpose

(1) The purpose of the Mixed use zone code is to provide for a mixture of development that may include service industry, business, retail, residential, tourist accommodation and associated services and low impact industrial uses.

(2) The particular purpose of the code is to guide a range of activities which create an attractive mixed business and living environment and which do not compromise the principal centre (CBD), district or major centres.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) this zone accommodates small to medium-sized pockets and corridors of mixed use development throughout Townsville, which are generally close to centres, significant entry points, and providing interface between residential, commercial, retail or industrial uses;
- (b) mixed use areas do not compromise the intended role or successful functioning of other centres. They do not contain full line supermarkets, discount department stores or department stores;
- (c) unless otherwise stated for a particular precinct, the areas in this zone evolve to contain a wider mix of medium density residential uses as well as dining, convenience shops and specialty retailing, small-scale office uses, professional services, and service and low impact industries;
- (d) uses such as showrooms and outdoor sales may occur in the zone, other than within the Breakwater precinct. Where they occur, showrooms are located and designed so that they contribute to the attractiveness, pedestrian focus and continuity of the streetscape;
- (e) built form and landscaping create an attractive, pedestrian oriented streetscape, and visual amenity along major roads is improved;
- (f) mixed use areas identified along major roads are designed to encourage a consolidation of built form and activities, access points and signage. Commercial strip development does not extend beyond the zoned mixed use land along major roads;
- (g) where they occur, residential uses are designed to minimise adverse impacts on occupants as a result of noise and other characteristics of the local environment;
- (h) development facilitates improved accessibility by walking, cycling and public transport. Along major roads, access is managed to avoid conflict points and to give priority to pedestrian and cyclist movements;
- (i) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (j) development is designed and operated to minimise adverse impacts on the amenity of surrounding residential neighbourhoods; and
- (k) opportunities for energy efficiency through built form are maximised.

Editor's note—To remove any doubt, each development site does not need to contain a mixed use development.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts.

Magnetic Island villages precinct:

(a) development within this precinct supports the consolidation of retail, business, and service industry activities in dedicated activity nodes for residents and visitors to the various townships around Magnetic Island; and

(b) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and the use of a variety of materials and finishes.

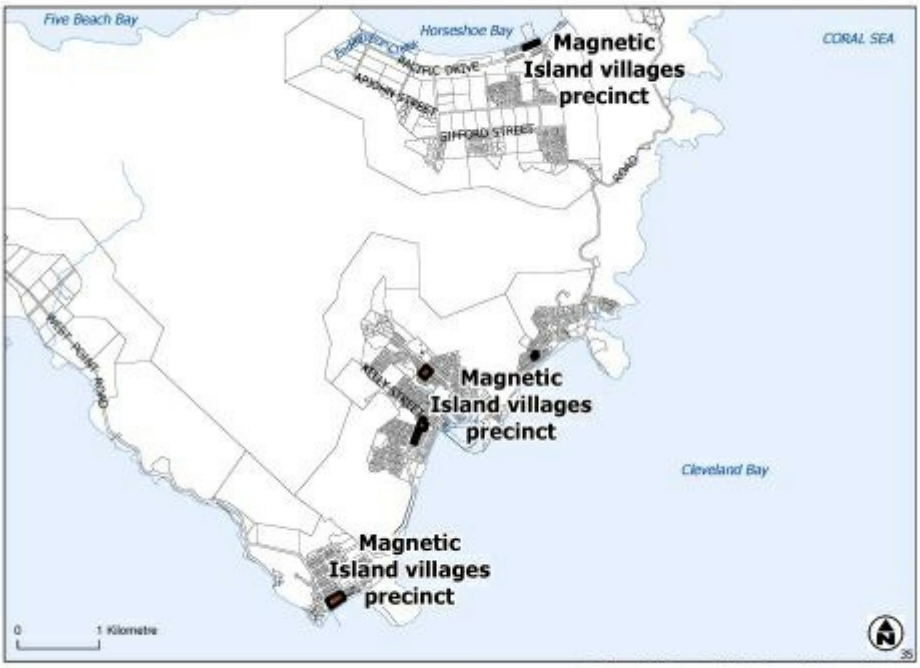


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Figure 6.127 – Magnetic Island villages precinct

Nelly Bay sub-precinct:

(i) a range of tourist and residential uses is provided, including:

  (A) the continuation of small-scale retail and other uses which support tourism; and

  (B) island-style low-rise medium density residential and short-term accommodation close to tourist uses.

(ii) buildings within the precinct are low-rise (up to 2 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

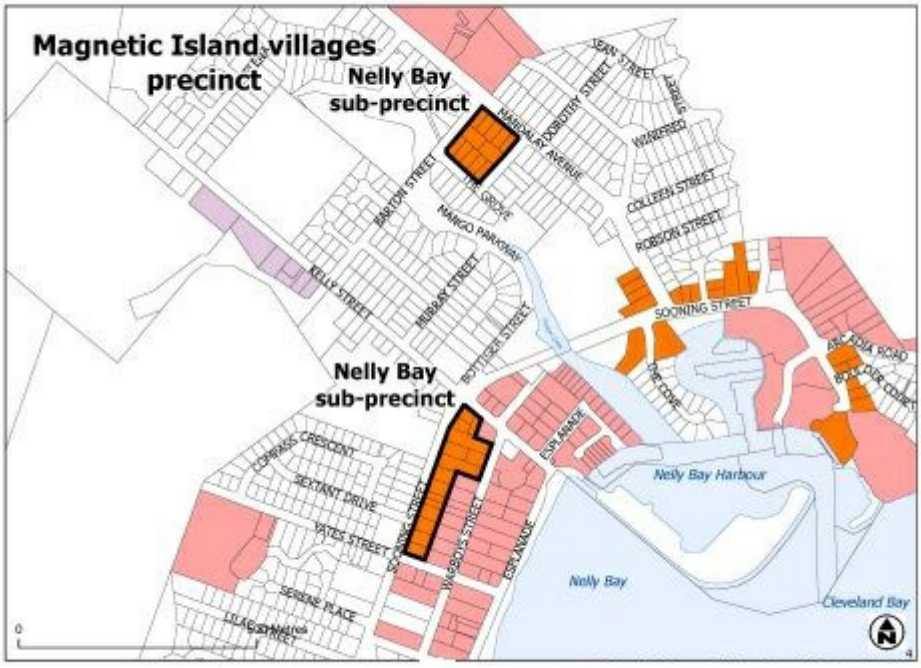

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Figure 6.128 – Nelly Bay sub-precinct

Picnic Bay sub-precinct:

(i) development supports tourism activities and contributes to the revitalisation of existing retail and food related uses including:

(A) cafes and restaurants; and

(B) the consolidation of new tourist and retail uses, in the vicinity of the hotel and the jetty/promenade.

(ii) buildings within the precinct are low-rise (up to 3 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

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Figure 6.129 – Picnic Bay sub-precinct

Horseshoe Bay sub-precinct:

(i) development supports the ongoing tourism focus in this location, facilitating the consolidation of retail, office and tourist activity. Short-term accommodation occurs in a ‘shop-top’ format; and

(ii) buildings within the precinct are low-rise (up to 2 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island.

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Figure 6.130 – Horseshoe Bay sub-precinct

Nelly Bay gateway precinct:

(a) development supports the creation of a gateway within proximity to the primary entrance point to Magnetic Island, at the Nelly Bay ferry terminal;

(b) local tourism-related and other retail and commercial uses and services are encouraged to establish in this precinct;

(c) development creates a strong relationship with Sooning Street and Mandalay Avenue, by sleeving the roads with buildings that are oriented to the street and screening parking areas behind;

(d) buildings within the precinct are low-rise (up to 3 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island; and

(e) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and the use of a variety of materials and finishes.

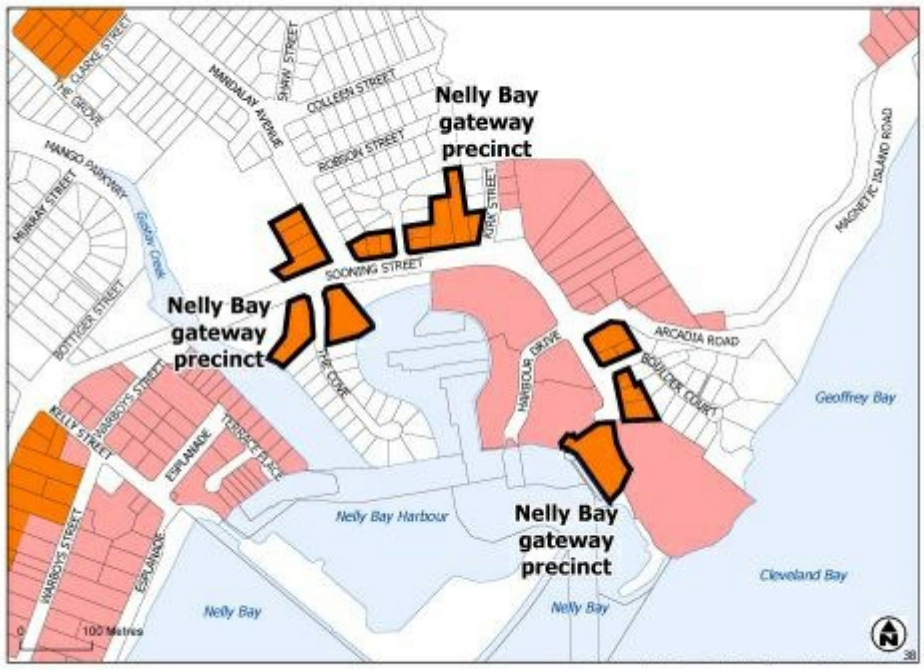

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Figure 6.131 – Nelly Bay gateway precinct

Arcadia Central precinct:

(a) development facilitates the transformation of the precinct as a defined local centre of activity for Arcadia including uses such as shops, small offices, medium density residential and tourist accommodation;

(b) development creates a strong relationship with Marine Parade and Armand Way, by sleeving the precinct with buildings that are oriented to the street and screening parking areas behind;

(c) development incorporates central community space with road frontage, located opposite the beach. Pedestrian connections are provided to surrounding uses such as the restaurants and cafes;

(d) buildings within the precinct are low-medium rise (up to 4 storeys in building height) and the scale and massing of buildings limits the impact on the natural character of Magnetic Island; and

(e) new buildings and streetscape treatments are in a design style that builds local character by articulation of buildings, incorporating extensive planting and use of a variety of materials and finishes.

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Figure 6.132 – Arcadia Central precinct

Kirwan Traders precinct:

(a) small-scale commercial buildings are established, to provide space to incubate small, locally-based businesses;

(b) built form and streetscape treatments in this area contribute to a distinct character as a business hub, in particular on the frontages of Tavern Street, Carlton Street, Castlemaine Street and Burnda Street; and

(c) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

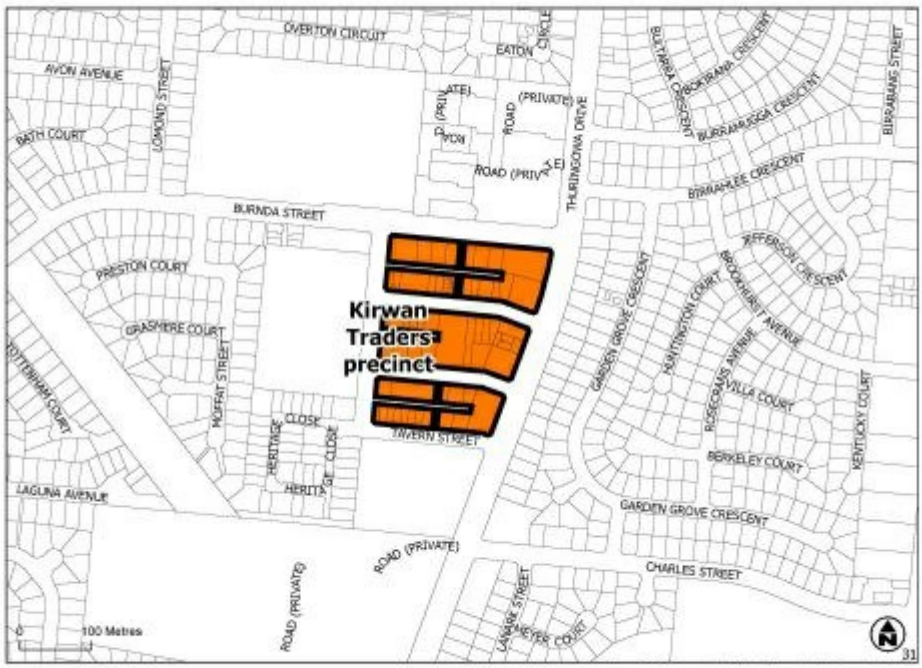

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Figure 6.133 – Kirwan Traders precinct

Charters Towers Road business precinct:

(a) built form and streetscape treatments in this area combine to create a distinct character as a business hub, in particular on the frontages of Woolcock Street, Charters Towers Road and Somer Street;

(b) development at the intersection of Charters Towers Road and Woolcock Street is appropriately treated and designed to serve as a significant gateway feature;

(c) new development located along the frontage of Charters Towers Road supports a transition to new and well-designed commercial activities, including small-scale offices and local service businesses;

(d) residential uses occur in this precinct where they do not restrict or impact on the intended industrial and commercial activities; and

(e) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

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Figure 6.134 – Charters Towers Road business precinct

CBD gateway precinct:

(a) this precinct provides for an emerging employment and business area in proximity to, and supporting the development of the principal centre (CBD). Uses in the precinct are intended to include service and low impact industrial uses, convenience shopping and showroom activities;

(b) offices occur where ancillary to industrial uses on the site;

(c) residential uses occur within this precinct where they do not restrict or impact on the intended industrial and commercial activities;

(d) Flinders Street (West) is reinforced as a significant gateway to the principal centre (CBD);

(e) the location of convenience shopping assist in reinforcing key intersections along Flinders Street (West); and

(f) improved pedestrian linkages to the principal centre (CBD) and Ross Creek are created.

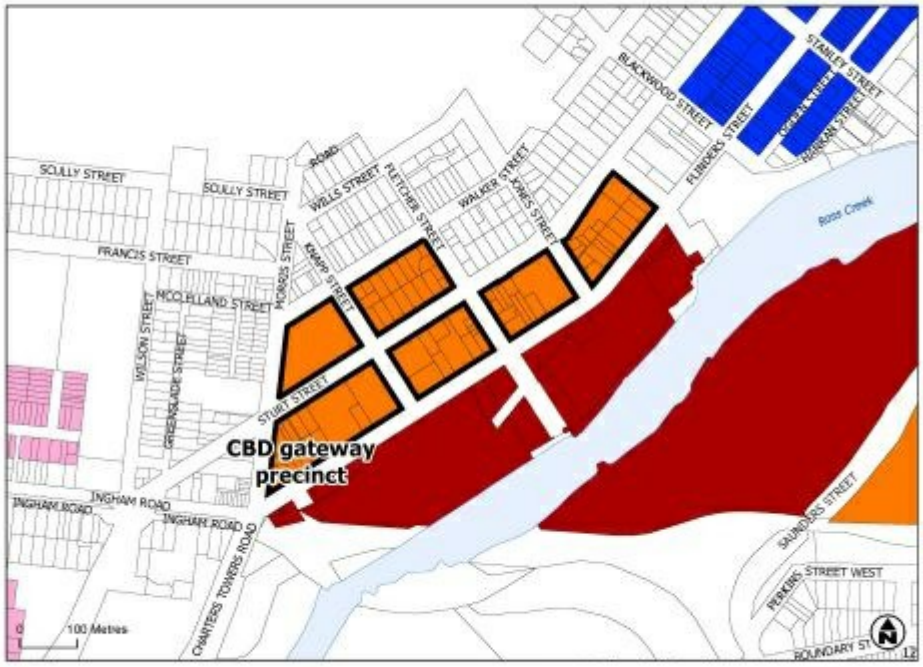

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Figure 6.135 – CBD gateway precinct

South Townsville Railyards and Dean Park precinct:

(a) the South Townsville Railyards and Dean Park present a significant opportunity for the delivery of future strategic infrastructure and 'city making' facilities for the whole of Townsville;

(b) the current use of the South Townsville Railyards site is protected until such time as these uses are relocated or become redundant. At that time, redevelopment of this area facilitates:

  (i) the provision of a city centre based sports stadium within an urban setting that relies on a nexus with public transport access;

  (ii) the redevelopment of Dean Park to create a usable parkland of approximately half its current size;

  (iii) the provision of an entertainment and convention centre on the other half of the Dean Park site; and

  (iv) the provision of a bus layover and driver facilities;

(c) interim uses do not compromise the future development of the land;

(d) new development is located and designed to be well-connected to the principal centre (CBD) and nearby high density residential areas;

(e) servicing and loading facilities in new development are considered within the overall design minimising impacts on surrounding residential uses and public spaces;

(f) the intended major facilities may be supported by a mix of complementary uses including service and low impact industry, office, retail and showroom activities, and residential uses, in a low to medium-rise built form; and

(g) Development of a commercial nature is not of a type or size that detracts from the function of the principal centre (CBD), district centres or major centres.

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Figure 6.136 – South Townsville Railyards and Dean Park precinct

Wotton Street precinct:

(a) the precinct provides for a transition between service and low impact industries to the north and the mixed use area to the south adjoining Ross River Road;

(b) residential uses occur in this precinct where they do not restrict or impact on the intended industrial and commercial activities and where they are located above ground storey non-residential uses; and

(c) buildings within the precinct are generally low-medium rise and create a sensitive transition in scale from the surrounding neighbourhood.

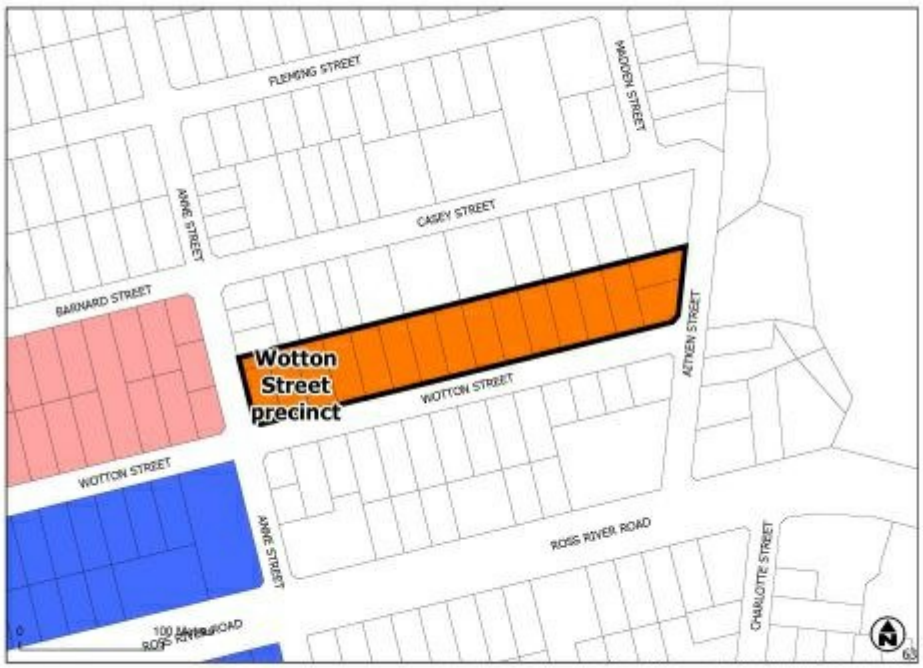

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Figure 6.137 – Wotton Street precinct

Breakwater precinct:

(a) the Breakwater precinct accommodates ongoing use and further development of residential, tourism and entertainment uses;

(b) the precinct will grow to establish a landmark high quality accommodation and entertainment destination for Townsville's tourists and residents;

(c) development includes the establishment of a new marina and waterfront pathway on the seaward side of the point, dining, boat club, local convenience facilities and tourist activities, as well as short and long-term accommodation. The precinct does not contain low impact industries other than where there is a nexus with a future marina or boat club;

(d) pedestrian access is focussed on a waterfront pathway, and includes integrated pedestrian pathways providing a high level of permeability throughout the precinct;

(e) development facilitates the consolidation of the casino and allied uses as a highly significant destination for Townsville. Should the Townsville Entertainment Centre re-locate, redevelopment of this site occurs which:

  (i) facilitates a range of activities including short-term accommodation, markets and a new boat club;

  (ii) integrates private and public transport options;

  (iii) enables reuse of existing surface parking areas; and

(f) short-term or permanent high density residential accommodation, is predominant in the central and western part of the precinct. Where adjoining the future marina, uses at the ground floor include local dining and shops.

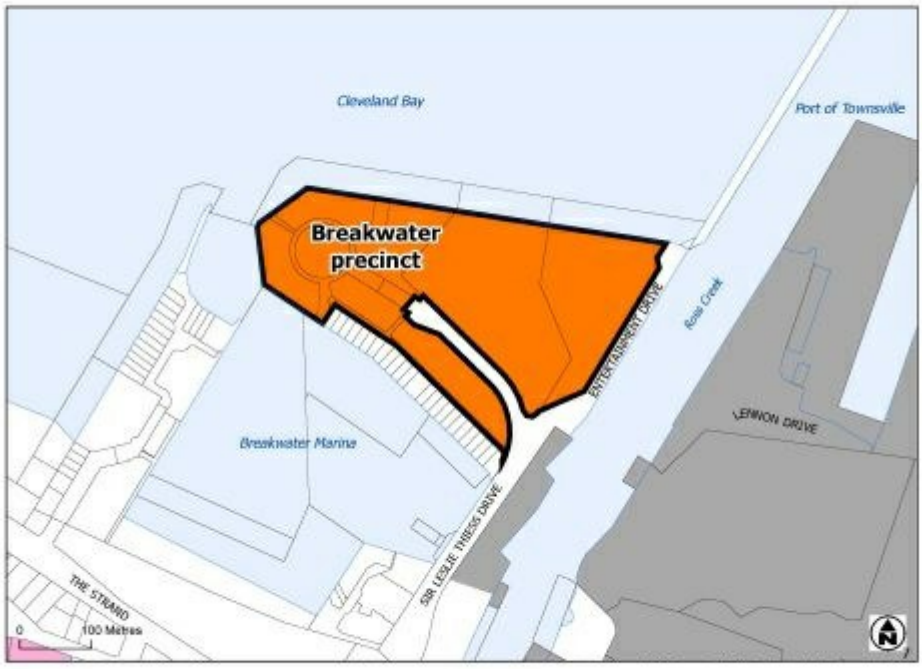

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Figure 6.138 – Breakwater precinct

King Street quarter precinct:

(a) the precinct provides for a revitalised tourism and education based destination in proximity to the principal centre (CBD), and functions as a focus point of activity between the CBD and the Breakwater precinct;

(b) development facilitates the establishment of allied educational uses such as a centre of excellence for marine studies;

(c) the precinct also includes high quality accommodation, dining and entertainment facilities. Residential uses are focused in the pocket of land bounded by Wickham and King Streets;

(d) development protects and respects the values of heritage buildings in the precinct, including the Queens Hotel;

(e) pedestrian permeability is improved through the provision of linkages through and between development sites, and through the continuation of a waterfront pathway along Ross Creek;

(f) improved vehicle circulation and visual links between the CBD, the King Street quarter precinct and the Breakwater precinct are created; and

(g) new parkland is established at the southern end of Anzac Park, and a new pedestrian and visual link across Ross Creek is created in line with the southern end of The Strand.

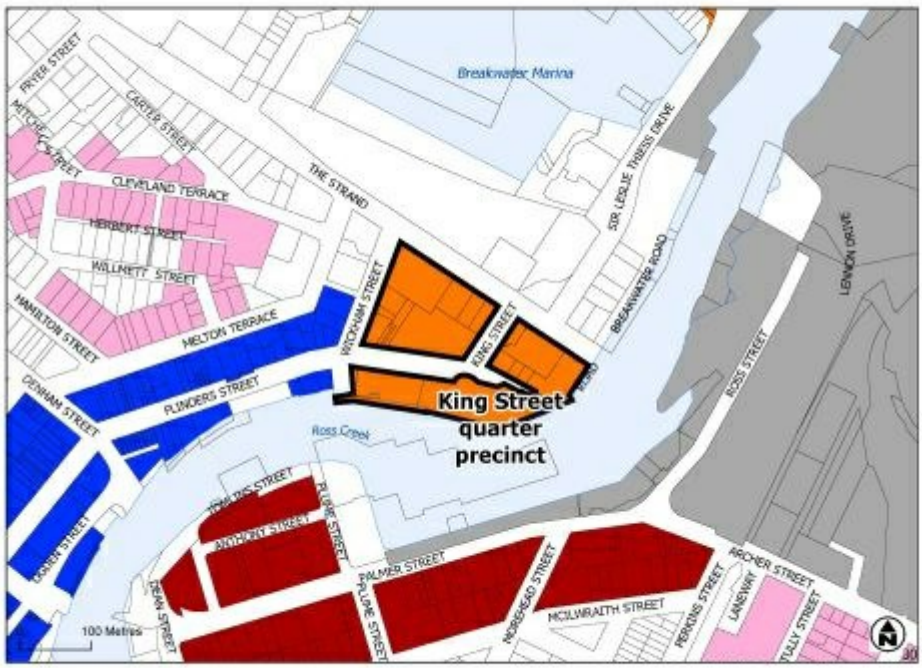

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Figure 6.139 – King Street quarter precinct

Kings Road precinct:

(a) redevelopment facilitates a change in focus for the area to include medium density residential uses and a range of smaller scale retail, dining and entertainment activities that contribute to the area's day and night-time vibrancy;

(b) the precinct plays a support role to the Hyde Park major centre in accommodating non-residential uses;

(c) development creates a medium-rise built form, with variation in built form to create visual interest across the precinct;

(d) the interface with the lake is enhanced through building frontages which orientate towards the lake and contain active uses at street level; and

(e) impacts on residential amenity from the rail corridor and showgrounds are minimised.

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Figure 6.140 – Kings Road precinct

6.3.7.3 Assessment benchmarks

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO1.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO1.2 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 –Road Lighting – Vehicular Traffic (Category V)* *Lighting – Performance and Installation Design Requirements*.
PO2 Residential uses within the centre do not interrupt the continuity of the streetscape or the active, pedestrian focus of the street frontage.	**AO2** Any residential uses are located above or behind ground storey retail, commercial or community uses.
PO3 Residential uses within the centre are provided with a reasonable level of privacy.	**AO3.1** Windows, balconies, and terraces of a dwelling unit are screened where overlooking a habitable room or private open space of another dwelling within 9m.
	AO3.2 Screening is a solid translucent screen or perforated panels or trellises which have a maximum of 50% openings.
PO4 Residential uses within the centre are provided with a reasonable level of private outdoor living space.	**AO4** Dwellings are provided with private open space or a balcony directly accessible from a habitable room with: (a) a minimum area of 9m^2; (b) a minimum dimension of 3m; and (c) clear of any utilities such as gas, water tanks and air conditioning units.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Role and function	
PO5 The type and scale of retail and other commercial development does not compromise the intended role or successful functioning of other centres.	No acceptable outcome is nominated. **Editor's note—**Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Built form	
PO6 Built form is generally low to medium rise.	**AO6** All buildings and structures do not exceed 3 storeys in building height, except where stated otherwise for a particular precinct.
PO7 Built form provides for a sensitive transitioning in height and scale from surrounding land uses.	No acceptable outcome is nominated.
PO8 Development contributes to an attractive, coherent and integrated streetscape, by: (a) ensuring buildings assist in defining and enclosing the street frontage; (b) improving the continuity of built form; and (c) using complementary landscaping and streetscape treatments.	No acceptable outcome is nominated.
PO9 Built form is designed to: (a) create a pedestrian rather than car oriented street frontage; (b) break down the facade into finer scaled components; and (c) avoid large expanses of blank walls oriented to the street.	**AO9.1** Buildings are built to the street frontage and provide an awning over the full width of the footpath, except where stated otherwise for a particular precinct.
	AO9.2 Parking is provided to the side or the rear of buildings or below ground level, and is not located along the street frontage.
	AO9.3 Entrances to buildings face the street and any public space to which the building has frontage.
	AO9.4 The maximum length of any unarticulated wall is 15m, without a change in plane of at least 0.75m.
	AO9.5 At the ground storey, a minimum of 65% of building frontage is provided as predominantly transparent windows or glazed doors and a maximum of 35% as solid facade.
PO10 Building caps and rooftops create an attractive roofscape and screen plant and equipment.	No acceptable outcome is nominated.
PO11 Built form maximises use of natural ventilation, solar heating and cooling and water conservation through building orientation and design, landscaping, building materials and on-site infrastructure.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO12 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and way finding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO13 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	No acceptable outcome is nominated.
PO14 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.
PO15 New development provides for safe vehicular and pedestrian access and efficient operation of surrounding roads.	**AO15** Either: (a) development provides no net increase in driveway crossovers; or (b) lots are consolidated to gain access from a minor or lower-order road, except where stated otherwise for a particular precinct.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO16 Development minimises impacts on surrounding land and provides for an appropriate level of amenity within the site, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook.	No acceptable outcome is nominated.
PO17 Development is located, designed and operated so that adverse impacts on privacy and amenity on nearby land in a residential zone are minimised.	**AO17.1** Buildings are set back 3m from any boundary shared with a residential zone, or half the height of the part of the building, whichever is the greater.
	AO17.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential zone. AND **AO17.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential zone.
	AO17.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO18 Refuse storage areas, loading/unloading and other service or storage areas are screened from view from the street and adjoining land.	**AO18** Refuse storage areas loading/unloading and other service or storage areas are located to the rear or side of a building and are screened from view by a 1.8m high solid fence.
PO19 On-site landscaping is provided to: (a) enhance the appearance of the development, particularly in parking and service areas and in public spaces; (b) contribute to pedestrian comfort through shade; and (c) screen servicing components.	No acceptable outcome is nominated.

PO20 Streetscape treatments are provided to enhance amenity to contribute positively to the city image, particularly along major roads and streets.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Magnetic Island villages precinct	
PO21 Convenient and legible connections are provided for pedestrians and cyclists to the precinct, particularly having regard to linkages to the bay foreshore, residential areas in the community and the open space network.	No acceptable outcome is nominated.
PO22 Building design and massing is consistent with the low-density scale of the Magnetic Island character and articulates individual buildings.	**AO22** Building height does not exceed 2 storeys, or when in the Picnic Bay sub-precinct 3 storeys.
PO23 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO24 The design of buildings in this precinct provides for pedestrian-friendly and visually interesting frontages.	No acceptable outcome is nominated.
PO25 Suitable vegetation screening and treatments are provided within the building setback, to minimise the visual impact of the buildings.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Arcadia Central precinct	
PO26 Development supports the creation of a new community node for Arcadia in accordance with Figure 6.141 — Arcadia Central precinct concept plan.	No acceptable outcome is nominated.

PO27 Frontages shown on Figure 6.141 — Arcadia Central precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO28 Development on the corner of Marine Parade and Armand Way creates a gateway to Arcadia. Built form, landscape and streetscape treatment at this corner reinforces a gateway statement.	No acceptable outcome is nominated.
PO29 Building height is of a low to medium-rise scale and building massing is consistent with the low density character of Magnetic Island.	**AO29** Building height does not exceed 4 storeys.
PO30 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO31 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages to the foreshore and the open space network.	No acceptable outcome is nominated.
PO32 Access points are minimised along Marine Parade.	No acceptable outcome is nominated.
PO33 New pedestrian connnections consistent with Figure 6.141 — Arcadia Central precinct concept plan are provided.	No acceptable outcome is nominated.
PO34 Increased public open space and improvements to the public domain are provided throughout the precinct.	No acceptable outcome is nominated.

Figure 6.141 – Arcadia Central precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay gateway precinct	
PO35 Development in this precinct supports the creation of a high quality activity hub for Nelly Bay and Magnetic Island, in accordance with Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.
PO36 Development creates a gateway to Nelly Bay and Magnetic Island. Built form, landscape and streetscape treatment reinforces a key entry point to the village.	No acceptable outcome is nominated.
PO37 Frontages shown on Figure 6.142 — Nelly Bay gateway precinct concept plan as having active edges, contain: (a) primary building entrances; (b) awnings to provide shade for pedestrians; (c) significant use of glazing or transparent materials; and (d) uses which promote a high level of pedestrian movement and interaction.	No acceptable outcome is nominated.
PO38 Streetscaping and landscaping provides increased shade and amenity for pedestrians along roads indicated as having local streetscape treatment on Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.
PO39 Building design and massing is consistent with the low density scale and character of Magnetic Island.	**AO39** Building height does not exceed 3 storeys.
PO40 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) natural setting of buildings within the landscape; and (c) maximising views to the bay.	No acceptable outcome is nominated.
PO41 Access arrangements are appropriate for the volume, frequency and type of vehicle usage.	**AO41** Access points are limited to Sooning Street, Mandalay Avenue and The Cove with minimal crossovers.
PO42 Convenient and legible connections are provided for pedestrians and cyclists to the site, particularly having regard to linkages to the ferry terminal, foreshore and the open space network.	No acceptable outcome is nominated.

PO43 Mixed use development contributes to the creation of a waterfront promenade. Figure 6.142 — Nelly Bay gateway precinct concept plan.	No acceptable outcome is nominated.

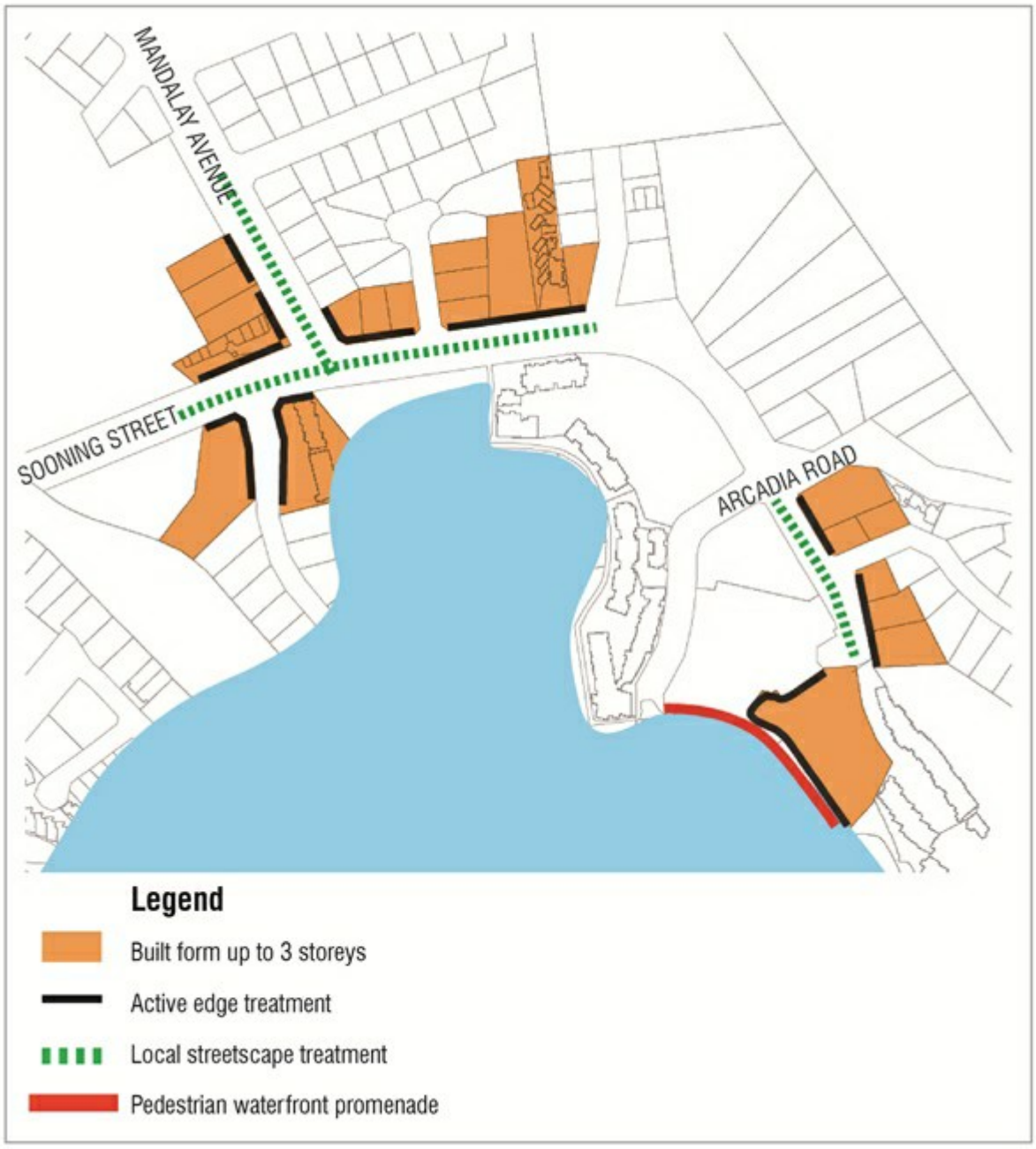

Figure 6.142 – Nelly Bay gateway precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kirwan Traders precinct	
PO44 Built form, landscape and streetscape treatment along Thuringowa Drive reinforces the precinct identity as a place for business.	No acceptable outcome is nominated.
PO45 Landscape and streetscape treatments are provided along Tavern Street, Carlton Street, and Laguna Avenue which reflect the intended character of the precinct.	No acceptable outcome is nominated.
PO46 Building size and bulk are consistent with the scale and character of the Kirwan Traders precinct, and retain an appropriate relationship with the established streetscape.	**AO46** Development involves reuse of existing buildings that contribute to the built form character and context of the immediate area.
PO47 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	**AO47** Access to on-site parking is provided through the rear access lanes connecting to Toohey Street.
PO48 Development on the corner of Thuringowa Road and Burnda Street, and Burnda Street and Toohey Street, creates a gateway to Kirwan Traders precinct. Built form, landscape and streetscape treatment at these corners reinforces a gateway statement.	No acceptable outcome is nominated.
PO49 Development provides mid-block linkages and increased open space for the public on private land, particularly on larger sites and those sites with two street frontages.	No acceptable outcome is nominated.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note**—Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Charters Towers Road business precinct	
PO50 Development in this precinct supports the transition of the precinct from a predominantly low impact industry area to a mixed business focus.	No acceptable outcome is nominated.
PO51 Development along Woolcock Street contributes positively to the city image.	**AO51** Buildings are setback 4m from Woolcock Street, and incorporate a landscaped buffer along that road frontage.
PO52 Wherever practicable, vehicular access is provided from rear or side streets or facilitates the amalgamation of access points.	**AO52** Access to on-site parking is provided through the rear access lanes connecting to Yeatman Street.
PO53 Development on the corner of Woolcock Street and Charters Towers Road, creates a gateway to Charters Towers Road business area. Built form, landscape and streetscape treatment at these corners reinforces a gateway statement. Figure 6.143 – Charters Towers Road business precinct concept plan	No acceptable outcome is nominated.
PO54 Development provides mid-block linkages and increased open space for the public on private land, particularly on larger sites and those sites with two street frontages.	No acceptable outcome is nominated.
PO55 Development contributes to the boulevard treatment of Ross River Road and Woolcock Street through landscaping and streetscape treatments along the road frontages.	No acceptable outcome is nominated.

Figure 6.143 – Charters Towers Road business precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
CBD gateway precinct	
PO56 Along Flinders Street (West), development responds to the role of the street as a key entrance to the principal centre (CBD), and presents high quality built form, landscape and streetscape treatment.	No acceptable outcome is nominated.
PO57 Shops primarily service workers within the precinct and are located only at key nodes formed by the intersections of Flinders Street (West) and Knapp and Fletcher Streets.	**AO57** Shops are located at the nominated intersections and include only convenience stores, newsagents and café/takeaway food premises limited to less than 250m^2 gross floor area per tenancy.

PO58 Buildings are generally low to medium rise and ensure the protection of the visual primacy of the principal centre (CBD).	**AO58** Building height does not exceed 6 storeys on the frontage of Flinders Street (West), and transition to 4 storeys where situated to the north of Sturt Street. In accordance with Figure 6.144 — CBD gateway precinct concept plan.
PO59 Development contributes to an attractive, coherent and integrated streetscape, by: (a) ensuring buildings assist in defining and enhancing the Flinders Street (West) frontage; (b) improving the quality and continuity of built form; and (c) using complementary landscaping and streetscape treatments.	No acceptable outcome is nominated.
PO60 Pedestrian links are provided and reinforced in accordance with Figure 6.144 — CBD gateway precinct concept plan.	No acceptable outcome is nominated.

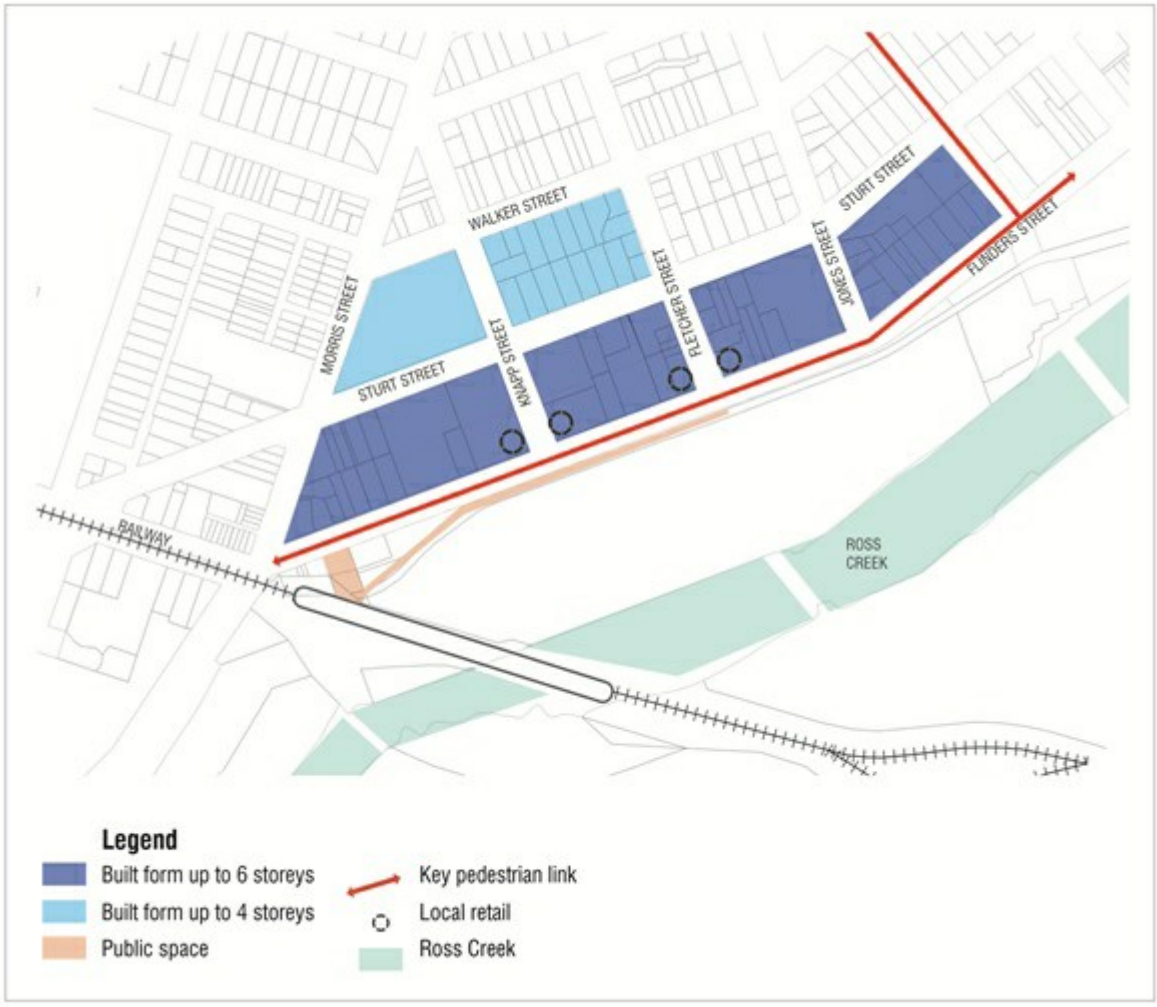

Figure 6.144 – CBD gateway precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
South Townsville Railyards and Dean Park precinct	
PO61 Development is generally in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan.	No acceptable outcome is nominated.
PO62 Development in the precinct: (a) integrates all aspects of the land use elements through good built form and public realm treatments; and (b) appropriately stages development and particularly the sequencing of supporting infrastructure including transport and access, parking and services.	No acceptable outcome is nominated.
PO63 A new entertainment centre and a range of allied uses are established on the Dean Park site, in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan. The development: (a) incorporates leading tropical design; (b) is oriented to both the Saunders Street and Rooney Street frontages; (c) establishes uses which promote a high level of pedestrian movement and interaction along Saunders Street and Rooney Street, creating an active edge; (d) provides a new public plaza at the Saunders and Rooney Street corner, integrating with the future plaza area for the stadium opposite; and (e) has its primary vehicular and public transport access via a new road alignment extending from Barlow Street. A new bus terminus and driver facilities are provided in this location.	No acceptable outcome is nominated.

PO64 A stadium is established on the northern corner of the existing railyards land, in accordance with Figure 6.145 — South Townsville Railyards and Dean Park precinct concept plan. The development: (a) is capable of being used for multiple events; (b) incorporates leading tropical design; (c) provides extensive public space surrounding the stadium structure; (d) is oriented to both the Saunders Street and Rooney Street frontages; (e) establishes uses which promote a high level of pedestrian movement and interaction along Saunders Street and Rooney Street, creating an active edge; (f) provides a new public plaza at the Saunders and Rooney Street corner, integrating with the future plaza area for the stadium opposite; and (g) facilitates vehicle access by construction of a new public road around the stadium.	No acceptable outcome is nominated.
PO65 Land to the south of the stadium site and backing onto the rail line predominantly consists of service and low impact industry and commercial uses.	No acceptable outcome is nominated.
PO66 Access to and permeability within the precinct are facilitated including: (a) the extension of Barlow Street to provide a new road extension from South Townsville to Saunders Street; (b) an upgrade of the Saunders Street and Rooney Street intersection, with a focus on ensuring pedestrian access and amenity and sense of arrival to the precinct; and (c) improved pedestrian priority and accessibility in street profile and streetscaping for all streets surrounding the stadium site, including Saunders, Rooney, and Morehead Streets and Perkins Street West.	No acceptable outcome is nominated.
PO67 Parking for the entertainment centre and stadium is established sequentially as key components of the precinct occur, and may include a staged program of parking solutions at grade and in various areas of the precinct over time. Ultimately, parking for both facilities is to be incorporated within the built form.	No acceptable outcome is nominated.

Figure 6.145 – South Townsville Railyards and Dean Park precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Wotton Street precinct	
PO68 The ongoing activities of the low impact industrial area to the north are not compromised.	**AO68** Development provides the following along the common boundary with adjacent industrial uses: (a) a minimum 3m wide landscaped buffer; and (b) a solid 1.8m fence along the full length of the boundary.

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Breakwater precinct	
PO69 Development is generally in accordance with Figure 6.146 — Breakwater precinct concept plan.	No acceptable outcome is nominated.
PO70 A new marina is established on the seaward side of the precinct, and includes a new boat launch facility as shown on Figure 6.146 — Breakwater precinct concept plan.	No acceptable outcome is nominated.
PO71 An open space and pedestrian network is provided as identified on Figure 6.146 — Breakwater precinct concept plan, and includes the provision of a boardwalk adjoining the future marina, pedestrian links along all waterfront areas, and a new park at the north eastern point of the precinct.	No acceptable outcome is nominated.
PO72 Where shown as an 'active frontage' on Figure 6.146 — Breakwater precinct concept plan, new buildings contribute to the creation of an attractive and activated edge to the waterfront by having facades which contain windows, doors, materials and features which generate visual interest and engagement with the water frontage.	No acceptable outcome is nominated.
PO73 Dining, entertainment and tourist-oriented uses occur at the ground storey.	No acceptable outcome is nominated.
PO74 Development within the Breakwater entertainment area shown on Figure 6.146 — Breakwater precinct concept plan supports the consolidation of the casino and allied uses, including short-term accommodation, boat club and market.	No acceptable outcome is nominated.

PO75 Development within the Breakwater living area shown on Figure 6.146 — Breakwater precinct concept plan primarily facilitates high density short or long-term accommodation uses, with local dining and shops at the ground floor where adjoining the future marina.	No acceptable outcome is nominated.
PO76 Building heights ensure the protection of the visual primacy of the principal centre (CBD), the retention of key views to Castle Hill and Melton Hill, and to the sea and Magnetic Island.	**AO76** Building heights are in accordance with Figure 6.146 — Breakwater precinct concept plan.

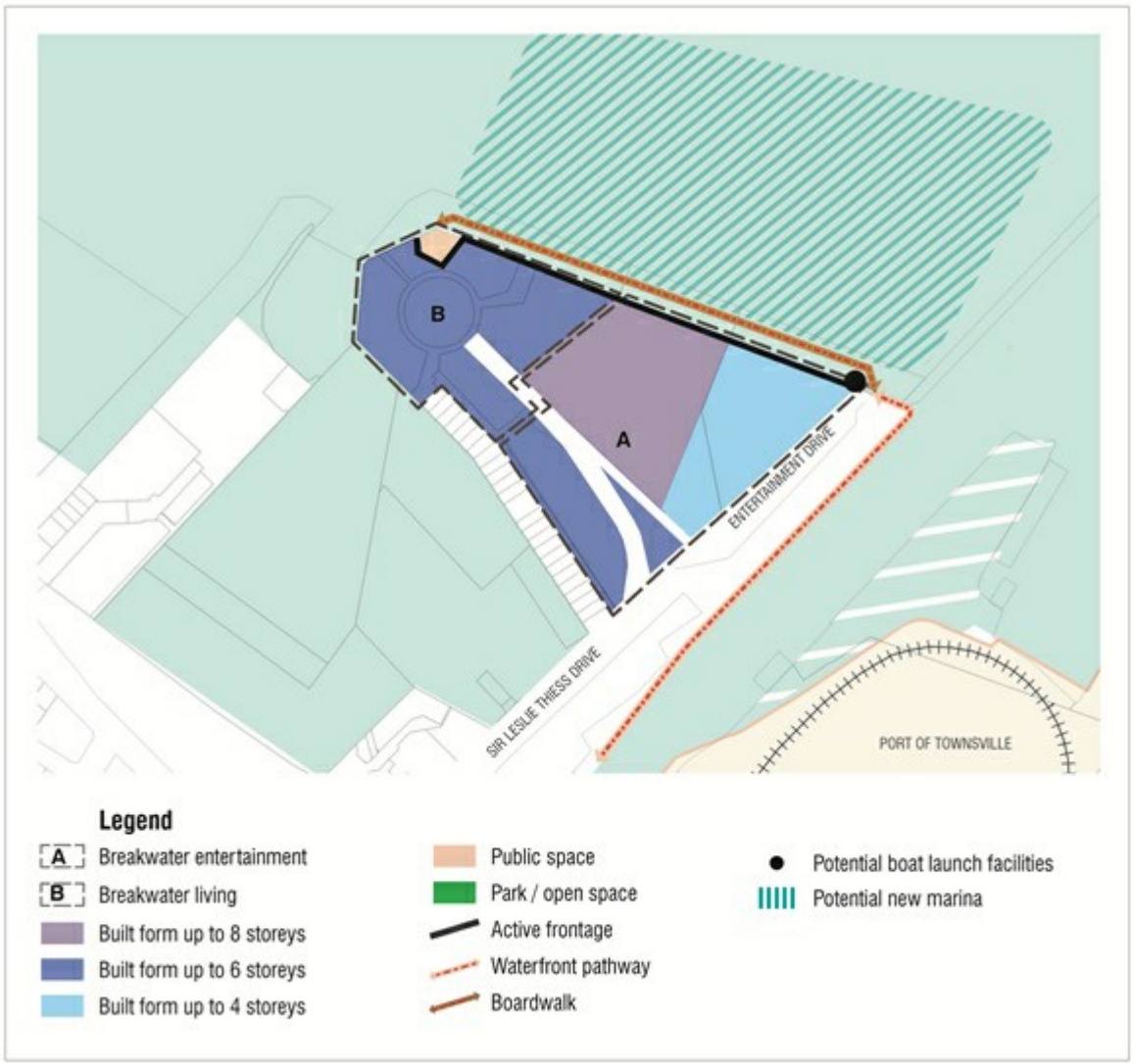

Figure 6.146 – Breakwater precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
King Street quarter precinct	
PO77 Development is generally in accordance with Figure 6.147 — King Street quarter precinct concept plan.	No acceptable outcome is nominated.
PO78 Development supports a mix of uses, including day and night-time activity.	No acceptable outcome is nominated.
PO79 Café and restaurant uses establish predominantly at the ground floor along the street frontages to Wickham Street, King Street and Flinders Street, and also to Ross Creek frontages.	No acceptable outcome is nominated.
PO80 Residential uses including long and short-term accommodation are predominantly located in the area bounded by Flinders Street, King Street and Wickham Street and The Strand.	No acceptable outcome is nominated.
PO81 Building height is medium rise, and ensures the protection of the visual primacy of the principal centre (CBD). The tallest buildings occur in the centre of the Wickham Street/King Street/Flinders Street/The Strand block.	**AO81** Building heights are in accordance with Figure 6.147 — King Street quarter precinct concept plan.
PO82 An open space and pedestrian network is provided as identified on Figure 6.147 — King Street quarter precinct concept plan, and includes: (a) the provision of, pedestrian links along all waterfront areas; (b) an extension to Anzac Park (following realignment of Sir Leslie Thiess Drive and King Street); (c) a new open space and pedestrian link to the southern end of The Strand linking to a future pedestrian creek crossing; and (d) pedestrian through block links.	No acceptable outcome is nominated.

PO83 Where shown as 'active frontage' on Figure 6.147 — King Street quarter precinct concept plan, new buildings contribute to the creation of an attractive and activated edge to the street frontage by; (a) being built to the street frontage; (b) having facades which contain windows, doors, materials and features which generate visual interest and engagement with the street frontage; (c) providing awnings to all street frontages; and (d) providing a continuous building alignment.	No acceptable outcome is nominated.

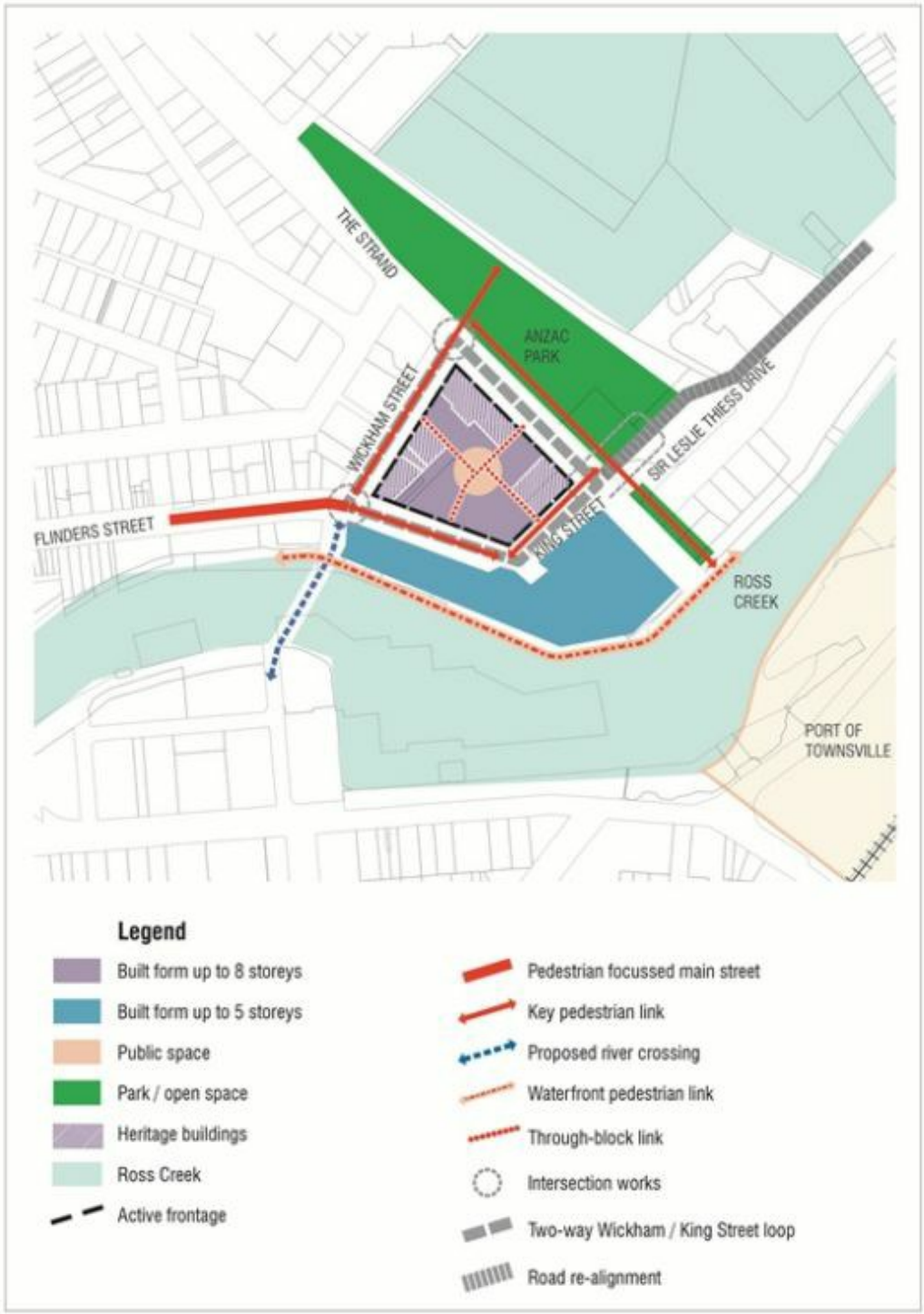

Figure 6.147 – King Street quarter precinct concept plan

Table 6.3.7.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Kings Road precinct	
PO84 Building height creates a medium-rise environment.	**AO84** Building height does not exceed 5 storeys.
PO85 Development provides for enhanced public realm and pedestrian connectivity, in accordance with Figure 6.148 — Kings Road precinct concept plan, including: (a) enhanced north south and east west links through the precinct; (b) a civic node on the lake frontage; (c) enhanced pedestrian access to and along the lake; and (d) a primary pedestrian and cycle pathway along Kings Road.	No acceptable outcome is nominated.
PO86 The civic node at the lake frontage is sleeved by active street level uses.	No acceptable outcome is nominated.
PO87 Residential uses are appropriately buffered from the railway corridor.	No acceptable outcome is nominated.

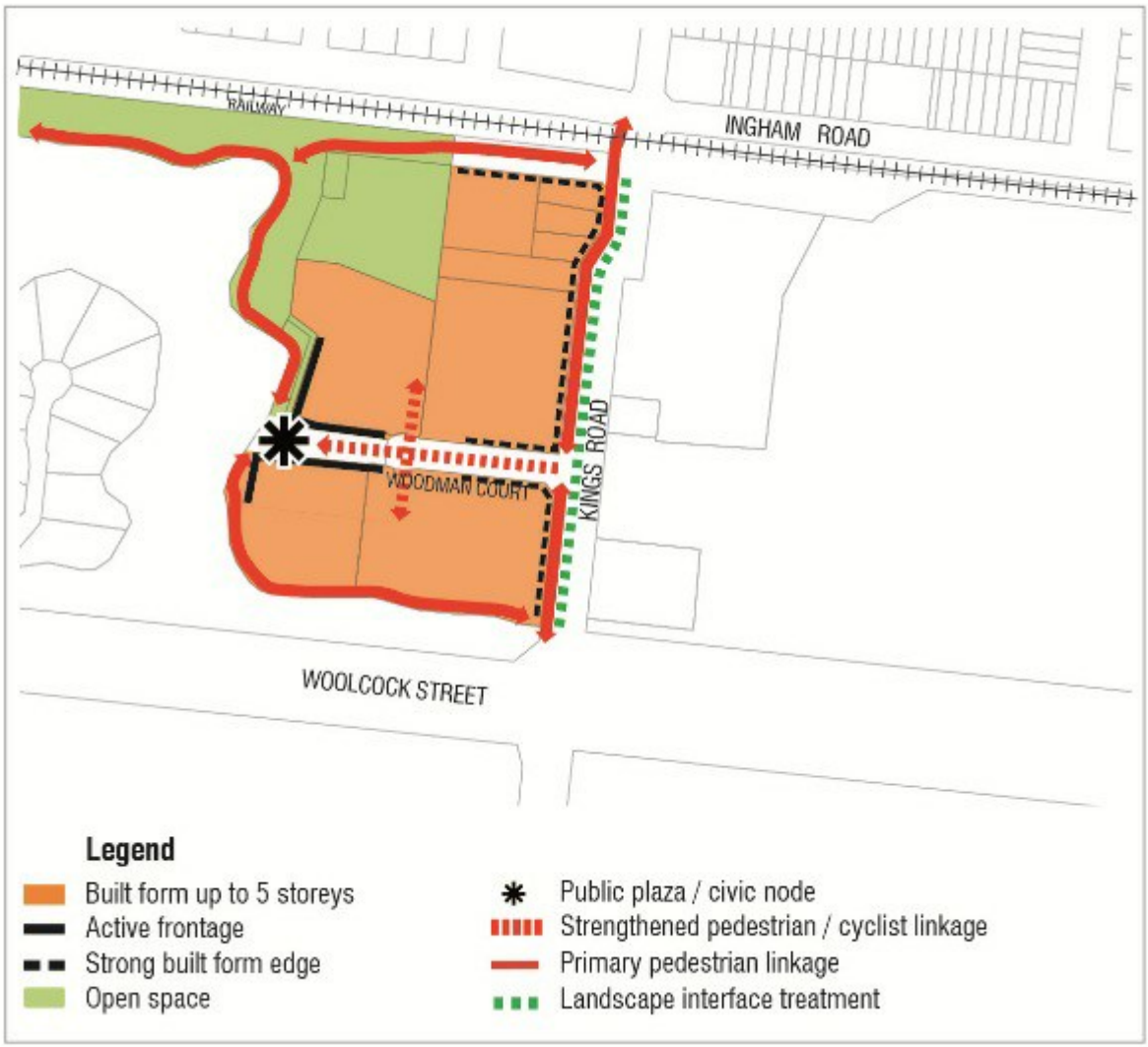

Figure 6.148 – Kings Road precinct concept plan

6.4 Community facilities and open space zone category

6.4.1 Sport and recreation zone code

6.4.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.1.2 Purpose

(1) The purpose of the Sport and recreation zone code is to provide for a range of organised activities that include sport, cultural and educational activities where the uses require a level of built infrastructure.

It includes built structures, such as clubhouses, gymnasiums, public swimming pools and tennis courts, and infrastructure to support the activities, safe access and essential management, where required to meet community needs.

(2) The particular purpose of the code is to ensure:

- (a) residents have convenient access to sport and recreation activities which are safe, attractive and appropriate for the community's needs; and
- (b) development minimises impacts on surrounding land.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) local, district, regional and specialised sports parks provide for a variety of formal sporting activities and a range of training and competition infrastructure;
- (b) development directly supports the primary recreational function of the site or provides for the co-location of a complementary and compatible community-related activity;
- (c) development does not restrict public access and does not detract from the primary function of the site for sport and recreation activities;
- (d) development provides for safe and convenient internal pedestrian and cyclist pathways and external connections to existing and proposed public transport infrastructure and surrounding activities wherever possible;
- (e) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (f) facilities are sited, designed and operated to minimise adverse impacts on surrounding land; and
- (g) adverse impacts on any ecological values are avoided where land includes or adjoin natural habitats such as bushland, wetlands or waterways, or act as a buffer between natural and developed areas.

(4) The purpose of the zone will also be achieved by the following additional outcomes for particular precincts:

Balgal Beach golf course precinct:

(a) development of the precinct maintains the golf course and other outdoor recreational facilities and provides an integrated mix of residential and small-scale tourist accommodation;

(b) reconfiguration facilitates a range of lot sizes to accommodate dwelling houses typically on lots with an average size of 600m^2;

(c) the ultimate development of the entire precinct does not result in more than 590 residential lots for dwelling house purposes;

(d) tourist-oriented development may also occur in the form of small-scale, low-rise accommodation and support facilities;

(e) building scale and massing limits the impact on the natural character of Balgal Beach; and

(f) development of the precinct does not compromise the efficient and orderly provision of infrastructure.

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Figure 6.149 – Balgal Beach golf course precinct

Cluden precinct:

(a) Development facilitates the ongoing operation of the Cluden racecourse and is directly associated with or ancillary to horse racing.

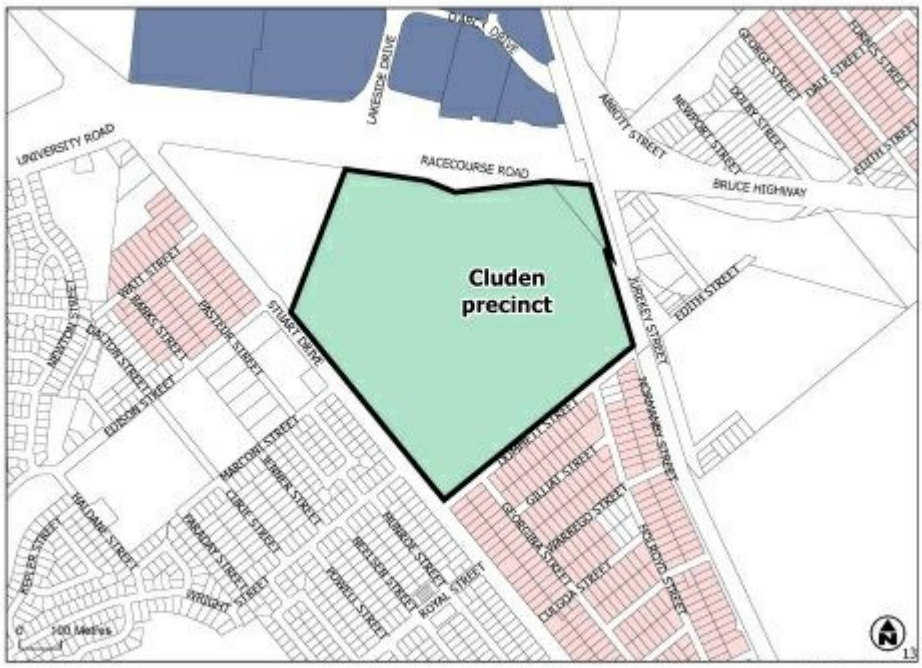

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Figure 6.150 – Cluden precinct

6.4.1.3 Assessment benchmarks

Table 6.4.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Built form	
PO1 Development does not substantially exceed the height of existing buildings in the area or is designed to sympathetically transition from lower rise neighbouring buildings.	**AO1** Building height does not exceed 3 storeys.
PO2 Building setbacks and orientation provide for an attractive streetscape that is compatible with existing characteristics of the local area.	**AO2** Buildings are set back from street and road frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO3 Development minimises the bulk of buildings to assist integration with surrounding development.	**AO3** Walls are articulated so that they do not exceed a length of 15m without a change in plane of at least 0.75m depth.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Amenity	
PO4 Development provides adequate separation, buffering and screening from residential uses and land within a residential zone so that adverse impacts on privacy and amenity are minimised.	**AO4.1** Buildings and structures are set back 6m or half of the building height, whichever is greater from any boundary shared with a residential use or land within a residential zone.
	AO4.2 Site access and parking, servicing or outdoor storage areas are setback 6m from any boundary shared with a residential use or land within a residential zone.
	AO4.3 Where buildings, parking, servicing or outdoor storage areas are located within 15m of any boundary shared with an residential use or land within a residential zone, the following is provided: (a) a minimum 1.8m high solid screen fence; or (b) a landscaped buffer area consisting of dense screen planting of a minimum 3m width. **Editor's note—**Landscaping is to be provided to a standard specified in the Landscape code.
	AO4.4 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.
PO5 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO5** The open area used for the storage of refuse, vehicles, machinery, goods and materials on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO6 Development does not compromise the effective operation of the primary use.	**AO6** No more than one (1) caretaker's accommodation unit is provided on the site.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community use and club	
PO7 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO7** At least one (1) lockable storage space of a minimum of 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO8 The site predominantly accommodates sport and recreational activities and facilitates optimum use of the land for the intended sport or recreational purpose.	No acceptable outcome is nominated.
PO9 Non-recreation uses occur only where they: (a) directly support the primary function of the site; or (b) are a compatible community-related activity.	No acceptable outcome is nominated.
PO10 Development does not impede public access to and use of facilities.	No acceptable outcome is nominated.
PO11 Buildings, structures and use areas are designed to ensure efficient use of buildings and facilities, and provide for multiple or shared use of facilities where practicable.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO12 Development maintains a high level of general amenity within the site and for surrounding areas, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance criterion.	No acceptable outcome is nominated.
PO13 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO15 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.
PO16 Safe and convenient pedestrian and cyclist circulation is provided for as an integrated component of the site layout.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns, ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note-**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Balgal Beach golf course precinct	
PO18 Development does not reduce the area dedicated to the golf course and other outdoor recreational uses or reduce its amenity or functionality.	No acceptable outcome is nominated.
PO19 Reconfiguration of a lot does not result in more than 590 lots or detached dwelling house purposes across the entire precinct.	No acceptable outcome is nominated.
PO20 Reconfiguration creates lots that have sufficient area and dimension to facilitate residential development.	**AO20** Lots have an average size of 600m^2.
PO21 Tourist-oriented development is small-scale and low rise.	**AO21** Building height does not exceed 2 storeys.
PO22 Design and articulation for tourism-oriented development contributes to the natural character of the locality through tropical architectural design elements and the natural setting of buildings within the landscape.	No acceptable outcome is nominated.
PO23 Development is within the capacity of available infrastructure and is supported by adequate infrastructure, including: (a) connection to reticulated water and sewage networks; (b) connection to stormwater drainage system; and (c) constructed roads.	No acceptable outcome is nominated. **Editor's note-**Council will request an overall area/precinct-scale structure plan - comprising land use, infrastructure, staging, urban design for the entire precinct before development takes place.

6.4.2 Open Space zone code

6.4.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.2.2 Purpose

(1) The purpose of the Open space zone code provides for informal recreation where the built form is not essential to the enjoyment of the space.

It may provide for local, district and regional scale parks which serve the recreational needs of a wide range of residents and visitors.

Where required to meet community needs, development may include shelters, amenity facilities, picnic tables, and playgrounds and infrastructure to support safe access and essential management.

(2) The particular purpose of the code is to ensure:

- (a) residents have convenient access to parks and opportunities for informal outdoor recreation that are safe, attractive and appropriate for the community's needs; and
- (b) places that contribute to the visual amenity and character of the city are protected; and
- (c) the environmental and drainage functions of open space are protected.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) open space is accessible to the general public for a range of informal outdoor recreation activities at local, district and regional levels;
- (b) development directly supports the primary recreational function of the site or provides for the co-location of a complementary and compatible community-related activity;
- (c) development does not restrict public access and does not detract from the site's primary open space function, visual quality or cultural values;
- (d) land within the zone is generally free from buildings other than ancillary structures which enhance the utility and enjoyment of the open space and buildings required for small-scale clubs and community facilities;
- (e) development provides for safe and convenient internal pedestrian and cyclist pathways and external connections to existing and proposed public transport infrastructure and surrounding activities wherever possible;
- (f) facilities are sited, designed and operated to minimise adverse impacts on surrounding land;
- (g) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour;
- (h) the drainage functions of open space are protected and development is compatible with these functions; and
- (i) adverse impacts on any ecological values are avoided where land includes or adjoin natural habitats such as bushland, wetlands or waterways, or act as a buffer between natural and developed areas;

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Riverway precinct:

(a) development in Pioneer Park and Riverway is subordinate to, and does not compromise, its primary role and function as a pedestrian-focussed recreational and open space area; and

(b) connections between Pioneer Park and Riverway and Thuringowa central major centre are reinforced, including the creation of an active entry precinct along Village Boulevard.

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Figure 6.151 – Riverway precinct

6.4.2.3 Assessment benchmarks

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Built form	
PO1 Built form: (a) is limited in scale and extent; (b) is visually unobtrusive and maintains the open, parkland character; and (c) does not restrict access to utility or enjoyment of the open space.	**AO1.1** Building height does not exceed 1 storey.
	AO1.2 Buildings do not exceed a site cover of 5%.
	AO1.3 Buildings are set back 10m from any site boundary.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community use and club	
PO2 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO2** At least one (1) lockable storage space of a minimum of 4m^2 is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO3 Land predominantly accommodates parks and any development facilitates optimum enjoyment and use of the land for informal recreation purposes.	No acceptable outcome is nominated.
PO4 Other than at Riverway precinct, non-recreational uses occur only where: (a) they directly support the primary function of the site or are a compatible community-related activity; and (b) have a built form that is limited in scale and extent.	No acceptable outcome is nominated.
PO5 Development does not impede public access to and use of facilities.	No acceptable outcome is nominated.
PO6 Development does not detract from the site's visual quality or cultural values.	No acceptable outcome is nominated.
PO7 Development is compatible with any drainage function of the land and does not interfere with that function.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO8 Development maintains a high level of amenity within the site and for surrounding areas, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance criterion.	No acceptable outcome is nominated.
PO9 Landscaping is provided to enhance the appearance of the development and assist in its integration with the open space setting.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO10 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO11 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, other parts of the open space network, sport and recreational activities, centres and community-related activities.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO12 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns and ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Riverway precinct	
PO13 Leisure focussed shops and dining uses are established along Village Boulevard opposite High Range Drive, creating an active link to the town centre heart precinct and a gateway feature for Riverway. This gateway area may incorporate a residential component in the form of shop top housing.	No acceptable outcome is nominated.

6.4.3 Community facilities zone code

6.4.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.3.2 Purpose

(1) The purpose of the Community facilities zone code is to provide for community-related activities and facilities whether under public or private ownership.

These may include the provision of municipal services, public utilities, government installations, hospitals and schools, transport and telecommunication networks and community infrastructure of an artistic, social or cultural nature.

(2) The particular purpose of the code is to ensure:

(a) the effective location, design and operation of a wide variety of community-related activities and facilities so that these facilities adequately meet the needs of current and future users; and

(b) community-related activities and facilities are provided in a safe, accessible and attractive environment, and minimise impacts on surrounding land uses.

(3) The purpose of the zone will be achieved through the following overall outcomes:

(a) the zone primarily accommodates a variety of community-related activities and facilities such as community uses, educational establishments, emergency services, places of worship and utility installations in a manner that best meets community needs;

(b) other complementary uses may occur within the zone, where community-related activities and facilities remain the dominant use and continue to effectively meet community needs;

(c) development does not prejudice the ongoing operation and expansion of community activities and facilities;

(d) where appropriate, development enables the co-location of community-related activities and facilities;

(e) development facilitates improved accessibility by walking, cycling and public transport, and facilitates easy access by all members of the community, including older and less mobile people and people with disabilities;

(f) unless separation is required due to safety and operational requirements of the use, integration with surrounding areas is strengthened through built form and site layout;

(g) buildings provide for an attractive, pedestrian friendly environment at street level;

(h) design of built form and public spaces facilitates safe and secure environments and discourages antisocial behaviour; and

(i) development is sited, designed and operated to minimise adverse impacts on surrounding land.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Picnic Bay community facilities precinct:

(a) the intersection of Birt Street and Nelly Bay Road creates a gateway to Picnic Bay. Built form and streetscape treatments at this intersection reinforces this gateway function;

(b) development of this precinct supports a transition from the existing landfill uses to form a more community-focussed hub including uses such as education, open space, recreation and other community facilities; and

(c) design of built form and public spaces is of high quality and is consistent with the low density Magnetic Island character.

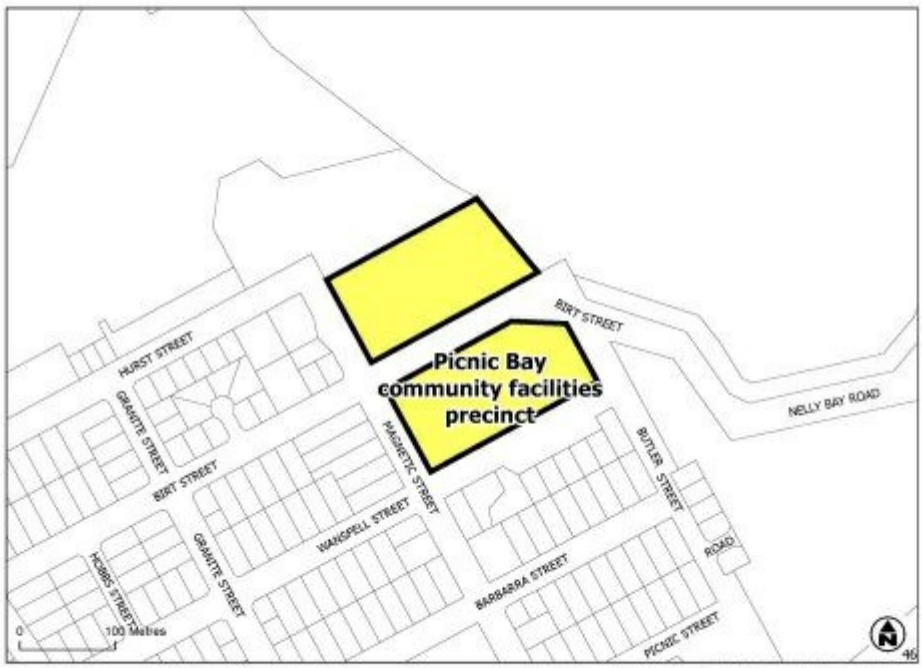

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Figure 6.152 – Picnic Bay community facilities precinct

6.4.3.3 Assessment benchmarks

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development – where involving a new building or expansion to an existing building	
Built form	
PO1 Development does not substantially exceed the height of existing buildings in the area.	**AO1** Building height does not exceed 3 storeys.
PO2 Building setbacks and orientation provide for an attractive streetscape that is compatible with existing characteristics of the local area.	**AO2** Buildings have their main face to the street and are set back from that frontage: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO3 Development minimises the bulk of buildings to assist integration with surrounding development.	**AO3** Walls are articulated so that they do not exceed in length of 15m without a change in plane of at least 0.75m depth.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building	
Amenity	
PO4 Development provides adequate separation, buffering and screening from residential uses and land within a residential zone so that adverse impacts on privacy and amenity are minimised.	**AO4.1** Buildings are set back 6m or half the height of that part of the building, whichever is the greater, from any boundary shared with a residential use or land within a residential zone.
	AO4.2.1 A 1.8m high solid screen fence is provided along all boundaries shared with a residential use or land within a residential zone. OR **AO4.2.2** A landscaped buffer with a minimum width of 3m and consisting of dense screen planting is provided along all boundaries shared with a residential use or land within a residential zone. **Editor's note–**landscaping is to be provided to a standard specified in Section 9.3.3 Landscape code.
	AO4.3 Windows that have a direct view into an adjoining residential use are provided with fixed screening that is a maximum of 50% transparent to obscure views and maintain privacy for residents.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Where provided, outdoor lighting does not adversely affect the amenity of adjoining properties or create a traffic hazard on adjacent roads.	**AO5.1** Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting.*
	AO5.2 Outdoor lighting is provided in accordance with *Australian Standard AS1158.1.1 – Road Lighting – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements*.
PO6 Refuse storage areas and storage of goods or materials in open areas is presented in a manner that does not detract from the visual amenity of the local area.	**AO6** The open area used for the storage of refuse, vehicles, machinery, goods and materials used on the site is: (a) located no closer than 3m from any boundary; and (b) are screened from view by a 1.8m high solid screen fence.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO7 Development does not compromise the effective operation of the primary use.	**AO7** No more than one (1) caretaker's accommodation unit is provided on the site.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Community uses and clubs	
PO8 Adequate lockable storage space is provided on-site to meet the needs of users.	**AO8** At least one (1) lockable storage space of a minimum of $4m^2$ is provided for each room or area that can be hired out or used by community organisations or the public.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO9 The site accommodates community-related activities or facilities in a manner that safely and efficiently meet community needs.	No acceptable outcome is nominated.
PO10 Other uses occur on a site where they: (a) support or are otherwise complementary to the community-related activities or facilities on the site; and (b) are subordinate to those activities or facilities.	No acceptable outcome is nominated.
PO11 Development does not prejudice the ongoing operation and expansion of existing uses on the site.	No acceptable outcome is nominated.
PO12 Development facilitates opportunities for appropriate co-location of community-related activities or facilities.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Amenity	
PO13 Development maintains a level of amenity appropriate to the use and minimises impacts on surrounding land, having regard to: (a) noise; (b) hours of operation; (c) traffic; (d) visual impact; (e) signage; (f) odour and emissions; (g) lighting; (h) access to sunlight; (i) privacy; and (j) outlook. **Editor's note—**Applicants may be required to engage specialists to provide detailed investigations into the above matters in order to demonstrate compliance with this performance outcome.	No acceptable outcome is nominated.
PO14 Landscaping is provided to enhance the appearance of the development, screen unsightly components, create an attractive on-site environment and provide shading.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Accessibility	
PO16 Convenient and legible connections are provided for pedestrians and cyclists to and from the site, particularly having regard to linkages with existing and proposed public transport infrastructure, the open space network, centres and other community-related activities.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Protection of natural values	
PO17 The site layout and design responds sensitively to on-site and surrounding topography, drainage patterns, ecological values by: (a) minimising earthworks; (b) maximising retention of natural drainage patterns; (c) ensuring existing drainage capacity is not reduced; (d) maximising the retention or enhancement of existing vegetation and ecological corridors; and (e) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.4.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Picnic Bay community facilities precinct	
PO18 Development in this precinct supports a transition from the existing use as a waste facility to uses which present as a gateway feature and key community node for Picnic Bay.	No acceptable outcome is nominated.
PO19 The existing land fill site is rehabilitated to a standard that is suitable to accommodate a range of community activities.	No acceptable outcome is nominated.
PO20 Building height and massing is consistent with the low density scale of the Magnetic Island character and articulates individual buildings.	**AO20** Building height does not exceed 2 storeys.
PO21 Design of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; (b) the natural setting of buildings within the landscape; and-Accepted development subject to requirements (c) maximising views to the bay.	No acceptable outcome is nominated.
PO22 Built form, landscape and streetscape treatment at the intersection of Birt Street and Nelly Bay Road reinforces a gateway statement.	No acceptable outcome is nominated.
PO23 Vehicle access points along Birt Street are minimised.	**AO23** Access points are limited to only one either side of Birt Street within this precinct.

6.4.4 Environmental management and conservation zone code

6.4.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.4.4.2 Purpose

(1) The purpose of the Environmental management and conservation zone code is to provide for the protection, restoration and maintenance of areas identified as supporting significant biological diversity and ecological integrity.

(2) The particular purpose of the code is to ensure that areas of conservation value, including land in the protected estate (including council owned or controlled land held for conservation) and some privately owned land are maintained and protected from the impacts of development.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) the conservation values of the land are maintained or enhanced;
- (b) these areas remain undeveloped apart from small-scale facilities that support conservation, low impact nature-based recreational activities on the land and essential infrastructure; and
- (c) adverse impacts on ecological features and processes are avoided.

6.4.4.3 Assessment benchmarks

Table 6.4.4.3—Assessable development

Performance outcomes	Acceptable outcomes
For assessable development only	
PO1 Development is limited to: (a) development that facilitates conservation activities on the land; or (b) development that provides information or education of visitors directly connected to the values of the land; or (c) development that is ancillary to and directly supports visitation to the land for conservation or recreation purposes consistent with (a) or (b), for example through the provision of light refreshments; or (d) the establishment of infrastructure that cannot practicably be located elsewhere; or (e) the establishment of a single dwelling house or caretaker's accommodation unit.	No acceptable outcome is nominated.
PO2 Tourist accommodation is not established.	**AO2** No acceptable outcome is nominated.
PO3 The footprint of any development is minimal and built form is of a low key, low-rise scale.	**AO3.1** Development occurs within existing buildings.
	AO3.2 Development does not involve any clearing of vegetation.

PO4 The land is not further subdivided.	**AO4** No new lots are created.
PO5 Environmental values on the site are maintained or enhanced.	No acceptable outcome is nominated.

6.5 Industry zones category

6.5.1 Low impact industry zone code

6.5.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.1.2 Purpose

(1) The purpose of the Low impact industry zone code is to provide for service industry and low impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.

Activities considered appropriate in this zone are defined as Low impact industry or Service industry in the schedule of definitions.

(2) The particular purpose of the code is to:

- (a) facilitate the safe, efficient and attractive use of land for smaller scale and lower impacting industries; and
- (b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

- (a) the zone primarily accommodates a range of generally smaller scale industrial uses which have low levels of potential impacts on surrounding areas and often provide services to the general public;
- (b) the zone also accommodates storage, wholesale and trade supplies, uses requiring significant outdoor sales areas and indoor sport and recreation uses which are difficult to locate elsewhere, where these have low levels of potential impacts on the surrounding area;
- (c) other non-industrial uses occur where they are ancillary to or directly support the industrial functions of the area, and are limited in extent;
- (d) the zone does not accommodate uses which are primarily oriented to retail sales and which are more appropriately located in centres, such as shops, shopping centres, showrooms or retail based hardware supplies;
- (e) the intrusion of incompatible uses, or uses which are more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;
- (f) any interface between industrial uses and sensitive land uses is designed and managed to minimise adverse impacts;
- (g) development makes a positive contribution to the public domain, particularly along major roads and near centres; and
- (h) development avoids significant adverse effects on water quality and the natural environment.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Nelly Bay low impact industry precinct:

(a) design of built form is of high quality and consistent with the low density Magnetic Island character.

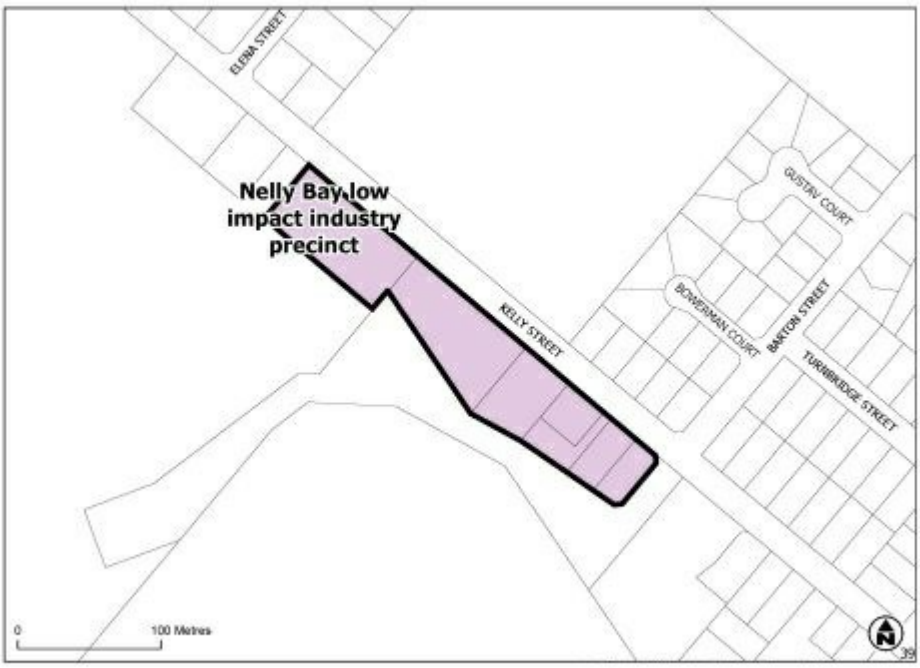

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Figure 6.153 – Nelly Bay low impact industry precinct

6.5.1.3 Assessment benchmarks

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the height and scale of surrounding buildings and includes features that contribute to an attractive streetscape.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Walls that have frontage to a street or road are articulated so that they do not exceed a length of 15m without a change in plane of at least 0.75m depth.
	AO1.3 New building and structure height does not exceed 12m.
	AO1.4 Buildings are set back from street and road frontages: (a) within 20% of the average front set back of adjoining buildings; or (b) where there are no adjoining buildings, 4m.
	AO1.5 Vehicle manoeuvring and loading and unloading areas are located to the side or behind of the building, and are not located in front of the building.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries to buildings are visible from the street and visitor parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Where adjoining a residential zone, development provides adequate buffering and screening so that adverse impacts on privacy and amenity are minimised.	**AO3.1** New buildings, plant and equipment, active outdoor use areas, site access and parking, servicing or outdoor storage areas are set back a minimum of 5m from any boundary adjoining a residential zone.
	AO3.2 Within the setback area adjoining a residential zone, the following are provided: (a) a minimum 1.8m high solid boundary fence; or (b) a densely planted landscape strip, having a minimum depth of 2m and the balance setback area turfed.
	AO3.3 Windows or openings that have direct views into adjoining residential buildings are provided with fixed screening that is a maximum of 50% transparent to obscure views into the adjoining residential building and maintain privacy for those residents.
PO4 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from the street and land within other zones.	**AO4** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.
PO5 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO5** Landscaping is provided along all road frontages of the site for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO6 Development minimises impacts on surrounding land having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO6.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO6.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO6.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO6.4 All external areas are sealed, turfed or landscaped.
	AO6.5 Light emanating from any source complies with *Australian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO6.6 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.
PO7 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off-site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO7.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO7.2 Roof water is piped away from areas of potential contamination.
PO8 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO8** Development does not involve earthworks involving more than $100m^3$.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one (1) caretaker's accommodation dwelling is established on the site.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Ancillary office uses	
PO10 Offices are accommodated within the zone where they are ancillary to the primary use.	**AO10** The area used for an office use does not exceed 250m^2 or 10% of the gross floor area, whichever is the lesser.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO11 Development within the zone is of a low impact nature and is either: (a) an industrial activity; or (b) trade related; or (c) difficult to locate in other zones due to land area or operational requirements (such as outdoor sales areas and indoor sport and recreation uses); or (d) small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 Development is not primarily oriented to retail sales, other than where involving an outdoor sales activity.	No acceptable outcome is nominated.
PO13 Development does not compromise the use of land for industrial purposes.	No acceptable outcome is nominated.
PO14 The zone does not accommodate uses that attract high volumes of heavy vehicle movement or generally involve 24-hour operation.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO15 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate signage and wayfinding; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO16 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO17 The site layout and design responds sensitively to on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.5.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Nelly Bay low impact industry precinct	
PO18 Building design and massing is consistent with the low density scale of the Magnetic Island character and articulates individual buildings.	No acceptable outcome is nominated.
PO19 Design and articulation of buildings contribute to the creation of the local Magnetic Island character through: (a) climate-responsive design; and (b) natural setting of buildings within the landscape.	No acceptable outcome is nominated.
PO20 Streetscape and landscape treatments contribute to the creation of the local Magnetic Island character.	No acceptable outcome is nominated.

6.5.2 Medium impact industry zone code

6.5.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.2.2 Purpose

(1) The purpose of the Medium impact industry zone code is to provide for medium impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.
Activities considered appropriate in this zone are defined as Medium impact industry in the schedule of definitions.

(2) The particular purpose of the code is to:

(a) facilitate the safe and efficient use of land for a range of industrial activities; and

(b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone accommodates a wide range of industrial uses that are likely to have some potential for off-site impacts, including manufacturing, transport, storage, outdoor sales and other uses which require larger sites in locations separated from sensitive land uses;

(b) other non-industrial uses are those which are ancillary to or directly support the industrial functions of the area, and are limited in extent;

(c) the zone does not accommodate uses which are primarily oriented to retail sales and which are more appropriately located in centres, such as shops, shopping centres, showrooms, or retail based hardware supplies;

(d) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;

(e) the impacts of development are managed to ensure public health and safety and achieve acceptable levels of amenity for nearby sensitive land uses;

(f) development avoids significant adverse effects on water quality and the natural environment;

(g) development does not adversely affect the safe and efficient operation of nearby Department of Defence landholdings;

(h) development is safe and legible, and designed to establish safe and efficient movement systems;

(i) lot sizes provide for a range of large format industrial uses and discourage take up of land for smaller scale activities better suited to the Low impact industry zone; and

(j) development makes a positive contribution to the public domain, particularly along major roads.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Roseneath medium impact industry precinct:

(a) medium impact industries, including those with a transport and logistics focus, occurs in the precinct;

(b) development provides adequate new infrastructure to support new uses, including roads, stormwater, water and sewer infrastructure;

Editor's note—Conditions of approval or infrastructure agreements will be used (as appropriate) to ensure that infrastructure is provided.

(c) development minimises impacts on surrounding land uses, including existing residential uses as far as practicable; and

(d) development protects the hydraulic capacity and environmental qualities of waterways, including Stuart and Stoney Creeks, and unnamed tributaries.

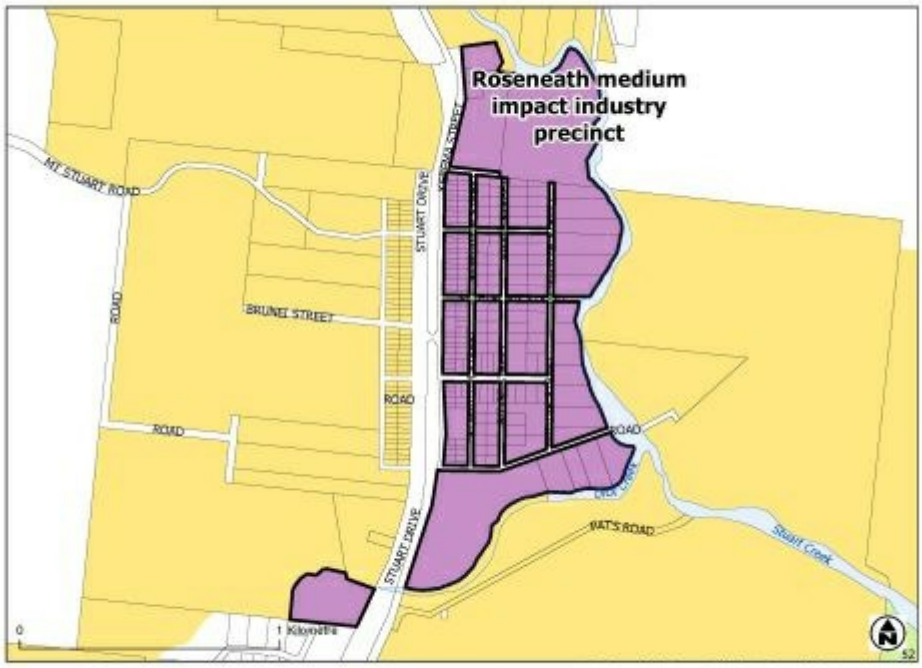

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Figure 6.154 – Roseneath medium impact industry precinct

6.5.2.3 Assessment benchmarks

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the scale of surrounding buildings.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Buildings are set back from street and road frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries are visible from the primary street frontage and visitor car parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion to an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from the street and sensitive land uses.	**AO3** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.
PO4 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO4** Landscaping is provided for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Development minimises impacts on sensitive land uses having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO5.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO5.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO5.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO5.4 All external areas are sealed, turfed or landscaped.
	AO5.5 Light emanating from any source complies with A*ustralian Standard AS4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO5.6 Outdoor lighting is provided in accordance with *Australian Standard AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.

PO6 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off-site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO6.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO6.2 Roof water is piped away from areas of potential contamination.
PO7 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO7** Development does not involve earthworks involving more than 100m^3.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Defence land	
PO8 Development does not adversely affect the safe and efficient operation of nearby Department of Defence land.	**AO8** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one (1) caretaker's accommodation dwelling is established on the site.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Ancillary office uses	
PO10 Offices are accommodated where they are ancillary to the primary industrial use on the site.	**AO10** The area used for an office use does not exceed 250m^2 or 10% of the gross floor area, whichever is the lesser.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO11 Development within the zone facilitates: (a) industrial activities whose impacts on sensitive land uses and the natural environment can be appropriately managed; or (b) uses which require larger sites in locations that are separated from sensitive land uses, and are not more appropriately accommodated in other zones; or (c) non-industrial uses which are small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 Development is not primarily oriented to retail sales, other than where involving an outdoor sales activity.	No acceptable outcome is nominated.
PO13 Development does not significantly detract from the availability or utility of land for industry purposes.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate signage and wayfinding; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO15 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO16 The site layout and design responds sensitively to on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Table 6.5.2.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts	
Roseneath medium impact industry precinct	
PO17 Development is supported by adequate infrastructure, including: (a) connection to reticulated water and sewage networks; (b) connection to a stormwater drainage system; and (c) constructed roads.	No acceptable outcome is nominated. **Editor's note—**In accordance with the Act, council may seek to secure the necessary infrastructure through conditions of approval or infrastructure agreements.
PO18 Development protects the environmental quality, existing riparian vegetation and hydraulic capacity of waterways including Stuart and Stoney Creeks.	No acceptable outcome is nominated.
PO19 Development does not compromise the safe use of the nearby magazine reserve.	**AO19** The development does not compromise the protective works safety distance from explosive storage stipulated in *AS2187-1 Explosives — Storage, transport and use* and is otherwise consistent with that standard. **Editor's note—**The magazine reserve is located on the following property descriptions, Lot 103 Plan EP2187 and Lot 220 Plan SP138418.
PO20 Impacts on nearby residential uses are minimised as far as practicable. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	No acceptable outcome is nominated.

6.5.3 High impact industry zone code

6.5.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.5.3.2 Purpose

(1) The purpose of the High impact industry zone code is to provide for high impact industry uses.

It may include non-industrial and business uses that support the industrial activities where they do not compromise the long-term use of the land for industrial purposes.

Activities considered appropriate in this zone are defined as High impact industry in the schedule of definitions.

(2) The particular purpose of the code is to:

(a) facilitate the safe and efficient use of land for a range of higher impacting industrial activities; and

(b) ensure development does not detract from the function and viability of centres, and minimises impacts on the amenity of nearby sensitive uses.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone accommodates industrial uses that are likely to have a higher potential for off-site impacts and other uses that are of a similar nature or scale and are compatible with the impacts and risks associated with the zone;

(b) the zone does not accommodate uses which attract visitation by members of the public.

(c) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;

(d) the impacts of development are managed to ensure public health and safety;

(e) development avoids significant adverse effects on water quality and the natural environment;

(f) development does not adversely affect the safe and efficient operation of Department of Defence landholdings;

(g) development is safe and legible and designed to facilitate large format industrial uses.

(h) development makes a positive contribution to the public domain, particularly along major roads.

6.5.3.3 Assessment benchmarks

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion of an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Built form	
PO1 Development is consistent with the scale of surrounding buildings.	**AO1.1** Site cover does not exceed 80%.
	AO1.2 Buildings are set back from street frontages: (a) within 20% of the average front setback of adjoining buildings; or (b) where there are no adjoining buildings, 6m.
PO2 Building entrances are legible and safe.	**AO2.1** Pedestrian entries are visible from the primary street frontage and visitor parking areas, and are separate to vehicle access points.
	AO2.2 Doorway recesses in building facades are not of a size or configuration that would conceal a person, unless lighting, mirrors, transparent materials or angled approaches are included to offset the potential for impacts on safety.
	AO2.3 Each building or tenancy is provided with a highly visible street and unit number respectively.
	AO2.4 Premises are provided with external lighting sufficient to provide safe ingress and egress for site users.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development — where involving a new building or expansion of an existing building **Note—**The following acceptable outcomes will not apply where the development is a change of use in an existing building that does not involve any expansion of that building.	
Amenity	
PO3 Utility elements (including refuse areas, outdoor storage, plant and equipment, loading and unloading areas) are screened from view from major roads.	**AO3** Utility elements are: (a) located within or behind the building; or (b) screened by a 1.8m high solid wall or fence; or (c) behind landscaping having the same screening effect as a 1.8m screen fence. **Editor's note—**Screening can be provided by any combination of the above treatments to meet the acceptable outcome.

PO4 Landscaping is provided to create streetscapes which contribute positively to the city image, particularly along major roads and streets.	**AO4** Landscaping is provided along all road frontages of the site for a minimum depth of: (a) 4m along an arterial or sub-arterial road; or (b) 2m along any other road or street frontage.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
General	
PO5 Development minimises impacts on sensitive land uses having regard to noise, vibration, odour, dust, light or other emissions. Adverse impacts on the health, safety or amenity of nearby residential zoned land or other sensitive land uses are minimised. **Editor's note—**Applicants should have regard to relevant legislative, industry and licensing requirements.	**AO5.1** Development achieves the noise generation levels set out in the Environmental Protection (Noise) Policy 2008.
	AO5.2 Development achieves the air quality objectives set out in the Environmental Protection (Air) Policy 2008.
	AO5.3 Materials that are capable of generating air contaminants are wholly enclosed in storage bins.
	AO5.4 All external areas are sealed, turfed or landscaped.
	AO5.5 Light emanating from any source complies with *Australian Standard AS 4282 Control of the Obtrusive Effects of Outdoor Lighting*.
	AO5.6 Outdoor lighting is provided in accordance with Australian Standard *AS 1158.1.1 — Road Lighting — Vehicular Traffic (Category V) Lighting — Performance and Installation Design Requirements*.
PO6 Development provides for the collection, treatment and disposal of liquid wastes or sources of contamination such that off- site releases of contaminants do not occur. **Editor's note—**Applicants should also have regard to Section 9.3.7 Works Code, Section 9.3.2 Healthy waters code and other relevant legislative, industry and licensing requirements.	**AO6.1** Areas where potentially contaminating substances are stored or used, are roofed and sealed with concrete, asphalt or similar impervious substance and bunded.
	AO6.2 Roof water is piped away from areas of potential contamination.
PO7 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO7** Development does not involve earthworks involving more than $100m^3$.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Defence land	
PO8 Development does not adversely affect the safe and efficient operation of Department of Defence land.	**AO8** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.5.3.3 - Self-assessable and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation	
PO9 Development does not compromise the viability of the primary use of the site.	**AO9** No more than one caretaker's accommodation dwelling is established on the site.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO10 The zone predominantly accommodates industrial uses with potential for higher impacts.	No acceptable outcome is nominated.
PO11 Other uses are accommodated where they: (a) are uses which: (i) require larger sites in locations that are separated from sensitive land uses; (ii) are not more appropriately accommodated in other zones; and (iii) are compatible with the impacts and risks associated with the zone; or (b) are small in scale and ancillary to or directly support the industrial functions of the area.	No acceptable outcome is nominated.
PO12 The zone does not accommodate uses that attract members of the public who are not employed in the zone.	No acceptable outcome is nominated.
PO13 Development does not significantly detract from the availability or utility of land for industrial purposes.	No acceptable outcome is nominated.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Crime prevention through environmental design	
PO14 Site layout facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building designs which promote safety and deter graffiti; (c) adequate definition of uses and ownership; (d) adequate lighting; (e) appropriate wayfinding mechanisms; (f) minimisation of entrapment locations; and (g) building entrances, loading and storage areas being well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.5.3.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO15 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO16 The site layout and design minimises impacts of on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

6.6 Rural zones category

6.6.1 Rural zone code

6.6.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.6.1.2 Purpose

(1) The purpose of the Rural zone code is to:

(a) provide for a wide range of rural uses including cropping, intensive horticulture, intensive animal industries, animal husbandry, animal keeping and other primary production activities;

(b) provide opportunities for non-rural uses that are compatible with agriculture, the environment, and the landscape character of the rural area where they do not compromise the long-term use of the land for rural purposes; and

(c) protect or manage significant natural features, resources, and processes, including the capacity for primary production.

(2) The particular purpose of the code is to ensure:

(a) the productive capacity of all rural land and opportunities to diversify and add value to rural production are maximised, within the ecological constraints of the land;

(b) the character and landscape values of non-urban land are maintained; and

(c) urban or rural residential development does not expand into rural zoned land.

(3) The purpose of the code will be achieved through the following overall outcomes:

(a) the zone primarily accommodates cropping or animal husbandry and ancillary detached houses;

(b) all rural land is protected from further fragmentation. A lack of viability for existing farm units and small holdings does not justify their further subdivision or use for non-rural purposes;

(c) housing in the rural zone only occurs to the extent that it supports the productive use of the land. Urban and rural residential development is contained within designated growth areas and does not expand into the rural zone;

(d) other new enterprises, including rural industries and tourism activities, are accommodated where:

(i) they are directly associated with rural production, a natural resource or the natural environment or need to be remote from urban uses as a result of their impacts;

(ii) the productive capacity of the land is not diminished and conflicts with existing and intended activities in the surrounding area are avoided;

(iii) the existing landscape and natural resource values of the land are maintained; and

(iv) the development is not more appropriately located in another zone;

(e) extractive resources and existing extractive operations on rural land are protected from encroachment by incompatible uses;

(f) the environmental, character and landscape values of all rural land are maintained; and

(g) adequate separation and buffering is provided by new development in nearby urban or rural residential zoned land to ensure the encroachment by more intensive residential and other sensitive uses is avoided.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts:

Horticulture precinct:

(a) this precinct contains the most productive areas in the Townsville region, in which cropping is the predominant land use. The productive capacity of this land is maximised;

(b) rural industries which have a direct nexus with the rural production in the immediate locality and only small-scale farm stay or bed and breakfast accommodation are established in this precinct;

(c) forestry does not adversely affect horticultural production, natural or scenic values on nearby land;

(d) permanent plantations, animal keeping (being kennels and catteries), intensive animal industries and aquaculture are not established in this precinct; and

(e) subdivision of lots below 40ha generally does not occur.

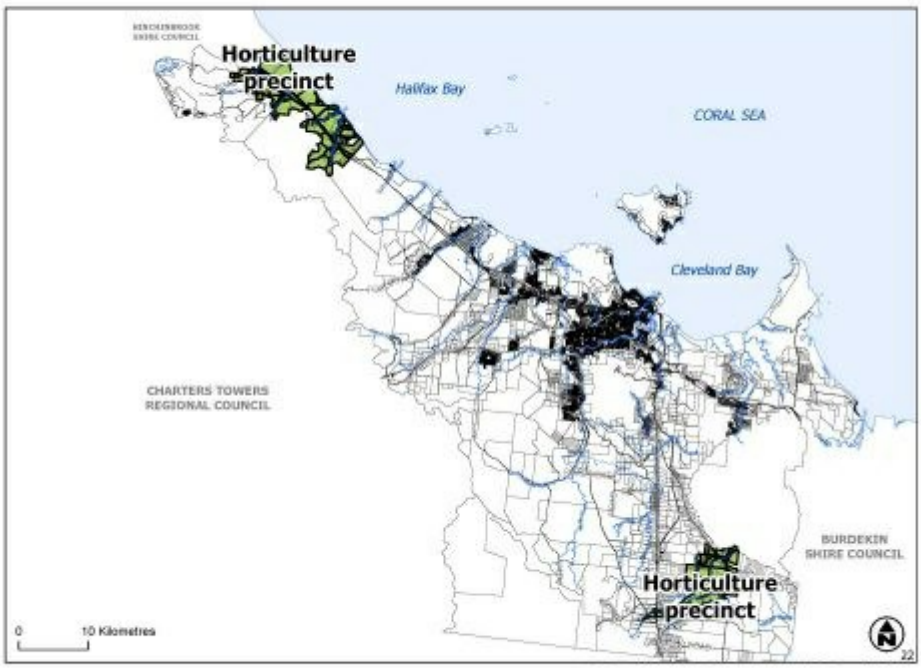

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Figure 6.155 – Horticulture precinct

Mixed farming precinct:

(a) this precinct contains low intensity animal husbandry with some potential for cropping.

(b) animal keeping (being kennels and catteries), intensive animal industries, aquaculture and rural industries establish where they:

  (i) are able to be located on less productive land within the precinct;

  (ii) are adequately separated from rural dwellings and other sensitive land uses;

  (iii) do not diminish the productive capacity of other land nearby; and

  (iv) do not diminish water quality, natural, scenic or environmental values, including remnant vegetation;

(c) subdivision of lots below 400ha in the Ross River Dam catchment and 40ha elsewhere generally does not occur.

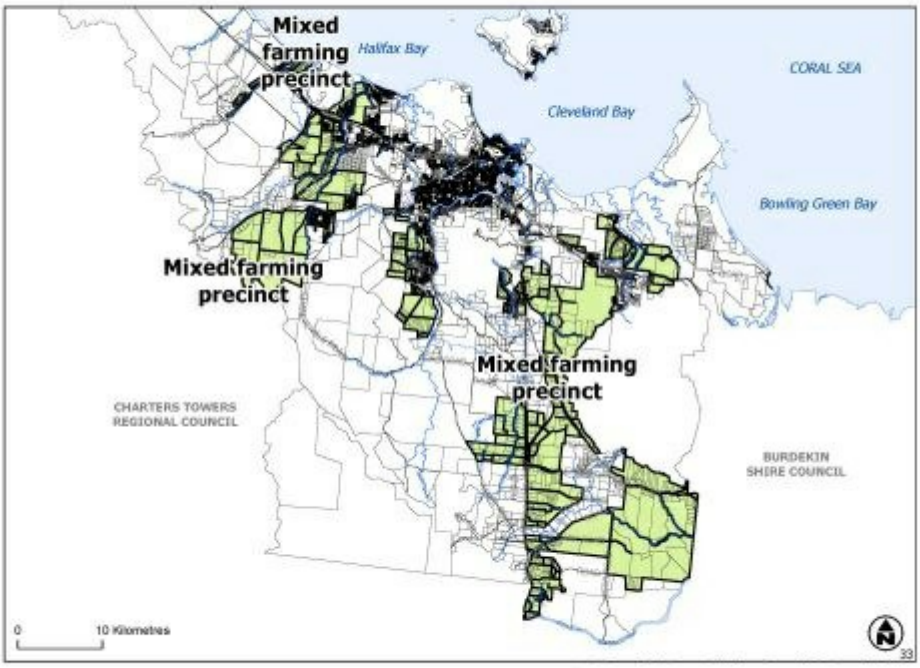

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Figure 6.156 – Mixed farming precinct

Grazing precinct:

(a) this precinct predominantly contains broad hectare grazing;

(b) the landscape character of elevated areas with high landscape significance is protected;

(c) animal keeping (being kennels and catteries), intensive animal industries, aquaculture and rural industries establish where they:

  (i) are able to be located on less productive land within the precinct;

  (ii) are adequately separated from rural dwellings and other sensitive land uses;

  (iii) do not diminish the productive capacity of other land nearby; and

  (iv) do not diminish water quality, natural, scenic or environmental values, including remnant vegetation;

(d) development does not prejudice the long-term potential of the Woodstock area for accommodating high impact, noxious or hazardous industries; and

(e) subdivision of lots below 400ha generally does not occur.

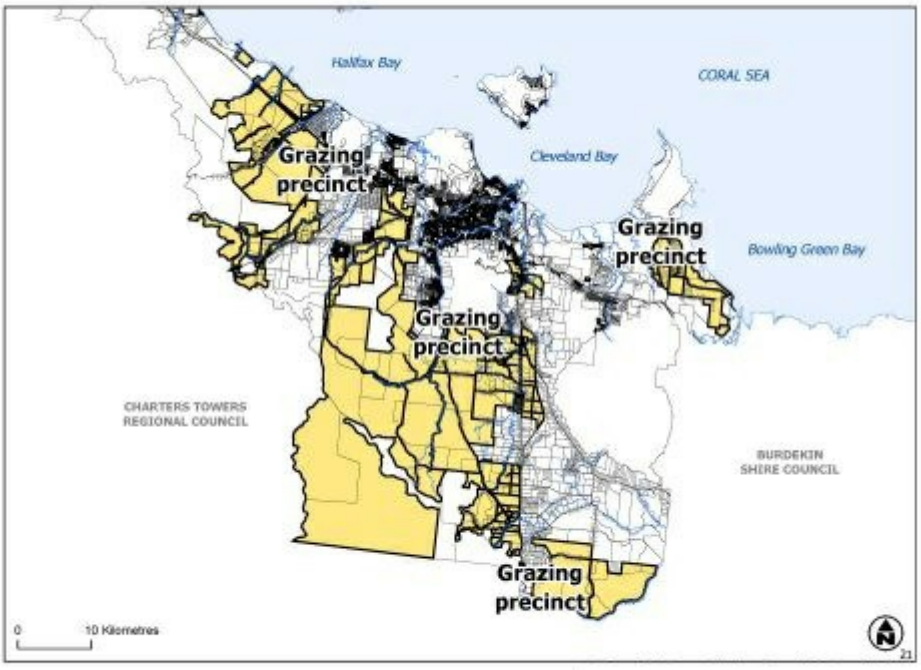

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Figure 6.157 – Grazing precinct

Cungulla precinct:

(a) rural land in the Cungulla precinct includes smaller lots used for primarily residential purposes. Agricultural uses are of lesser importance at Cungulla;

(b) houses are established on rural zoned land at Cungulla, providing that appropriate residential amenity and safety can be maintained, with particular regard to nearby extractive industry activities;

(c) houses are provided with adequate water supply and sewage treatment and disposal can be provided; and

(d) subdivision of lots below 10ha generally does not occur.

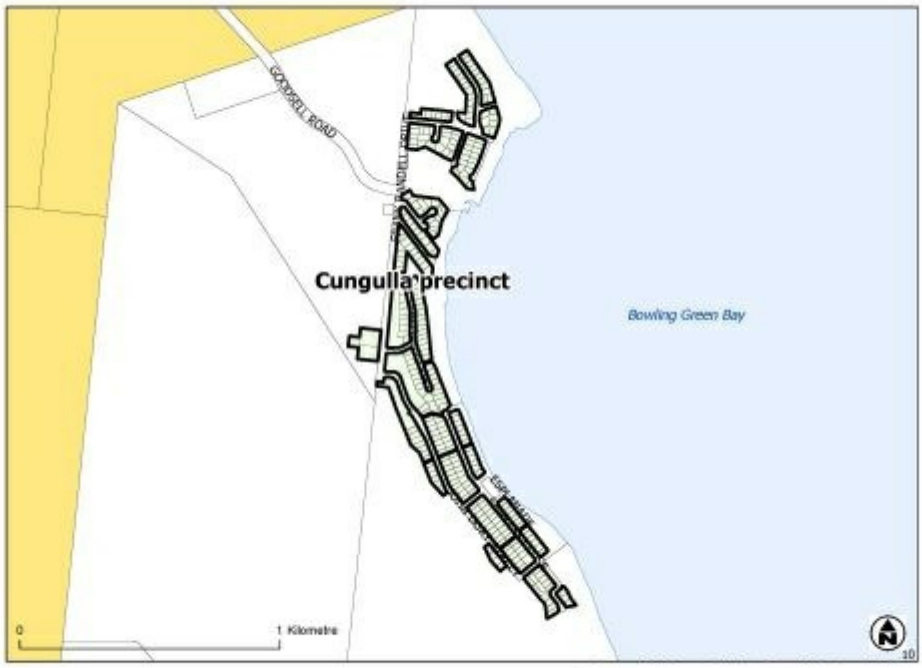

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Figure 6.158 – Cungulla precinct

Jensen precinct:

(a) this precinct contains smaller rural living lots with some potential for cropping;

(b) houses are provided with reticulated water supply, and on-site sewerage treatment and disposal; and

(c) subdivision of lots below 10ha generally does not occur.

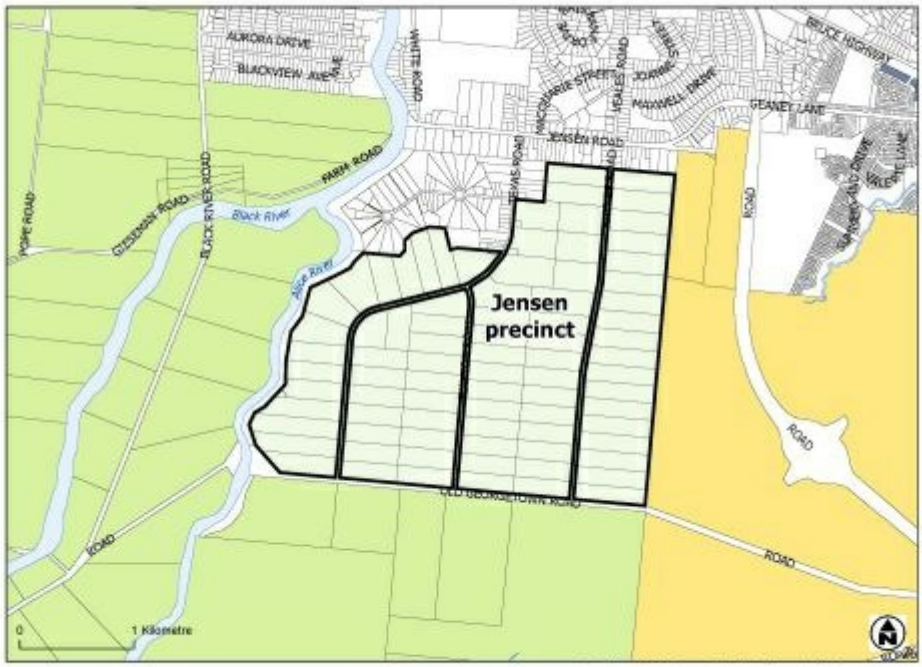

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Figure 6.159 – Jensen precinct

6.6.1.3 Assessment benchmarks

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Editor's note—Dwelling houses may also be accepted development subject to requirements against the Water resources catchment overlay code.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Caretaker's accommodation, community residence or dwelling house	
PO1 Development does not detract from the effective operation of the primary use or the rural landscape character and amenity of site.	**AO1.1** Dwellings are not established on lots less than 1ha in size, other than in the Cungulla precinct.
	AO1.2.1 Where on a lot less than 1ha (in accordance with AO1.1), no more than 1 dwelling is established. OR **AO1.2.2** On lots greater than 1ha, no more than 2 dwellings are established.
PO2 Dwellings have adequate access to basic services to ensure the safety and wellbeing of residents and the protection of water quality and other environmental values.	**AO2** A dwelling: (a) has a legal access to a constructed road; (b) has a legal connection to either: (i) reticulated water supply; or (ii) a water tank with a minimum capacity of 45,000 liters; and (c) if in the Cungulla precinct, does not rely on bore water.
PO3 Dwellings are sufficiently separated from existing lawful activities in the locality in order to protect the safety and amenity of residents and to ensure the ongoing operation of those activities is not prejudiced.	**AO3.1** Dwellings are separated from: (a) an existing or approved intensive animal industry use by at least 1km; (b) an existing or approved extractive industry operation or a resource/processing area shown on overlay map OM-05 by: (i) 500m from a hard rock extractive industry; (ii) 200m from a sand and gravel extractive industry; and (iii) 100m from a haul route used by any existing operation.
	AO3.2 Dwellings are set back from all site boundaries by 20m, other than in the Cungulla precinct where dwellings and ancillary structures are set back a minimum of 6m from front boundaries, 3m from side boundaries where adjoining a road or 1.5m otherwise for side and rear boundaries.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO4 Development does not detract from the effective operation of the primary use or the rural landscape character and amenity of site. **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes GVM (gross vehicle mass), GCM (gross combination mass) or more than 2 tonnes ATM (aggregate trailer mass).	**AO4.1** The home based business does not: (a) require more than the owner and 2 employees on-site at any one time; (b) does not generate more than 14 visitor trips per day, where one trip includes arriving and departing the site. These trips are additional to normal trips associated with the dwelling or rural use; (c) include an area exceeding 20m^2 used for the sale of the goods made on the site; (d) involve hiring out of materials, goods, appliances or vehicles; and (e) involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business or rural use on the site.
	AO4.2 Bed and breakfast or farm stay accommodation does not exceed three bedrooms or three cabins.
PO5 Heavy vehicle parking: (a) has a direct nexus with a home based business or rural use carried out on the site; and (b) does not adversely affect the amenity of neighbouring properties.	**AO5.1** Not more than two heavy vehicles are parked on the site.
	AO5.2 While on-site, vehicles: (a) are not operated between the hours of 10pm and 6am; (b) are not left idling for more than 5 minutes at any one time; and (c) do not have a refrigeration unit running.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Roadside stall	
PO6 Roadside stalls are small in scale and do not impact negatively upon the amenity, character or safety of rural areas and the safety and efficiency of roads.	**AO6.1** Any structure used for the sale of goods or produce is limited to 20m^2 gross floor area.
	AO6.2 Access to the structure is via the primary property access point.
	AO6.3 Produce or goods sold is grown, made or produced on the land on which the road side stall is erected.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Rural industry, community use, wholesale nursery	
PO7 Development does not impact negatively upon the amenity, character or safety of surrounding areas.	**AO7.1** Non-residential buildings, animal enclosures storage facilities and waste disposal areas are set back: (a) 100m from the boundary of any land included in residential zone or the rural residential zone; or (b) 50m from other site boundaries.
	AO7.2 Buildings are set back 20m from any road frontage.
	AO7.3 Building height does not exceed 2 storeys.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General benchmarks	
PO8 Development: (a) is located on the least productive parts of a site; (b) does not restrict the ongoing safe and efficient use of nearby rural uses; and (c) is adequately separated or buffered where it is likely to be sensitive to the operational characteristics associated with rural uses, rural industries, extractive industries or other lawful use.	No acceptable outcome is nominated.
PO9 Tourism-related uses are established only where they are directly associated and compatible with rural production, natural resources or landscape amenity in the immediate vicinity.	No acceptable outcome is nominated.

PO10 Uses that require isolation from urban areas are accommodated only where: (a) they cannot be more appropriately located in an industrial or other relevant zone; (b) they can be adequately separated from sensitive uses (whether or not in the rural zone); (c) they can be adequately separated from land in the Horticulture precinct; and (d) potential impacts can be appropriately managed. **Editor's note—**Applicants seeking approval for intensive animal industries should refer to the *'National Guidelines for Beef Cattle Feedlots in Australia, National Beef Cattle Feedlot Environmental Code of Practice'*, 'Queensland Dairy Farming Environmental Code of Practice', *'National Environmental Guidelines for Piggeries'* and *'Queensland Guidelines Meat Chicken Farms* and that applicants consult with the relevant State government department prior to the lodgement of a development application. For other uses council may require a study that, amongst other matters, identifies how the development is in accordance with Environmental Protection (Air) Policy 1997 or Environmental Protection (Noise) Policy 1997.	No acceptable outcome is nominated.
PO11 Development is designed and managed so that it provides appropriate protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO12 Development does not adversely impact on the character, amenity or scenic values of the locality, having regard to: (a) the scale, siting and design of buildings; (b) the visibility of buildings, structures and infrastructure; (c) likely emissions including water-borne contaminants, noise, dust, lighting and odour; and (d) the nature or volume of traffic generated.	No acceptable outcome is nominated.
PO13 Ecological values, habitat corridors and soil and water quality are protected, having regard to: (a) maximisation of vegetation retention and protection of vegetation from the impacts of development; (b) avoidance of potential for erosion and minimisation of earthworks; (c) retention and protection of natural drainage lines and hydrological regimes; and (d) avoidance of leeching by nutrients, pesticides or other contaminants, or potential for salinity.	No acceptable outcome is nominated.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Horticulture precinct	
PO14 Productive land within this precinct is maintained.	No acceptable outcome is nominated.
PO15 Rural industries are established only where associated with rural production in the immediate vicinity.	No acceptable outcome is nominated.
PO16 Tourist related uses are limited to small-scale bed and breakfast and farm stay which do not detract from the ongoing productive use of the site.	No acceptable outcome is nominated.
PO17 Reconfiguration is limited to protect the ongoing viability of existing and potential horticulture.	**AO17** The minimum lot size in the precinct is 40ha.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Mixed farming precinct	
PO18 Reconfiguration is limited to protect the ongoing viability of existing and potential horticulture uses, water quality and ecological and landscape values.	**AO18** The minimum lot size in the precinct is 40ha, except in the Ross River Dam Catchment area where the minimum lot size is 400ha. **Editor's note—**The Ross River Dam catchment area is depicted on the Water resource catchment overlay map OM-09.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Grazing precinct	
PO19 Development in the vicinity of the Woodstock industry investigation area does not prejudice its future potential for industry.	No acceptable outcome is nominated.
PO20 Reconfiguration is limited to reflect the suitability of the land for primarily grazing purposes and to protect water quality and ecological and landscape values.	**AO20** The minimum lot size in the precinct is 400ha.

Table 6.6.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional benchmarks for assessable development in precincts **Note—**Where acceptable outcomes in this section vary from those provided earlier in this code, the precinct-based acceptable outcomes take precedence.	
Cungulla precinct	
PO21 Development is compatible with the residential amenity of the locality and avoids adverse impacts on surrounding dwellings.	No acceptable outcome is nominated.

6.7 Other zones category

6.7.1 Emerging community zone code

6.7.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.7.1.2 Purpose

(1) The purpose of the Emerging community zone code is to:

- (a) identify land that is suitable for urban purposes and conserve land that may be suitable for urban development in the future;
- (b) manage the timely conversion of non-urban land to urban purposes; and
- (c) prevent or discourage development that is likely to compromise appropriate longer term land use.

(2) The particular purpose of the code is:

- (a) to ensure that future development:
  - (i) creates an integrated and compact urban form;
  - (ii) establishes safe, attractive and walkable communities;
  - (iii) provides for a wide choice of housing, employment and accessible community services; and
  - (iv) avoids areas within the Emerging community zone that are unsuited to urban development because of their natural, scenic or cultural values; and
- (b) to ensure that any development which occurs prior to urbanisation of an area maintains the suitability and capacity for future urban development.

(3) The purpose of the zone will be achieved through the following overall outcomes:

- (a) structure planning of areas within the zone is undertaken in advance of development of the land for urban purposes;
- (b) land is developed in a logical pattern that facilitates the efficient provision of infrastructure;
- (c) a high level of integration with existing and future urban development is achieved having regard to movement networks, open space and recreational facilities, centres and community infrastructure;
- (d) development facilitates the establishment of new residential communities together with an appropriate level of supporting land uses such as centres, industry and community activities;
- (e) residential development provides for a range of housing types and achieves a minimum dwelling yield of 15 dwellings per hectare net;
- (f) movement networks are established to promote active transport (walking and cycling) and public transport;
- (g) development retains and protects significant environmental, topographic, scenic and cultural features and values;
- (h) development provides for sufficient buffering to existing or intended non-urban or incompatible uses in surrounding areas; and
- (i) development which is, or has the potential to become, incompatible with future urban development of the area does not occur.

(4) The purpose of the zone will also be achieved through the following additional overall outcomes for particular precincts.

Burdell precinct:

- (a) creates an identifiable community, which is developed through detailed subdivision design, focused land use provision and clear building requirements;
- (b) provides housing diversity to meet the evolving needs of various household types and lifestyles;

(c) development is integrated and respects the site's character and provides access to open space and community facilities;

(d) provides a defined open space system that protects wetland and riparian environmental values and provides various recreational opportunities;

(e) development facilitates safe and functional access within the precinct and to external connections;

(f) is designed to achieve tropical urban design outcomes;

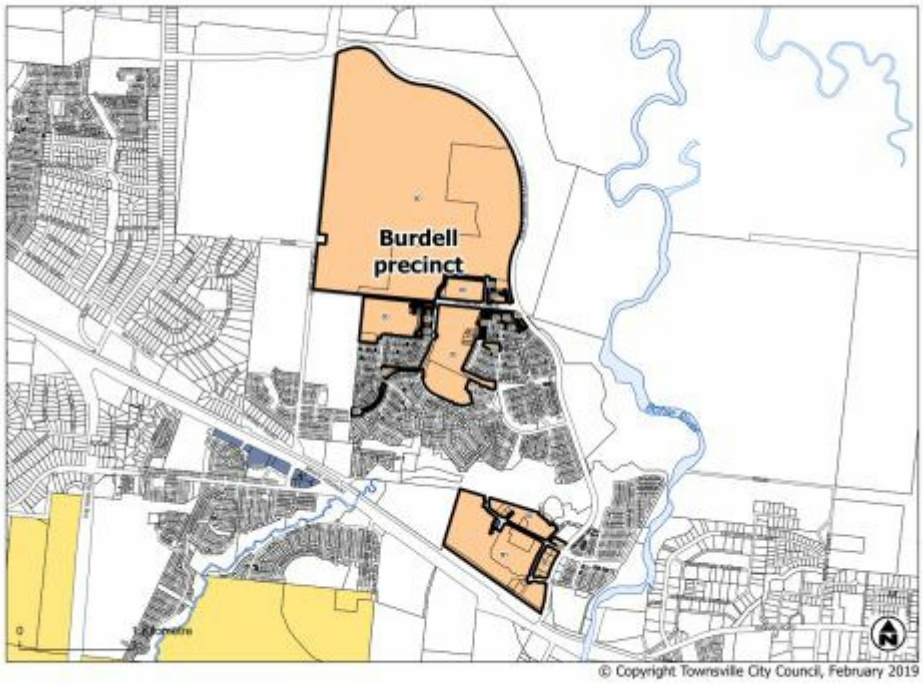
(g) is developed for community and commercial facilities to:

(A) service the residents of the precinct, residents of the region, and the travelling public; and

(B) ensure that residential amenity is not detrimentally affected;

(h) provides for an integrated linear open space system along the major drainage paths with linkages to the Bohle River; and

(i) provides for innovative development over the life of the development of the precinct area, to account for technological development and changing patterns in the community.



Click here to view high resolution PDF.

Figure 6.160 - Burdell precinct

6.7.1.3 Assessment benchmarks

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Home based business	
PO1 The use does not adversely impact on the amenity of the surrounding residential land uses and local character.	**AO1.1** The home based business: (a) is carried out in an existing building or structure; (b) does not use more than 60m² of the gross floor area of the building or structure; (c) involves at least one or more residents of the dwelling house; (d) involves not more than one non-resident employee; (e) where bed and breakfast or farm stay accommodation does not exceed three bedrooms or cabins; (f) does not generate more than 1 heavy vehicle trip per week; **Editor's note—**A heavy vehicle is a vehicle with more than 4.5 tonnes gross vehicle mass. (g) does not generate more than 14 vehicle trips per day by other vehicles, where one trip includes arriving and departing the site. These trips are additional to normal domestic trips associated with the dwelling; (h) contains visitor parking within the site; (i) does not involve hiring out of materials, goods, appliances or vehicles; and (j) does not involve the repair or maintenance of vehicles, other than minor maintenance of vehicles used in conjunction of the home business on the site. **Editor's note—**home based business operators should also refer to signage requirements under Table 5.8.2 -Operational work being placing an advertising device on a premises and Section 9.3.1-Advertising devices code.
	AO1.2 Functional aspects of the use such as service areas, material storage or use activities are not visible from the street.
	AO1.3 Other than where a bed and breakfast, farm stay or home based childcare, the business use does not operate outside the hours of 8am to 5pm Monday to Friday, 8am to 2pm Saturday and does not operate on Sunday.
	AO1.4 Noise levels do not exceed acoustic quality objectives under the Environmental Protection (Noise) Policy 2008.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Sales office	
PO2 The use does not adversely impact on the amenity of the surrounding land uses and local character.	**AO2** Development of the sales office is in place for no more than five years.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Interim land uses	
PO3 Development does not reduce or preclude the long-term use of the site or nearby land for urban purposes, having regard to the scale and nature of the activity and its likely impacts, and would not compromise the implementation of a future structure plan over the site.	No acceptable outcome is nominated.

Table 6.7.1.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Creating new communities	
PO4 New development of an urban nature: (a) contributes to a logical pattern and sequence of development; (b) facilitates efficient use of land and infrastructure; (c) facilitates integration with existing and future urban development, having regard to movement networks, open space networks and accessibility to community infrastructure; (d) provides accessibility for all modes of transport including pedestrian, cyclist, public transport and private car; (e) creates clear, direct pedestrian and cycle access to centres, local parks and public transport stops; (f) achieves an average net residential density of at least 15 dwellings per hectare; (g) locates higher density residential development in and around centres, along connector streets and close to transit nodes; (h) locates community facilities requiring high levels of accessibility within or adjoining centres; (i) responds to constraints and natural values on the site and avoids or minimises any impacts on areas of environmental significance; (j) facilitates integrated water cycle management; (k) orients major streets and vistas to landmarks; (l) provides a road network with a capacity adequate for current and future demand; (m) does not increase hazard or risk to existing or future residents; and (n) provides an open space network suitable for current and future needs.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.
PO5 Emerging communities are provided with the range of supporting services and uses, including those that provide local employment opportunities, that: (a) are commensurate to the size of the relevant emerging community; (b) do not detract from planning scheme intentions for other parts of the city; and (c) are planned as an integrated and compatible component of the emerging community they serve.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.

PO6 New centres are designed to create: (a) a coherent and integrated built form, public realm and circulation networks; (b) central, accessible and attractive public spaces for people to congregate and interact; (c) continuity of streetscape and landscape characteristics; (d) pedestrian friendly and visually interesting frontages to streets and public spaces; (e) active primary frontages with parking areas sleeved by buildings; (f) optimum energy efficiency; (g) a well-integrated mix of uses; (h) connectivity of pedestrian and cyclist paths and spaces internal and external to the centre; (i) connectivity to public transport services; and (j) sensitive transitioning to surrounding land and uses.	No acceptable outcome is nominated. **Editor's note—** Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code.
PO7 Where centre development is proposed, development is consistent with the centres hierarchy and does not compromise the intended role or successful functioning of other centres in the network. The growth of floor space within centres is balanced with anticipated growth within their primary catchment and does not substantively impact on the trading of other centres for an extended period of time or unduly undermine the potential for another centre to expand into its intended role.	No acceptable outcome is nominated. **Editor's note—**Emerging community planning scheme policy no. SC6.6 provides guidance to applicants on expected structure planning processes to facilitate development that complies with this code and Section 9.3.4 Reconfiguring a lot code. **Editor's note—** Applicants should have regard to Economic impact assessment planning scheme policy SC6.5 for guidance on how to demonstrate compliance with this performance outcome.

Table 6.7.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For assessable development	
Crime prevention through environmental design	
PO8 Development facilitates the security of people and property having regard to: (a) opportunities for casual surveillance and sight lines; (b) exterior building design that promotes safety; (c) adequate lighting; (d) appropriate signage and wayfinding; (e) minimisation of entrapment locations; and (f) building entrances, loading and storage areas that are well lit and lockable after hours. **Editor's note—**Applicants should have regard to Crime Prevention through Environmental Design Guidelines for Queensland.	No acceptable outcome is nominated.

Table 6.7.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Burdell precinct	
PO9 A site is to be suitable in size and configuration for the intended use.	**AO9** A variety of lot sizes and configurations are provided to facilitate a well-connected master planned community.

6.7.2 Special purpose zone code

6.7.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

6.7.2.2 Purpose

(1) The purpose of the Special purpose zone code is to facilitate industrial development that is of regional, state and national significance.

(2) The particular purpose of the code is to:

- (a) recognise and facilitate reconfiguration of land in the Townsville State Development Area;
- (b) protect the area's suitability for industrial development and the expansion of existing industrial uses;
- (c) facilitate and maintain linkages to the Port of Townsville and major freight routes;
- (d) protect environmental values in the Townsville State Development Area; and
- (e) ensure development minimises impacts on the amenity of nearby sensitive land uses.

Editor's note—Material change of use applications in the Townsville State Development Area are administered by the Coordinator-General through the Development Scheme for the Townsville State Development Area. In this area, only development applications for reconfiguration of a lot and operational works will be assessed by Townsville City Council.

(3) The purpose of the code will be achieved through the following overall outcomes:

- (a) the Townsville State Development Area accommodates a wide range of large-scale industry uses, particularly those which support or have a nexus with the Port of Townsville and minerals processing;
- (b) other non-industrial uses are those which are ancillary to or directly support the industrial functions of the area, and are limited in extent;
- (c) the intrusion of incompatible uses, or uses which may be more appropriately accommodated in other zones, is avoided to protect the availability of land for industrial purposes and the viability and efficient operation of existing and future industry uses;
- (d) the impacts of development are managed to ensure public health and safety;
- (e) development avoids significant adverse effects on water quality and the natural environment;
- (f) development does not adversely affect the safe and efficient operation of Department of Defence landholdings;
- (g) development is safe and legible, and designed to establish safe and efficient movement systems;
- (h) lot sizes provide for a range of large format industrial uses and discourage take up of land for smaller scale activities better suited to other zones;
- (i) development makes a positive contribution to the public domain, particularly along major roads;
- (j) opportunities for energy efficiency through groupings and relationships between industries are accommodated where possible; and
- (k) development is adequately serviced by infrastructure and maximises the efficient use of existing and planned infrastructure.

6.7.2.3 Assessment benchmarks

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
General	
PO1 The site layout and design: (a) minimises earthworks; (b) maximises retention of natural drainage patterns; and (c) ensures existing drainage capacity is not reduced.	**AO1** Development does not involve: (a) earthworks involving more than 100m^3; and (b) any changes to existing drainage lines and wetlands.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Defence land	
PO2 Development does not adversely affect the safe and efficient operation of nearby Department of Defence land.	**AO2** All buildings and operational components of a use are setback not less than 100m from the closest boundary of land in the control of or used by the Department of Defence.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Uses	
PO3 Development does not significantly detract from the availability or utility of land for industrial purposes.	No acceptable outcome is nominated.

Table 6.7.2.3 - Assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Community and environmental risk	
PO4 Development is designed and managed so that it provides protection for community health and safety, and avoids unacceptable risk to life and property.	No acceptable outcome is nominated.
PO5 The site layout and design minimises impacts of on-site and surrounding drainage patterns and ecological values by: (a) maximising retention of natural drainage patterns; (b) ensuring existing drainage capacity is not reduced; (c) maximising the retention or enhancement of existing vegetation and ecological corridors; and (d) providing buffers to protect the ecological functions of waterways.	No acceptable outcome is nominated.

Part 7 Local plans

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Part 8 Overlays

8.1 Preliminary

(1) Overlays identify areas in the planning scheme that reflect state or local level interests and that have one or more of the following characteristics:

(a) there is a particular sensitivity to the effects of development;

(b) there is a constraint on land use or development outcomes;

(c) there is the presence of valuable resources; and

(d) there are particular opportunities for development.

(2) Overlays are mapped and included in Schedule 2.

(3) The changed category of development and assessment, if applicable, for development affected by an overlay are stated in Part 5.

(4) Some overlays may be included for information purposes only. This will not result in a change to the category of development and assessment or any additional assessment benchmarks.

(5) Assessment benchmarks for an overlay may be contained in one or more of the following:

(a) a map for an overlay;

(b) a code for an overlay;

(c) a zone code; and

(d) a development code.

Editor's note—In this planning scheme all assessment benchmarks for an overlay are contained in an overlay code.

(6) Where development is proposed on premises partly affected by an overlay, the assessment benchmarks for the overlay only relate to the part of the premises affected by the overlay.

(7) The overlays for the planning scheme are:

(a) Airport environs overlay;

(b) Bushfire hazard overlay;

(c) Coastal environment overlay;

(d) Cultural heritage overlay;

(e) Extractive resources overlay;

(f) Flood hazard overlay;

(g) Landslide hazard overlay;

(h) Natural assets overlay; and

(i) Water resource catchment overlay.

(8) The following overlays for the planning scheme are for information purposes only:

(a) Infrastructure noise corridors overlay.

Editor's note—The Infrastructure noise corridors identify land affected by transport noise in accordance with Chapter 8B of the *Building Act 1975*. In these areas building work will be assessable against the Queensland Development Code Part 4.4 – Buildings in a Transport Noise Corridor.

8.2 Overlay codes

8.2.1 Airport environs overlay code

8.2.1.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Airport environs overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.1.2 Purpose

(1) The purpose of the Airport environs overlay code is to ensure the safe and efficient operations of the airport, RAAF base and aviation facilities are protected.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) development avoids adversely affecting the safety and efficiency of an airport's operational airspace or the functioning of aviation facilities;

(b) large increases in the numbers of people adversely affected by significant aircraft noise are avoided; and

(c) development does not increase the risk to public safety near airport runways.

8.2.1.3 Assessment benchmarks

Table 8.2.1.3 - Accepted development subject to requirements and assessable development (Part)

Editor's note—This code will apply to accepted development subject to requirements as well as assessable development.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Operational airspace (overlay map OM-01.1)	
PO1 Development does not involve permanent or temporary physical obstructions that will adversely affect the airport's operational airspace area identified on overlay map OM-01.1. **Editor's note—**The *Defence (Areas Control) Regulation* (DACR) is a Commonwealth regulation under the *Defence Act 1903*. Development in the area covered by this regulation which exceeds certain heights will require a separate assessment process under Regulation 8 of the DACR by the Department of Defence. The Department of Defence also requires that all tall structures (30m high within 30km of the airport and 45m high elsewhere) are registered by forwarding "as constructed" information to Airservices Australia at the following email address: vod@airservices.com.	**AO1.1** Development involving a permanent or temporary building, structure or landscaping does not enter operational airspace areas identified on overlay map OM-01.1. **Editor's note-**Alternative heights which enter the operational airspace areas may be possible. In particular, building heights which meet the acceptable outcomes for a particular zone or precinct under this planning scheme. However, applicants should note the requirement for assessment under the Defence (Areas Control) Regulation (DACR) for development which exceed AO1 above.
	AO1.2 Development on land within the area identified on overlay map OM-01.1 as operational airspace areas does not involve transient intrusions within the operational airspace.
PO2 Emissions do not significantly affect air turbulence, visibility or aircraft engine operation in the airport's operational airspace area identified on overlay map OM-01.1.	**AO2** Development does not generate: (a) a gaseous plume with a velocity exceeding 4.3m per second; or (b) smoke, dust, ash or steam that will penetrate operational airspace areas identified on overlay map OM-01.1.

Table 8.2.1.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Wildlife hazard buffer zones (overlay map OM-01.2)	
PO3 Development does not attract a significant number of flying vertebrates, such as birds and bats, into areas identified on overlay map OM-01.2.	**AO3.1** Within 13km of airport runways, development does not involve a putrescible waste disposal facility.
	AO3.2 Within 8km of airport runways, development does not involve: (a) aquaculture; or (b) food handling or processing of an industrial nature; or (c) stock handling or slaughtering; or (d) pig production; or (e) fruit production; or (f) turf production; or (g) the keeping or protection of wildlife outside enclosures.
	AO3.3 Within 3km of airport runways, development does not involve: (a) the keeping, handling or racing of horses; or (b) outdoor dining, food handling or food consumption.

Table 8.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Public safety areas (overlay map OM-01.2)	
PO4 A significant increase in the numbers of people living, working or congregating in public safety areas identified on overlay map OM-01.2 is avoided.	**AO4** Within a public safety area identified on overlay map OM-01.2, development does not involve the following: (a) residential uses; or (b) a new building or an increase in the gross floor area of an existing building accommodating a non-residential use, other than an industrial use; or (c) any activities involving the manufacture or bulk storage of hazardous or flammable materials.

Table 8.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Aviation facilities (overlay map OM-01.3)	
PO5 Development within the area identified on overlay map OM-01.3 is located and designed to protect the function of aviation facilities from physical obstructions, electrical or electromagnetic interference and deflection of signals.	**AO5.1** No building, structures or other works which exceed 7.9m in height are located between 150m and 500m of non-directional beacon (NDB) site (as depicted on overlay map OM-01.3).
	AO5.2 Within the buffer area of the Townsville Airport distance measuring equipment (DME) site (as depicted on overlay map OM-01.3), no building, structure or other works involving a change to, or a physical projection above, the ground level are located: (a) within 115m of the DME site; or (b) between 115m and 230m of the DME site if exceeding 1m in height; or (c) between 230m and 500m of the DME site if exceeding 2m in height; or (d) between 500m and 1,000m of the DME site if exceeding 4m in height; or (e) between 1,000m and 1,500m of the DME site if exceeding 8.5m in height.
	AO5.3 Within the buffer area of the Townsville Airport VHF omni-directional radio range (VOR) site (as depicted on overlay map OM-01.3): (a) no building, structures or other works involving a change to, or a physical projection above, the ground level are located within 300m of the site; and (b) the following are not located between 300m and 1,000m of the site: (i) fences exceeding 2.5m in height; or (ii) overhead lines exceeding 5m in height; or (iii) metallic structures exceeding 8m in height; or (iv) trees and open lattice towers exceeding 10m in height; or (v) wooden structures exceeding 13m in height.

	AO5.4 Within the buffer area of the Townsville Airport Glidepath site (as depicted on overlay map OM-01.3), no building, structures or other works involving a change to, or a physical projection above, the ground level are located between: (a) 700m and 1,000m of the site if exceeding 6m in height; or (b) 1,000m and 1,500m of the site if exceeding 8.7m in height.
	AO5.5 Within the buffer area of the Townsville Airport middle marker site (as depicted on overlay map OM-01.3, no buildings, structures or other works involving a change to, or a physical projection above, the ground level occurs that exceed 20m in height.
	AO5.6 No buildings, fences or landscaping are established within the buffer area of the Townsville Airport localiser (as depicted on overlay map OM-01.3).

Table 8.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	**Acceptable outcomes**
For accepted development subject to requirements and assessable development	
Australian noise exposure forecast contours (overlay map OM-01.4)	
PO6 Development within the area identified on overlay map OM-01.4 is compatible with forecast levels of aircraft noise unless there is an overriding need in the public interest and there is no reasonable alternative site available for the use. **Editor's note—**Where the acceptable outcomes cannot be met, an appropriately qualified acoustic practitioner may be required to be engaged in order to demonstrate compliance with this performance outcome.	**AO6.1** Above the 25 ANEF contour (as depicted on overlay map OM-01.4), development does not involve the following: (a) child care centre; (b) educational establishment; or (c) hospital.
	AO6.2 Above the 30 ANEF contour (as depicted on overlay map OM-01.4), development does not involve a community use or community care centre.
	AO6.3 Above the 35 ANEF contour areas (as depicted on overlay map OM-01.4), development does not involve residential uses.
	AO6.4 The siting and design of any building is in accordance with Australian Standard AS2021 and Australian Standard AS/NZS2107.

Table 8.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Lighting area buffer zones (overlay map OM-01.5)	
PO7 Development within the area identified on overlay map OM-01.5 does not involve external lighting or reflective surfaces that could distract or confuse pilots. **Editor's note—**The standards specified in CASA Guidelines: Lighting in the vicinity of aerodromes: Advice to lighting designers, may be used to demonstrate compliance with this performance outcome.	**AO7.1** Development within the 6km radius shown on overlay map OM-01.5 does not involve: (a) straight parallel lines of lighting 500m to 1000m long; or (b) lighting which extends more than 3 degrees above the horizon; or (c) flare plumes; or (d) buildings with reflective cladding; or (e) upward-shining lights; or (f) flashing lights; or (g) sodium lights.
	AO7.2 In zone A shown on overlay map OM-01.5, lighting does not exceed 0 candela.
	AO7.3 In zone B shown on overlay map OM-01.5, lighting does not exceed 50 candela.
	AO7.4 In zone C shown on overlay map OM-01.5, lighting does not exceed 150 candela.
	AO7.5 In zone D shown on overlay map OM-01.5, lighting does not exceed 450 candela.

8.2.2 Bushfire hazard overlay code

8.2.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Bushfire hazard overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.2.2 Purpose

(1) The purpose of the Bushfire hazard overlay code is to ensure that development does not:

- (a) increase the extent or the severity of bushfire hazard; or
- (b) increase the risk to life, property, community and the environment.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) development is compatible with the nature of the bushfire hazard except where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal;
- (b) where development is not compatible with the nature of the bushfire hazard and there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal; and
- (c) wherever practicable, facilities with a role in emergency management and vulnerable community services are located and designed to function effectively during and immediately after bushfire hazard events.

8.2.2.3 Assessment benchmarks

Table 8.2.2.3 - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
General — all development **Editor's note —** Applicants should also refer to the Mitigating bushfire hazard planning scheme policy no. SC6.8 for additional information.	
PO1 Development maintains the safety of people and property.	No acceptable outcome is nominated.
PO2 Highly vulnerable development does not occur in high hazard areas unless there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal.	**AO2** The following uses are not located in a high bushfire hazard area: (a) child care centre; or (b) detention facility; or (c) educational establishment; or (d) emergency services; or (e) hospital; or (f) industry activities involving manufacture or storage of hazardous materials in bulk; or (g) multiple dwelling; or (h) residential care facility; or (i) retirement facility; or (j) relocatable home park; or (k) rooming accommodation; or (l) shopping centre; or (m) short-term accommodation; or (n) telecommunications facility; or (o) tourist park; or (p) tourist attraction; or (q) transport depot; or (r) utility installation.
PO3 Development mitigates the risk of bushfire hazard through the siting and design of the development. **Editor's note—**In demonstrating compliance with this performance outcome, applicants should be aware that setbacks and buffers for fire management purposes are in addition to any buffers or setbacks required for ecological purposes and are located outside of areas of ecological significance to the greatest extent possible.	No acceptable outcome is nominated.
PO4 Development provides for an adequate and accessible water supply for firefighting purposes.	**AO4.1.1** The development is connected to a reticulated water supply where within a water supply area. OR **AO4.1.2** Where outside a water supply area a tank water supply is provided, at least one tank is within 100m of a class 1, 2, 3 or 4 building which has fire brigade fittings. **Editor's note -** Applicant should also refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.11 On site water supply for additional information.

PO5 Public safety and the environment are not adversely affected by the detrimental impacts of bushfire on hazardous materials manufactured or stored in bulk.	**AO5** Development does not involve the manufacture or storage of hazardous materials within a high or medium bushfire hazard area as identified on overlay map OM-02.
PO6 Facilities with a role in emergency management and vulnerable community services are able to function effectively during and immediately after bushfire events.	No acceptable outcome is nominated.
PO7 Additional lots are not created in bushfire hazard areas.	**AO7** Development does not involve the creation of additional lots in areas mapped as high or medium hazard on overlay map OM-02.
PO8 Development is designed to allow for efficient emergency access to buildings for firefighting appliances, including by avoiding long, narrow access arrangements.	No acceptable outcome is nominated.
PO9 Development provides a fire break which also facilitates adequate access for firefighting and emergency vehicles, and safe evacuation.	**AO9.1** Lot boundaries and development sites are separated from hazardous vegetation by a distance of 20m where adjacent to high hazard areas and 10m where adjacent to medium hazard.
	AO9.2 The separation area mentioned in AO9.1 contains a fire access trail that: (a) has a minimum cleared and formed width of 6m; (b) has vehicular access at each end; (c) provides passing bays and turning areas for fire-fighting appliances; and (d) are either located on public land, or within an access easement that is granted in favour of council and QFRS.
	AO9.3 Roads and trails: (a) have a maximum gradient of 12.5%; and (b) do not involve a cul-de-sac. **Editor's note—**Applicants should also be aware that Part 9 of the planning scheme sets out additional requirements for the construction of roads and other operational works associated with reconfiguration.

8.2.3 Coastal environment overlay code

8.2.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Coastal environment overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.3.2 Purpose

(1) The purpose of the Coastal environment overlay code is to ensure development in the coastal zone is planned, designed, constructed and operated to:

(a) avoid risk to people and property from coastal hazards, including storm tide inundation and coastal erosion, and taking into account the predicted effects of climate change; and

(b) manage the coast to protect coastal resources and allow for the natural fluctuations of coastal processes as far as possible.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) the foreshore and foreshore ecosystems are protected and managed to maintain their protective functions and allow for natural fluctuations to continue as far as possible;

(b) the exposure of communities and development to coastal hazards is minimised;

(c) urban and rural residential development does not expand into coastal hazard areas beyond areas zoned for urban and rural residential purposes;

Editor's note—To remove any doubt areas zoned for urban purposes includes the Emerging community zone.

(d) in areas zoned for urban and rural residential purposes and located in a coastal hazard area, the risks of storm tide inundation and erosion are avoided, or are mitigated and managed;

(e) opportunities for sustainable coastal-dependent development are protected;

(f) coastal-dependent development is undertaken in a manner that minimises impacts on coastal resources;

(g) public access to the foreshore is maintained and enhanced for current and future generations; and

(h) wherever practicable, facilities with a role in emergency management and vulnerable community services are located and designed to function effectively during and immediately after coastal hazard events.

8.2.3.3 Assessment benchmarks

Table 8.2.3.3(a) -Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements	
Development in coastal hazard areas	
PO1 Development is designed and located to minimise susceptibility to, and the potential impacts of, storm tide inundation and erosion. **Editor's note—**Applicants must be aware that in some areas flood hazard areas will also co-exist with storm tide hazard areas. In these instances, the floor levels and other design responses will need to be sufficient to comply with both this code and the *Building Regulation 2006*.	**AO1.1** Floor levels of all habitable rooms are above the defined storm tide event level. **Editor's note—**For Townsville the defined storm tide event level can be taken as RL 4.5m AHD, within 100m of the coastline or RL 3.9m AHD in other areas.
	AO1.2 Underground parking is designed to prevent the intrusion of storm tide waters by the incorporation of a bund above the defined storm tide event level.
	AO1.3 Buildings have open ground floors that allow for the flow through of storm tide water and buildings are not designed as slab on ground.

	AO1.4 Buildings are located outside the erosion prone area or where this would be impractical, do not extend any further seaward than existing immediately adjacent buildings.

Table 8.2.3.3(a) -Accepted development subject to requirements and assessable development (Part)

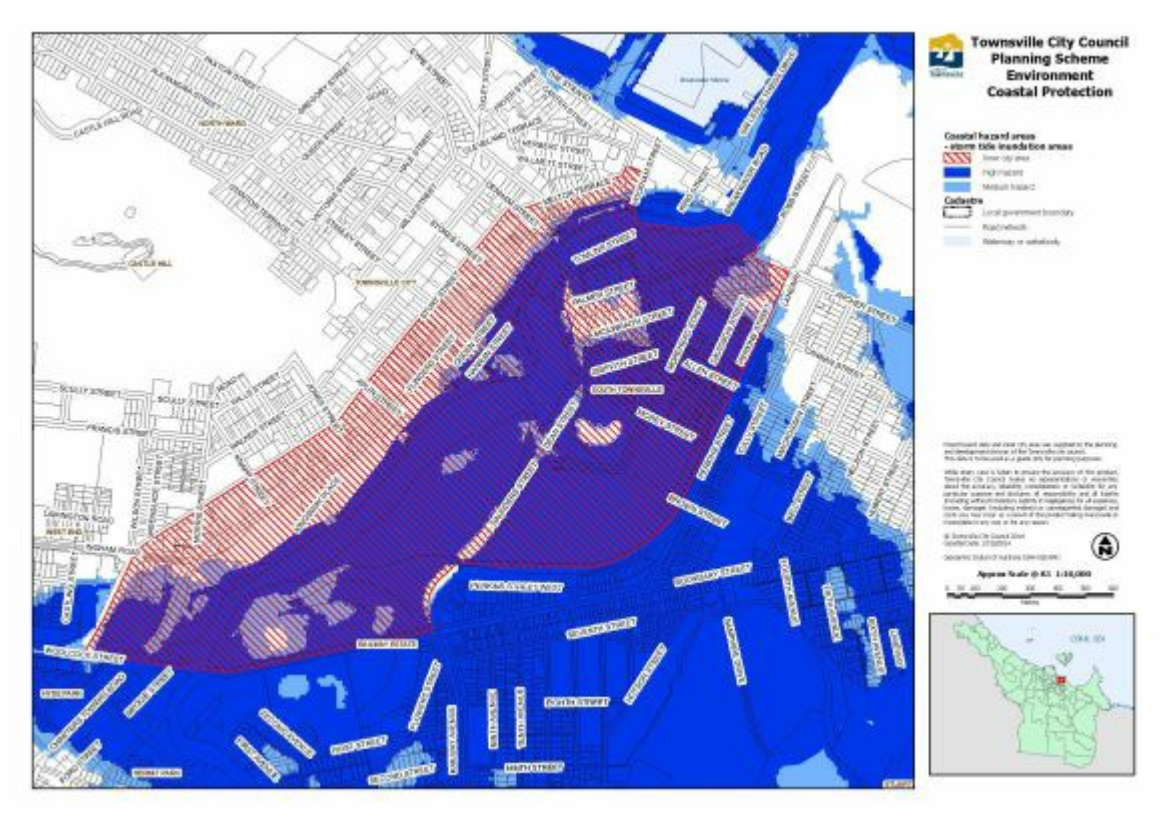
Performance outcomes	Acceptable outcomes
For assessable development	
Development in coastal hazard areas - erosion prone area	
PO2 Development locates outside erosion-prone areas identified on overlay map OM-03.3, apart from: (a) temporary or relocatable structures for safety and recreational purposes; or (b) development that does not intensify the extent of existing development within the erosion prone area; or (c) development that does not extend any further seaward than the existing adjacent buildings.	No acceptable outcome is nominated.
PO3 Development mitigates any increase in risk to people and property from adverse coastal-erosion impacts, avoiding the need for coastal protection works as far as practicable, having regard to: (a) minimising the footprint of the development of the part within the erosion prone area and locating the development as far landward as possible; (b) the practical design life of the development in the context of future erosion threat; (c) the ability for buildings or structures to be decommissioned, dis-assembled or relocated either on the site or to another site; and (d) use of appropriate foundations for the building or structure.	No acceptable outcome is nominated.
PO4 Where used, coastal protection works are: (a) consistent with a shoreline erosion management plan that has been prepared for the area; or (b) in response to a demonstrated need to protect existing permanent structures from an imminent threat of coastal erosion, if abandonment or relocation of the structures is not feasible, and a relevant shoreline erosion management plan has not been prepared.	No acceptable outcome is nominated.

PO5 Coastal erosion is mitigated by: (a) beach nourishment undertaken in accordance with a program of nourishment works; or (b) the construction of an erosion control structure where it is demonstrated that installing an erosion control structure is the only feasible option for protecting existing permanent structures from an imminent threat of coastal erosion at the location. **Editor's note—**Where a shoreline erosion management plan has not been prepared and coastal protection work is required to protect existing structures from coastal erosion threats, beach nourishment is favoured in preference to erosion control structures, such as seawalls and groynes. The location and materials for beach nourishment works are to ensure the natural characteristics and landform of the beach or foreshore is maintained. Applications involving erosion control structures must demonstrate the consideration of beach nourishment techniques and include a statement of why nourishment (in whole or part) has not been adopted as the preferred means of controlling the erosion risk.	No acceptable outcome is nominated.
PO6 Any development using erosion control structures to protect private property from threat of coastal erosion ensures: (a) erosion control structures are located wholly on private land; and (b) physical coastal processes outside the area subject to the coastal protection work are maintained. **Editor's note—**Applications for coastal protection work must be supported by a report certified by a registered professional engineer with coastal engineering experience that demonstrates how the engineering solution sought by the work will be achieved.	No acceptable outcome is nominated.

Table 8.2.3.3(a) - Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Development in coastal hazard areas — storm tide inundation areas	
PO7 Development is located outside high or medium storm tide inundation areas and erosion areas from sea level rise identified on overlay maps OM-03.1 and OM-03.2 unless it: (a) does not result in an increase in the intensity of development on the site; or (b) is located within the inner city area shown on Figure 8.1 — Coastal hazard areas: storm tide inundation areas and provides measures to ensure critical services remain operational up to the defined storm tide event; or (c) avoids any increase in risk to people or property from coastal hazard impacts (including impacts on the development's ongoing operation).	No acceptable outcome is nominated.
PO8 Development in storm tide inundation areas and erosion areas from sea level rise identified on overlay maps OM-03.1-OM-03.2 is located, designed, constructed and operated to: (a) ensure structures can sustain flooding from a defined storm tide event; and (b) maintain the safety of people living and working on the premises from a defined storm tide event.	**AO8.1** Development within a high or medium storm tide inundation area identified on overlay maps OM-03.1-OM-03.2 ensures: (a) habitable rooms of built structures are located above the defined storm tide event level; (b) underground parking is designed to prevent the intrusion of flood waters by the incorporation of a bund above the defined storm tide event level; and (c) where reconfiguring a lot, at least one evacuation route remains passable for emergency evacuations during a defined storm tide event. **Editor's note—**For Townsville the defined storm tide event level can be taken as RL 4.5m AHD, within 100m of the coastline or RL 3.9m AHD in other areas.
	AO8.2 Structures used for the manufacture or storage of hazardous materials in bulk are designed to prevent the intrusion of waters from a defined storm tide event.
PO9 Facilities with a role in emergency management and vulnerable community services are located, designed and constructed to ensure it is able to function during and after a storm tide inundation event.	**AO9.1** Development is either: (a) located in an area that is above the storm tide event level specified for that activity in table 8.2.3.3(b); or (b) designed to ensure any components of the infrastructure that are likely to fail to function or may result in contamination when inundated by storm tide inundation are above the storm tide event level for that activity in table 8.2.3.3(b).

	AO9.2 Emergency services and shelters, police facilities and hospitals, and associated facilities have an emergency rescue area above the storm tide event level specified for that infrastructure in table 8.2.3.3(b).



Click here to view PDF high resolution map.

Figure 8.1 - Coastal hazard areas: storm tide inundation areas

Table 8.2.3.3(a) -Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Public access	
PO10 Development maintains or enhances safe and convenient public access to the foreshore.	No acceptable outcome is nominated.

Table 8.2.3.3(a) -Accepted subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Canals and artificial waterways	
PO11 Development that involves the construction of canals or artificial waterways connected to tidal water (either directly or indirectly) does not adversely affect coastal resources and their values.	No acceptable outcome is nominated.
PO12 The design, location, construction and operation of artificial tidal waterways are to maintain the tidal prism volume of the natural waterway to which it is connected.	No acceptable outcome is nominated.

Table 8.2.3.3(b)-Storm tide event levels for essential community services and facilities

Development	Level of immunity annual exceedance probability (AEP)
Development involving: (a) hospitals and associated facilities; or (b) major electricity infrastructure.	0.2% AEP event
Development involving: • emergency/evacuation shelters; or • fire and police stations; or • the storage of valuable records or items of historic or cultural significance (e.g. libraries, galleries); or • aeronautical facilities; or • telecommunication facilities; or • substations; or • water treatment plants; or • regional fuel storage; or • food storage warehouse; or • retirement facility and residential care facility.	0.5% AEP event
Development involving sewerage treatment plants requiring licensing as an environmentally relevant activity.	1% AEP event

8.2.4 Cultural heritage overlay code

8.2.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Cultural heritage overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

Editor's note—Places of cultural heritage significance are identified in Schedule 7, as well as on overlay maps OM-04.1, OM-04.2. OM-04.3 and OM-04.4.

8.2.4.2 Purpose

(1) The purpose of the Cultural heritage overlay code is to ensure:

- (a) the cultural heritage of Townsville continues to be a major contributor to the identity of the city and local communities;
- (b) the cultural heritage of Townsville is conserved for present and future communities;
- (c) development is consistent with the Burra Charter;
- (d) new development reflects and respects cultural heritage significance; and
- (e) places of cultural heritage significance are appropriately re-used.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) places having cultural heritage significance in Townsville are conserved;
- (b) change is managed to ensure significant heritage features and values of a place are retained;
- (c) any demolition, removal or relocation of a heritage place does not have an adverse impact on the heritage significance of that place;
- (d) development on or adjoining a heritage place does not detract from the cultural heritage significance of the heritage place and its cultural heritage values;
- (e) development on or adjoining a heritage place is visually subservient to the heritage place and does not cause adverse impacts on significant views or the visual setting of the heritage place;
- (f) development on or adjoining a place of cultural heritage significance incorporates features which complement rather than replicate the heritage place;
- (g) restoration or reconstruction of known earlier states of heritage places is encouraged where practical; and
- (h) places of Aboriginal and Torres Strait Islander cultural heritage significance are conserved and managed in a culturally appropriate way.

Editor's note—Cultural heritage planning scheme policy no. SC6.3 will provide applicants with guidance in meeting the requirements of this code.

Editor's note—Council's process for adding or removing a place within Schedule 7 Places of cultural heritage value is stated in the Cultural heritage planning scheme policy SC6.3.

8.2.4.3 Assessment benchmarks

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Demolition or removal of, or within, a heritage place	
PO1 The removal or partial or total demolition, or relocation of a building or structure that is a heritage place only occurs if it can be demonstrated that the: (a) loss of the building or structure will not contribute to the loss of cultural heritage values; and (b) building or structure is not capable of structural repair.	No acceptable outcome is nominated. **Editor's note—**A heritage impact statement produced by a suitably qualified professional will be required to demonstrate there is no adverse impact on the cultural heritage significance of the place, and a suitably qualified professional provides a report on the building's condition, demonstrating that the place is not capable of repair. **Editor's note—** Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on writing a Heritage Impact Statement.
PO2 When demolition or relocation of a heritage place occurs, appropriate archival recording is undertaken.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on the archival recording of heritage places, with which the action should be consistent.

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Development within a heritage place	
PO3 Development is sympathetic to, and consistent with the significant features and values of the heritage place, including: (a) maintaining significant views to and from the heritage place; (b) built form and setback; (c) scale; and (d) open space and landscaping features.	No acceptable outcome is nominated. **Editor's note—**A heritage impact statement produced by a suitably qualified professional will be required to demonstrate there is no adverse impact on the cultural heritage significance of the place, and any change will be effectively managed. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on writing a Heritage Impact Statement.
PO4 New buildings within a heritage place are visually subservient to the cultural heritage significance of the heritage place.	No acceptable outcome is nominated. **Editor's note—**A heritage impact statement produced by a suitably qualified professional may be required to demonstrate compliance with this performance outcome. Cultural heritage planning scheme policy no. SC6.3 provides guidance on how to write a heritage impact statement. It also sets out relevant parts of the Burra Charter. **Editor's note—**A proposed development should be designed by a suitably qualified architect or a building designer with demonstrated relevant experience.
PO5 Development incorporates compatible elements which complement rather than reproduce traditional building forms and details in terms of: (a) architecture; (b) scale; (c) external materials; and (d) finishes and colours.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on achieving performance outcomes.
PO6 Development does not alter, remove or conceal the significant features or values of the heritage place.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on achieving performance outcomes.

PO7 Development being a reconfiguration of a lot reflects the pattern and lot layout of the original subdivision in the locality and does not: (a) reduce public access to the place; or (b) obscure or destroy the historical context, the landscape settings or the scale and consistency of the built environment.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on writing a Heritage Impact Statement.
PO8 Any new fencing, landscaping, advertising device, access or parking arrangements are designed and sited in a manner that: (a) does not have a detrimental impact on the significant values or view of the place; (b) enhances the overall appearance of the heritage place; and (c) is sensitive to materials, colours, scale, placement and layout of the place.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on achieving performance outcomes.

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Signage	
PO9 Signage on Flinders Street East does not adversely affect the fabric and setting of the heritage place.	**AO9** For heritage places on Flinders Street East, signage is in accordance with the Cultural heritage planning scheme policy no. SC6.3.
PO10 If the loss of a heritage place occurs, interpretive signage is erected.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on how such signage should be established.

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Archaeology	
PO11 Development does not adversely impact on known or potential archaeological deposits.	No acceptable outcome is nominated. **Editor's note—**The Cultural heritage planning scheme policy no. SC6.3 provides guidance on how this may be achieved to council's satisfaction. Earthworks, including those associated with demolition, should be monitored by a suitably qualified archaeologist and archaeological deposits should be managed in accordance with the policy.

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Indigenous heritage significance	
PO12 There are no adverse impacts on any place that has cultural heritage significance to Aboriginal or Torres Strait Islander people.	No acceptable outcome is nominated. **Editor's note—**All proposed development on or adjacent to identified sites of indigenous cultural heritage significance is required to be carried out in accordance with the latest version of the *Aboriginal Cultural Heritage Act 2003 - Duty of Care Provisions.*

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Development adjoining a heritage place	
PO13 Development is sympathetic to and consistent with the features and values of the heritage place, including: (a) maintaining views to and from the heritage place where significant; (b) consistency of built form and setback; (c) potential for overshadowing; and (d) consistency with open space and landscaping features.	No acceptable outcome is nominated. **Editor's note—**Refer to the Cultural heritage planning scheme policy no. SC6.3 for guidance on achieving performance outcomes.
PO14 Reconfiguring a lot does not: (a) reduce public access to the heritage place; or (b) create the potential to adversely affect significant views to and from the heritage place; or (c) obscure, destroy or disrupt any pattern of historic subdivision, the historical context, the landscape settings or the scale and consistency of the built environment relevant to the heritage place.	No acceptable outcome is nominated.

Table 8.2.4.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Elements in the road reserve	
PO15 Elements in the road reserve make a positive contribution to cultural heritage values of a place. Introduced features are compatible with significant features of the place.	No acceptable outcome is nominated.

8.2.5 Extractive resources overlay code

8.2.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Extractive resources overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.5.2 Purpose

(1) The purpose of the Extractive resources overlay code is to ensure:

- (a) extractive resources are protected from development that might prevent or constrain current or future extraction or mining when the need for the resource arises; and
- (b) extractive industry uses are operated in a way that minimises impacts on surrounding land uses and environmental values.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) development not associated with extractive industry is not located where likely to have an adverse impact upon existing and future extraction, processing and transportation of extractive resources;
- (b) development is compatible with the existing and future mining within mining tenements granted or renewed under the *Mineral Resources Act 1989*;
- (c) development does not increase the number of people living within a separation area for a resource/processing area or transport route; and
- (d) development for the purpose of extractive industry
  - (i) protects personal health and safety;
  - (ii) minimises impacts to the amenity of surrounding land uses;
  - (iii) avoids impacts to environmental values on external premises; and
  - (iv) minimises impacts to environmental values on the premises.

8.2.5.3 Assessment benchmarks

Table 8.2.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Development other than extractive industry	
PO1 Development located within a resource/processing area maintains the long-term availability and efficient winning of the extractive resource for extraction and processing, except where the following can be demonstrated: (a) there is an overriding benefit to the community; and (b) the development cannot reasonably be located elsewhere.	No acceptable outcome is nominated.

PO2 Development located in a separation area for a resource/processing area: (a) does not increase the number of people living in the separation area; and (b) minimises impacts from existing and future extractive industries on people working or congregating in the separation area; and does not compromise the function of the separation area as a buffer from incompatible uses outside the buffer area.	No acceptable outcome is nominated.
PO3 Development in a separation area for a transport route does not increase the number of people living in the separation area and is compatible with the safe and efficient operation of the transport route.	No acceptable outcome is nominated.
PO4 Development in the vicinity of mining-related leases: (a) does not compromise current or future utilisation of mineral resources; and (b) is not located where likely to be adversely impacted upon by existing and future mining activities.	No acceptable outcome is nominated.
PO5 Development with direct vehicle access to a transport route does not adversely impact the safety and efficiency of transport route.	No acceptable outcome is nominated.

Table 8.2.5.3—Assessable development (Part)

Performance outcomes	**Acceptable outcomes**
Extractive industry	
PO6 Extractive industry is operated such that: (a) blasting activities do not create a public safety risk; and (b) on-site workers and the public are adequately warned of the activities and safety hazards.	No acceptable outcome is nominated.
PO7 Measures are taken to avoid or minimise adverse impacts from dust, sand, or soil on nearby properties.	No acceptable outcome is nominated.
PO8 Premises are secured to ensure that a person not involved in the operation is unable to gain entry to the premises.	No acceptable outcome is nominated.
PO9 The development maintains the extractive industry transport route to a standard commensurate with the volume, type, and nature of vehicular traffic utilising the transport route.	No acceptable outcome is nominated.

PO10 Development avoids adverse impacts on land uses, having regard to: (a) noise; (b) vibration; (c) airblast overpressure; (d) dust; (e) flyrock; (f) visual amenity; and (g) safety.	No acceptable outcome is nominated.
PO11 The extractive industry use is screened from any adjoining major road.	No acceptable outcome is nominated.
PO12 Development avoids or minimises impact on areas of ecological significance, ecological processes or biodiversity values external to the site.	No acceptable outcome is nominated.
PO13 Surface and groundwater quality external to the site is protected.	No acceptable outcome is nominated.
PO14 Development provides for the rehabilitation of the premises to restore the nature conservation values of the premises prior to the extractive industry as far as is reasonably practicable. **Editor's note—**A rehabilitation plan and expert ecological advice may be required to demonstrate achievement of this performance outcome.	No acceptable outcome is nominated.

8.2.6 Flood hazard overlay code

8.2.6.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Flood hazard overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.6.2 Purpose

(1) The purpose of the Flood hazard overlay code is to manage development outcomes in flood hazard areas so that risk to life, property, community, economic activity and the environment during future flood events is minimised, and to ensure that development does not increase the potential for flood damage on-site or to other property.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) development is compatible with the nature of the flood hazard except where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal;
- (b) where development is not compatible with the nature of the flood hazard and there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal:
  - (i) development minimises as far as practicable the adverse impacts from the hazard; and
  - (ii) does not result in unacceptable risk to people or property;
- (c) wherever practicable, facilities with a role in emergency management and vulnerable community services are located and designed to function effectively during and immediately after flood hazard event;
- (d) development maintains the safety of people and minimises the potential damage to property from flood events on the development site; and
- (e) development does not result in adverse impacts on people's safety, the environment or the capacity to use land within the floodplain.

8.2.6.3 Assessment benchmarks

Note—To avoid any doubt, the term medium hazard area used in this code includes areas shown on the overlay maps as medium hazard – further investigation areas.

Editor's note—Areas shown on the overlay maps as medium hazard — further investigation areas are based on Queensland Reconstruction Authority mapping. Limited information is available on flood characteristics in these areas. Further investigation may be required as a result. Flood hazard planning scheme policy no. SC6.7 will provide applicants with guidance in meeting the requirements of this code in these and other identified hazard areas.

Table 8.2.6.3(a)-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Development in medium and high hazard areas is designed and located to minimise susceptibility to and potential impacts of flooding. **Editor's note—**The *Building Regulation 2006* may also establish requirements with which development will need to comply. The defined flood event is identified in this planning scheme as the 1% annual exceedance probability (AEP) flood and is mapped as the combined extent of the high and medium flood hazard areas identified on overlay map OM-06.1 and 06.2. Other than in the medium hazard — further investigation area, council will be able to make available the height of the flood level for any particular location upon request. Applicants must be aware that in some areas storm tide hazard areas will also co-exist with flood hazard areas. In these instances, the floor levels and other design responses will need to be sufficient to comply with this code, the Coastal environment overlay code and the *Building Regulation 2006*.	**AO1.1** Where the development is located within an area shown on overlay map OM-06.1 or 06.2 as medium hazard — further investigation area, new buildings containing habitable rooms: (a) are sited on a part of the site which is outside the medium hazard — further investigation area; or (b) are sited on the highest part of the site. OR **AO1.2** Where development is located within another hazard area shown on overlay map OM-06.1 or 06.2: (a) floor levels of all habitable rooms are a minimum of 300mm above the defined flood level; (b) floor levels of all non-habitable rooms (other than class 10 buildings) are above the defined flood event; (c) parking spaces associated with non-residential development are located outside the high hazard areas identified on overlay map OM-06.1 or 06.2; and **Editor's note—**Class 10 buildings are identified under the Building Code of Australia and includes carports and outbuildings. (d) underground parking is designed to prevent the intrusion of flood waters by the incorporation of a bund or similar barrier with a minimum height of 300mm above the defined flood level.
PO2 Development in high hazard areas does not significantly impede the flow of flood waters through the site or worsen flood flows external to the site.	**AO2.1** Development in high hazard areas do not involve: (a) filling with a height greater than 150mm; or (b) block or solid walls or solid fences; or (c) garden beds or other structures with a height more than 150mm; or (d) the planting of dense shrub hedges.

Table 8.2.6.3(a)-Self-assessable and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
PO3 Development does not intensify use in high hazard areas, in order to avoid risks to people and property. **Editor's note—**High hazard areas are those likely to experience deep and/or fast moving water in a defined flood event.	**AO3.1** New buildings are located outside high hazard areas identified on overlay map OM-06.1 or 06.2.
	AO3.2 New lots or roads are not created within high hazard areas identified on overlay map OM-06.1 or 06.2.
	AO3.3 Sites for non-permanent accommodation such as tents, cabins or caravans (whether intended for short or long-term accommodation) are located outside the high hazard areas identified on overlay map OM-06.1 or 06.2.
PO4 Siting and layout of development maintains the safety of people and property in medium hazard areas. **Editor's note—**The *Building Regulation 2006* establishes requirements with which development will need to comply. The defined flood event is identified in this planning scheme as the 1% annual exceedance probability (AEP) flood and is mapped as the combined extent of the high and medium flood hazard areas identified on overlay map OM-06.1 and 06.2. Other than in the medium hazard — further investigation area, council will be able to make available the height of the flood level for any particular location upon request. Applicants must be aware that in some areas storm tide hazard areas will also co-exist with flood hazard areas. In these instances, the floor levels and other design responses will need to be sufficient to comply with this code, the Coastal environment overlay code and the *Building Regulation 2006*.	**On existing lots** **AO4.1** Floor levels for residential buildings are 300mm above the defined flood level. **Editor's note—**In medium hazard — further investigation area, a flood assessment in accordance with the Flood hazard planning scheme policy no. SC6.7 may be needed to establish the defined flood level.
	AO4.2 Floor levels of non-residential buildings (other than class 10 buildings) are above the defined flood level. **Editor's note—**Class 10 buildings are identified under the *Building Code of Australia* and includes carports and outbuildings.
	AO4.3 Underground parking is designed to prevent the intrusion of flood waters by the incorporation of a bund or similar barrier with a minimum height of 300mm above the defined flood level.
	AO4.4 Development for non-permanent accommodation such as tents, cabins or caravans (whether intended for short or long-term accommodation) are located outside the medium hazard areas identified on overlay map OM-06.1 or 06.2.
	Where reconfiguring a lot **AO4.5** Where reconfiguring a lot, new lots contain designated building envelopes (whether or not for residential purposes) outside the medium hazard areas identified on overlay map OM-06.1 or 06.2 and those building envelopes are of a sufficient size to accommodate buildings associated with the development.
	AO4.6 In new subdivisions, arterial, sub-arterial or major collector roads are located above the 2% AEP flood level.

	AO4.7 Reconfiguration of lots does not involve cul-de-sacs or dead end streets within medium hazard areas identified on overlay map OM-06.1 or 06.2.
PO5 Signage is provided within high and medium hazard areas to alert residents and visitors to the flood hazard.	**AO5** Signage is provided on-site (regardless of whether land will be public or private ownership) to indicate depth at key hazard points, such as at floodway crossings, entrances to low-lying reserves or parking areas.
PO6 Development within high and medium hazard areas ensures any changes to the depth, duration, velocity of flood waters are contained within the site. **Editor's note—**Impacts on a range of floods may need to be assessed and in most instances can be evaluated by analysing the minor drainage system capacity event and the defined flood event for the catchment wide critical duration, unless the site is located in an area noted in the Flood hazard planning scheme policy SC6.7.	No acceptable outcome is nominated.
PO7 Development within high and medium hazard areas does not directly, indirectly or cumulatively worsen flood characteristics outside the development site, having regard to: (a) increased scour and erosion; or (b) loss of flood storage; or (c) loss of or changes to flow paths; or (d) flow acceleration or retardation; or (e) reduction in flood warning times. **Editor's note—**To adequately assess the impacts of development on flooding regimes, applicants may need to have a hydrological and hydraulic assessment carried out by a suitably qualified and experienced hydrologist or engineer.	No acceptable outcome is nominated.
PO8 Facilities with a role in emergency management and vulnerable community services are able to function effectively during and immediately after flood events. **Editor's note—**This provision applies to high, medium and low flood hazard areas.	**AO8** The development is provided with the level of flood immunity set out in Table 8.2.6.3(b).
PO9 Public safety and the environment are not adversely affected by the detrimental impacts of flooding on hazardous materials manufactured or stored in bulk.	**AO9.1** Development does not involve the manufacture or storage of hazardous materials within a high flood hazard area identified on overlay map OM-06.1 or 06.2.
	AO9.2 Within the low or medium flood hazard area identified on overlay map OM-06.1 or 06.2, structures used for the manufacture or storage of hazardous materials in bulk are designed to prevent the intrusion of flood waters up to at least a 0.2% AEP flood event.

Table 8.2.6.3(b)-Flood immunity for community services and facilities

Development	**Level of flood immunity annual exceedance probability (AEP)**
Development involving: (a) emergency services; (b) hospitals and associated facilities; (c) major electricity infrastructure.	0.2% AEP flood event
Development involving: (a) emergency/evacuation shelters; (b) the storage of valuable records or items of historic/cultural significance (e.g. libraries, galleries); (c) aeronautical facilities; (d) telecommunication facilities; (e) substations; (f) water treatment plants; (g) regional fuel storage; (h) food storage warehouse; (i) retirement facility and residential care facility.	0.5% AEP flood event
Sewerage treatment plants (requiring licensing as an environmentally relevant activity).	1% AEP flood event

8.2.7 Landslide hazard overlay code

8.2.7.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Landslide hazard overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.7.2 Purpose

(1) The purpose of the Landslide hazard overlay code is to manage development so that there is no increase to the extent or the severity of a landslide hazard and risk to life, property, community and the environment during landslide events is avoided.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) development is compatible with the nature of the landslide hazard except where there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal;

(b) where development is not compatible with the nature of the landslide hazard and there is an overriding need for the development in the public interest and no other site is suitable and reasonably available for the proposal:

(i) development minimises as far as practicable the adverse impacts from landslide hazards; and

(ii) does not result in unacceptable risk to people or property.

(c) wherever practicable, facilities with a role in emergency management and vulnerable community services are located and designed to function effectively during and immediately after landslide hazard events.

8.2.7.3 Assessment benchmarks

Table 8.2.7.3-Assessable development

Editor's note—The Development manual planning scheme policy no. SC6.4 - SC6.4.3.7 Steep land development design guidelines will provide applicants with guidance in meeting requirements of this code.

Performance outcomes	Acceptable outcomes
PO1 Development is not subject to potential debris flow hazard.	**AO1** Development does not occur within the potential debris flow areas identified on OM-07.1.
PO2 People and property within the development site are protected from landslide hazard originating from inside or external to the site.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.18 Geotechnical investigations will provide applicants with guidance in meeting requirements of this code.
PO3 Development does not increase the risk of landslide to adjoining properties.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.18 Geotechnical investigations will provide applicants with guidance in meeting requirements of this code.
PO4 The development ensures the long-term stability of the development site.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.18 Geotechnical investigations will provide applicants with guidance in meeting requirements of this code.
PO5 Site access is not at risk from being permanently impeded by a landslide event.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.18 Geotechnical investigations will provide applicants with guidance in meeting requirements of this code.

PO6 The siting, design and construction works of development minimises the impacts on the natural landform and do not have a detrimental impact on slope stability or erosion potential.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.18 Geotechnical investigations will provide applicants with guidance in meeting requirements of this code.
PO7 Development maintains the safety of hazardous materials manufactured or stored in bulk. **Editor's note—** The term "hazardous material" is defined in the State Planning Policy.	**AO7** The manufacture or storage of hazardous materials in bulk does not occur: (a) within the medium, high or potential debris flow areas identified on overlay map OM-07.1; or (b) on land with a slope angle >23 degrees identified on overlay map OM-07.2.
PO8 Facilities with a role in emergency management and vulnerable community services are able to function effectively during and immediately after landslide events.	**AO8.1** Facilities with a role in emergency management and vulnerable community services are not located on land: (a) within the medium, high or potential debris flow areas identified on overlay map OM-07.1; or (b) on land with a slope angle >23 degrees identified on overlay map OM-07.2. OR **AO8.2** The development does not: (a) result in any new building work other than an addition to an existing building; (b) involve vegetation clearing; or (c) alter site levels or stormwater conditions.

8.2.8 Natural assets overlay code

8.2.8.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Natural assets overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.8.2 Purpose

(1) The purpose of the Natural assets overlay code is to:

(a) protect areas of environmental significance, and the ecological processes and biodiversity values of terrestrial and aquatic ecosystems;

(b) maintain ecosystem services and other functions performed by Townsville's natural areas; and

(c) protect water quality, ecosystem health and the natural hydrological functioning of waterways, wetlands and their riparian areas.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) development avoids or minimises direct and indirect impacts on areas of environmental significance and their associated ecological functions and biophysical processes;

(b) development provides for the protection or enhancement of a linked network of habitat areas, including maximising opportunities for rehabilitation and restoration of degraded ecosystems, ecological communities, remnant vegetation and connecting corridors wherever possible;

(c) development, including infrastructure, is located and designed to maintain or enhance ecological functions including facilitation of wildlife movement for native terrestrial and aquatic species and native and migratory avian species;

(d) the water quality values and ecological functions of wetlands, waterways and their riparian areas and buffers are protected or enhanced;

(e) development maintains, protects or enhances the natural hydrological regime and functioning of waterways and wetlands, including surface and ground waters and their interaction;

(f) fragmentation of remnant vegetation and habitat areas is avoided to maintain ecological function and biodiversity values, and to maintain or increase the resilience of natural assets to threatening processes, including climate change; and

(g) development incorporates appropriate buffering and mitigation strategies to avoid or minimise potential damage to natural areas and other environmental assets.

Editor's note—Natural assets planning scheme policy no. SC6.9 will provide applicants with guidance in meeting the requirements of this code.

8.2.8.3 Assessment benchmarks

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Protection of biodiversity values and ecological processes	
PO1 In areas identified as having high or very high environmental importance, significant values are protected and associated ecological functions and biophysical processes are maintained to ensure long term viability. **Editor's note—**Applicants should also refer to other state and federal legislation which may also require applicants to obtain additional approvals.	No acceptable outcome is nominated. **Editor's note**—Natural assets planning scheme policy no. SC6.9 provides information on the primary attributes included in very high, high and medium environmental importance areas. The overlay map has been produced using local government area wide data. Site-specific investigation will be required to confirm the extent and nature of values indicated on the overlay map or otherwise identify site-specific natural assets and ecological functions.
PO2 In areas identified as having medium environmental importance, development is located, designed and operated to: (a) retain and protect significant values; and (b) maintain the underlying ecological functions and biophysical processes. **Editor's note—**Applicants should also refer to other state and federal legislation which may also require applicants to obtain additional approvals.	No acceptable outcome is nominated. **Editor's note—**This category of environmental importance will also require a high level of investigation as part of any development application, to determine on the ground values and priority for protection. A detailed environmental assessment is to be undertaken by applicants in accordance with the guidance provided in the Natural assets planning scheme policy no. SC6.9.
PO3 Degraded areas with significant ecological and environmental values or important to the maintenance of underlying ecological functions and biophysical processes required to maintain biodiversity and ecosystem services are rehabilitated as near as is practical to the naturally occurring suite of native plant species and ecological communities.	No acceptable outcome is nominated. **Editor's note—**A rehabilitation plan supported by expert ecological advice prepared in accordance with Natural assets planning scheme policy no. SC6.9 will assist in demonstrating achievement of this performance outcome.

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Significant species and ecological communities	
PO4 Development avoids direct and indirect impacts on significant ecological communities and significant species and their habitats, including disturbance from the presence of vehicles, pedestrian use, increased exposure to domestic animals and noise and lighting impacts. **Editor's note—**Significant species and ecological communities include those identified in the Natural assets planning scheme policy no. SC6.9.	No acceptable outcome is nominated. **Editor's note—**Applications for development should identify any significant species or communities that may be affected by the proposal. A detailed environmental assessment is to be undertaken by applicants in accordance with the guidance provided in the Natural assets planning scheme policy no. SC6.9.
PO5 Areas of habitat that support a critical life cycle stage such as feeding, breeding or roosting or ecological function for threatened species, ecological communities or migratory species are not impacted by development.	No acceptable outcome is nominated.

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Buffering and edge impacts	
PO6 Development provides a vegetated buffer to an area of significant ecological or environmental value, in order to: (a) protect core habitat areas from threatening processes; (b) maintain connectivity or support linkages; (c) reduce threats to the environmental values from non-native or pest fauna or flora; and (d) avoid undesirable microclimate effects. Any setbacks or other areas required for bushfire management, safety, recreation, maintenance or any other purpose, are provided in addition to a vegetated buffer provided for ecological and environmental protection purposes.	**AO6** A buffer extending from the outside edge of a declared fish habitat area (measured from highest astronomical tide (HAT)) has a minimum width of 100m. For other areas, no acceptable outcome is nominated. **Editor's note—**Areas which are expected to constitute core habitat as well as declared fish habitat areas are identified on maps contained in the Natural assets planning scheme policy no. SC6.9. Declared fish habitat areas may also be obtained from the relevant state agency. Buffers for significant species and ecological communities, including areas of habitat for listed threatened and migratory species, should be based on best practice and current scientific knowledge of individual species requirements and supported by an environmental assessment prepared in accordance with the Natural assets planning scheme policy no. SC6.9. Other legislation, including the *Nature Conservation Act* and *Environment Protection and Biodiversity Conservation Act* may establish other requirements with which applicants must comply.
PO7 Buffering, rehabilitation or restoration: (a) uses site appropriate or endemic native vegetation; (b) replicates as far as practicable, the species composition and structural components of healthy remnant native vegetation and associated habitats, including understorey vegetation; and (c) excludes declared plants, environmental weeds and other non-native plants likely to displace native flora species or degrade habitat.	No acceptable outcome is nominated. **Editor's note—**A site-based management and rehabilitation plan prepared in accordance with the Natural assets planning scheme policy no. SC6.9 will assist in demonstrating achievement of this performance outcome.
PO8 Pest species are prevented from encroaching into ecologically significant areas.	No acceptable outcome is nominated. **Editor's note—**A site-based management and rehabilitation plan prepared in accordance with the Natural assets planning scheme policy no. SC6.9 will assist in demonstrating achievement of this performance outcome.
PO9 During construction and operation of development, measures are implemented to prevent light, noise, visual and other disturbances.	No acceptable outcome is nominated. **Editor's note—**A site-based management and rehabilitation plan prepared in accordance with the Natural assets planning scheme policy no. SC6.9 will assist in demonstrating achievement of this performance outcome.

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Ecological corridors and habitat connectivity	
PO10 Significant ecological corridors and habitat linkages are protected and have dimensions and characteristics to support: (a) ecological processes and functions that enable the natural change in distributions of species and provide connectivity between populations of species over long periods of time; (b) ecological responses to climate change; (c) connectivity between large tracts and patches of remnant vegetation and habitat areas; and (d) effective and unhindered day-to-day and seasonal movement of avian, terrestrial and aquatic fauna.	No acceptable outcome is nominated where in an urban residential zone or centre zone. In all other zones (including the Emerging community zone, Rural residential zone or industry zones): **AO10** Major ecological corridors identified on Figure SC6.9.3 in the Natural assets planning scheme policy no. SC6.9 are maintained and restored to achieve a minimum width of 350m, consisting of: (a) a 250m wide core corridor to support avian species and most arboreal mammals; and (b) a 50m wide vegetated buffer extending from the outside edges on both sides of the core corridor. No acceptable outcome is nominated for the great eastern ranges conservation corridor identified on Figure SC6.9.3 in the Natural assets planning scheme policy no SC6.9.
PO11 Corridors and linkages are provided to supplement and create additional ecological corridors and habitat linkages along waterways, drainage lines, ridgelines, coastlines and other areas where possible.	No acceptable outcome is nominated.
PO12 Development facilitates unimpeded use and movement of terrestrial and aquatic fauna that are associated with or are likely to use an ecological corridor as part of their normal life cycle by: (a) ensuring development, including roads, pedestrian access and in-stream structures, does not create barriers to the movement of fauna along or within ecological corridors; (b) providing effective wildlife management infrastructure to direct fauna to locations where wildlife movement infrastructure has been provided to enable fauna to safely negotiate a development area; and (c) separating fauna from potential hazards through the use of appropriate barriers and buffers.	No acceptable outcome is nominated.

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Riparian and buffer area management for wetlands and waterways	
PO13 Development locates outside of, and does not impact on wetlands, to ensure long-term ecological function.	**AO13** Development, including any associated filling or excavation (other than restorative works) is located outside of any mapped, defined or identified boundary of a wetland and its associated buffer. **Editor's Note—**Natural assets planning scheme policy no. SC6.9 contains Figure SC6.9.2 which identifies wetland areas. This information may also be obtained from the relevant state agency.
PO14 Development provides a buffer to a wetland area to: (a) protect or enhance habitat values, connectivity and other ecological functions and values; (b) protect water quality and aquatic conditions; (c) maintain natural micro-climatic conditions; (d) maintain natural hydrological processes; (e) prevent mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding; and (f) avoid loss or modification of chemical, physical or biological properties or functions of soil. Any setbacks or other areas required for bushfire management, safety, recreation, maintenance or any other purpose, are provided in addition to a vegetated buffer provided for ecological purposes.	**AO14** A development-free buffer is provided and maintained with a minimum width of: (a) for wetlands designated as high ecological significance (HES) by the Queensland Government: (i) 50m from the outermost part of the wetland where located in an urban area; or (ii) 200m from the outermost part of the wetland where located in a non-urban area; or (b) for other wetlands: 50m from the outermost part of the wetland in either urban or non-urban areas. **Editor's note—**Natural assets planning scheme policy no. SC6.9 contains Figure SC6.9.2 which identifies wetland areas. This information may also be obtained from the relevant state agency. **Editor's note—**To avoid conflict, where a development requires multiple buffers to be established by this code to protect watercourses, corridors, wetlands or core habitat, the greatest distances required by this code will prevail to the extent of any inconsistency.
PO15 Development (including operation) and construction maintains or enhances the natural hydrological regime of wetlands, including surface and ground waters. **Editor's note—**The hydrological regime of surface waters includes: (i) peak flows; (ii) volume of flows; (iii) duration of flows; (iv) frequency of flows; (v) seasonability of flows; (vi) water depth (seasonal average); and (vii) wetting and drying cycle.	**AO15.1** Development does not change the existing surface hydrological regime of a wetland including through channelisation, redirection or interruption of flows. **AO15.2** There is no change to the reference duration high-flow and low-flow duration frequency curves, low-flow spells frequency curve and mean annual flow to and from the wetland. **AO15.3** Any relevant stream flows into the wetland comply with relevant environmental flow objectives. **AO15.4** The water table and hydrostatic pressure in the wetland is either: (a) returned to its natural state; or (b) not lowered or raised outside the bounds of variability under existing pre-development conditions.

	AO15.5 Development does not result in the ingress of saline water into freshwater aquifers.
PO16 Development provides a buffer to a waterway, in order to: (a) protect or enhance habitat values, connectivity and other ecological processes and values; (b) protect water quality and aquatic conditions; (c) maintain natural micro-climatic conditions; (d) maintain natural hydrological processes; (e) prevent mass movement, gully erosion, rill erosion, sheet erosion, tunnel erosion, stream bank erosion, wind erosion, or scalding; and (f) prevent loss or modification of chemical, physical or biological properties or functions of soil. Any setbacks or other areas required for bushfire management, safety, recreation, maintenance or any other purpose, are provided in addition to a vegetated buffer provided for ecological purposes.	No acceptable outcome is nominated where in an urban residential zone or centre zone. Elsewhere (including the Emerging community zone, Rural residential zone or industry zones): **AO16** Other than where cropping for forestry for wood production, a development-free buffer is provided and maintained, extending from top of the bank of a waterway and with a minimum width of: (a) where in the Wet Tropics bioregion: (i) stream order 1 to 4: 25m; or (ii) stream order 5 and above: 50m; OR (b) in all other regions (Brigalow Belt North Bioregion or the Einasleigh Uplands Bioregion): (i) stream order 1 or 2: 25m; or (ii) stream order 3 or 4: 50m; or (iii) stream order 5 and above: 100m; **Editor's note—**Natural assets planning scheme policy no. SC6.9 contains Figure SC6.9.1 which identifies stream orders and bioregions. This information may also be obtained from the relevant state agency. **Editor's note—** Where a development requires multiple buffers to be established by this code to protect watercourses, corridors, wetlands or core habitat, the greatest distances required by this code will prevail to the extent of any inconsistency.

Table 8.2.8.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Ongoing management, construction and operation	
PO17 During construction and operation of development, ongoing management, monitoring and maintenance is undertaken to ensure impacts on significant ecological areas, underlying ecological functions and biophysical processes and environmental values are avoided or minimised.	No acceptable outcome is nominated. **Editor's note**–Applicants will be asked to prepare an site based management plan to guide construction and operation.
PO18 Management arrangements facilitate the effective conservation and protection of significant ecological areas and underlying ecological functions and biophysical processes.	**AO18** Significant ecological areas are: (a) transferred into public ownership where the land is required for public access or for some other public purpose consistent with its values; or (b) incorporated within private open space and included within a voluntary statutory covenant by registration under the *Land Title Act 1994.*

8.2.9 Water resource catchment overlay code

8.2.9.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for the Water resource catchment overlay. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

8.2.9.2 Purpose

(1) The purpose of the Water resource catchment overlay code is to ensure:

(a) the quality of surface and ground waters and the ecological values and hydrological processes of water resource catchments are protected;

(b) natural environment values and the ecological processes of terrestrial and aquatic ecosystems within the catchment area are protected;

(c) the water resource catchment area is maintained predominantly in a natural state and is protected from development and activities that would have unacceptable impacts on water quality, either directly or indirectly.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) the establishment, expansion or intensification of development is avoided in a water resource catchment area;

(b) rural residential development is contained within the zoned Oak Valley community and development densities minimise the potential for impact on the catchment;

Editor's note—Applicants should refer to the Rural residential zone code.

(c) the ecological values, hydrological processes and water quality values of ground and surface waters in water resource catchment areas are protected from direct and indirect development impacts;

(d) development does not adversely affect the physical integrity of waterways, wetlands, lakes, springs, riparian areas and natural ecosystems that support water quality; and

(e) vegetated buffers to the full supply level of a water storage area are provided and maintained.

8.2.9.3 Assessment benchmarks

For accepted development subject to requirements

Table 8.2.9.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
PO1 Development is set back from features contributing to catchment waters and incorporates a buffer to protect and enhance water quality values of ground and surface waters for ecosystem health and human consumption.	**AO1** Development, including all buildings and supporting infrastructure, is set back from the top of the bank of a waterway as shown on Figure 8.2 – Waterways within the Ross Dam Catchment with a minimum width of: (a) for stream order 3 or 4: 50m; or (b) for stream order 5 and above: 100m.

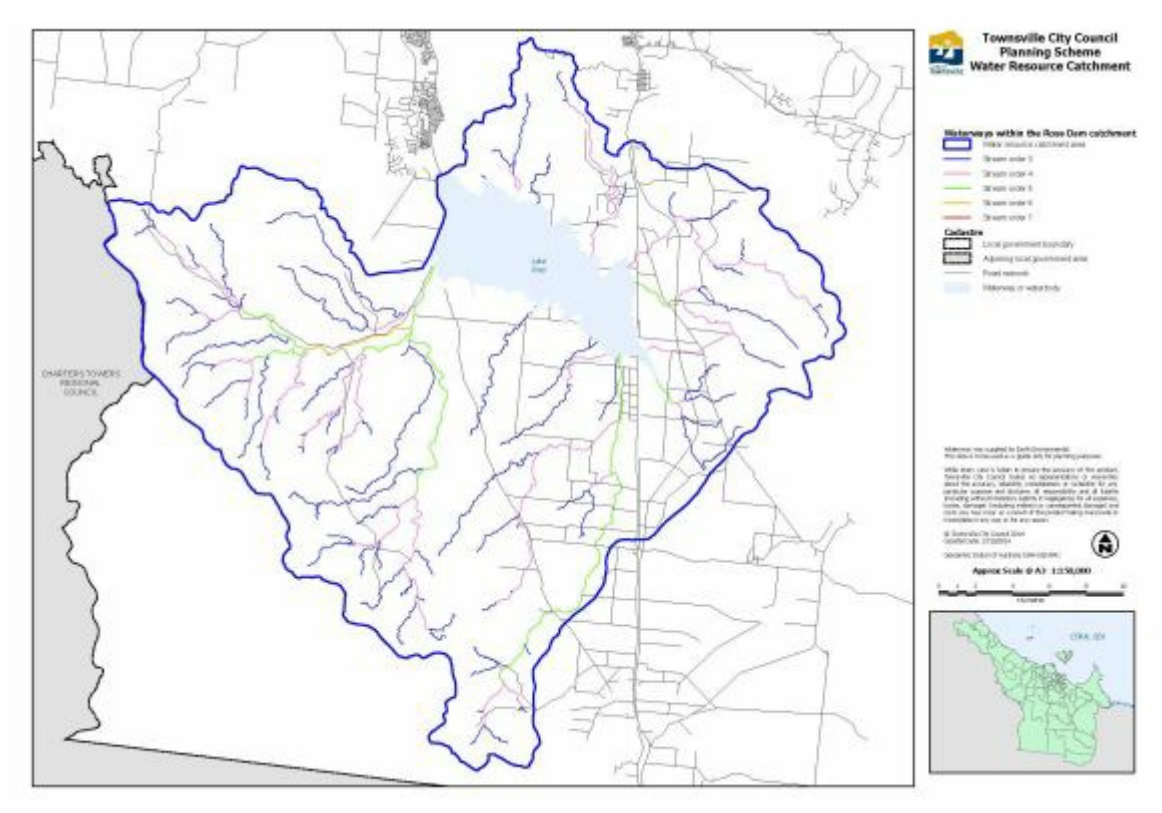
Table 8.2.9.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Nature of development	
PO2 The intensification of activities within catchments is avoided, including any: (a) development, land use and management practices with the potential to degrade or contribute to the degradation of water quality in the water resource catchment area; and (b) development, use or activity that adversely affects the physical integrity of waterways, lakes, springs, riparian areas, wetlands and natural ecosystems.	No acceptable outcome is nominated.
PO3 Reconfiguration of lots does not increase the number of lots within the catchment, other than within the zoned Oak Valley rural residential area.	No acceptable outcome is nominated.
PO4 Within Oak Valley, the creation of additional lots is minimised.	**AO4** The minimum lot size in the rural residential zone within the catchment is 4ha.
PO5 Development in a water resource catchment area minimises land disturbance through appropriate siting, design and construction of buildings, structures, roadways and other work, and does not result in land degradation.	**AO5.1** Development does not involve earthworks.
	AO5.2 Development locates on slopes that do not exceed a 6% gradient.
PO6 Development in a water resource catchment area is managed in a way that maintains the structure and function of remnant vegetation and including erosion and associated loss to the soil fertility.	**AO6** Development does not involve vegetation clearing.

Table 8.2.9.3-Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Buffers	
PO7 Development adjoining the water storage area identified on overlay map OM-09 protects and restores a vegetated buffer to avoid sediment, nutrients and pollutants from entering a waterway, wetland, lake, spring, riparian area or water storage area.	**AO7.1** Development including buildings, infrastructure, structures, enclosures and ancillary activities are not carried out within 500m of the water storage area identified on overlay map OM-09 and all existing vegetation is retained within the buffer.
	AO7.2 A vegetated buffer having a minimum width of 100m is established and maintained from the water storage area identified on overlay map OM-09.

PO8 Riparian vegetation within the water resource catchment area is protected.	**AO8** Development does not result in the clearing of any native riparian vegetation.
PO9 Development is set back from features contributing to catchment waters and incorporates a buffer to protect and enhance water quality values of ground and surface waters for ecosystem health and human consumption.	**AO9** Development, including all buildings and supporting infrastructure, is set back from the top of the bank of a waterway as shown on Figure 8.2 – Waterways within the Ross Dam Catchment with a minimum width of: (a) for stream order 3 or 4: 50m; or (b) for stream order 5 and above: 100m.



Click here to view PDF high resolution map.

Figure 8.2 - Waterways within the Ross Dam Catchment

Part 9 Development codes

9.1 Preliminary

(1) Development codes are assessment benchmarks where identified as an applicable code in Part 5.

(2) Use codes and other development codes are specific to each planning scheme area.

Editor's note–the Planning Regulation may establish requirements for development it prescribes to be accepted (for example, community residences and forestry) and assessment benchmarks that it prescribes to be assessable (for example, reconfiguration of 1 lot into 2).

(3) The following are the use codes for the planning scheme:

(a) Telecommunications facilities and utilities code.

(4) The following are the other development codes for the planning scheme:

(a) Advertising devices code;

(b) Healthy waters code;

(c) Landscape code;

(d) Reconfiguring a lot code;

(e) Transport impact, access and parking code;

(f) Works code.

9.2 Use codes

9.2.1 Telecommunications facilities and utilities code

9.2.1.1 Application

This code applies to a material change of use for telecommunications facilities, utilities, substations and major electricity infrastructure where the code is identified as applicable in the categories of development and assessment. When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

Editor's note—Low impact telecommunications facilities and minor electricity infrastructure are not regulated by the planning scheme. The *Telecommunications (Low Impact Facilities) Determination 1997* provides a full list of low impact facilities. Low impact facilities remain the responsibility of the Commonwealth Government.

9.2.1.2 Purpose

(1) The purpose of the Telecommunications facilities and utilities code is to ensure that facilities are located, designed and managed to be compatible with the locality in which they are established.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) development avoids or minimises adverse impacts on the natural environment;

(b) development does not unreasonably impact on the character and amenity of the locality;

(c) risks to public health and safety are minimised and contained to acceptable levels; and

(d) development facilitates co-location of infrastructure wherever possible.

9.2.1.3 Assessment benchmarks

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Editor's note—Applicants must also comply with the relevant zone code and any applicable overlay code or development code.

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements development	
PO1 Aerial cabling and associated works for broadband telecommunications purposes is located and constructed in a manner that minimises visual impacts on the locality.	**AO1.1** The cables are co-located with operating works for a transmission entity or a distribution entity under the *Electricity Act 1994* wherever practicable.
	AO1.2 Any new cable has substantially the same appearance as existing cables.
	AO1.3 The average width of cabling for the facility is 25mm or less (excluding overmoulds).
	AO1.4 Any new cable is located: (a) above any existing street lighting cable; or (b) if there is no existing street cable lighting — no further than 600mm below any existing cable.
	AO1.5 In all other respects, the development complies with ACIF C524:2013 — External telecommunication cable networks.
PO2 Development does not unduly detract from the continued use and enjoyment of land included in a residential zone or of any other existing sensitive land use.	**AO2** The development is separated by a minimum of 50m to any land in a residential zone.

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Visual integration, character and amenity	
PO3 The building height and the height of structures do not significantly detract from the scenic amenity and character of the locality.	No acceptable outcome is nominated.

PO4 Development is: (a) of high quality design and construction; (b) integrated with the surrounding area so as not to be visually dominant or intrusive, having regard to: (i) scale; (ii) height; (iii) bulk; (iv) materials and colour; and (v) aesthetic appearance; and (c) treated to eliminate glare and reflectivity.	No acceptable outcome is nominated.
PO5 Development in the Rural zone is not visually obtrusive when viewed from highways or significant public vantage points.	**AO5** Development in the Rural zone is setback from highway frontages by a minimum of 50m.
PO6 Where development is attached to an existing structure, it does not: (a) increase the visual prominence of the structure; or (b) detract from the design and architectural qualities of the structure.	No acceptable outcome is nominated.
PO7 Development does not unduly detract from the continued use and enjoyment of land included in a residential zone or of any other existing sensitive land use.	No acceptable outcome is nominated.
PO8 Development is setback from the site boundaries, to minimise impacts on adjoining land as a result of noise, glare, overshadowing, loss of privacy or visual obtrusiveness.	**AO8.1** The following minimum setbacks to all site boundaries are achieved: (a) 10m, where the height of the structure is less than 20m; (b) 15m, where the height of the structure is between 20m and 30m; (c) 20m, where the height of the structure is greater than 30m; and (d) 50m where adjoining a residential zone. OR **AO8.2** Where development reuses, extends or is attached to an existing structure, existing setbacks are not reduced.
PO9 Screening is provided to reduce the visual impacts of the facility and to enhance the character of the local area.	**AO9** A minimum 3m deep landscaped strip of dense planting is provided along all site boundaries.

PO10 Development prevents or minimises the generation of any noise such that: (a) nuisance is not caused; and (b) ambient noise levels are maintained.	**AO10** Development provides that: (a) noise levels measured as the adjusted maximum sound pressure level LAmax, adj. T at a noise sensitive place do not exceed: (i) background noise level plus 5dB(A) between the hours of 7am and 10pm; and (ii) background noise level plus 3dB(A) between the hours of 10pm and 7am; and (b) noise levels measured as the adjusted maximum sound pressure level LAmax, adj. T at a business place do not exceed: (i) background noise level plus 10dB(A) between the hours of 7am and 10pm; and (ii) background noise level plus 8dB(A) between the hours of 10pm and 7am.

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Public health and safety	
PO11 Facilities are established, operated and maintained in a way to minimise the risk to public health and safety from electromagnetic emissions.	**AO11** For telecommunications facilities, development is designed and operated to restrict electromagnetic emissions in accordance with: (a) Radiocommunications (Electromagnetic Radiation — Human Exposure) Standard 2014; and (b) Radio Protection Standard for Maximum Exposure Levels to Radiofrequency Fields — 3KHz to 300GHz; or (c) other standards as specified by the Commonwealth Government Minister responsible for communications. For other development, no acceptable outcome is nominated.
PO12 Security fencing encloses the outermost boundaries of the land on which the facility is built in order to: (a) prevent unauthorised access; and (b) protect ease of maintenance access to the property.	**AO12** The site is securely fenced along all boundaries, including areas used for vehicle parking and storage.

PO13 Development incorporating access control arrangements includes: (a) providing warning information signs on all boundaries to prevent unauthorised entry; (b) the minimisation of the number and width of entry points; and (c) safe vehicular access to the site.	No acceptable outcome is nominated.

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Environmental impact	
PO14 Development does not adversely impact on the natural environment.	**AO14** Development does not involve vegetation clearing or earthworks.

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
For upgrading an existing substation or bulk supply substation only	
PO15 When the proposal involves the upgrade of an existing substation to a bulk supply substation, the existing substation is: (a) in a location where viable corridors are accessible to connect powerline infrastructure to the site; and (b) in proximity to existing powerline infrastructure, to ensure that the need for additional powerline infrastructure is minimised.	No acceptable outcome is nominated.

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
For major electricity infrastructure	
PO16 The proposed major electricity infrastructure: (a) maximise co-location with other existing powerlines and easements; and (b) avoid, where possible, location near residential uses.	No acceptable outcome is nominated.
PO17 The proposed overhead powerline infrastructure is positioned with safe clearances to land uses and vegetation.	**AO17** The proposed powerline infrastructure maintains mandatory clearances from any existing or proposed buildings, structures and operational equipment to existing powerlines in accordance with Schedules 4 and 5 of the *Electrical Safety Regulation 2013.*

Table 9.2.1.3—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
For major electricity infrastructure (underground powerline infrastructure) only	
PO18 Powerline infrastructure minimises any potential impact on transport, access and utilities infrastructure in an area.	No acceptable outcome is nominated.

9.3 Other development codes

9.3.1 Advertising devices code

9.3.1.1 Application

This code applies to assessing operational work for placing an advertising device on premises where the code is identified as applicable in the categories of development and assessment for operational works.
When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.1.2 Purpose

(1) The purpose of the advertising devices code is to facilitate economic activity through the advertising of business, products and/or services, while ensuring high levels of visual amenity, public safety and maintaining the character of the locality.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) advertising devices are compatible with the character of the local area and do not diminish visual amenity; and

(b) advertising devices do not create a hazard to people or property, in particular pedestrians, cyclists and vehicular traffic.

9.3.1.3 Assessment benchmarks

Table 9.3.1.3(a)—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Character and amenity	
PO1 The type, location and design of advertising devices do not diminish the character and amenity of the zone or precinct in which they are located.	**AO1.1** The following types of advertising device are not located in the Community facilities zone: (a) in any circumstance any advertising device defined in Table 9.3.1.3(b) as a higher impact advertising device, other than: (i) a pole sign not exceeding 1.5m in any dimension; or (ii) a wall sign not exceeding 4m^2; or (iii) an inflatable sign.
	AO1.2 No advertising devices are located within the Environmental management and conservation zone.
	AO1.3 Any advertising device defined in Table 9.3.1.3(b) as either an intermediate impact advertising device or a higher impact advertising device is not located in the Open space zone.

AO1.4
Advertising devices are not located in the residential zones other than where:

(a) in the High density residential zone; or

(b) in the Medium density residential zone (Picnic Bay, Nelly Bay tourist, North Ward villages, Hyde Park medium density, Aitkenvale village or The Strand precincts only); or

(c) comprising of a fence sign or a wall sign for a home based business, and:

  (i) limited to a maximum of one advertising device per premises; and

  (ii) limited to a maximum sign face area of 1m²; or

(d) comprising of an advertising device defined in Table 9.3.1.3(b) as a lower impact or intermediate impact advertising device for short-term accommodation and rooming accommodation.

AO1.5
Advertising devices in the High and Medium density residential zone are associated with the residential use or non-residential use located on the same site.

AO1.6
The following types of advertising devices are not located in the Rural zone:

(a) any advertising device not part of a business activity, roadside stall, short-term accommodation, outdoor sport and recreation or winery located on the same site; and

(b) a wall sign greater than 4m²; and

(c) in any circumstances, an animated sign.

AO1.7
The following types of advertising devices are not located in the Sport and recreation zone:

(a) in any circumstances any advertising device defined in Table 9.3.1.3(b) as a higher impact advertising device other than:

  (i) a billboard; or

  (ii) a pole sign; or

  (iii) a wall sign less than 4m².

	AO1.8 Bunting is only located on premises used for any of the following purposes: (a) Bulk landscape supplies; or (b) Garden centre; or (c) Market; or (d) Outdoor sales; or (e) Service station; or (f) Outdoor sport and recreation; or (g) Roadside stall.
	AO1.9 Advertising devices are illuminated only in the following circumstances: (a) if located within a centres zone, the Community facilities zone or an industry zone; (b) not in the Flinders Street East precinct; (c) not located within 50m of a sensitive land use located within a residential zone, the Rural zone or the Community facilities zone; and (d) not exceeding the following night time luminance values: (i) 500 candella/m² in an industry zone; or (ii) 400 candella/m² in a centre zone; or (iii) 300 candella/m² in the community facilities zone.
	AO1.10 Advertising devices comply with the design parameters set out in Table 9.3.1.3(c).
	AO1.11 Advertising devices are produced or manufactured and installed by a commercial painting or signwriting business or professional advertising business and are not constructed of cardboard, paper or similar product.
PO2 Development avoids a visually cluttered and confusing proliferation of advertising devices.	**AO2** Advertising devices, other than billboards, advertise the business or premises on, or in front of, which they are located, or a product or service offered by such business or premises.
PO3 Advertising devices in the Flinders Street East precinct do not adversely affect the fabric and setting of the heritage place.	**AO3** Advertising devices for heritage places in the Flinders Street East precinct are in accordance with the Cultural heritage planning scheme policy no. SC6.3.

Table 9.3.1.3(a)—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For accepted development subject to requirements and assessable development	
Safety	
PO4 Advertising devices do not obstruct or endanger pedestrian or vehicular traffic.	**AO4.1** Advertising devices, other than those listed below, are entirely contained within the lot and do not encroach into a road reserve or other public place: (a) awning sign (above-awning, awning fascia or under-awning sign); (b) blind/canopy sign; (c) footway sign; (d) inflatable sign; (e) projecting sign; (f) hamper sign, stallboard sign, fence sign or wall sign, subject to the provisions of AO4.9; and (g) animated sign of a type mentioned in (a) to (e) above.
	AO4.2 Animated signs involving changing content are not located within 100m of a road with a speed limit exceeding 60km/hr.
	AO4.3 Advertising devices are not located on or over a public road carriageway.
	AO4.4 Advertising devices do not obscure any road signs, traffic signals, direction signs, information signs, street numbers or street lighting.
	AO4.5 Advertising content does not include or resemble any official road signs.
	AO4.6 Advertising devices, other than a footway sign, are not located on a footpath. A footway sign is not located on a footpath less than 2.5m in width, or within 250mm of a kerb.
	AO4.7 Footway signs are only displayed during the business hours of the advertised business.

	AO4.8 Advertising devices do not project into or over a driveway, vehicle access, parking area, cycleway or pedestrian footpath unless maintaining a minimum vertical clearance of: (a) 4.5m where intended for use by buses or commercial vehicles comprising small rigid vehicles and above; or (b) 2.5m for any other driveway, vehicle access, parking area, cycleway or pedestrian footpath. **Editor's note—**As defined in AS/NZS 2890.2 – 2002.
	AO4.9 Advertising devices attached flat to a wall, fence or other structure adjacent to a road, driveway, vehicle access, parking area, cycleway or pedestrian footpath have a maximum thickness of 30mm, unless maintaining a minimum vertical clearance of: (a) 4.5m where intended for use by buses or commercial vehicles comprising small rigid vehicles and above; or (b) 2.5m for any other driveway, vehicle access, parking area, cycleway or pedestrian footpath. **Editor's note—**As defined in AS/NZS 2890.2 – 2002.
	AO4.10 An inflatable sign is: (a) securely tethered to purpose-made anchor points on a building or permanent structure, and by means of a minimum of two safety-tested tether lines; (b) located and tethered so as to remain contained at all times within an envelope formed by the vertical projection of the lot boundaries; and (c) inflated only by cold air or helium.
PO5 Advertising devices are structurally sound and durable.	**AO5.1** Advertising devices, other than a commercial flag, banner sign, bunting or footway sign are permanently attached to a building, structure or the ground.
	AO5.2 Advertising devices being a commercial flag, banner sign or bunting are securely attached to a pole or structure that is permanently attached to a building, structure or the ground.
PO6 Advertising devices do not impact on the safe and efficient operation of infrastructure.	**AO6.1** Advertising devices maintain a minimum clearance of 1.5m to any installation or object relating to telecommunications (excluding a public telephone booth or kiosk), water supply, sewerage or stormwater drainage infrastructure. **Editor's note—**Additional separation distances to infrastructure may be required by other legislation or utility providers.

	AO6.2 Advertising devices maintain a separation distance from power supply and electrical infrastructure in accordance with the distances prescribed by the Electrical Safety Regulation 2013.

Table 9.3.1.3(a)—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Character and amenity	
PO7 Advertising devices do not adversely impact on the visual amenity of the locality, having regard to the following: (a) significant and unreasonable loss of views; (b) overshadowing; (c) loss of access to breezes; (d) illumination effects; (e) impact on sight lines for vehicular access and egress; (f) significant and unreasonable loss of landscaping; and (g) the creation of visual clutter or proliferation of advertising devices.	No acceptable outcome is nominated.
PO8 Advertising devices are subservient to, and not dominant over, a building's appearance and are reasonably integrated with architectural features.	No acceptable outcome is nominated.

Table 9.3.1.3(a)—Accepted development subject to requirements and assessable development (Part)

Performance outcomes	Acceptable outcomes
For assessable development	
Safety	
PO9 Advertising devices do not pose a safety hazard.	No acceptable outcome is nominated.

Table 9.3.1.3(b)—Types of advertising devices (Part)

Device name and definition	Example of device
Lower impact advertising devices	
Blind/canopy sign A sign that is printed, painted or otherwise affixed to a solid or flexible material suspended from an awning, veranda or wall.	

Commercial flag A cloth or similar non-rigid fabric hung from, or attached to, a pole for the purpose of advertising a business, product or service.	
Footway sign A portable, free-standing sign normally supported by an 'A-frame' or inverted 'T-frame' and typically displayed on a footway.	
Hamper sign A sign painted or otherwise affixed in the area between a door head and the underside of an awning, or at equivalent level.	
Stallboard sign A sign painted or otherwise affixed to the base of a shopfront, normally below a shop window.	

Street furniture sign A sign attached to an item of street furniture, such as alfresco dining demarcation, telephone booths/kiosks, bus shelters, garbage bins, public seating and the like.	
Under-awning sign A sign affixed underneath, or suspended from, an awning or veranda.	
Window sign A sign affixed to or printed on the glass of a display window, or displayed behind the glass of the display window and facing outside. The term does not include products displayed in a window.	

Table 9.3.1.3(b)—Types of advertising devices (Part)

Device name and definition	Example of device
Intermediate impact advertising devices	
Above-awning sign A sign located on top of an awning or veranda of a building.	
Awning Fascia sign A sign painted or otherwise affixed flat to the fascia of an awning, or the balustrade of a veranda.	
Banner sign A removable advertising device attached or tethered to, or suspended from, a fixed object and displaying signage applied to, or printed or painted on, fabric or similar material.	
Bunting Decorative flags, pennants or streamers displayed for the purposes of advertising a business.	
Fence sign A sign that is painted or otherwise affixed to a fence or wall, usually located on a boundary of a site.	

Ground sign A sign that is painted on, or affixed to, a free-standing, low-level wall or similar freestanding structure located on the ground.	
Panel sign A free-standing sign that is typically similar in proportions to, but significantly smaller than, a billboard. The term does not include any sign otherwise defined herein.	
Projecting sign A sign: (a) directly attached to, and projecting horizontally from, and perpendicular to, a wall or building façade; or (b) suspended from a pole or similar device projecting horizontally from, and perpendicular to, a wall or building facade.	

Table 9.3.1.3(b)—Types of advertising devices (Part)

Device name and definition	Example of device
Higher impact advertising devices	
Animated sign A sign with a moving or changing display, such as moving, flashing, changing or chasing lights or scrolling, changing or projected images.	
Billboard A free-standing display surface which may be positioned on the ground or a building or structure, or mounted on one or multiple vertical supports.	
Inflatable sign An advertising device in the form of a fixed or tethered balloon, or similar lighter than air device.	
Pole sign A free-standing sign on one vertical support.	

Pylon sign A free-standing advertising device, the height of which is greater than the width, that is attached to the ground and either self-supporting or attached to one or more vertical supports.	
Roof sign A sign painted onto or otherwise affixed to the roof of a building. The term does not include an above-awning sign.	
Three-dimensional object sign A sign in the form of a three-dimensional object attached to a building, structure or the ground. The term does not include an inflatable sign.	

Wall sign A sign painted or otherwise affixed flat to the wall or façade of a building or structure. The term includes a parapet sign and a building name sign where advertising the name and/or logo of a business.	

Table 9.3.1.3(c)—Design parameters for advertising devices (Part)

Notes—

* Sign face area is measured as the total surface area of any face of an advertising device, excluding any supporting structure or, where applicable, as the surface area encompassing the outer extent of the advertising material contained on that face.

** Unless otherwise specified, height is measured from the highest point on any sign face to ground level below.

Device type	Maximum number of devices	Maximum dimensions (m) or sign face area (m^2)*	Maximum number of sign face per advertising device	Maximum height**	Minimum separation distance to another device of the same type	Other
Lower impact advertising devices						
Blind/canopy sign		A maximum of 50% of the external surface area of the blind or canopy.				
Commercial flag		5m²		6.5m		
Footway sign	One per business, tenant or occupant.	1m²	2	1m		
Hamper sign or Stallboard sign						Contained within the limits of the hamper or stallboard to which it is attached.
Under-awning sign	One per business, tenant or occupant.	Length: • the lesser of 2m or 75% of awning/veranda width; • height - 0.5m; • thickness - 60mm.	2		3m	• Contains advertising material on both sign faces. • Sign faces are oriented either perpendcular or parallel to the building facade.
Window sign		A maximum of 25% of the window surface area.				

Table 9.3.1.3(c)—Design parameters for advertising devices (Part)

Notes—

* Sign face area is measured as the total surface area of any face of an advertising device, excluding any supporting structure or, where applicable, as the surface area encompassing the outer extent of the advertising material contained on that face.

** Unless otherwise specified, height is measured from the highest point on any sign face to ground level below.

Device type	Maximum number of devices	Maximum dimensions (m) or sign face area (m^2)*	Maximum number of sign face per advertising device	Maximum height**	Minimum separation distance to another device of the same type	Other
Intermediate impact advertising device						
Above-awning sign	One per business, tenant or occupant.	2.5m^2.	2	1.5m measured to the awning surface below.	3m	• The horizontal dimension exceeds the vertical dimension. • Sign faces are back-to-back and perpendicular to the building façade.
Awning fascia sign	One per business, tenant or occupant.					• Contained within the limits of the fascia to which it is attached; or • Exceeds only the upper and/or lower limits of the fascia by a maximum of 500mm in each case.
Banner sign	One per business, tenant or occupant.	5m^2 if in a Centre zone or an Industry zone. Otherwise 2.5m^2 .		5m		• Contains advertising material on all visible sign faces. • Not attached at both ends to the same building. • Not erected above the eave or parapet line of a building.
Bunting				6m		Does not extend beyond the boundaries of the subject premises.
Fence sign	One per lot.	Maximum thickness of 30mm.				Is contained within the outer limits of the fence on which it is located.
Ground sign	One per lot.	10m^2.		2m		Advertising material covers a maximum of 75% of each side of the advertising device.
Panel sign	One per business, tenant or occupant.	Horizontal – 2.5m; Vertical – 1.5m; Thickness – 60mm.	2	2.5m	3m	• Sign faces are back-to-back. • Contains advertising material on any sign face visible from a road or public place.

Projecting sign	One per business, tenant or occupant.	2m², with a maximum projection from the façade of 2m.	2	4.5m	3m	• Sign faces are back-to-back and perpendicular to the building façade. • Not erected above the eave or parapet line of a building.

Table 9.3.1.3(c)—Design parameters for advertising devices (Part)

Notes—

* Sign face area is measured as the total surface area of any face of an advertising device, excluding any supporting structure or, where applicable, as the surface area encompassing the outer extent of the advertising material contained on that face.

** Unless otherwise specified, height is measured from the highest point on any sign face to ground level below.

Device type	Maximum number of devices	Maximum dimensions (m) or sign face area (m²)*	Maximum number of sign face per advertising device	Maximum height**	Minimum separation distance to another device of the same type	Other
Higher impact advertising devices						
Animated sign	One per lot, if the lot area is less than 1,000m². Otherwise, one per 1,000m² of lot area, or part thereof exceeding 500m².	20m²		12m	50m if not in a Centre zone or an Industry zone.	
Billboard		48m², if located in the Rural zone, a Centre zone or an Industry zone. Otherwise, 18m².	2		500m if located in the Rural zone. Otherwise, 200m.	• Sign faces are back-to-back or may be oriented at an angle to each other for best viewing. • Contains advertising material on all sign faces visible from a road or public place. • Where a single-sided sign or the back of a sign structure is visible from a road or public space, the back of the sign structure must be attractively treated or screened with vegetation to minimise visual impact.

Inflatable sign	One per lot.				500m	• Is not located on a lot less than 1,000m² in extent. • Is not able to rise to a height of more than 25m above ground level below.
Pole sign	One per lot.	2.5m2.	2	5m	50m	• Sign faces are back-to-back. • Contains advertising material on all sign faces visible from a road or public place. • Is located only on a lot frontage.
Pylon sign	One per lot.	36m2.		12m	60m	• Is not located on a lot less than 1,000m² in extent. • Contains advertising material on all sign faces visible from a road or public place. • Is located only on a lot frontage.
Roof sign	One per roof surface.			2.5m above roof level below the advertising device.	3m	• Is contained entirely within the roof line/profile whether seen in plan view or elevation. • Contains advertising material on all sign faces visible from a road or public place.
Three-dimensional object sign	One per lot.	3m in any dimension.		6m		
Wall sign		• A maximum of 20% of the area of the applicable building elevation; and • If a parapet sign, a maximum of 50% of the parapet area.		9m		Does not project beyond the outer extremities of the wall to which it is affixed or on which it is painted.

9.3.2 Healthy waters code

9.3.2.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.2.2 Purpose

(1) The purpose of the code is to ensure development manages stormwater and wastewater as part of the integrated total water cycle and in ways that help protect the environmental values specified in the *Environmental Protection (Water) Policy 2009*.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) environmental values of receiving water are protected from adverse development impacts arising from altered stormwater quality and altered stormwater flow;

(b) environmental values of receiving water are protected from waste water impacts;

(c) environmental values of receiving water are protected from development impacts arising from the creation or expansion of non-tidal artificial waterways such as urban lakes;

(d) potential adverse impacts on the natural and built environment, including infrastructure and human health as a result of acid sulfate soils are avoided;

(e) public health and safety are protected and damage or nuisance caused by stormwater is avoided;

(f) stormwater is designed to maintain or recreate natural hydrological processes and minimise run-off;

(g) whole of lifecycle costs of infrastructure are minimised; and

(h) well-designed developments are responsive to receiving water quality.

9.3.2.3 Assessment benchmarks

Table 9.3.2.3—Asessable development (Part)

Performance outcomes	Acceptable outcomes
Stormwater management - protecting water quality	
PO1 Development contributes to the protection of environmental values and water quality objectives of receiving waters to the extent practicable. **Editor's note—**The environmental values and water quality objectives are established under the *Environmental Protection (Water) Policy (2009)*. For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.8 Stormwater management plans for development, SC6.4.3.9 Water sensitive urban design guidelines; and SC6.4.6.1 Water sensitive urban design construction and establishment requirements.
PO2 High environmental value waters and slightly disturbed waters (shown on Figure 9.1 — High environmental value waters and slightly disturbed waters) are protected from the impacts of development within their catchments. Existing water quality, habitat and biota values, flow regimes and riparian areas are maintained or enhanced.	No acceptable outcome is nominated. **Editor's note—**Refer to the *Queensland Water Quality Guidelines (QWQG)* for details on how to establish a minimum water quality data set for these areas.

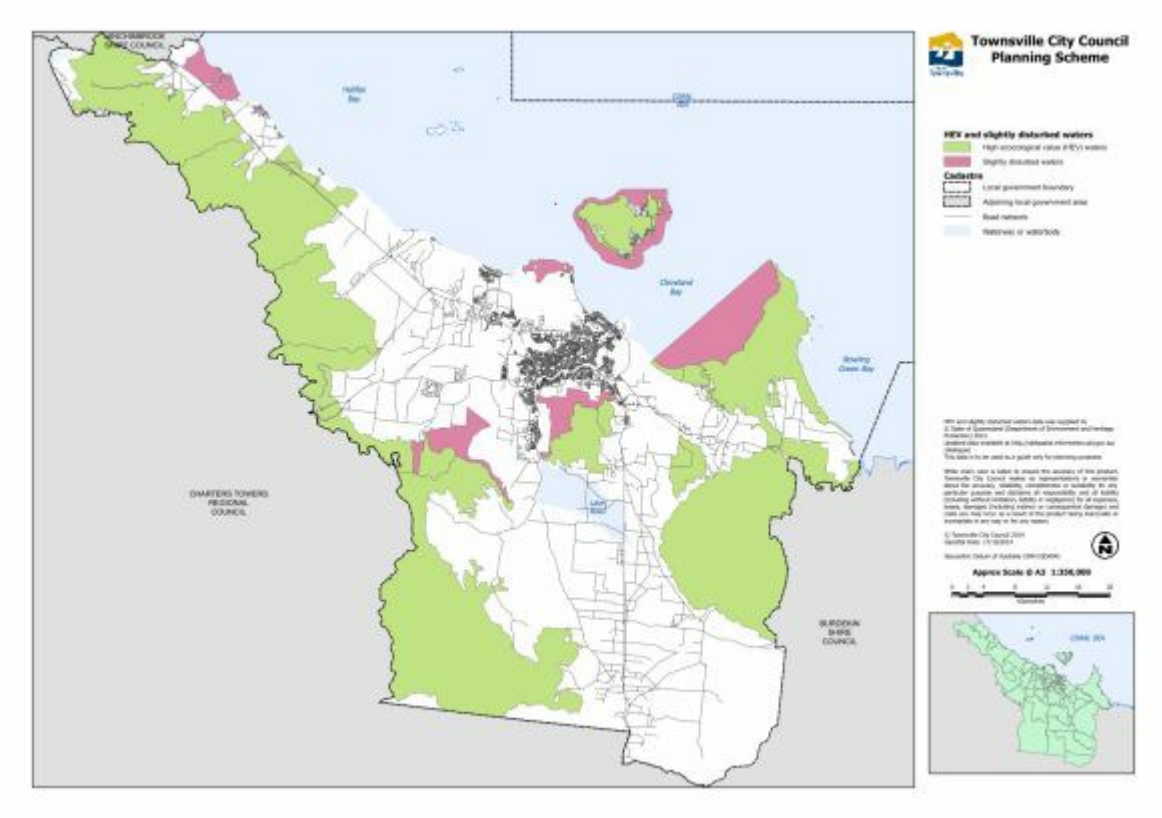


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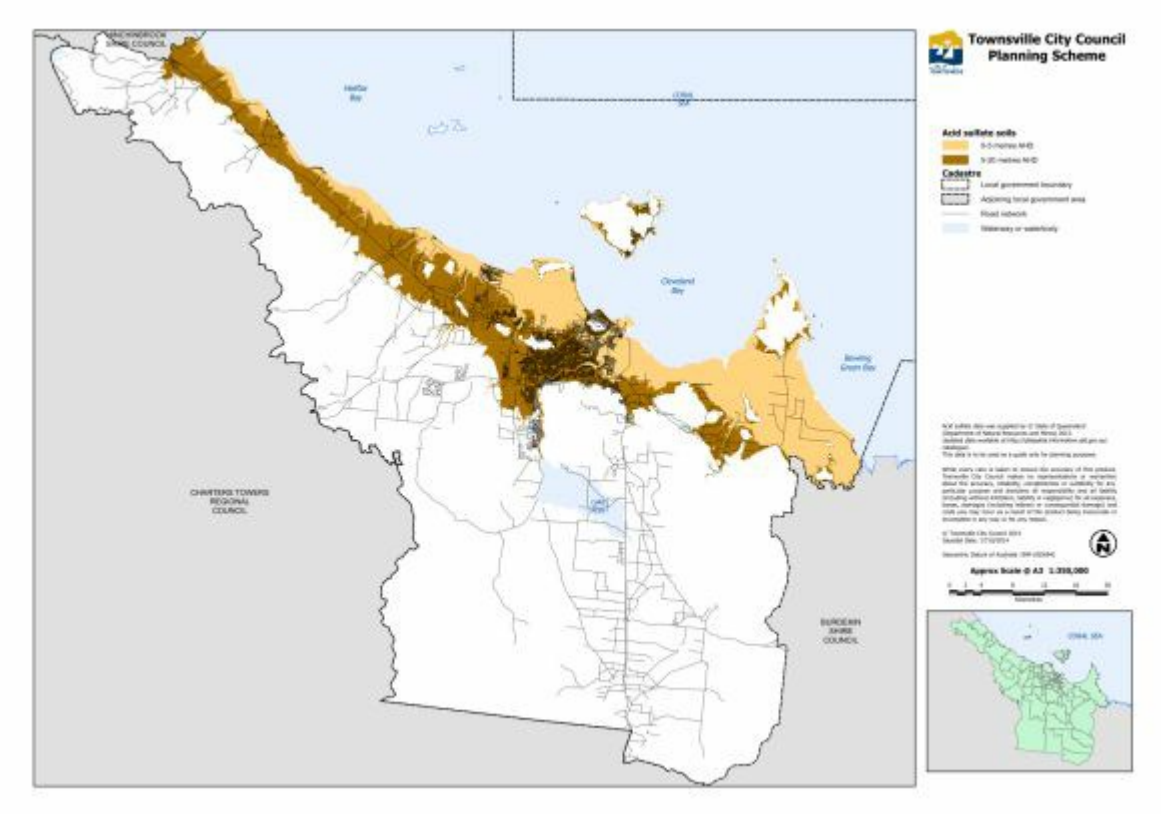
Figure 9.1 - High environmental value waters and slightly disturbed waters

Table 9.3.2.3—Assessable development (Part)

PO3 The entry of contaminants into, and transport of contaminants in, stormwater is avoided or minimised.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.8 Stormwater management plans for development, SC6.4.3.9 Water sensitive urban design guidelines; and SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

PO4 Within the areas identified as potential acid sulfate soils on Figure 9.2 — Acid sulfate soils, the generation or release of acid and metal contaminants into the environment from acid sulfate soils is avoided by: (a) not disturbing acid sulfate soils when excavating or otherwise removing soil or sediment, draining or extracting groundwater, excluding tidal water or filling land; or (b) where disturbance of acid sulfate soils cannot be avoided, development: (i) neutralises existing acidity and prevents the generation of acid and metal contaminants; and (ii) prevents the release of surface or groundwater flows containing acid and metal contaminants into the environment.	**AO4.1** Development does not: (a) involve excavating or removing 100m^3 or more of soil and sediment at or below 5m AHD; or (b) permanently or temporarily drain or extract groundwater or exclude tidal water resulting in the aeration of previously saturated acid sulfate soils; or (c) involve filling with 500m^3 or more with an average depth of 0.5m or greater that results in: (i) actual acid sulfate soils being moved below the water table; or (ii) previously saturated acid sulfate soils being aerated. OR **AO4.2** Development manages waters so that: (a) all disturbed acid sulfate soils are adequately treated and/or managed so that they can no longer release acid or heavy metals; (b) the pH of all site any water including discharges and seepage to groundwater, is maintained between 6.5 and 8.5 (or an agreed pH in line with natural background); (c) waters on the site, including discharges and seepage to groundwater, do not contain elevated levels of soluble metals; (d) there are no visible iron stains, flocs or sums in discharge water; (e) all reasonable preparations and actions are undertaken to ensure that aquatic health is safeguarded; and (f) infrastructure such as buried services, pipes, culverts and bridges are protected from acid attack. **Editor's note—**Where works are proposed within the areas identified as potential acid sulfate soils on Figure 9.2 - Acid sulfate soils, the applicant is required to undertake an on-site acid sulfate investigation. The reason for undertaking an acid sulfate soils investigation is to determine the presence of acid sulfate soil in order to avoid disturbance. Where acid sulfate soils cannot reasonably be avoided, investigation results assist in the planning of treatment and remedial activities and must be undertaken in accordance with the *Queensland Acid Sulfate Soil Technical Manual* and relevant State Planning Policy. Applicants should also refer to the *Guidelines for Sampling Analysis of Lowland Acid Sulfate Soils in Queensland*, Acid Sulfate Soils Laboratory Methods Guidelines or Australian Standard 4969. It is highly recommended that the applicant develop a practical Acid Sulfate Soil Management Plan for use in monitoring and treating acid sulfate soils.



Click here to view PDF high resolution map.

Figure 9.2 - Acid sulfate soils

Table 9.3.2.3—Assessable development (Part)

PO5 Construction activities for the development avoid or minimise adverse impacts on stormwater quality or hydrological processes.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.8 Stormwater management plans for development, SC6.4.5 Construction management; and SC6.4.6.1 - Water sensitive urban design construction and establishment requirements.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Hydrological processes	
PO6 The stormwater management system: (a) retains natural waterway corridors and drainage paths; and (b) maximises the use of natural channel design in constructed components.	**AO6.1** All existing waterways and overland flow paths are retained.
	AO6.2 The stormwater management system is designed in accordance with the Development manual planning scheme policy no. SC6.4 — SC6.4.3.9 Water sensitive urban design guidelines.
PO7 The development is designed to minimise run-off and peak flows by: (a) minimising large areas of impervious material; and (b) maximising opportunities for capture and reuse.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.8 Stormwater management plans for development, SC6.4.3.9 Water sensitive urban design guidelines; and SC6.4.6.1 Water sensitive urban design construction and establishment requirements.

PO8 Stormwater management is designed to: (a) protect in-stream ecosystems from the significant effects of increased run-off frequency by capturing the initial portion of run-off from impervious areas; and (b) create conditions such that the frequency of hydraulic disturbance to in-stream ecosystems in developed catchments is similar to pre-development conditions. **Editor's note—**Frequent flow management is distinct from flood management purposes, which is concerned with the management of less frequent, more extreme stormwater flows. The latter is an important part of integrated stormwater management and should in no way be compromised in pursuit of the management of more frequent flows for waterway health enhancement.	**AO8** The stormwater management system is designed in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.8 Stormwater management plans for development.
PO9 Stormwater management is designed to prevent exacerbated in-stream erosion downstream of a development site by controlling the magnitude and duration of sediment-transporting, erosion-causing flows.	**AO9** The stormwater management system is designed in accordance with the Development manual planning scheme policy no. SC6.4 — SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.3.8 Stormwater management plans for development.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Stormwater drainage generally	
PO10 The proposed stormwater management system or site works does not adversely affect flooding or drainage characteristics of properties that are upstream, downstream or adjacent to the development site.	**AO10.1** The development does not result in an increase in flood level or flood duration on upstream, downstream or adjacent properties.
	AO10.2 The stormwater management system is designed and constructed in accordance with the Development manual planning scheme policy SC6.4 – SC6.4.4.4 Stormwater drainage design, SC6.4.3.9 Water sensitive urban design guidelines; and SC6.4.6.4 Stormwater drainage.
PO11 Development does not cause ponding, or changes in flows and velocities such that the safety, use and enjoyment of nearby properties are adversely affected.	**AO11** The stormwater management system is designed and constructed in accordance with the Development manual planning scheme policy SC6.4 – SC6.4.4.4 Stormwater drainage design; SC6.4.3.9 Water sensitive urban design guidelines; and SC6.4.6.4 Stormwater drainage.
PO12 The drainage network has sufficient capacity to safely convey stormwater run-off from the site.	**AO12** Development is undertaken in accordance with the Development manual planning scheme policy SC6.4 – SC6.4.4.4 Stormwater drainage design; SC6.4.6.5 Drainage structures and SC6.4.6.4 Stormwater drainage.

PO13 The stormwater management system: (a) provides for safe access and maintenance; and (b) where relevant, provides for safe recreational use of stormwater management features.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.8 Stormwater management plans for development and SC6.4.4.4 Stormwater drainage design, SC6.4.3.9 Water sensitive urban design guidelines; SC6.4.3.6 Landscape policy; SC6.4.6.1 Water sensitive urban design construction and establishment requirements; and SC6.4.6.4 Stormwater drainage

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Point source waste water management (other than contaminated stormwater and sewage)	
PO14 Waste water is managed in accordance with a waste management hierarchy that: (a) avoids waste water discharge to waterways; or (b) if waste water discharge to waterways cannot practicably be avoided, minimises waste water discharge to waterways by re-use, recycling, recovery and treatment for disposal to sewer, surface water and groundwater. **Editor's note—**To meet this outcome, a waste water management plan (WWMP) should be prepared by a suitably qualified person. The WWMP is to account for the waste water type, climatic conditions, Water Quality Objective (WQOs) and best practice environmental management.	No acceptable outcome is nominated.
PO15 Any treatment and disposal of waste water to a waterway: (a) protects the applicable water quality objectives for the receiving waters; and (b) avoids adverse impact on ecosystem health of receiving waters.	No acceptable outcome is nominated.
PO16 Development avoids or minimises and appropriately manages soil disturbance or altering natural hydrology in nutrient hazardous areas.	No acceptable outcome is nominated.
PO17 Waste water discharge to waterways is managed to avoid or minimise the release of nutrients of concern so as to minimise the occurrence, frequency and intensity of coastal algal blooms. **Editor's note—**Compliance with this outcome can be demonstrated by following the management advice in the Implementing Policies and Plans for Managing Nutrients of Concern for Coastal Algal Blooms in Queensland and associated technical guideline.	No acceptable outcome is nominated.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Constructed lakes and artificial waterways	
PO18 Where established, a constructed lake or artificial waterway is designed to maintain a reasonable standard of water quality, having regard to factors affecting lake health, including: (a) nutrients and eutrophication; (b) gross pollutants, including organic material; (c) light and turbidity; (d) organic carbon loads; (e) lake stormwater detention time; (f) salinity; (g) temperature; (h) water depth and seasonal variations; (i) water column mixing temperature; and (j) pesticides and other chemicals.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO19 Stormwater run-off entering and leaving a constructed lake or artificial waterway maintains receiving water quality.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO20 The location, design and operation of a constructed lake or artificial waterway: (a) protects environmental values in downstream and upstream waterways; (b) protects any groundwater recharge areas; (c) incorporates low lying areas of a catchment connected to an existing waterway; (d) does not disrupt natural wetlands and any associated buffer areas; (e) avoids disturbing soils or sediments; and (f) avoids altering the natural hydrologic regime in acid sulfate soil and nutrient hazardous areas. **Editor's Note—**Monitoring and maintenance programs will be required to adaptively manage water quality and to achieve relevant water quality objectives.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.

PO21 The constructed lake or artificial waterway is located in a way that is compatible with existing tidal waterways.	For constructed lakes — No acceptable solution is nominated. **AO21** For an artificial waterway: Where an artificial waterway is located adjacent to, or connected to, a tidal waterway by means of a weir, lock, pumping system or similar: (a) there is sufficent flushing or tidal flushing with water level variation >0.3m; (b) any tidal flow alteration does not adversely impact on the tidal waterway; and (c) there is no introduction of salt water into freshwater environments. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO22 The construction phase for the constructed lake or artificial waterway is compatible with protecting aquatic environmental values in existing natural waterways and wetlands.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO23 A constructed lake or artificial waterway is designed to avoid terrestrial and aquatic weeds, vectors and concentrations of populations.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO24 The lake design provides for suitable machinery access to enable maintenance of the lake, including the removal of terrestrial and aquatic weeds.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO25 A constructed lake or artificial waterway has no adverse impact on flood capacity, including the capacity of upstream catchments and floodplain areas.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO26 A constructed lake or artificial waterway is designed to minimise hazards to ensure public safety is maintained.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO27 A constructed lake or artificial waterway is designed to provide a high level of amenity for surrounding residents.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.
PO28 Opportunities for incorporation of accessible passive and active recreation facilities into the design of the constructed lake or artificial waterway are facilitated.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC 6.4 - SC6.4.3.12 Constructed Lakes.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Efficiency and whole of life cycle cost	
PO29 Life cycle costs are minimised, taking into account acquisition, construction, establishment, operation, monitoring, maintenance, replacement and disposal costs.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 for assistance in demonstrating this outcome.
PO30 The design of the development allows for sufficient site area to accommodate an effective stormwater management system.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 for assistance in demonstrating this outcome.
PO31 The proposal provides for the orderly development of stormwater infrastructure within a catchment, having regard to: (a) existing capacity of stormwater infrastructure and ultimate catchment conditions; (b) discharge for existing and future upstream development; and (c) protecting the integrity of adjacent and downstream development.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 for assistance in demonstrating this outcome.
PO32 Proposed stormwater infrastructure remains fit for purpose for the life of the development.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 for assistance in demonstrating this outcome.
PO33 Proposed stormwater infrastructure can be easily accessed and can be maintained in a safe and cost effective way.	**AO33** The stormwater management system is designed in accordance with the Development manual planning scheme policy SC6.4 – SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.4.4 Stormwater drainage design.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Water management in reconfiguring a lot	
PO34 Reconfiguration of lots includes water management measures in the design of any road reserve, streetscape or drainage networks to: (a) minimise impacts on the water cycle; (b) protect waterway health by improving stormwater quality and reducing site run-off; and (c) avoid large areas of impervious surfaces.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 for assistance in demonstrating this outcome.

Table 9.3.2.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Ship-sourced pollutants	
PO35 Common user facilities for the handling and disposal of ship-sourced pollutants including oil, garbage and sewage are provided at a suitable location in any development involving a marina or berthing facilities. **Editor's note—**Refer to: *Australian and New Zealand Environment and Conservation Council (ANZECC)*, 1997, *Best Practice Guidelines for Waste Reception Facilities at Ports*, *Marinas and Boat Harbours in Australia and New Zealand.*	No acceptable outcome is nominated.
PO36 Marinas or berthing facilities are designed and operated to ensure the risk of spillage from operations is minimised.	No acceptable outcome is nominated.
PO37 Equipment to contain and remove spillages is stored in a convenient position near marina or berthing facilities and is available for immediate use.	No acceptable outcome is nominated.
PO38 Where practical, the marina pollutant reception facility is connected to a sewerage or other waste reception infrastructure. **Editor's note—**Reception facilities require compliance assessment under the *Plumbing and Drainage Act 2002*. The plumbing compliance assessment process will ensure that the proposed facilities address 'peak load'.	No acceptable outcome is nominated.

9.3.3 Landscape code

9.3.3.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.3.2 Purpose

(1) The purpose of the Landscape code is to ensure landscaping in both the private and public domains is designed and constructed to a high standard, provides a strong contribution to the city image, is responsive to the local character, site and climatic conditions and remains fit for purpose over the long-term.

(2) The purpose of the code will be achieved by the following overall outcomes:

- (a) a high quality streetscape and on-site landscape enhances the character of the city;
- (b) landscape design is used to integrate the natural and built form elements of the site and the locality;
- (c) landscape elements create a legible and attractive street frontage, and enhance the continuity of the streetscape;
- (d) screening is used to soften built form, mitigate adverse aesthetic impacts and provide privacy and character;
- (e) plant species and landscaping materials are suited to the Dry Tropics' cyclone prone climate;
- (f) plant species, landscape materials and surface treatments are suited to their intended function and user requirements;
- (g) plant species, landscaping materials and surface treatments are designed to remain attractive, fit for purpose and be cost effective to maintain over the long-term;
- (h) landscape design facilitates an accessible, safe and comfortable environment for all users; and
- (i) significant on-site vegetation is retained, protected and integrated into the site design wherever practicable.

9.3.3.3 Assessment benchmarks

Table 9.3.3.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Landscape design and character	
PO1 The overall landscape design of both public and private spaces: (a) creates a sense of place that is consistent with the intended character of the streetscape, city or locality; and (b) is functional and designed to be visually appealing in the long-term as well as when first constructed.	**AO1** When the development is in an identified locality in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy, landscape design is in accordance with the requirements for that area. Otherwise, no acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.

PO2 Tree and plant selection ensures: (a) climatically appropriate landscaping; (b) creation of a diverse palette: in form, texture and seasonal colour; (c) longevity of plants and the form and function of landscaped areas; and (d) cost effective and convenient maintenance over the long-term.	**AO2.1** Species are selected from those listed in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
	AO2.2 Plant species do not include undesirable species as listed in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO3 Where appropriate, provision is made for on-street planting that: (a) complements the local streetscape; (b) ensures visibility is maintained from entrances and exits to properties and at intersections; (c) establishes healthy vegetation of suitable species; (d) minimises the potential for vegetation to cause damage to persons, property or infrastructure; and (e) does not limit or hinder pedestrian or vehicular flow and movement.	**AO3** Street planting is provided that is consistent with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy. **Editor's note—**Applicants may also have reference to the Development manual planning scheme policy no. SC6.4 - SC6.4.4.1 Geometric road design.
PO4 Streetscape treatments and paving form a functional and attractive component of the overall landscape scheme.	**AO4.1** All general streetscape elements are provided in accordance with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
	AO4.2 Streetscape pavements are provided in accordance with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
	AO4.3 Streetscape furniture is provided in accordance with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO5 Landscaping within on-site open space areas is well-designed, having regard to its purpose and the provision of shading, climatic response, and the proportion of soft and hard elements.	**AO5.1** Selected tree species within communal recreation areas are to provide at least 30% shade coverage within 5 — 10 years of planting.
	AO5.2 A minimum of 50% of landscaped areas are to be covered in soft landscaping (turf areas and planting beds), with at least 25% of that area being planting.
PO6 Landscaping and embellishments in local recreational parks is fit for purpose and well-designed, having regard to shading, climatic response, and the proportion of soft and hard elements. Landscaping softens edges and creates an attractive interface with adjoining land.	**AO6** Landscaping and embellishments are provided that are consistent with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy. **Editor's note—**Applicants should also have regard to requirements for local recreational parks in the Reconfiguring of a lot code.

PO7 The use of hard surface treatments within private and public spaces do not detract from a high standard of amenity, and large unbroken areas of hardstand material is avoided.	**AO7** Surface treatments are provided that are consistent with the standards set out in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.

Table 9.3.3.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Edge treatments	
PO8 Where provided, landscape design along site frontages is used to mitigate adverse aesthetic elements, provide privacy and reduce illumination impacts, while maintaining a safe environment for users.	**AO8** Landscaped areas along the frontage of a site consists of: (a) shade or rounded canopy trees that will provide a minimum of 50% shade to the frontage of the site within 5 years of planting; (b) shrubs that provide screening to blank walls and privacy as required; and (c) low shrubs and ground covers that reach a maximum height of 750mm at maturity.
PO9 Where appropriate, acoustic barriers and long fences along road frontages and within the development are screened or softened by landscaping or architectural embellishment to improve visual amenity of the development.	No acceptable outcome is nominated. **Editor's note—**Guidance on desirable treatments in particular circumstances is provided in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO10 Where provided, landscaping along a side or rear boundary assists in maintaining privacy, screening unsightly or service elements and enhancing the appearance of the development from nearby premises.	**AO10.1** Screen planting is provided along the side or rear boundary of a site, which consists of: (a) either trees with a maximum spacing of 3m (measured from centres) and capable of providing a dense screen within 3 years of planting or screening shrubs capable of growing to a height of 3m within 2 years of planting; and (b) low shrubs and ground covers, where appropriate, to allow for complete covering of planting area.
	AO10.2 A minimum of 25% of all trees are to grow above the height of the eaves of the equivalent second storey of the building.
PO11 Landscaped areas along or near retaining walls, long unbroken walls, service areas and parking areas consist of an appropriate combination and species of trees, shrubs and groundcovers to minimise the visual impact of these elements.	No acceptable outcome is nominated. **Editor's note—**Guidance on desirable treatments in particular circumstances is provided in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO12 Screening trees, shrubs, low shrubs, ground covers and vertical accent plants are appropriate for the space available, orientation and functional requirements of the area.	No acceptable outcome is nominated. **Editor's note—**Guidance on desirable treatments in particular circumstances is provided in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.

Table 9.3.3.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Maintenance, drainage, utilities, services and construction	
PO13 Plant selection and location protects the integrity and function of overhead and underground services.	**AO13** Plant selection and location complies with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO14 Landscape elements do not adversely affect stormwater quantity or quality by ensuring: (a) the flow of water along overland flow paths is not restricted; (b) opportunities for water infiltration are maximised; and (c) areas of pavement, turf and mulched garden beds are appropriately located and adequately drained.	No acceptable outcome is nominated. **Editor's note—**Applicants should also refer to Section 9.3.6 Works code and Section 9.3.2 Healthy waters code and the Development manual planning scheme policy no. SC6.4 to assist in demonstrating the outcome.
PO15 Landscaping works, design and materials used minimise maintenance costs and whole of life cycle costs. **Editor's note—**Council may request a lifecycle cost analysis and maintenance cost plan for developments that create new public landscape embellishment to determine the appropriateness of landscaping treatment lifecycle costs to the community.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 to assist in demonstrating the outcome, including SC6.4.3.6 Landscape policy and SC6.4.6. Construction standards.
PO16 All turf areas on-site are accessible externally by standard lawn maintenance equipment and receive adequate sunlight for the turf species used.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 including SC6.4.3.6 Landscape policy to assist in demonstrating the outcome.
PO17 Drainage of podium planters allows for flush out in future and are adequately drained.	No acceptable outcome is nominated.
PO18 Irrigation is installed within private and public spaces to ensure the long-term viability and integrity of landscaped areas. Where provided, irrigation is designed to facilitate the efficient supply of water in accordance with micro-climatic conditions.	**AO18** Irrigation is provided accordance with the Development manual planning scheme policy no. SC6.4 including - SC6.4.3.6 Landscape policy. **Editor's note—**Irrigation systems should be minimized where practical, such as in natural areas or areas where landscaping is likely to endure due to landform and microclimate, for example.
PO19 Limited on-site maintenance is achieved for private and public landscaping, by selecting plant species having regard to long life expectancy and minimal leaf litter drop, pruning, watering and fertilising requirements.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4.3.6 Landscape policy to assist in demonstrating the outcome.
PO20 Container sizes and planting stock maturity is consistent with the intended role of the landscaping.	**AO20** Landscaping is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO21 Planting stocks are of a quality to ensure vigorous growth.	**AO21** Landscaping is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy and SC6.4.6.26 Landscaping.

PO22 Plants are protected and maintained to facilitate in-situ growth, vigour and quality form.	**AO22** Landscaping is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy and SC6.4.6.26 Landscaping.
PO23 Site preparation works ensure a stable and enhanced landscape form.	**AO23** Landscaping is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy and SC6.4.6.26 Landscaping.

Table 9.3.3.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Sustainability	
PO24 Wherever possible, landscape design facilitates the retention of significant existing vegetation, both within and external to the site.	**AO24.1** Site design integrates and incorporates retained and significant trees and vegetation within and external to the site.
	AO24.2 Removed or damaged significant vegetation is replaced with mature vegetation of a comparable quantity and species.
PO25 Appropriate site planning and construction management is undertaken to ensure the longevity and health of retained and significant trees and vegetation.	**AO25.1** Retained trees are protected by a tree protection zone (TPZ) and fenced along the canopy/drip line to comply with AS4970- 2009 Protection of Trees on Development Sites.
	AO25.2 Any required pruning or trimming work is undertaken in accordance with AS4373 — Pruning of Amenity Trees and is carried out by a qualified aborist.
	AO25.3 Retained and significant vegetation damaged during development or construction is treated to repair any damage to the extent practicable by a qualified aborist.
	AO25.4 Protective measures and practices are employed for work adjacent to trees in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.5 Construction management.
PO26 Landscape design optimises water and energy efficiency and responds appropriately to local conditions, by: (a) maximising the exposure to the prevailing summer breezes and the north-east winter morning sun; (b) minimising exposure to the prevailing winter winds and western summer sun; and (c) optimising shade to create useable and comfortable areas; (d) hydro-zoning planting.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.

PO27 Planting bed profiles and edging encourage plant viability, reduce erosion, control weed invasion, provide adequate water infiltration and ease of maintenance to support long-term plant viability and vigorous growth.	**AO27** Planting beds are designed in accordance with the Development manual planning scheme policy no. 6.4 - SC6.4.3.6 Landscape policy.
PO28 Landscape buffering and species selection is consistent and compatible with any ecological values on or adjoining the site.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO29 Landscaping elements are provided within parking areas, along driveways and internal roadways to provide adequate shading, and safe and legible parking areas.	**AO29** Landscaping is provided in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.

Table 9.3.3.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Safety	
PO30 Landscape design enhances community safety and reduces the potential for crime and antisocial behaviour. **Editor's note—**Applicants may find useful guidance in the Queensland Government's Crime Prevention through Environmental Design Guidelines for Queensland.	**AO30.1** Access to a site, parking area, buildings or public open space is well lit, free from obstructions and clearly defined by landscape treatments.
	AO30.2 Trees with a minimum 1.8m of clear trunk (at maturity) are located along pathways, at building entries, within parking areas, on street corners, adjacent to street lighting and along driveways. Garden beds within the aforementioned areas consist of low shrubs and groundcovers that do not exceed 750mm in height.
	AO30.3 Any solid wall or semi permeable fence is protected from graffiti through means of vertical landscaping or vandal resistant paint or artwork.
PO31 Where appropriate and practicable, all elements of the landscape design are safe and provide accessibility for all abilities.	**AO31.1** Paving material, tactile indicators and construction complies with AS1428 - Design for Access and Mobility.
	AO31.2 Pavement material or treatment clearly delineates between pedestrian and vehicular movement systems through contrasting materials, colours or level changes.
	AO31.3 Hard landscaping materials are not highly reflective, or likely to create glare, slipperiness or other hazardous conditions.

9.3.4 Reconfiguring a lot code

9.3.4.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment for reconfiguring a lot.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.4.2 Purpose

(1) The purpose of the reconfiguring a lot code is to:

(a) facilitate the creation of attractive, accessible and functional neighbourhoods and districts, and a well-integrated, compact and sustainable city form; and

(b) protect the productive capacity, landscape character and ecological and physical functions of Townsville's diverse natural resources.

(2) The purpose of the code will be achieved through the following overall outcomes:

(a) lot reconfiguration creates safe, convenient, functionally efficient and attractive neighbourhoods and districts that are consistent with the intended character of the area;

(b) lot reconfiguration creates walkable residential neighbourhoods and centres, and accessible community facilities and employment opportunities;

(c) lot reconfiguration is responsive to the local environment, including topography, natural drainage systems, vegetation and habitat, cultural heritage features, streetscape character, landmarks, views and vistas;

(d) lot reconfiguration near infrastructure corridors and other major facilities ensures that sensitive land uses are protected from activities generating amenity impacts;

Editor's note—Applicants will also need to have regard to the relevant overlays dealing with natural hazards, including bushfire, landslide, storm surge, coastal erosion and flooding.

(e) lot reconfiguration assists in protecting areas containing important ecological values or providing important environmental services;

(f) lot reconfiguration does not facilitate fragmentation or alienation of land that would prejudice the productive use of rural land resources;

(g) lot reconfiguration facilitates compatible relationships between different land uses and with the natural environment;

(h) lot design and lot sizes are suited to the intended use of the land having regard to the ability to accommodate buildings, vehicle access, parking, on-site services and open space;

(i) lot orientation facilitates the conservation of non-renewable energy sources and the siting of buildings that is appropriate for the local climatic conditions;

(j) infrastructure is supplied to all lots in a safe, efficient, coordinated and sequenced manner, which minimises whole of life cycle costs and is sensitive to the environment in which they are provided;

(k) the street system provides for high levels of permeability and safety for all users and in particular, facilitates high levels of accessibility by public transport, walking and cycling; and

(l) public open space is attractive and accessible and equitably meets user requirements for recreational, social and cultural activities.

9.3.4.3 Assessment benchmarks

Table 9.3.4.3(a)-Assessable development (Part)

Editor's note—In order to demonstrate compliance with this code, council may request the preparation of a structure plan for the locality, which may include land external to the site. This is likely where the proposed development involves more than 5 lots or the construction of a new road. The structure plan should be prepared in accordance with the guidance provided in the Emerging community planning scheme policy no. SC6.6. Such a plan may form the basis of a preliminary approval for development in an area.

Editor's note—Applicants should also have regard to Crime Prevention through Environmental Design Guidelines for Queensland when addressing relevant sections of the code.

Performance outcomes	Acceptable outcomes
General design elements	
PO1 The layout of roads, streets, lots and infrastructure avoids or minimises impacts on environmental features of the locality by: (a) following the natural topography and minimising earthworks; (b) avoiding crossing or otherwise fragmenting waterways, wetlands, habitat areas or ecological corridors; (c) maintaining natural drainage features and hydrological regimes; and (d) maintaining important ecological corridors and habitat areas.	No acceptable outcome is nominated.
PO2 The development is well integrated with the surrounding locality, having regard to: (a) the layout of, and connections to, surrounding roads, streets, pedestrian and cycle networks and other infrastructure networks; (b) open space networks, habitat areas or corridors; (c) connections to centres and employment areas; (d) opportunities for shared use of public facilities; (e) surrounding landscaping and streetscape treatments; and (f) the interface between incompatible land uses.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 provides applicants with guidance and additional information.
PO3 The design of urban street blocks encourages walking.	No acceptable outcome is nominated. **Editor's note—**Applicants may refer to Figure 16-3 in Complete Streets: Guidelines for urban street design to assist in compliance with this performance outcome. **Editor's note—**The Development manual planning scheme policy no. SC6.4 provides applicants with guidance and additional information.
PO4 Street blocks and lot types are generally in a grid pattern and arranged to provide: (a) an efficient development pattern that supports walking, cycling and public transport use; (b) regular shaped lots; and (c) development that is consistent with the intent of the zone.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 provides applicants with guidance and additional information.
PO5 New development optimises views and physical connections to important landscape features to enhance legibility and sense of place.	No acceptable outcome is nominated.

PO6 Reconfiguring a lot does not facilitate development that would be visually obtrusive on ridgelines and prominent landscape features, or does not intensify development where already occurring on such features.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.7 Steep land development design guidelines provides applicants with guidance and additional information.
PO7 Development maintains or rehabilitates vegetated buffers to coastal waters where practicable.	No acceptable outcome is nominated.
PO8 Where a reconfiguration involves the creation of a new road or street (other than in the Rural zone), streetscape and landscape treatments are provided that: (a) create an attractive and legible environment which establishes character and identity; (b) enhance safety and comfort, and meet user needs; (c) complement the function of the street in which they are located by reinforcing desired traffic speed and behaviour; (d) support safe pedestrian and cycling movement; (e) maximise infiltration of stormwater runoff wherever practicable; and (f) minimise maintenance and whole of lifecycle costs.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 provides applicants with guidance and additional information.

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Parks and open space **Editor's note—**Where acceptable outcomes are set out in this section, it is acknowledged that they may primarily be practicable in greenfield developments. Alternative outcomes are likely to be appropriate in existing developed areas. This may include works and embellishment to existing parks or recreational corridors to meet the development's demand, or as part of an infrastructure partnership agreement. **Editor's note—**The Development manual planning scheme policy SC6.4 - SC6.4.3.6 Landscape policy provides applicants with guidance and additional information regarding parks and open space.	
PO9 Reconfiguration facilitates the provision of a hierarchy of open space at local, district and regional levels that: (a) contributes to the legibility and character of the neighbourhood; (b) is linked to existing parkland or open space networks wherever possible; (c) meets the community's needs and is designed to maximise use by the community it serves; and (d) offer a broad range of informal and formal experiences to the community.	No acceptable outcome is nominated. **Editor's note—**The Local government infrastructure plan identifies desired standards of service for trunk open space infrastructure. Trunk infrastructure does not include local recreational parks.

PO10 Within residential areas, local recreation parks are created which provide informal recreational opportunities to supplement private open space of the neighbourhood.	**AO10.1** Local recreational parks are provided at a rate of 1ha per 1,000 people.
	AO10.2 Local recreational parks are provided at a maximum distance of 400m from the residents they serve.
PO11 Local recreational parks are of a sufficient size, shape and topography to accommodate a usable activity area, accommodating recreational facilities that meet local needs for a range of age cohorts, such as play equipment, kick-about areas, picnic areas, seating and the like. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy to assist in complying with this outcome.	**AO11.1** Local recreational parks have a minimum usable activity area of 0.5ha.
	AO11.2 Parks are square to rectangular with the ratio of dimensions no greater than 2:1.
	AO11.3 At least 80% of the park has a grade of no more than 1:10.
PO12 Local recreational parks are located and designed to maximise accessibility and to ensure a majority of the park has good casual surveillance established through overlooking from adjacent land uses.	**AO12** At least 50% of the perimeter of the park has a direct road frontage.
PO13 Local recreational parks are provided with a reasonable level of flood immunity such that community space remains available during most flood events.	**AO13** At least 10% of the park area is above the 2% AEP and embellishments, including play equipment, shelters and shared pathways are constructed above the 2% AEP flood level.
PO14 Parkland is safe and secure, with a clear relationship between the public realm and adjoining land uses through treatment including alignment, fencing, public lighting and landscaping.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy to assist in complying with this outcome.
PO15 Design and embellishments of local recreational parks: (a) reflect the likely demographic needs of the local community which the park services; (b) complement those in nearby parks, increasing the range of facilities available to the community; and (c) are fit for purpose.	**AO15** The design and embellishments of local recreational parks is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy.
PO16 Local recreational parks are to provide pathway connections to the on-street verge pathway network and pathways are provided to connect to activity areas within the park.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy SC6.4 - SC6.4.3.6 Landscape policy to assist in complying with this outcome.

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Climatic response	
PO17 Road, street and lot orientation and lot size facilitate development that conserves non-renewable energy sources and enhances climate responsiveness by: (a) optimising a generally north-south orientation for the long axis of street blocks, or where east-west orientation is unavoidable, proportioning lots to allow for appropriate building orientation; and (b) creating lots that are generally rectangular in shape.	No acceptable outcome is nominated.
PO18 Road, street and lot orientation and lot size are responsive to north east prevailing winds and facilitates air permeability.	**AO18.1** Where practicable, parallel side boundaries are staggered. Figure 9.3 — Staggered parallel boundaries illustrates.
	AO18.2 The layout does not create more than three small lots, solid fencing or other barriers perpendicular to the target winds. OR **AO18.3** Where barriers exist perpendicular to target winds, the distance between a down-wind barrier or receptor and the up-wind barrier is not less than 7 times the height of the upwind barrier. Figure 9.4 — Airflow and barriers illustrates. **Editor's note—**Research has shown that long horizontal barriers perpendicular to airflow, such as solid fencing or continuous building lines, attenuates airflow for a horizontal distance of seven times the height of the barrier. Where a second barrier occurs airflow continues to 'skim' and does not return to the unimpeded pattern for the same seven-times height distance.
	AO18.4 Where they are proposed, built to boundary walls are located on the west-southwest boundary of lots, except where these boundaries are on the higher side of a sloping lot.

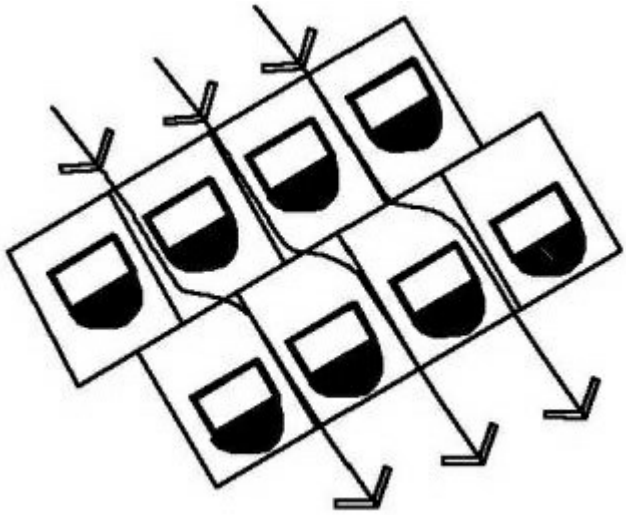


Figure 9.3 - Staggered parallel boundaries

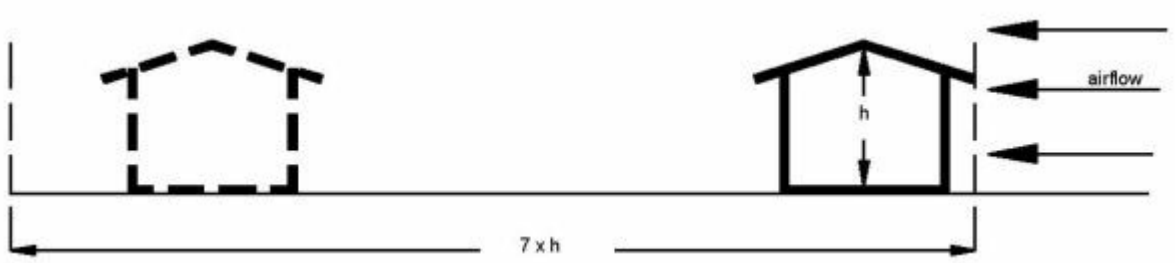


Figure 9.4 - Airflow and barriers

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Development near infrastructure corridors and other major facilities	
PO19 Reconfiguration within 100m of any high pressure gas pipeline does not: (a) increase the number of lots; (b) affect the long-term operation of the pipeline; and (c) put at risk the safety and lives of people or the safety of property.	No acceptable outcome is nominated.
PO20 Lots are designed and oriented to: (a) minimise the visual exposure of electricity transmission lines; (b) facilitate a substantive vegetated buffer adjoining electricity transmission line easements; and (c) ensure habitable buildings and recreation areas are well separated from electricity transmission line easements.	**AO20.1** Where on land that includes or adjoins a high voltage electricity easement (above 33kV), lot design and layout incorporates: (a) a vegetated buffer within a distance of 20m from the boundary of the electricity transmission line easement; and (b) the orientation of the primary lot frontage away from transmission line easement.
	AO20.2 Lots are designed and oriented to ensure that a habitable building or primary open space areas on each lot can comply with the separation distance set out in Table 9.3.4.3(b).

PO21 Reconfiguration ensures an appropriate level of amenity and safety is achieved for residential and other sensitive land uses through appropriate separation and buffering from nearby incompatible uses, including Department of Defence landholdings, major hazard facilities, intensive animal industries, major sport, recreation and entertainment facilities, sewerage, water and waste treatment and disposal facilities and industrial areas. The continued safe and efficient operation of these types of facilities is protected. **Editor's note—**A report by a suitably qualified person may be required to allow an assessment to be made of the potential environmental impacts of or affecting the proposed reconfiguration. Council recommends that applicants seeking approval for lots potentially affected by intensive animal industries refer tothe *Reference Manual for the Establishment and Operation or Beef Cattle Feedlots in Queensland, Queensland Dairy Farming Environmental Code of Practice, Environmental Code of Practice for Queensland Piggeries* and *Best Practice Technical Guide for the Meat Chicken Industry* and that applicants consult with Primary Industries and Fisheries prior to the lodgment of a development application. For other uses council may require a study that, amongst other matters, identifies how the development is in accordance with *Environmental Protection (Air) Policy 2008* or *Environmental Protection (Noise) Policy 2008*. **Editor's note—**Applicants may be required to prepare a Noise impact assessment as outlined in the Development manual planning scheme policy no. SC6.4 - SC6.4.3.15 Noise and vibration assessment guidelines	No acceptable outcome is nominated.
PO22 Reconfiguration of land potentially affected by the impacts of a transport corridor or other noise generating activities ensures the development is designed to facilitate adequate noise management. **Editor's note—**Applicants may be required to prepare a Noise impact assessment in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.15 Noise and vibration assessment guidelines.	No acceptable outcome is nominated.
PO23 Where they are used, noise attenuation measures are: (a) compatible with the local streetscape and do not preclude the creation of active street frontages where desired; (b) durable and easily maintained; and (c) are designed to discourage crime and antisocial behaviour, having regard to: (i) opportunities for graffiti; (ii) provision of casual surveillance of public open space and movement networks; and (iii) opportunities for concealments or vandalism.	No acceptable outcome is nominated.

PO24 Reconfiguration does not result in lots being subject to adverse air quality impacts. **Editor's note—**A report by a qualified air quality expert may be required to allow an assessment to be made of the air quality or impacts. The Queensland Odour Impact Assessment Guidelines provides a methodology for assessing impact.	No acceptable outcome is nominated.

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Services	
PO25 Services, including water supply, stormwater drainage management, sewerage infrastructure, reticulated gas, public lighting, waste disposal, electricity and telecommunications, are provided in a manner that: (a) is efficient; (b) is adaptable to allow for future infrastructure upgrades; (c) minimises risk of adverse environmental or amenity-related impacts; (d) promotes total water cycle management, the efficient use of water resources and the protection of environmental values and water quality objectives of receiving waters; and (e) minimises whole of life cycle costs for that infrastructure. **Editor's note—**The environmental values and water quality objectives are established under the *Environment Protection Policy (2009)*. For Townsville, they are specified in the Ross River Basin Environmental Values and Water Quality Objectives 2012 and Black River Basin Environmental Values and Water Quality Objectives (2012).	No acceptable outcome is nominated. **Editor's note—**Section 9.3.2 Healthy waters code, Section 9.3.6 Works code and the Development manual planning scheme policy SC6.4, set out standards for the design and construction of services.

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Lot sizes and design	
PO26 Reconfiguration creates lot sizes that: (a) are consistent with the intended character of the zone, precinct or sub-precinct in which the land is located; (b) do not compromise the future development potential of land in the Emerging community zone for urban purposes; (c) are sufficient to protect the productive capacity, environmental and landscape values of rural land resources; (d) are sufficient to protect ground and surface water quality in the Rural residential zone; and (e) are sufficient to protect areas with significant ecological values.	**AO26** Minimum lot size is in accordance with Table 9.3.4.3(c).
PO27 Lots have regular shape and dimensions to facilitate the efficient development of the land for its intended purpose, and have sufficient area to provide for: (a) buildings and structures appropriate to the zone, precinct or sub-precinct; (b) adequate usable open space and landscaping; (c) ventilation and sunlight; (d) privacy for residents; (e) suitable vehicle access and on-site parking where required; and (f) any required on-site services and infrastructure such as effluent disposal areas.	**AO27** The dimensions of lots are in accordance with Table 9.3.4.3(c).
PO28 Where rear lots are created, they: (a) provide for an appropriate level of amenity; (b) incorporate direct access of a sufficient width for the use of the lot; and (c) ensure infrastructure services to the lot can be easily constructed, monitored and maintained. **Editor's note—** Applicants should also address any performance outcomes of the relevant zone code which may affect whether rear lots are appropriate.	**AO28.1** Only one rear lot is provided behind each standard lot. **AO28.2** No more than two rear lot access strips directly adjoin each other. **AO28.3** No more than two rear lots gain access from the head of a cul-de-sac. **AO28.4** Where a rear lot is proposed in a residential zone, a square building envelope with sides of 17m is capable of being contained entirely within the lot.

	AO28.5 An access strip for a rear lot has a minimum width of: (a) 8m in a rural or rural residential zone for access lengths up to 50m and greater than 50m, 15m width; or (b) 3.5m in urban residential zones; or (c) 8m in an industry zone; or (d) in any other zone, no acceptable outcome is nominated.
	AO28.6 A passing bay is provided for access strips greater than 30m in length.
PO29 Realignment of boundaries in the Rural zone only occurs where this contributes to: (a) a reduction in the number of lots or level of fragmentation in the zone; or (b) potential for improved land management practices; or (c) improved protection and management of significant ecological values.	No acceptable outcome is nominated.

Table 9.3.4.3(a)-Assessable development (Part)

Performance outcomes	Acceptable outcomes
Movement network design **Editor's note**—The Transport impact, access and parking code and the Development manual planning scheme policy no. SC6.4 sets out other requirements relating to movement network design.	
PO30 The movement network has a legible structure, with roads and streets that conform to their function in the network, having regard to: (a) traffic volumes, vehicle speeds and driver behaviour; (b) on street parking; (c) sight distance; (d) provision for public transport routes and stops; (e) provision for pedestrian and cyclist movement, prioritising these where appropriate; (f) provision for waste collection and emergency vehicles; (g) lot access; (h) convenience; (i) public safety; (j) amenity; (k) the incorporation of public utilities and drainage; and (l) landscaping and street furniture.	No acceptable outcome is nominated. **Editor's note—**The outcomes of a Traffic impact assessment report undertaken as per the Development manual planning scheme policy no. SC6.4.3.14 Traffic impact assessment guidelines will assist in informing the movement network design. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4-SC6.4.3.5 Car parking and public transport facilities guidelines, SC6.4.4.7 Bicycle, pedestrian and shared path design, SC6.4.3.22 Waste management guidelines, SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design, SC6.4.3.6 Landscape policy, SC6.4.3.9 Water sensitive urban design, SC6.4.3.20 Public lighting and utility services and SC6.4.4.4 Stormwater drainage design to assist in complying with this outcome.

PO31 The road and street network provides for convenient and safe movement between local streets and higher order roads.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design and SC6.4.3.14 Traffic impact assessment guidelines to assist and comply with this outcome.
PO32 A cul—de—sac is not included in the road and street design unless no other practical options exist.	No acceptable outcome is nominated.
PO33 Local streets do not operate as through traffic routes for externally generated traffic (other than for pedestrians, cyclists and public transport).	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy and SC6.4.3.14 Traffic impact assessment guidelines to assist and comply with this outcome.
PO34 Safe, convenient and efficient intersections are provided for vehicles, pedestrians, cyclists and public transport.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy and SC6.4.3.14 Traffic impact assessment guidelines to assist and comply with this outcome.
PO35 Access arrangements for lots do not affect the function, vehicle speeds, safety, efficiency and capacity of streets and roads.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy and SC6.4.3.14 Traffic impact assessment guidelines to assist and comply with this outcome.
PO36 Rear lanes are designed to: (a) provide enough width to enable safe vehicle movement, including service vehicles; (b) connect to other streets at both ends; (c) enable safe access into and out of garages without using doors that open into the lane; (d) not create a more direct through-route alternative for vehicles, cyclists or pedestrians than the adjoining street network; (e) ensure rear yards of properties can be fenced for security; (f) ensure any rear boundary treatment or tree planting does not create concealed recesses, obstructed access or allow uninvited access opportunities into rear yards; and (g) not provide for visitor parking within the lane.	**AO36** Rear lanes are designed and provided in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.3.16 Rear lane design.
PO37 Reconfigurations, where involving a frontage to an existing or historical rear lane are designed to not diminish the character of the rear lane.	**AO37.1** Lots have primary frontage to a street or road, other than rear lane.
	AO37.2 Development is undertaken in accordance with the Development manual planning scheme policy SC6.4 - SC6.4.3.16 Rear lane design.

Table 9.3.4.3(a)—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Road design **Editor's note—**The Transport impact, access and parking code sets out other requirements relating to road design.	
PO38 The geometric design features of each type of road: (a) convey its primary function for all relevant design vehicle types; (b) have an adequate horizontal and vertical alignment that is not conducive to excessive speeds; (c) encourage traffic speeds and volumes to levels commensurate with road hierarchy function; (d) ensure unhindered access by emergency and waste collection vehicles and buses; (e) ensures safe access to lots; (f) ensure design has regard and includes treatment to address the function, the necessary legibility and place making to support adjoining land uses; and (g) accommodate appropriate bicycle, pedestrian and shared paths.	**AO38** Roads are designed in accordance with the standards identified in Development manual planning scheme policy no. SC6.4 — SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.3.22 Waste management guidelines, SC6.4.4.7 Bicycle, pedestrian and shared path design and SC6.4.4.8 Standard drawings.

Table 9.3.4.3(a)—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Pedestrian and cyclist facilities	
PO39 A network of bicycle, pedestrian and shared paths is provided which encourage pedestrian activites and cycling for transportation and recreational purposes and that links open space networks, employment areas and community facilities, including public transport stops, activity centres and schools, and is designed having regard to: (a) topography; (b) cyclist and pedestrian safety; (c) cost effectiveness and maintenance costs; (d) likely user volumes and types; (e) convenience, including end of trip facilities; and (f) accessibility, including public lighting, signage and pavement making.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4-SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy, SC6.4.3.14 Traffic impact assessment guidelines and SC6.4.4.7 Bicycle, pedestrian and shared path design to assist in complying with this outcome.

PO40 The alignment of pedestrian paths and cycleways is designed so that they: (a) allow for the retention of trees and other significant features; (b) maximise the visual interest provided by views and landmarks where they exist; (c) do not compromise the operation of or access to other infrastructure services; and (d) minimise potential conflict points with vehicles.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 for additional information to assist in achieving this outcome.
PO41 Where possible, the bicycle, pedestrian and shared path design facilitates uninterrupted movement of users and safe street crossings are provided for pedestrians and cyclists across major roads.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4-SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 — Geometric road design, SC6.4.4.7 Bicycle, pedestrian and shared path design and SC6.4.4.8 Standard drawings to assist in complying with this outcome.

Table 9.3.4.3(a)—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Public transport	
PO42 The movement network caters for the extension of existing or future public transport routes to provide services that are convenient and accessible to the community.	**AO42** Except in the Rural zone and the Rural residential zone, at least 90% of proposed lots are within 400m walking distance from an existing or potential bus route or 500m walking distance of an identified bus stop. **Editor's note—**The outcomes of a Traffic impact assessment report undertaken as per the Development manual planning scheme policy no. SC6.4.3.14 — Traffic impact assessment guidelines will assist in informing the design outcomes and alignment for public transport routes. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no.SC6.4-SC6.4.3.5 — Car parking and public transport facilities guidelines and SC6.4.4.7 — Bicycle, pedestrian and shared path design and SC6.4.4.1 Geometric road design to assist in complying with this outcome.
PO43 Residential densities are optimised within walking distance of existing and potential public transport stations, where this is consistent with the intended character of the zone or precinct in which the land is located.	No acceptable outcome is nominated.
PO44 Public transport stops are located and designed to: (a) ensure adequate sight distances are available to and for passing traffic; (b) be part of the pedestrian network and allow for safe pedestrian crossing; (c) provide shelter or shade, seats, adequate lighting and timetable information; (d) be in keeping with the character of the locality; (e) be able to be overlooked from nearby buildings where in urban areas; and (f) minimise adverse impacts on the amenity of nearby dwellings.	No acceptable outcome is nominated. **Editor's note—**The outcomes of a Traffic impact assessment report undertaken as per the Development manual planning scheme policy no.SC6.4 - SC6.4.3.14 — Traffic impact assessment guidelines will assist in informing the design outcomes and alignment for public transport routes. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no.SC6.4 - SC6.4.3.5— Car parking and public transport facilities guidelines and SC6.4.4.7— Bicycle, pedestrian and shared path design and SC6.4.4.8 Standard drawings and SC6.4.4.1 Geometric road design to assist in complying with this outcome.

Table 9.3.4.3(a)—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Additional requirements for volumetric subdivision	
PO45 The reconfiguration of the space above or below the surface of the land facilitates appropriate development in accordance with the intent of the zone or precinct in which the land is located or is consistent with a lawful approval that has not lapsed.	No acceptable outcome is nominated.

Table 9.3.4.3(b)-Separation distances to electricity transmission line easement for habitable building or primary open space areas

Column 1 Nominal operating voltage of the transmission line	Column 2 Separation distance – measured from the edge of the easement
Up to 132 kV	20m
275 kV and 330 kV	30m
500kV	40m

Table 9.3.4.3(c)-Minimum lot size dimensions

Zone	**Minimum Lot Size** (Exclusive of any accessway associated with a rear lot)	**Average Lot Size**	**Minimum Frontage** (other than for a rear lot)	**Minimum Depth**
Low density residential	1,000m² if in the Stables precinct	-	8m	25m
	If in the Marlow Street precinct, no acceptable outcome is nominated.	1,700m² if in the Marlow Street precinct	-	-
	400m² otherwise	-	8m	25m
Medium density residential	400m²	-	8m	25m
Character residential	500m² if In the Interwar to 1950s asymmetrical gable precinct or the Interwar gables and Queensland bungalows precinct or the Queenslanders precinct	-	8m	40m
	400m² otherwise	-	8m	25m
High density residential	800m²	-	15m	25m
Centres zones	450m²	-	8m	-
Mixed use	450m²	-	8m	-
Low impact industry	1,000m²	-	20m	50m
Medium impact industry	2,000m²	-	30m	50m
High impact industry	5,000m²	-	40m	50m
Special purpose	5,000m²	-	40m	50m
Emerging community	10ha	-	-	-
Rural	40ha if in the Horticulture precinct	-	300m	-
	If in the Mixed farming precinct: (a) 400ha if on land to which the water resource catchment overlay applies; or (b) 40ha otherwise.	-	300m	-
	400ha if in the Grazing precinct	-	300m	-
	10ha if in the Jensen precinct	-	300m	-
	10ha if in the Cungulla precinct	-	300m	-
Rural residential	4ha if on land to which the water resource catchment overlay applies	-	40m	50m
	4,000m² otherwise	-	40m	50m
Sport and recreation zone	400m² if in the Balgal Beach golf course precinct	600m² if in the Balgal Beach golf course precinct	8m	25m

	Otherwise, no acceptable outcome is nominated	-	-	-
Any other zone	No acceptable outcome is nominated	-	-	-

9.3.5 Transport impact, access and parking code

9.3.5.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.5.2 Purpose

(1) The purpose of the Transport impact, access and parking code is to ensure appropriate provision for transport and end of trip facilities, and to facilitate, as far as practicable, an environmentally sustainable transport network.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) the function, safety and efficiency of the transport network are optimised;
- (b) pedestrians (including people with a disability) and cyclists are provided with a high level of accessibility, safety, amenity and convenience within a development site and on-site facilities are integrated with external walking and cyclist networks and public transport nodes;
- (c) the use of public transport is facilitated wherever appropriate;
- (d) access, parking, servicing and associated manoeuvring areas are designed to be safe, functional and meet the reasonable demands generated by the development;
- (e) access, parking, servicing and associated manoeuvring areas do not detract from streetscape character, and are designed to discourage crime and antisocial behaviour; and
- (f) adverse impacts on the environment and the amenity of the locality are avoided.

9.3.5.3 Assessment benchmarks

Table 9.3.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Transport impact **Editor's note—**Applicants should note that the Department of Transport and Main Roads may have additional requirements. **Editor's note—**Applicants should also note that a transport impact assessment may be required to demonstrate compliance with this code.	
PO1 The development is located on roads that are appropriate for the nature of traffic generated, having regard to the safety and efficiency of the transport network, and the functions and characteristics identified of the road hierarchy. The road hierarchy is shown on Figure 9.5 — Road hierarchy existing and Figure 9.6 Road Hierarchy Future	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design and SC6.4.3.14 Traffic impact assessment guidelines.

Click here to view PDF high resolution map.

Figure 9.5 - Road hierarchy existing

Click here to view PDF high resolution map.

Figure 9.6 - Road hierarchy future

PO2 Development does not compromise the orderly provision or upgrading of the transport network.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design and SC6.4.3.14 Traffic impact assessment guidelines.
PO3 On-site transport network infrastructure (including roads, parking, access and public transport, pedestrian and cyclist facilities) appropriately integrates and connects with surrounding networks. **Editor's note—**To demonstrate compliance with this performance outcome with regard to pedestrian and cyclist elements, applicants may be requested to provide a walk and cycle network plan to show connections to internal and external attractions, existing and proposed walk and cycle facilities and which respond to desire lines of all users.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and transport facilities guidelines, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.4.7 bicycle, pedestrian and shared path design, SC6.4.4.1 Geometric road design and SC6.4.3.13 Townsville road hierarchy.
PO4 As far as practicable, development is designed to encourage travel by public transport, walking and cycling.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and transport facilities guidelines, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.4.7 bicycle, pedestrian and shared path design, SC6.4.4.1 Geometric road design and SC6.4.3.13 Townsville road hierarchy

Table 9.3.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Site access **Editor's note—**Local government (or other service owner) approval must be obtained before interfering with any infrastructure or undertaking works in the road reserve. In addition, be aware that the location of a driveway may be influenced by an approved plan of development that applies to the site or by the location of existing infrastructure or existing vehicle crossovers.	
PO5 Access arrangements are appropriate for: (a) the capacity of the parking area; (b) the volume, frequency and type of vehicle usage; (c) the function and characteristics of the access road and adjoining road network; and (d) the safety and efficiency of the road network.	**AO5** Access is provided in accordance with the standards identified in the Development manual planning scheme policy SC6.4 — SC6.4.3.17 Driveways and SC6.4.3.5 Carparking and public transport facilities guidelines. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.13 Townsville road hierarchy and SC6.4.3.14 Traffic impact assessment guidelines.
PO6 Where practical, access for cyclists and pedestrians is clearly distinguished from vehicle access.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and public transport facilities guidelines.
PO7 Access is located and designed to provide safe and easy access to the site, having regard to its position, width and gradient.	**AO7** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways and SC6.4.4.8 Standard drawings **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.3.14 Traffic impact assessment guidelines and SC6.4.3.13 Townsville road hierarchy.
PO8 All vehicles reasonably expected to use the site are able to travel the length of the driveway or driveway access without damage to vehicle or the driveway surface.	**AO8** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways and SC6.4.3.5 Carparking and public transport facilities guidelines.

PO9 A driveway does not cause change in the level of a footpath that is unsafe or inaccessible for people with mobility difficulties.	**AO9** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways and SC6.4.4.8 Standard drawings.
PO10 Driveways are designed to withstand loadings from all vehicles reasonably expected to use the site.	**AO10** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways.
PO11 A driveway does not allow water to pond on adjacent properties or adjacent buildings and does not allow water to enter a building or property.	**AO11** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways.
PO12 Construction of a driveway does not damage or interfere with the location, function of or access to any services and infrastructure.	**AO12** Access is provided in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.17 Driveways, SC6.4.3.5 Carparking and public transport facilities guidelines, and SC6.4.4.8 Standard drawings.
PO13 All vehicles reasonably expected to access the site can safely manoeuvre to allow vehicles to exit and enter in a forward motion.	**AO13** Access is provided in accordance with the standards identified in Development manual planning scheme policy no. SC6.4 - SC6.4.3.17 Driveways, SC6.4.3.5 Carparking and public transport facilities guidelines and SC6.4.4.8 Standard drawings such that all vehicles reasonably expected to access the site, can exit and enter in a forward motion with no more than a three-point turn.

Table 9.3.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Pedestrian and cyclist facilities	
PO14 Provision is made for the safe and convenient movement of pedestrians on-site and connecting to the external network, having regard to desire lines, legibility, safety, topographical constraints, shading and other weather protection and equitable access arrangements.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.4.7 Bicycle, pedestrian and shared path design, SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design and SC6.4.3.6 Landscape policy to assist in complying with this outcome.
PO15 Provision is made for safe and convenient cycle movement to the site and within the site and connecting to the external network having regard to desire lines, users' needs, safety, topographical constraints and legibility. **Editor's note—**End of trip bicycle facilities will need to be provided for major development in accordance with the Queensland Development Code Mandatory Part 4.1 — Sustainable Buildings. "Major development" is defined in MP4.1.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.4.7 Bicycle, pedestrian and shared path design, SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design and SC6.4.3.6 Landscape policy to assist in complying with this outcome.

PO16 Parking areas, pathways and other elements of transport network infrastructure are designed to enhance public safety by discouraging crime and antisocial behaviour, having regard to: (a) provision of opportunities for casual surveillance; (b) provision of lighting; (c) the use of fencing to define public and private spaces, whilst allowing for appropriate sight lines; (d) minimising potential concealment points and assault locations; (e) minimising opportunities for graffiti and other vandalism; and (f) restricting unlawful access to buildings and between buildings. **Editor's note—**Crime Prevention through Environmental Design Guidelines for Queensland prepared by the State Government may provide applicants with guidance on these matters.	No acceptable outcome is nominated. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.4.7 Bicycle, pedestrian and shared path design, SC6.4.3.13 Townsville road hierarchy, SC6.4.4.1 Geometric road design, SC6.4.3.20 Public lighting and utility services and SC6.4.3.6 Landscape policy to assist in complying with this outcome.

Table 9.3.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Parking	
PO17 Provision is made for on-site vehicle parking to: (a) meet the demand likely to be generated by the development; and (b) avoid on street parking that would adversely impact on the safety or capacity of the road network or unduly impact on local amenity.	**AO17** Parking is provided in accordance with the standards identified in Parking rates planning scheme policy no. SC6.10. **Editor's note—** Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.4.1 Geometric road design and SC6.4.3.13 Townsville road hierarchy to assist in complying with this outcome.
PO18 Parking ensures access is provided for people with disabilities.	**AO18** Parking areas are designed in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Car parking and public transport facilities guidelines.
PO19 Where the nature of the proposed development creates a demand, provision is made for set-down and pick-up facilities by bus, taxis or private vehicle, which: (a) are safe for pedestrians and vehicles; (b) are conveniently connected to the main component of the development by pedestrian pathway; and (c) provide for pedestrian priority and clear sight lines.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy and SC6.4.3.6 Landscape policy to assist in complying with this outcome.

PO20 Parking and servicing areas are designed to: (a) be clearly defined, marked and signed; (b) be convenient and accessible; (c) minimise large unbroken areas of hardstand to the extent practicable; (d) be safe for vehicles, pedestrians and cyclists; (e) provide shading; (f) be located to encourage multi-purpose trip ends and minimise vehicle movements within the site; and (g) minimise any adverse impacts on the amenity of surrounding land.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.5 Carparking and public transport facilities guidelines, SC6.4.3.17 Driveways, SC6.4.3.14 Traffic impact assessment guidelines, SC6.4.4.1 Geometric road design and SC6.4.3.6 Landscape policy.
PO21 Vehicle spaces have adequate dimensions to meet user requirements.	**AO21** Parking areas are designed in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Car parking and public transport facilities guidelines.
PO22 Pavement is constructed to an appropriate standard.	No acceptable outcome is nominated.
PO23 Parking and servicing areas are kept accessible and available for use as a parking area at all times during the normal business hours of the activity.	No acceptable outcome is nominated.
PO24 Visitor parking for accommodation activities remains accessible and useable to visitors at all times.	No acceptable outcome is nominated.
PO25 Multi-level parking areas are designed, articulated and finished to make a positive contribution to the local external streetscape character, as well as the internal user experience of the facility ensuring way finding technologies and aesthetic treatments are provided.	No acceptable outcome is nominated.

Table 9.3.5.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Servicing	
PO26 Provision is made for the on-site loading, unloading, manoeuvring and access by service vehicles that: (a) are adequate to meet the demands generated by the development; (b) are able to accommodate the design service vehicle requirements; and (c) does not unduly impede vehicular, cyclist and pedestrian safety and convenience both within the site and external to the site.	**AO26** Servicing areas are provided and designed in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 – SC6.4.3.5 Car parking and public transport facilities guidelines.
PO27 Refuse collection vehicles are able to safely access on-site refuse collection facilities.	**AO27** Refuse collection areas are provided and designed in accordance with the standards identified in the Development manual planning scheme policy no. SC6.4 – SC6.4.3.22 Waste management guidelines and SC6.4.3.5 Car parking and public transport facilities guidelines.
PO28 Servicing arrangements minimise any adverse impact on the amenity of premises in the vicinity, having regard to operating hours, noise generation, proximity to sensitive uses, odour generation and dust.	No acceptable outcome is nominated.

9.3.6 Works code

9.3.6.1 Application

This code applies to development where the code is identified as applicable in the categories of development and assessment.

When using this code, reference should be made to section 5.3.2 and where applicable, section 5.3.3 located in Part 5.

9.3.6.2 Purpose

(1) The purpose of the Works code is to ensure development is provided with a level of infrastructure which maintains or enhances community health, safety and amenity and which avoids or minimises impacts on the natural environment.

(2) The purpose of the code will be achieved through the following overall outcomes:

- (a) premises are provided with a level of service which is appropriate to the intended character and function of the zone;
- (b) risk to life and property is avoided;
- (c) development does not detract from environmental values, including the quality of receiving waters;
- (d) development does not detract from the desired character and amenity of the locality;
- (e) the integrity and quality of existing infrastructure is maintained;
- (f) access, parking, streets and pedestrian and cycle paths are provided to standards that ensure safe, convenient and efficient operation of movement networks;
- (g) development facilitates an efficient provision of infrastructure and use of resources; and
- (h) whole of life cycle costs for infrastructure are minimised.

9.3.6.3 Assessment benchmarks

Accepted development subject to requirements-Access and parking

Table 9.3.6.3—Accepted development subject to requirements (Part)

Performance outcomes	Acceptable outcomes
Access and parking	
PO1 Access arrangements are appropriate for: (a) the capacity of the parking area; (b) the volume, frequency and type of vehicle usage; and (c) the function and characteristics of the access road and adjoining road network.	**AO1** Access is provided in accordance with Australian Standard AS2890.1.
PO2 Provision is made for on-site vehicle parking to meet the demand likely to be generated by the development and to avoid on street parking where that would adversely impact on the safety or capacity of the road network or unduly impact on local amenity.	**AO2.1** Parking is provided at the rates set out in Parking rates planning scheme policy no. SC6.10. OR **AO2.2** Where an existing lawful premises and involves not more than 5% or 50m^2 (whichever is the greater) of additional gross floor area, the existing number of on-site parking is retained or increased.

PO3 Parking areas are designed to: (a) be clearly defined, marked and signed; (b) be convenient and accessible; (c) be safe for vehicles, pedestrians and cyclists; and (d) provide spaces which meet the needs of people with disabilities.	**AO3.1** Parking areas are designed in accordance with Australian Standard AS2890.1. OR **AO3.2** Where an existing lawful premises and involves not more than 5% or 50m2 (whichever is the greater) of additional gross floor area, the existing standard of on-site parking is maintained or improved.
PO4 Landscaping is provided to soften the visual impact of parking areas and to provide shading.	**AO4.1** Shade trees within parking areas are provided at the following rate: (a) in single sided, angle or parallel bays - 1 tree per 3 parking spaces; and (b) in double sided, angle or parallel bays - 1 tree per 6 parking spaces. **Editor's note—**The Development manual planning scheme policy no. SC6.4 - SC6.4.3.6 Landscape policy sets out guidance on tree species and planting standards. OR **AO4.2** Where an existing lawful premises and involves not more than 5% or 50m2 (whichever is the greater) of additional gross floor area, the existing standard of landscaping is maintained or improved.
PO5 Provision is made for the onsite loading, unloading, manoeuvring and access by service vehicles that: (a) is adequate to meet the demands generated by the development; (b) is able to accommodate the design service vehicle requirements; (c) is wholly contained within the site; and (d) does not unduly impede vehicular, cyclist and pedestrian safety and convenience within the site.	**AO5.1** Servicing areas are provided and designed in accordance with Australian Standard AS2890.2. OR **AO5.2** Where an existing lawful premises and involves not more than 5% or 50m2 (whichever is the greater) of additional gross floor area, the existing provision for service vehicles is maintained or improved.

Table 9.3.6.3—Accepted development subject to requirements (Part)

Performance outcomes	Acceptable outcomes
Services and utilities	
PO6 A potable water supply is provided that is adequate for the needs of the intended use.	**AO6.1** The development is connected to council's reticulated water supply system in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines and SC6.4.4.8 Standard drawings. **Editor's note—**If a main exists, then an application for a water meter will be required.
	AO6.2 Water supply systems and connections are designed and constructed in accordance with Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines, SC6.4.6.2 Water supply and SC6.4.4.8 Standard drawings.

PO7 Wastewater treatment and disposal is provided that is appropriate for the level of demand generated, protects public health and avoids environmental harm.	**AO7.1** The development is connected to council's reticulated sewerage system via an existing sewer connection to the site.
	AO7.2 Waste water systems and connections are designed and constructed in accordance with Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines, SC6.4.6.3 Sewerage systems and SC6.4.4.8 Standard drawings.
PO8 Provision is made for waste management that is appropriate to the use, protects the health and safety of people and the environment. **Editor's note—**Applicants should also be aware that any provision for disposal of any trade waste is to be made in accordance council's Trade Waste Policy supporting the Water Act 2000, Plumbing and Drainage Act 2002 and the Standard Plumbing Regulation 2003	**AO8.1** The development provides a bin container storage area that has an imperviously sealed pad and is screened to the height of the bins.
	AO8.2 On sites in an industrial zone that are greater than 2,000m^2 in area, provision is made for refuse collection vehicles to access the collection area, undertake the collection activity and to enter and leave the site in a forward direction without having to make more than a 3 point turn.
PO9 The proposed stormwater management system or site works does not adversely affect flooding or drainage characteristics of properties that are upstream, downstream or adjacent to the development site.	**AO9.1** The development does not result in an increase in flood level or flood duration on upstream, downstream or adjacent properties.
	AO9.2 Roof and surface water is conveyed to the kerb and channel or an inter-allotment drainage system in accordance with Australian Standard AS/NZS3500.3:2003.
PO10 The drainage network has sufficient capacity to safely convey stormwater run-off from the site and development does not cause a drainage nuisance to a downstream or adjoining property.	**AO10** Post development discharge of stormwater from the subject land does not exceed predevelopment peak flows and no change to flows across a downstream or adjoining property is created.

Assessable development-Services and utilities

Table 9.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Services and utilities	
PO11 A potable water supply is provided that is adequate for the needs of the intended use.	**AO11.1** Where within an area designated for urban or rural residential development, the development is connected to council's reticulated water supply system in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines. OR **AO11.2** Otherwise, the development is provided with an on-site water supply in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.11 On-site water supply.
	AO11.3 Water supply systems and connections are designed and constructed in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines, SC6.4.3.23 Water and sewer network modelling guidelines, SC6.4.6.2 Water supply and SC6.4.4.8 Standard drawings.
PO12 Wastewater treatment and disposal is provided that is appropriate for the level of demand generated, protects public health and avoids adverse impacts on environmental values.	**AO12.1** Where within an area designated for urban development, the development is connected to the council's reticulated sewerage system in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines. OR **AO12.2** Otherwise, on-site waste water treatment and disposal is provided which complies with the Development manual planning scheme policy no. SC6.4-SC6.4.3.10 On-site sewerage facilities.
	AO12.3 Waste water systems and connections are designed and constructed in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.21 Townsville Water planning and design guidelines, SC6.4.3.23 Water and sewer network modelling guidelines, SC6.4.6.3 Sewerage systems and SC6.4.4.8 Standard drawings.

PO13 The design and management of the development integrates water cycle elements having regard to: (a) reducing potable water demand; (b) minimising wastewater production; (c) minimising stormwater peak discharges and run-off volumes; (d) maintaining natural drainage lines and hydrological regimes as far as possible; (e) reusing stormwater and greywater is encouraged where public safety and amenity will not be compromised; and (f) efficient use of water.	**AO13** Integrated water management practices and infrastructure are implemented in accordance with Development manual planning scheme policy no. SC6.4 - SC6.4.3.8 Stormwater quality management plans for development and SC6.4.3.9 Water sensitive urban design guidelines.
PO14 The development is provided with an adequate energy supply which maintains acceptable standards of public health, safety, environmental quality and amenity.	**AO14** For other than the Rural zone, premises are serviced by: (a) an underground electricity supply approved by the relevant energy authority; or (b) an overhead supply approved by the relevant energy authority where in the Rural residential zone, Special purpose zone or High impact industry zone or where on a lot of less than 2,500m^2 within an area where the existing supply is overhead. **Editor's note—**Applicants should also have regard to the Development manual planning scheme policy no. SC6.4 - SC6.4.3.20 Public lighting and utility services.
PO15 Premises are connected to a telecommunications service approved by the relevant authority.	**AO15** The development is connected to telecommunications infrastructure in accordance with the standards of the relevant regulatory authority. **Editor's note—**The Development manual planning scheme policy no. SC6.4-SC6.4.3.20 Public lighting and utility services provides additional information regarding the supply of telecommunications.
PO16 Provision is made for future telecommunications services (for example fibre optic cable).	No acceptable outcome is nominated.
PO17 Where available, provision is made for reticulated gas.	**AO17** Design and provision of reticulated gas is undertaken in accordance with the Development manual planning scheme policy no. SC6.4-SC6.4.3.20 Public lighting and utility services. **Editor's note—**Applicants should also have regard to the metering requirements of other relevant authorities.
PO18 Adequate access is provided to public services and utilities for future maintenance.	No acceptable outcome is nominated. **Editor's note—**The Development manual planning scheme policy no. SC6.4 provides additional information and requirements for applicants, including when council will require easements over public services and utilities.

Table 9.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Earthworks **Editor's note—**Applicants should be aware that some retaining walls constitute building works that are assessable under the *Building Regulation 2006*. No approval is required under the *Building Regulation 2006* for retaining walls if: (a) there is no surcharge loading; and (b) the height of wall or height of fill or excavation is not more than 1m; and (c) the wall is no closer than 1.5m to a building, structure (e.g. a swimming pool) or other retaining wall. In these cases, the "applicable code" for the purposes of the Act is the Building Code of Australia (refer to BCA Volume 2, Part 3.1.1). Retaining walls not more than 1m in height may be constructed in accordance with an accepted industry standard publication (e.g. timber, concrete masonry or similar). **Editor's note—**Applicants should note that council may request the submission of an engineering report undertaken by suitably qualified engineer to demonstrate compliance with the performance outcomes, particularly where alternative solutions are proposed.	
PO19 Filling and excavation does not result in contamination of land or pose a health and safety risk.	**AO19** Filling and excavation does not: (a) use contaminated materials as fill; (b) excavate contaminated material; and (c) use waste material as fill. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no. SC6.4 - SC6.4.6.10 Earthworks (construction) and SC6.4.5 Construction management for additional information.
PO20 Earthworks result in stable landforms and structures.	**AO20** Earthworks and the construction of retaining walls and batters are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction).
PO21 Earthworks are undertaken in a manner that: (a) maintains natural landforms as far as possible; and (b) minimises height of retaining walls and batter faces.	**AO21.1** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction). **AO21.2** Retaining walls are designed and constructed: (a) certified as stable by a Registered Professional Engineer of Queensland; and (b) have a combined height of retaining wall and fence of not more than 2 metres.
PO22 Earthworks do not unduly impact on amenity or privacy for occupants of the site or on adjoining land.	No acceptable outcome is nominated.
PO23 Earthworks do not cause environmental harm.	No acceptable outcome is nominated.
PO24 Filling or excavation does not worsen any flooding or drainage problems on the site or on neighbouring properties.	**AO24** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction).

PO25 Any structure used to restrain fill or excavation does not worsen drainage problems or cause surface water to be a nuisance to neighbouring properties.	**AO25** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction).
PO26 Filling or excavation does not adversely affect sewer, stormwater or water utility infrastructure or access to them for maintenance purposes.	**AO26** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction).
PO27 Filling or excavation does not prevent or create difficult access to any property.	**AO27** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.4.5 Earthworks (design) and SC6.4.6.10 Earthworks (construction).
PO28 Earthworks do not cause significant impacts through truck movements, dust or noise on the amenity of the locality in which the works are undertaken or along routes taken to transport the material and the transportation of materials minimises adverse impacts on the road network.	**AO28** Earthworks are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.6.10 Earthworks (construction) and SC6.4.5 Construction management.

Table 9.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Movement networks	
PO29 The following are provided along the full extent of the road frontage and to a standard that is appropriate to the function of the road or street and the character of the locality: (a) paved roadway; (b) appropriate pavement edging (including kerb and channel); (c) pedestrian paths and cycleways; (d) streetscaping and street tree planting; (e) stormwater drainage; (f) street lighting systems; and (g) conduits to facilitate the provision of and other utility services.	**AO29** Design and construction of external road works are undertaken in accordance with the Development manual planning scheme policy no. SC6.4. **Editor's note—**Applicants should have regard to the following sub-sections of the Development manual planning scheme policy no. SC6.4 - SC6.4.3.20 Public lighting and utility services; SC6.4.4.4 Stormwater drainage design; SC6.4.4.2 Pavement design; SC6.4.4.7 Bicycle, pedestrian and shared path design; SC6.4.3.6 Landscape policy, SC6.4.4.1 Geometric road design, SC6.4.3.3 Footpath treatment policy and SC6.4.6 Construction standards.
PO30 Provision is made in the road reserve for streetscaping, pedestrians and cyclists in a manner consistent with: (a) the current and projected level of usage; (b) the desired streetscape character; and (c) activities which are anticipated to occur within the verge.	**AO30** Streetscaping works, footpaths and cycle paths are provided in accordance with Development manual planning scheme policy no. SC6.4. **Editor's note—**Applicants should have regard to the following sub-sections of the Development manual planning scheme policy no. SC6.4 - SC6.4.3.3 Footpath treatment policy; SC6.4.4.1 Geometric road design; SC6.4.3.13 Townsville road hierarchy, SC6.4.4.7 Bicycle, pedestrian and shared path design; SC6.4.3.6 Landscape policy and SC6.4.3.20 Public lighting and utility services in demonstrating compliance.

PO31 Parking areas are designed and constructed in a manner that is sufficiently durable for the intended function, maintains all weather access and ensures the safe passage of vehicles, pedestrians and cyclists.	**AO31** Parking area design and construction is undertaken in accordance with the Development manual planning scheme policy no. SC6.4 — SC6.4.3.5 Car parking and public transport facilities guidelines.
PO32 Movement networks can be easily and efficiently maintained.	**AO32** Infrastructure is provided in accordance with the Development manual planning scheme policy no. SC6.4 — SC6.4.4.1 Geometric road design, SC6.4.3.13 Townsville road hierarchy and SC6.4.3.14 Traffic impact assessment guidelines.

Table 9.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Waste management	
PO33 Development provides adequate waste management facilities on site for the storage of waste and recyclable material in a manner which: (a) is of adequate size to accommodate the expected amount of refuse to be generated by the use; (b) is in a position that is conveniently accessible for collection at all times; (c) is able to be kept in a clean, safe and hygienic state at all times; and (d) minimises the potential for environmental harm, environmental nuisance and adverse amenity impacts.	**AO33** Waste management facilities are provided in accordance with the Development manual planning scheme policy no. SC6.4 – SC6.4.3.22 Waste management guidelines. **Editor's note—**Applicants may be requested to prepare a Waste management plan in accordance with the Development manual planning scheme policy no.SC6.4-SC6.4.3.22 Waste management guidelines.

Table 9.3.6.3—Assessable development (Part)

Performance outcomes	Acceptable outcomes
Construction management	
PO34 Work is undertaken in a manner which does not cause unacceptable impacts on surrounding areas as a result of dust, odour, noise or lighting.	No acceptable outcome is nominated. **Editor's note**—Applicants should refer to the Development manual planning scheme policy no.SC6.4 for assistance in complying with this outcome.
PO35 While undertaking development works, the site and adjoining road are maintained in a tidy, safe and hygienic manner.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no.SC6.4 for assistance in complying with this outcome.
PO36 Traffic and parking generated during construction are managed to minimise impact on the amenity of the surrounding area.	No acceptable outcome is nominated. **Editor's note**—Applicants should refer to the Development manual planning scheme policy no.SC6.4 for assistance in complying with this outcome.
PO37 Council's infrastructure is not damaged by construction activities.	No acceptable outcome is nominated. **Editor's note—**Applicants should refer to the Development manual planning scheme policy no.SC6.4 for assistance in complying with this outcome

PO38 The integrity of new infrastructure is maintained.	No acceptable outcome in nominated. **Editor's note—**Applicants should have regard to the following sections of the Development manual planning scheme policy no. SC6.4 - SC6.4.5 Construction management; SC6.4.6 Construction standards and SC6.4.7 Acceptance of completed works in demonstrating compliance.
PO39 Construction activities and works are carried out in a manner which avoids damage to the environment, retained vegetation and impacts on fauna.	**AO39** Construction activities and works are undertaken in accordance with the Development manual planning scheme policy no. SC6.4 - SC6.4.5 Construction management.
PO40 Vegetation cleared from a site is disposed of in a manner that maximises reuse and recycling and minimises impacts on public health and safety.	**AO40** Construction activities and works are carried out in accordance with Development manual planning scheme policy no. SC6.4 - SC6.4.6.11 Clearing and grubbing. **Editor's note—**Applicants shall also refer to Development manual planning scheme policy no. SC6.4 for assistance in complying with this outcome.

Part 10 Other plans

10.1 Preliminary

(1) Other plans provide the planning framework for priority development areas (PDAs) under the Economic Development Act 2012.

(2) The following are the development schemes for the PDAs:

  (a) Oonoonba Urban Development Area Development Scheme; and

  (b) Townsville City Waterfront Priority Development Area Development Scheme.

(3) Priority development area maps are included in Schedule 2 Mapping, SC6.2 Other plans maps.

10.2 Oonoonba Urban Development Area Development Scheme

The Oonoonba Urban Development Area Development Scheme was approved by the state government on 15 April 2011.

The development scheme is the planning document which will assist in the planning, carrying out, promoting, coordinating and controlling of development within the Oonoonba PDA.

All development applications within the PDA are assessed against the development scheme.

In the Oonoonba PDA, development applications are assessed by staff within the Department of Infrastructure, Local Government State Development, Infrastructure and Planning.

10.3 Townsville City Waterfront Priority Development Area Development Scheme

The Townsville City Waterfront PDA Development Scheme was approved by the state government on 23 October 2015.

The Townsville City Waterfront PDA Development Scheme is the planning document that will assist in the planning, carrying out, promoting, coordinating and controlling of development within the Townsville City Waterfront PDA.

All development applications within the PDA are assessed against the development scheme.

Development assessment for land within the Townsville City Waterfront PDA, which is strategic port land, will be managed by the Minister for Economic Development Queensland (MEDQ). For the remainder of land within the PDA, development assessment powers have been delegated by the MEDQ to Townsville City Council.

Schedule 1 Definitions

SC1.1 Use definitions

(1) Use definitions have a particular meaning for the purpose of the planning scheme.

(2) Any use not listed in Table SC1.1.2 column 1 is an undefined use.

Note—Development comprising a combination of defined uses is not considered to be an undefined use.

(3) A use listed in Table SC1.1.2 column 1 has the meaning set out beside that term in column 2.

(4) The use definitions listed here are the definitions used in this planning scheme.

(5) Column 3 of Table SC1.1.2 identifies examples of the types of activities that are consistent with the use identified in column 1.

(6) Column 4 of Table SC1.1.2 identifies examples of activities that are not consistent with the use identified in column 1.

(7) Columns 3 and 4 of Table SC1.1.2 are not exhaustive lists.

(8) Uses listed in Table SC1.1.2 columns 3 and 4 that are not listed in column 1, do not form part of the definition.

Table SC1.1.1 - Index of use definitions

- Adult store
- Agricultural supplies store
- Air services
- Animal husbandry
- Animal keeping
- Aquaculture
- Bar
- Brothel
- Bulk landscape supplies
- Caretaker's accommodation
- Car wash
- Cemetery
- Child care centre
- Club
- Community care centre
- Community residence
- Community use
- Crematorium
- Cropping
- Detention facility
- Dual occupancy
- Dwelling house
- Dwelling unit
- Educational establishment
- Emergency services
- Environment facility
- Extractive industry
- Food and drink outlet
- Function facility
- Funeral parlour
- Garden centre
- Hardware and trade supplies
- Health care services
- High impact industry
- Home based business
- Hospital
- Hotel
- Indoor sport and recreation
- Intensive animal industry
- Intensive horticulture
- Landing
- Low impact industry
- Major electricity infrastructure
- Major sport, recreation and entertainment facility
- Marine industry
- Market
- Medium impact industry
- Motor sport facility
- Multiple dwelling
- Nature-based tourism
- Nightclub entertainment facility
- Non-resident workforce accommodation
- Office
- Outdoor sales
- Outdoor sport and recreation
- Park
- Parking station
- Permanent plantation
- Place of worship
- Port services
- Relocatable home park
- Renewable energy facility
- Research and technology industry
- Residential care facility
- Resort complex
- Retirement facility
- Roadside stall
- Rooming accommodation
- Rural industry
- Rural workers' accommodation
- Sales office
- Service industry
- Service station
- Shop
- Shopping centre
- Short-term accommodation
- Showroom
- Special industry
- Substation
- Telecommunications facility
- Theatre
- Tourist attraction
- Tourist park
- Transport depot
- Utility installation
- Veterinary services
- Warehouse
- Wholesale nursery
- Winery

Table SC1.1.2 - Use definitions

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Adult store	Premises used as a shop where the primary purpose is for the display or sale of sexually explicit materials, products and devices associated with or used in a sexual practice or activity.	Sex shop	Shop, newsagent, registered pharmacist or video hire, where the primary use of these are concerned with: • the sale, display or hire of printed or recorded matter (not of a sexually explicit nature); or • the sale or display of underwear or lingerie; or • the sale or display of an article or thing primarily concerned with or used in association with a medically recognised purpose.
Agricultural supplies store	Premises used for the sale of agricultural products and supplies including agricultural chemicals and fertilisers, seeds, bulk veterinary supplies, farm clothing, saddlery, animal feed and irrigation materials.		Bulk landscape supplies, garden centre, outdoor sales, wholesale nursery
Air services	Premises used for any of the following: • the arrival and departure of aircraft; • the housing, servicing, refuelling, maintenance and repair of aircraft; • the assembly and dispersal of passengers or goods on or from an aircraft; • any ancillary activities directly serving the needs of passengers and visitors to the use; • associated training and education facilities; • aviation facilities.	Airport, airstrip, helipad, public or private airfield	
Animal husbandry	Premises used for production of animals or animal products on either native or improved pastures or vegetation. The use includes ancillary yards, stables and temporary holding facilities and the repair and servicing of machinery.	Cattle studs, grazing of livestock, non-feedlot dairying	Animal keeping, intensive animal industry, aquaculture, feedlots, piggeries

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Animal keeping	Premises used for boarding, breeding or training of animals. The use may include ancillary temporary or permanent holding facilities on the same site and ancillary repair and servicing of machinery.	Aviaries, catteries, kennels, stables, wildlife refuge	Aquaculture, cattle studs, domestic pets, feedlots, grazing of livestock, non-feedlot dairying, piggeries, poultry meat and egg production, animal husbandry
Aquaculture	Premises used for the cultivation of aquatic animals or plants in a confined area that may require the provision of food either mechanically or by hand.	Pond farms, tank systems, hatcheries, raceway system, rack and line systems, sea cages	Intensive animal industry
Bar	Premises used primarily to sell liquor for consumption on the premises and that provides for a maximum capacity to seat sixty persons at any one time. The use may include ancillary sale of food consumption on the premises and entertainment activities.		Club, hotel, nightclub entertainment facility, tavern
Brothel	Premises made available for prostitution by two or more prostitutes at the premises.		Adult store, club, nightclub entertainment facility, shop
Bulk landscape supplies	Premises used for bulk storage and sale of landscaping and gardening supplies, which may include soil, gravel, potting mix and mulch, where the majority of materials sold from the premises are not in pre-packaged form.		Garden centre, outdoor sales, wholesale nursery
Caretaker's accommodation	A dwelling provided for a caretaker of a non-residential use on the same premises.		Dwelling house
Car wash	Premises primarily used for commercially cleaning motor vehicles by an automatic or partly automatic process.		Service station
Cemetery	Premises used for interment of bodies or ashes after death.	Burial ground, crypt, columbarium, lawn cemetery, pet cemetery, mausoleum	Crematorium, funeral parlour

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Child care centre	Premises used for minding, education and care, but not residence, of children.	Crèche, early childhood centre, kindergarten, outside hours school care	Educational establishment, home based child care, family day care
Club	Premises used by persons associated for social, literary, political, sporting, athletic or other similar purposes for social interaction or entertainment. The use may include the ancillary preparation and service of food and drink.	Club house, guide and scout clubs, surf lifesaving club, RSL, bowls club	Hotel, nightclub entertainment facility, place of worship, theatre
Community care centre	Premises used to provide social support where no accommodation is provided. Medical care may be provided but is ancillary to the primary use.	Disability support services, drop in centre, respite centre, integrated Indigenous support centre	Child care centre, family day care, home based child care, health care services, residential care facility
Community residence	Any dwelling used for accommodation for a maximum of six persons who require assistance or support with daily living needs, share communal spaces and who may be unrelated. The use may include a resident support worker engaged or employed in the management of the residence.	Hospice	Dwelling house, dwelling unit, residential care facility, rooming accommodation, short-term accommodation
Community use	Premises used for providing artistic, social or cultural facilities and community support services to the public and may include the ancillary preparation and provision of food and drink.	Art gallery, community centre, community hall, library, museum	Cinema, club, hotel, nightclub, entertainment facility, place of worship
Crematorium	Premises used for the cremation or aquamation of bodies.		Cemetery
Cropping	Premises used for growing plants or plant material for commercial purposes where dependent on the cultivation of soil. The use includes harvesting and the storage and packing of produce and plants grown on the site and the ancillary repair and servicing of machinery used on the site.	Fruit, nut, vegetable and grain production, forestry for wood production, fodder and pasture production, plant fibre production, sugar cane growing, vineyard	Permanent plantations, intensive horticulture, rural industry

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Detention facility	Premises used for the confinement of persons committed by a process of law.	Prison, detention centre	
Dual occupancy	Premises containing two dwellings, each for a separate household, and consisting of: • a single lot, where neither dwelling is a secondary dwelling; or • two lots sharing common property where one dwelling is located on each lot.	Duplex, two dwellings on a single lot (whether attached or not attached), two dwellings within one single community title scheme under the *Body Corporate and Community Management Act 1997*, two dwellings within the one body corporate to which the *Building Units and Group Title Act 1980* continues to apply.	Dwelling house, multiple dwelling
Dwelling house	A residential use of premises for one household that contains a single dwelling. The use includes outbuildings and works normally associated with a dwelling and may include a secondary dwelling.		Caretaker's accommodation, dual occupancy, rooming accommodation, short-term accommodation, student accommodation, multiple dwelling
Dwelling unit	A single dwelling within a premises containing non-residential use(s).	'Shop-top' apartment	Caretaker's accommodation, dwelling house
Educational establishment	Premises used for training and instruction designed to impart knowledge and develop skills. The use may include outside hours school care for students or on-site student accommodation.	Pre-preparatory, preparatory and primary school, secondary school, special education, college, university, technical institute, outdoor education centres	Child care centre, home based child care, family day care

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Emergency services	Premises used by government bodies or community organisations to provide essential emergency services, disaster management services including management support facilities for the protection of persons, property and the environment.	State emergency service facility, ambulance station, rural fire brigade, auxiliary fire and rescue station, urban fire and rescue station, police station, emergency management support facility, evacuation centres	Community use, hospital, residential care facility
Environment facility	Facilities used for the conservation, interpretation and appreciation of areas of environmental, cultural or heritage value.	Nature-based attractions, walking tracks, seating, shelters, boardwalks, observation decks, bird hides	
Extractive industry	Premises used for the extraction and/or processing of extractive resources and associated activities, including their transportation to market.	Quarry	
Food and drink outlet	Premises used for preparation and sale of food and drink to the public for consumption on or off the site. The use may include the ancillary sale of liquor for consumption on site.	Bistro, café, coffee shop, drive-through facility, kiosk, milk bar, restaurant, snack bar, take-away, tea room	Bar, club, hotel, shop, theatre, nightclub entertainment facility
Function facility	Premises used for conducting receptions or functions that may include the preparation and provision of food and liquor for consumption on site.	Conference centre, reception centre	Community use, hotel
Funeral parlour	Premises used to arrange and conduct funerals, memorial services and the like, but do not include burial or cremation. The use includes a mortuary and the storage and preparation of bodies for burial or cremation.		Cemetery, crematorium, place of worship

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Garden centre	Premises used primarily for the sale of plants and may include sale of gardening and landscape products and supplies where these are sold mainly in pre-packaged form. The use may include an ancillary food and drink outlet.	Retail plant nursery	Bulk landscape supplies, wholesale nursery, outdoor sales
Hardware and trade supplies	Premises used for the sale, display or hire of hardware and trade supplies including household fixtures, timber, tools, paint, wallpaper, plumbing supplies and the like.		Shop, showroom, outdoor sales and warehouse
Health care services	Premises for medical, paramedical, alternative therapies and general health care and treatment of persons that involves no overnight accommodation.	Dental clinics, medical centres, natural medicine practices, nursing services, physiotherapy clinic	Community care centre, hospital
High impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring or treating of products and have one or more of the following attributes: • potential for significant impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; • potential for significant offsite impacts in the event of fire, explosion or toxic release; • generates high traffic flows in the context of the locality or the road network; • generates a significant demand on the local infrastructure network; • the use may involve night time and outdoor activities; • on-site controls are required for emissions and dangerous goods risks.	Abattoirs, asphalt plant, concrete batching plant, boiler making and engineering and metal foundry **Note**—Additional examples may be shown in SC1.1.2 industry thresholds.	Tanneries, rendering plants, oil refineries, waste incineration, manufacturing or storing explosives, power plants, manufacturing fertilisers, service industry, low impact industry, medium impact industry, special industry
Home based business	A dwelling used for a business activity where subordinate to the residential use.	Bed and breakfast, home office, home based child care	Hobby, office, shop, warehouse, transport depot

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Hospital	Premises used for medical or surgical care or treatment of patients whether or not involving overnight accommodation. The use may include ancillary accommodation for employees and ancillary activities directly serving the needs of patients and visitors.		Health care services, residential care facility
Hotel	Premises used primarily to sell liquor for consumption. The use may include short-term accommodation, dining and entertainment activities and facilities.	Pub, tavern	Nightclub entertainment facility
Indoor sport and recreation	Premises used for leisure, sport or recreation conducted wholly or mainly indoors.	Amusement parlour, bowling alley, gymnasium, squash courts, enclosed tennis courts	Cinema, hotel, nightclub entertainment facility, theatre
Intensive animal industry	Premises used for the intensive production of animals or animal products in an enclosure that requires the provision of food and water either mechanically or by hand. The use includes the ancillary storage and packing of feed and produce.	Feedlots, piggeries, poultry and egg production	Animal husbandry, aquaculture, drought feeding, milking sheds, shearing sheds, weaning pens
Intensive horticulture	Premises used for the intensive production of plants or plant material on imported media and located within a building or structure or where outdoors, artificial lights or containers are used. The use includes the storage and packing of produce and plants grown on the subject site.	Greenhouse and shade house plant production, hydroponic farms, mushroom farms	Wholesale nursery
Landing	A structure for mooring, launching, storage and retrieval of vessels where passengers embark and disembark.	Boat ramp, jetty, pontoon	Marina

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Low impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring or treating of products and have one or more of the following attributes: • negligible impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; • minimal traffic generation and heavy-vehicle usage; • demands imposed upon the local infrastructure network consistent with surrounding uses; • the use generally operates during the day (e.g. 7am to 6pm); • offsite impacts from storage of dangerous goods are negligible; • the use is primarily undertaken indoors.	Repairing motor vehicles, fitting and turning workshop **Note**—Additional examples may be shown in SC1.1.2 industry thresholds.	Panel beating, spray painting or surface coating, tyre recycling, drum re-conditioning, wooden and laminated product manufacturing, service industry, medium impact industry, high impact industry, special industry
Major electricity infrastructure	All aspects of development for either the transmission grid or electricity supply networks as defined under the *Electricity Act 1994*. The use may include ancillary telecommunication facilities.	Powerlines greater than 66kV	Minor electricity infrastructure, substation
Major sport, recreation and entertainment facility	Premises with large scale built facilities designed to cater for large scale events including major sporting, recreation, conference and entertainment events.	Convention and exhibition centres, entertainment centres, sports stadiums, horse racing	Indoor sport and recreation, local sporting field, motor sport, park, outdoor sport and recreation
Marine industry	Premises used for waterfront based marine industries involved in any activity relating to the manufacturing, storage, repair or servicing of vessels and maritime infrastructure. The use may include the provision of fuel and disposal of waste.	Boat building, boat storage, dry dock	Marina

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Market	Premises used for the sale of goods to the public on a regular basis, where goods are primarily sold from temporary structures such as stalls, booths or trestle tables. The use may include entertainment provided for the enjoyment of customers.	Flea market, farmers market, car boot sales	Shop, roadside stall
Medium impact industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring or treating of products and have one or more of the following attributes: • potential for noticeable impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; • potential for noticeable offsite impacts in the event of fire, explosion or toxic release; • generates high traffic flows in the context of the locality or the road network; • generates an elevated demand on the local infrastructure network; • onsite controls are required for emissions and dangerous goods risks; • the use is primarily undertaken indoors; • evening or night activities are undertaken indoors and not outdoors.	Spray painting and surface coating, wooden and laminated product manufacturing (including cabinet making, joining, timber truss making or wood working) **Note**—Additional examples may be shown in SC1.1.2 industry thresholds.	Concrete batching, tyre manufacturing and retreading, metal recovery (involving a fragmentiser), textile manufacture, chemically treating timber and plastic product manufacture, service industry, low impact industry, high impact industry, special industry
Motor sport facility	Premises used for organised or recreational motor sports whether on or off-road, which may include permanent, temporary or informal provision for spectators and other supporting uses.	Go-karting, lawn mower race tracks, trail bike parks, 4WD and all terrain parks, motocross tracks, off road motorcycle facility, motorcycle or car race tracks	Major sport, recreation and entertainment facility, outdoor sport and recreation
Multiple dwelling	Premises containing three or more dwellings for separate households.	Apartments, flats, units, townhouses, row housing, triplex	Rooming accommodation, dual occupancy, duplex, granny flat, residential care facility, retirement facility

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Nature-based tourism	The use of land or premises for a tourism activity, including tourist and visitor short-term accommodation, that is intended for the conservation, interpretation and appreciation of areas of environmental, cultural or heritage value, local ecosystem, and attributes of the natural environment. Nature-based tourism activities typically: • maintain a nature-based focus or product; • promote environmental awareness, education and conservation; • carry out sustainable practices.	Environmentally responsible accommodation facilities including lodges, cabins, huts and tented camps	Environment facility
Nightclub entertainment facility	Premises used to provide entertainment, which may include cabaret, dancing and music. The use generally includes the sale of liquor and food for consumption on site.		Club, hotel, tavern, pub, indoor sport and recreation, theatre, concert hall
Non-resident workforce accommodation	Premises used to provide accommodation for non-resident workers. The use may include provision of recreational and entertainment facilities for the exclusive use of residents and their visitors.	Contractor's camp, construction camp, single person's quarters, temporary workers' accommodation	Relocatable home park, short-term accommodation, tourist park.
Office	Premises used for an administrative, secretarial or management service or the practice of a profession, where no goods or materials are made, sold or hired and where the principal activity provides for one or more of the following: • business or professional advice; • service of goods that are not physically on the premises; • office based administrative functions of an organisation.	Bank, real estate agent, administration building	Home based business, home office, shop, outdoor sales

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Outdoor sales	Premises used for the display, sale, hire or lease of products where the use is conducted wholly or predominantly outdoors and may include construction, industrial or farm plant and equipment, vehicles, boats and caravans. The use may include ancillary repair or servicing activities and sale or fitting of accessories.	Agricultural machinery sales yard, motor vehicles sales yard	Bulk landscape supplies, market
Outdoor sport and recreation	Premises used for a recreation or sport activity that is carried on outside a building and requires areas of open space and may include ancillary works necessary for safety and sustainability. The use may include ancillary food and drink outlet(s) and the provision of ancillary facilities or amenities conducted indoors such as changing rooms and storage facilities.	Driving range, golf course, swimming pool, tennis courts, football ground, cricket oval	Major sport, recreation and entertainment facility, motor sport, park, community use
Park	Premises accessible to the public generally for free sport, recreation and leisure, and may be used for community events or other community activities. Facilities may include children's playground equipment, informal sports fields and ancillary vehicle parking and other public conveniences.	Urban common	Tourist attraction, outdoor sport and recreation
Parking station	Premises used for parking vehicles where the parking is not ancillary to another use.	Car park, 'park and ride', bicycle parking	
Permanent plantation	Premises used for growing plants not intended to be harvested.	Permanent plantations for carbon sequestration, biodiversity or natural resource management	Forestry for wood production, biofuel production
Place of worship	Premises used by an organised group for worship and religious activities. The use may include ancillary facilities for social, educational and associated charitable activities.	Church, chapel, mosque, synagogue, temple	Community use, child care centre, funeral parlour, crematorium

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Port services	Premises used for the following: • the arrival and departure of vessels; • the movement of passengers or goods on or off vessels; • any ancillary activities directly serving the needs of passengers and visitors or the housing, servicing, maintenance and repair of vessels.	Marina, ferry terminal	Landing
Relocatable home park	Premises used for relocatable dwellings (whether they are permanently located or not) that provides long-term residential accommodation. The use may include a manager's residence and office, ancillary food and drink outlet, kiosk, amenity buildings and the provision of recreation facilities for the exclusive use of residents.		Tourist park
Renewable energy facility	Premises used for the generation of electricity or energy from renewable (naturally reoccurring) sources.	Solar farm, wind farm, tidal power	Wind turbine or solar panels supplying energy to domestic or rural activities on the same site
Research and technology industry	Premises used for innovative and emerging technological industries involved in research design, manufacture, assembly, testing, maintenance and storage of machinery, equipment and components. The use may include emerging industries such as energy, aerospace, and biotechnology.	Aeronautical engineering, computer component manufacturing, medical laboratories, computer server facility	
Residential care facility	A residential use of premises for supervised accommodation where the use includes medical and other support facilities for residents who cannot live independently and require regular nursing or personal care.	Convalescent home, nursing home	Community residence, dwelling house, dual occupancy, hospital, multiple dwelling, retirement facility

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Resort complex	Premises used for tourist and visitor short-term accommodation that include integrated leisure facilities including: • restaurants and bars; • meeting and function facilities; • sporting and fitness facilities; • staff accommodation; • transport facilities directly associated with the tourist facility such as a ferry terminal and air services.	Island resort	
Retirement facility	A residential use of premises for an integrated community and specifically built and designed for older people. The use includes independent living units and may include serviced units where residents require some support with health care and daily living needs. The use may also include a manager's residence and office, food and drink outlet, amenity buildings, communal facilities and accommodation for staff.	Retirement village	Residential care facility
Roadside stall	Premises used for the roadside display and sale of goods in rural areas.	Produce stall	Market

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Rooming accommodation	Premises used for the accommodation of one or more households where each resident: • has the right to occupy one or more rooms; • does not have a right to occupy the whole of the premises in which the rooms are situated; • may be provided with separate facilities for private use; • may share communal facilities or communal space with one or more of the residents; The use may include: • rooms not in the same building on site; • provision of a food or other service; • on-site management or staff and associated accommodation. Facilities includes furniture and equipment as defined in the *Residential Tenancies and Rooming Act 2008*	Boarding house, hostel, monastery, off-site student accommodation	Hospice, community residence, dwelling house, short-term accommodation, multiple dwelling
Rural industry	Premises used for storage, processing and packaging of products from a rural use. The use includes processing, packaging and sale of products produced as a result of a rural use where these activities are ancillary to a rural use on or adjacent to the site.	Packing shed	Intensive animal husbandry, intensive horticulture, roadside stall, wholesale nursery, winery, abattoir, agricultural supply store
Rural workers' accommodation	Any premises used as quarters for staff employed in the use of land for rural purposes, such as agriculture, intensive animal husbandry and forestry, conducted on a lot in the same ownership whether or not such quarters are self-contained.	Farm workers' accommodation	Short-term accommodation building, caretaker's accommodation, dual occupancy, dwelling house, nature or rural based tourist accommodation, non-resident workforce accommodation, multiple dwellings

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Sales office	The temporary use of premises for displaying a land parcel or buildings that can be built for sale or can be won as a prize. The use may include a caravan or relocatable dwelling or structure.	Display dwelling	Bank, office
Service industry	Premises used for industrial activities that have no external air, noise or odour emissions from the site and can be suitably located with other non-industrial uses.	Audio visual equipment repair, film processing bicycle repairs, clock and watch repairs, computer repairs, dry cleaning, hand engraving, jewellery making, laundromat, locksmith, picture framing, shoe repairs, tailor	Small engine mechanical repair workshop, cabinet making, shop fitting, sign writing, tyre depot, low impact industry, medium impact industry, high impact industry, special industry
Service station	Premises used for the sale of fuel including petrol, liquid petroleum gas, automotive distillate and alternative fuels. The use may include, where ancillary, a shop, food and drink outlet, maintenance, repair servicing and washing of vehicles, the hire of trailers, and supply of compressed air.		Car wash
Shop	Premises used for the display, sale or hire of goods or the provision of personal services or betting to the public.	Hairdresser, liquor store, department store, discount department store, discount variety stores, betting agencies, supermarket, corner store	Adult shop, food and drink outlet, showroom, market
Shopping centre	Premises comprising two or more individual tenancies that is comprised primarily of shops, and that function as an integrated complex.		

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Short-term accommodation	Premises used to provide short-term accommodation for tourists or travellers for a temporary period of time (typically not exceeding three consecutive months) and may be self-contained. The use may include a manager's residence and office and the provision of recreation facilities for the exclusive use of visitors.	Motel, backpackers accommodation, cabins, serviced apartments, hotel, farm stay	Hostel, rooming accommodation, tourist park
Showroom	Premises used primarily for the sale of goods of a related product line that are of a size, shape or weight that requires: • a large area for handling, display or storage; • direct vehicle access to the building by members of the public for loading and unloading items purchased or hired.	Bulky goods sales, motor vehicles sales showroom, bulk stationary supplies	Food and drink outlet, shop, outdoor sales
Special industry	Premises used for industrial activities that include the manufacturing, producing, processing, repairing, altering, recycling, storing, distributing, transferring or treating of products and have one or more of the following attributes: • potential for extreme impacts on sensitive land uses due to offsite emissions including aerosol, fume, particle, smoke, odour and noise; • potential for extreme offsite impacts in the event of fire, explosion or toxic release; • onsite controls are required for emissions and dangerous goods risks; • the use generally involves night time and outdoor activities; • the use may involve the storage and handling of large volumes of dangerous goods; • requires significant separation from non-industrial uses.	Tanneries, rendering plants, oil refineries, waste incineration, manufacturing or storing explosives, power plants, manufacturing fertilisers **Note**—Additional examples may be shown in SC1.1.2 industry thresholds.	Low impact industry, medium impact industry, high impact industry, service industry

Column 1 Use	Column 2 Definition	Column 3 Examples include	Column 4 Does not include the following examples
Substation	Premises forming part of a transmission grid or supply network under the *Electricity Act 1994*, and used for: • converting or transforming electrical energy from one voltage to another; • regulating voltage in an electrical circuit; • controlling electrical circuits; • switching electrical current between circuits; • a switchyard; or • communication facilities for 'operating works' as defined under the *Electricity Act 1994* or for workforce operational and safety communications.	Substations, switching yards	Major electricity infrastructure, minor electricity infrastructure
Telecommunications facility	Premises used for systems that carry communications and signals by means of radio, including guided or unguided electromagnetic energy, whether such facility is manned or remotely controlled.	Telecommunication tower, broadcasting station, television station	Aviation facility, 'low-impact telecommunications facility' as defined under the *Telecommunications Act 1997*
Theatre	Premises used for presenting movies, live entertainment or music to the public and may include provision of food and liquor for consumption on the premises. The use may include the production of film or music, including associated ancillary facilities, which are associated with the production, such as sound stages, wardrobe and laundry facilities, makeup facilities, set construction workshops, editing and post-production facilities.	Cinema, movie house, concert hall, dance hall, film studio, music recording studio	Community hall, hotel, indoor sport and recreation facility, temporary film studio
Tourist attraction	Premises used for providing on-site entertainment, recreation or similar facilities for the general public. The use may include provision of food and drink for consumption on site.	Theme park, zoo	Hotel, major sport, recreation and entertainment facility, nightclub entertainment facility

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Tourist park	Premises used to provide for accommodation in caravans, self-contained cabins, tents and similar structures for the public for short term holiday purposes. The use may include, where ancillary, a manager's residence and office, kiosk, amenity buildings, food and drink outlet, or the provision of recreation facilities for the use of occupants of the tourist park and their visitors, and accommodation for staff.	Camping ground, caravan park, holiday cabins	Relocatable home park, tourist attraction, short term accommodation, non-resident workforce accommodation
Transport depot	Premises used for the storage, for commercial or public purposes, of more than one motor vehicle. The use includes premises for the storage of taxis, buses, trucks, heavy machinery and uses of a like nature. The term may include the ancillary servicing, repair and cleaning of vehicles stored on the premises.	Contractor's depot, bus depot, truck yard, heavy machinery yard	Home based business, warehouse, low impact industry, service industry
Utility installation	Premises used to provide the public with the following services: • supply or treatment of water, hydraulic power or gas; • sewerage, drainage or stormwater services; • transport services including road, rail or water; • waste management facilities; or • network infrastructure. The use includes maintenance and storage depots and other facilities for the operation of the use.	Sewerage treatment plant, mail depot, pumping station, water treatment plant	Telecommunications tower, major electricity infrastructure, minor electricity infrastructure, substation, renewable energy facility, transport depot
Veterinary services	Premises used for veterinary care, surgery and treatment of animals that may include provision for the short-term accommodation of the animals on the premises.		Animal keeping

Column 1 **Use**	**Column 2** **Definition**	**Column 3** **Examples include**	**Column 4** **Does not include the following examples**
Warehouse	Premises used for the storage and distribution of goods, whether or not in a building, including self-storage facilities or storage yards. The use may include sale of goods by wholesale where ancillary to storage. The use does not include retail sales from the premises or industrial uses.	Self-storage sheds	Hardware and trade supplies, outdoor sales, showroom, shop
Wholesale nursery	Premises used for the sale of plants, but not to the general public, where the plants are grown on or adjacent to the site. The use may include sale of gardening materials where these are ancillary to the primary use.		Bulk landscape supplies, garden centre
Winery	Premises used for manufacturing of wine, which may include the sale of wine manufactured on site.		Rural industry

SC1.1.1 Defined activity groups

There are no defined activity groups for the planning scheme.

SC1.1.2 Industry thresholds

(1) The industry thresholds listed below are to be used in conjunction with the defined uses listed in Table SC1.1.2- low impact industry, medium impact industry, high impact industry and special industry.

Table SC1.1.2.1 - Industry thresholds

Column 1 Use	Column 2 Additional examples include
Low impact industry	(1) Repairing and servicing motor vehicles, including mechanical components, radiators, electrical components, wheel alignments, exhausts, tyres, suspension or air conditioning, not including spray painting. (2) Repairing and servicing lawn mowers and outboard engines. (3) Fitting and turning workshop. (4) Assembling or fabricating products from sheet metal or welding steel, producing less than 10 tonnes a year and not including spray painting. (5) Assembling wood products not involving cutting, routing, sanding or spray painting. (6) Dismantling automotive or mechanical equipment, not including debonding brake or clutch components.
Medium impact industry	(1) Metal foundry producing less than 10 tonnes of metal castings per annum. (2) Boiler making or engineering works producing less than 10,000 tonnes of metal product per annum. (3) Facility, goods yard or warehouse for the storage or distribution of dangerous goods not involving manufacturing processes and not a major hazard facility under the *Work Health and Safety Act 2011.* (4) Abrasive blasting facility using less than 10 tonnes of abrasive material per annum. (5) Enamelling workshop using less than 15,000 litres of enamel per annum. (6) Galvanising works using less than 100 tonnes of zinc per annum. (7) Anodising or electroplating workshop where tank area is less than 400 square meters. (8) Powder coating workshop using less than 500 tonnes of coating per annum. (9) Spray painting workshop (including spray painting vehicles, plant, equipment or boats) using less than 20,000 litres of paint per annum. (10) Scrap metal yard (not including a fragmentiser), dismantling automotive or mechanical equipment including debonding brake or clutch components. (11) Manufacturing clay or ceramic products including bricks, tiles, pipes and pottery goods, less than 200 tonnes per annum. (12) Processing, smoking, drying, curing, milling, bottling or canning food, beverages or pet food, less than 200 tonnes per annum. (13) Vegetable oil or oilseed processing in works with a design production capacity of less than 1,000 tonnes per annum. (14) Manufacturing wooden products including cabinet making, joinery, wood working, producing less than 500 tonnes per annum. (15) Manufacturing medium density fibreboard, chipboard, particle board, plywood, laminated board or wood veneer products, less than 250 tonnes per annum.

	(16)	Sawmilling, wood chipping and kiln drying timber and logs, producing less than 500 tonnes per annum.
	(17)	Recycling and reprocessing batteries.
	(18)	Repairing or maintaining boats.
	(19)	Manufacturing substrate for mushroom growing.
	(20)	Manufacturing or processing plaster, producing less than 5,000 tonnes per annum.
	(21)	Recycling or reprocessing tyres including retreading.
	(22)	Printing advertising material, magazines, newspapers, packaging and stationery.
	(23)	Manufacturing fibreglass, foam plastic, composite plastic or rigid fibre-reinforced plastic or plastic products, less than 5 tonnes per annum (except fibreglass boats, tanks and swimming pools).
	(24)	Manufacturing PET, PETE, polypropylene and polystyrene plastic or plastic products, less than 10,000 tonnes per annum.
	(25)	Reconditioning metal or plastic drums.
	(26)	Glass fibre manufacture less than 200 tonnes per annum.
	(27)	Manufacturing glass or glass products, where not glass fibre, less than 250 tonnes per annum.
High impact industry	(1)	Metal foundry producing 10 tonnes or greater of metal castings per annum.
	(2)	Boiler making or engineering works producing 10,000 tonnes or greater of metal product per annum.
	(3)	Major hazard facility for the storage and distribution of dangerous goods not involving manufacturing processes.
	(4)	Scrap metal yard including a fragmentiser.
	(5)	Manufacturing clay or ceramic products including bricks, tiles, pipes and pottery goods, greater than 200 tonnes per annum.
	(6)	Processing, smoking, drying, curing, milling, bottling or canning food, beverages or pet food, greater than 200 tonnes per annum.
	(7)	Vegetable oil or oilseed processing in works with a design production capacity of greater than 1,000 tonnes per annum.
	(8)	Manufacturing wooden products including cabinet making, joinery, wood working, producing greater than 500 tonnes per annum.
	(9)	Manufacturing medium density fibreboard, chipboard, particle board, plywood, laminated board or wood veneer products, 250 tonnes or greater per annum.
	(10)	Sawmilling, wood chipping and kiln drying timber and logs, producing greater than 500 tonnes per annum.
	(11)	Manufacturing or processing plaster, producing greater than 5,000 tonnes per annum.
	(12)	Enamelling workshop using 15,000 litres or greater of enamel per annum.
	(13)	Galvanising works using 100 tonnes or greater of zinc per annum.
	(14)	Anodising or electroplating workshop where tank area is 400 square meters or greater.
	(15)	Powder coating workshop using 500 tonnes or greater of coating per annum.
	(16)	Spray painting workshop (including spray painting vehicles, plant, equipment or boats) using 20,000 litres or greater of paint per annum.
	(17)	Concrete batching and producing concrete products.
	(18)	Treating timber for preservation using chemicals including copper, chromium, arsenic, borax and creosote.
	(19)	Manufacturing soil conditioners by receiving, blending, storing, processing, drying or composting organic material or organic waste, including animal manures, sewage,

		septic sludges and domestic waste.
	(20)	Manufacturing fibreglass pools, tanks and boats.
	(21)	Manufacturing, fibreglass, foam plastic, composite plastic or rigid fibre-reinforced plastic or plastic products, 5 tonnes or greater per annum (except fibreglass boats, tanks and swimming pools).
	(22)	Manufacturing PET, PETE, polypropylene and polystyrene plastic or plastic products, 10,000 tonnes or greater per annum.
	(23)	Manufacturing tyres, asbestos products, asphalt, cement; glass or glass fibre, mineral wool or ceramic fibre.
	(24)	Abattoir.
	(25)	Recycling chemicals, oils or solvents.
	(26)	Waste disposal facility (other than waste incinerator).
	(27)	Recycling, storing or reprocessing regulated waste.
	(28)	Manufacturing batteries.
	(29)	Manufacturing wooden products including cabinet making, joinery, wood working, producing greater than 500 tonnes per annum.
	(30)	Abrasive blasting facility using 10 tonnes or greater of abrasive material per annum.
	(31)	Crematoria.
	(32)	Glass fibre manufacture producing 200 tonnes or greater per annum.
	(33)	Manufacturing glass or glass products, where not glass fibre, less than 250 tonnes per annum.
Special industry	(1)	Oil refining or processing.
	(2)	Producing, refining or processing gas or fuel gas.
	(3)	Distilling alcohol in works producing greater than 2500 litres per annum.
	(4)	Power station.
	(5)	Producing, quenching, cutting, crushing or grading coke.
	(6)	Waste incinerator.
	(7)	Sugar milling or refining.
	(8)	Pulp or paper manufacturing.
	(9)	Tobacco processing.
	(10)	Tannery or works for curing animal skins, hides or finishing leather.
	(11)	Textile manufacturing, including carpet manufacturing, wool scouring or carbonising, cotton milling, or textile bleaching, dyeing or finishing.
	(12)	Rendering plant.
	(13)	Manufacturing chemicals, poisons and explosives.
	(14)	Manufacturing fertilisers involving ammonia.
	(15)	Manufacturing polyvinyl chloride plastic.

SC1.2 Administrative definitions

(1) Administrative definitions assist with the interpretation of the planning scheme but do not have a meaning in relation to a use.

(2) A term listed in Table SC1.2.2 column 1 has the meaning set out beside that term in column 2 under the heading.

(3) The administrative definitions listed here are the definitions for the purpose of the planning scheme.

Table SC1.2.1-Index of administrative definitions

- Adjoining premises
- Advertising device
- Affordable housing
- Average width
- Base date
- Basement
- Boundary clearance
- Building height
- Contributing character building
- Defined flood event
- Defined flood level
- Defined storm tide event
- Defined storm tide event level
- Demand unit
- Development footprint
- Domestic outbuilding
- Dwelling
- Full time equivalent
- Gross floor area
- Ground level
- Household
- Major road
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- Net developable area
- Net residential density
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- Non-contributing property
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- Outermost projection
- Planning assumptions
- Plot ratio
- Projection area(s)
- Rear lot
- Secondary dwelling
- Setback
- Service catchment
- Site
- Site cover
- Storey
- Temporary use
- Total use area
- Ultimate development
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Table SC1.2.2 Administrative definitions

Column 1 **Activity group**	**Column 2** **Uses**
Adjoining premises	Premises that share all or part of a common boundary. A common boundary might be a single point such as a corner point.
Advertising device	Any permanent structure, device, sign or the like intended for advertising purposes. It includes any framework, supporting structure or building feature that is provided exclusively or mainly as part of the advertisement.
Affordable housing	Housing that is appropriate to the needs of households with low to moderate incomes.
Average width	In regard to a lot, the distance between the midpoints of the side boundaries of the lot.
Base date	The date from which a local government has estimated its projected infrastructure demands and costs.
Basement	A space that is situated between one floor level and the floor level below where not part of the space projects more than one metre above ground level.

Column 1 Activity group	Column 2 Uses
Boundary clearance	The shortest distance from the outermost projection of a structural part of the building or structure to the property boundary, including: (a) if the projection is a roof and there is a fascia – the outside face of the fascia; or (b) if the projection is a roof and there is no fascia – the roof structure. The term does not include rainwater fittings or ornamental or architectural attachments.
Building height	If specified: (a) in metres, the vertical distance between the ground level and the highest point of the building roof (apex) or parapet at any point but not including load-bearing antenna, aerial, chimney, flagpole or the like; (b) in storeys, the number of storeys above ground level; or (c) in both metres and storeys, both (a) and (b) apply.
Contributing character building	A building within the Character residential zone that is not listed in the appendix of the Character residential planning scheme policy SC6.2.
Defined flood event	For this planning scheme, this is the 1% annual exceedance probability (AEP) flood and is mapped as the combined extent of the high and medium flood hazard areas identified on overlay map OM-06.1 and OM-06.2.
Defined flood level	The flood level relative to the Australian Height Datum (AHD) of the 1% AEP flood. **Editor's note—**This will vary between locations.
Defined storm tide event	For this planning scheme, this is the 1% annual exceedance probability (AEP) storm tide event with an allowance of 0.8m sea level rise and an increase in maximum cyclone intensity of 10% relative to present day conditions.
Defined storm tide event level	For this planning scheme, this is RL4.5m Australian Height Datum (AHD), within 100m of the coastline or RL3.9m AHD in other areas.
Demand unit	Demand units provide a standard of unit measurement to express demand on a trunk infrastructure network.
Development footprint	The location and extent of all development proposed on a site. This includes all buildings and structures, open space, all associated facilities, landscaping, on-site stormwater drainage, on-site wastewater treatment, all areas of disturbance, on-site parking, access and manoeuvring areas.
Domestic outbuilding	A Class 10a building, as defined in the Building Code of Australia, that is ancillary to a residential use on the same premises and is limited to non-habitable buildings for the purpose of a shed, garage and carport.
Dwelling	A building or part of a building used or capable of being used as a self-contained residence that must include the following: (a) food preparation facilities; (b) a bath or shower; (c) a toilet and wash basin; (d) clothes washing facilities. This term includes outbuildings, structures and works normally associated with a dwelling.

Column 1 Activity group	Column 2 Uses
Full time eqivalent	FTE – 'Full time equivalent', a measure of the total level of staff resources used. The FTE of a full-time staff member is equal to 1.0. The calculation of FTE for part-time staff is based on the proportion of time worked compared to that worked by full-time staff performing similar duties.
Gross floor area	The total floor area of all storeys of a building (measured from the outside of the external walls or the centre of a common wall), other than areas used for the following: (a) building services, plant and equipment; (b) access between levels; (c) ground floor public lobby; (d) a mall; (e) the parking, loading and manoeuvring of motor vehicles; (f) unenclosed private balconies whether roofed or not.
Ground level	The level of the natural ground or, where the level of the natural ground has been changed, the level as lawfully changed.
Household	An individual or a group of two or more related or unrelated people who reside in the dwelling, with the common intention to live together on a long-term basis and who make common provision for food or other essentials for living.
Major road	A road that operates as a major collector, sub arterial or arterial road or highway.
Minor building work	Building work that increases the gross floor area of a building by no more than the lesser of the following: (a) 50m² (b) an area equal to 5% of the gross floor area of the building.
Minor electricity infrastructure	All aspects of development for an electricity supply network as defined under the *Electricity Act 1994*, (or for private electricity works that form an extension of, or provide service connections to properties from the network), if the network operates at standard voltages up to and including 66kV. This includes: (a) augmentations/upgrades to existing powerlines where the voltage of the infrastructure does not increase; (b) augmentations to existing substations (including communication facilities for controlling works as defined under the *Electricity Act 1994*) where the voltage of the infrastructure does not increase, and where they are located on an existing substation lot.
Net developable area	The area of land available for development. It does not include land that cannot be developed due to constraints such as acid sulphate soils, conservation land, flood affected land or steep slope. **Note—**for the purpose of a Local government infrastructure plan, net developable area is usually measured in hectares, net developable hectares (net dev ha).
Net residential density	The total number of dwellings divided by the combined area of residential lots, local parks , internal local roads and half the width of local roads bordering the site.
Netserv Plan	A distributor-retailer's plan about its water and wastewater networks and provision of water service and wastewater service pursuant to section 99BJ of the *South East Queensland (Distributor retailer Restructure) Water Act 2009*.

Column 1 Activity group	Column 2 Uses
Non-contributing property	A property within the Character residential zone that is listed in Appendix 1 of the Character residential planning scheme policy SC6.2.
Non-residential workers	Workers who reside in areas for extended periods when employed on projects directly associated with resource extraction, major industry, major infrastructure or rural uses, but have a permanent place of residence in another area. This includes workers engaged in fly-in/fly-out or drive-in/drive-out arrangements.
Outermost projection	The outermost projection of any part of a building or structure including, in the case of a roof, the outside face of the fascia, or the roof structure where there is no fascia, or attached sunhoods or the like, but does not include retractable blinds, fixed screens, rainwater fittings, or ornamental attachments.
Planning assumption	Assumptions about the type, scale, location and timing of future growth.
Plot ratio	The ratio of gross floor area to the area of the site.
Projection area(s)	Area or areas within a local government area for which a local government carries out demand growth projections.
Rear lot	A lot that does not have frontage or access to a road other than by means of an access way that forms part of the lot, or by means of an easement over adjoining land.
Secondary dwelling	A dwelling used in conjunction with, and subordinate to, a dwelling house on the same lot. A secondary dwelling may be constructed under a dwelling house, be attached to a dwelling house or be free standing.
Service catchment	An area serviced by an infrastructure network. An infrastructure network is made up of one or more service catchments. Service catchments are determined by the network type and how it has been designed to operate and provide service to the urban areas. **Note—**for example: • stormwater network service catchments can be delineated to align with watershed boundaries • open space network service catchment can be determined using local government accessibility standards • water network service catchment can be established as the area serviced by a particular reservoir.
Setback	For a building or structure, the shortest distance measured horizontally from the outermost projection of a building or structure to the vertical projection of the boundary of the lot.
Site	Any land on which development is carried out or is proposed to be carried out whether such land comprises the whole or part of one lot or more than one lot if each of such lots is contiguous.
Site cover	The proportion of the site covered by a building(s), structure(s) attached to the building(s) and carport(s), calculated to the outermost projections of the building(s) and is expressed as a percentage. The term does not include: (a) any structure or part thereof included in a landscaped open space area such as a gazebo or shade structure; (b) basement car parking areas located wholly below ground level; (c) eaves and sun shading devices.

Column 1 **Activity group**	**Column 2** **Uses**
Storey	A space that is situated between one floor level and the floor level next above, or if there is no floor above, the ceiling or roof above, but not a space that contains only: (a) a lift shaft, stairway or meter room; (b) a bathroom, shower room laundry, water closet, or other sanitary compartment; (c) a combination of the above. A mezzanine is a storey. A roofed structure on or part of a rooftop that does not solely accommodate building plant and equipment is a storey. A basement is not a storey.
Temporary use	A use that is impermanent and may be irregular or infrequent that does not require the construction of a permanent building or the installation of permanent infrastructure or services. **Note—**provisions for temporary use timeframes for defined uses may be provided in section 1.7 Local government administrative matters.
Total use area	Total use area – the sum of all areas (exclusive of walls, columns and balconies whether roofed or not) of all storeys of a building which are used or intended for use for a particular purpose, plus any other areas of the site which is also used or intended for use for the same purpose, except for: (a) areas (inclusive of walls and columns) of any lift wells, lift motor rooms, air conditioning and (b) associated mechanical or electrical plant and equipment rooms; (c) areas of any staircases; (d) areas of any public lobby; (e) areas of any public toilets; (f) areas of any staff toilets, washrooms, recreation areas and associated facilities; and (g) areas used for the access, parking and associated manoeuvring of motor vehicles.
Ultimate development	The realistic extent of development anticipated to be achieved when a site (or projection area or infrastructure service catchment) is fully developed.
Urban purposes	For the purpose of Local government infrastructure plans, urban purposes includes residential (other than rural residential), retail, commercial, industrial, community and government related purposes.

Schedule 2 Mapping

SC2.1 Map index

The table(s) below list any strategic framework, zoning, local plan and overlay maps applicable to the planning scheme area.

Editor's note—Mapping for the LGIP is contained within Schedule 3 of the planning scheme.

Table SC2.1.1—Map index

Map number	Map title	Gazettal date
Strategic framework maps		
SFM-001	Townsville City Council Planning Scheme Strategic Framework Map - Shaping Townsville	17 October 2014
SFM-002	Townsville City Council Planning Scheme Strategic Framework Map - Shaping Townsville and Strong and connected community	17 October 2014
SFM-003	Townsville City Council Planning Scheme Strategic Framework Map - Environmentally sustainable future	17 October 2014
SFM-004	Townsville City Council Planning Scheme Strategic Framework Map - Sustaining economic growth	28 April 2017
Zone maps		
	Townsville City Council Planning Scheme Zoning Index	17 October 2014
	Precinct and Sub Precinct Legend	17 October 2014
ZM-001	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-002	Townsville City Council Planning Scheme Zoning Map	28 April 2017
ZM-003	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-004	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-005	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-006	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-007	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-008	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-009	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-010	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-011	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-012	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-013	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-014	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-015	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-016	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-017	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-018	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-019	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-020	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-021	Townsville City Council Planning Scheme Zoning Map	17 October 2014

ZM-022	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-023	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-024	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-025	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-026	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-027	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-028	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-029	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-030	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-031	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-032	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-033	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-034	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-035	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-036	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-037	Townsville City Council Planning Scheme Zoning Map	9 December 2016
ZM-038	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-039	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-040	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-041	Townsville City Council Planning Scheme Zoning Map	27 April 2018
ZM-042	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-043	Townsville City Council Planning Scheme Zoning Map	29 January 2016
ZM-044	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-045	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-046	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-047	Townsville City Council Planning Scheme Zoning Map	17 October 2014
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ZM-049	Townsville City Council Planning Scheme Zoning Map	17 October 2014
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ZM-058	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-059	Townsville City Council Planning Scheme Zoning Map	17 October 2014
ZM-060	Townsville City Council Planning Scheme Zoning Map	17 October 2014
	Townsville City Council Planning Scheme Precinct Map Index	17 October 2014
	Precinct and Sub-precinct Legend	17 October 2014

PM-001	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-002	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-003	Townsville City Council Planning Scheme Precinct Map	27 April 2018
PM-004	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-005	Townsville City Council Planning Scheme Precinct Map	27 April 2018
PM-006	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-007	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-008	Townsville City Council Planning Scheme Precinct Map	27 April 2018
PM-009	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-010	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-011	Townsville City Council Planning Scheme Precinct Map	17 October 2014
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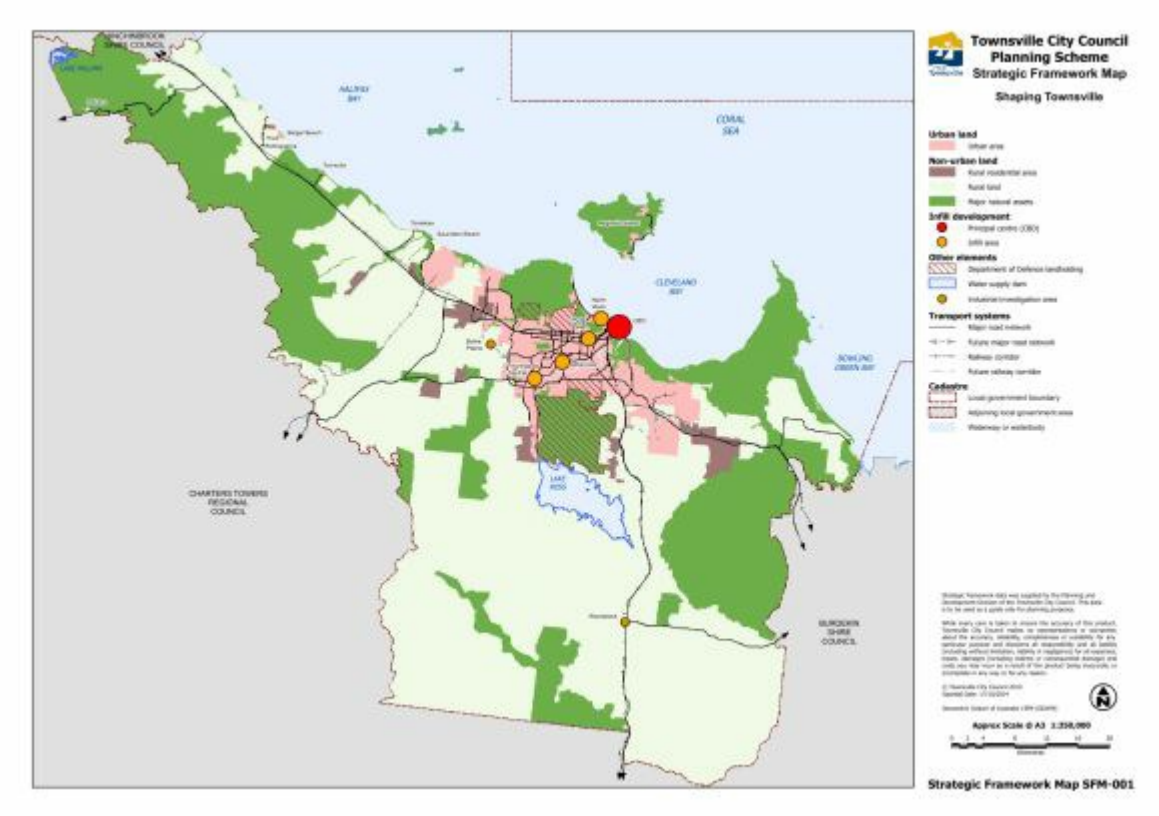
PM-014	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-015	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-016	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-017	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-018	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-019	Townsville City Council Planning Scheme Precinct Map	27 April 2018
PM-020	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-021	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-022	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-023	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-024	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-025	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-026	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-027	Townsville City Council Planning Scheme Precinct Map	17 October 2014
PM-028	Townsville City Council Planning Scheme Precinct Map	27 April 2018
Local plan maps		
There are no local plan maps in this planning scheme.		17 October 2014
Overlay maps		
OM-01.1	Townsville City Council Planning Scheme Development Constraints Airport Environs Overlay Map - Operational airspace	28 August 2015
OM-01.2	Townsville City Council Planning Scheme Development Constraints Airport Environs Overlay Map - Wildlife hazard buffer zones and public safety areas	9 December 2016
OM-01.3	Townsville City Council Planning Scheme Development Constraints Airport Environs Overlay Map - Aviation facilities	28 August 2015
OM-01.4	Townsville City Council Planning Scheme Development Constraints Airport Environs Overlay Map - Australian noise exposure forecast (ANEF) contours (2036)	3 March 2017

OM-01.5	Townsville City Council Planning Scheme Development Constraints Airport Environs Overlay Map - Lighting area buffer zones	9 December 2016
OM-02	Townsville City Council Planning Scheme Development Constraints Overlay Map - Bushfire hazard	29 January 2016
OM-03.1	Townsville City Council Planning Scheme Environment Coastal Environment Overlay Map - Coastal hazard areas – storm tide inundation areas	27 April 2018
OM-03.2	Townsville City Council Planning Scheme Environment Coastal Environment Overlay Map - Coastal hazard areas – storm tide inundation areas	27 April 2018
OM-03.3	Townsville City Council Planning Scheme Environment Coastal Environment Overlay Map - Coastal hazard areas – erosion prone area	27 April 2018
OM-04.1	Townsville City Council Planning Scheme Heritage Overlay Map - Cultural heritage	27 April 2018
OM-04.2	Townsville City Council Planning Scheme Heritage Overlay Map - Cultural heritage	27 April 2018
OM-04.3	Townsville City Council Planning Scheme Heritage Overlay Map - Cultural heritage	27 April 2018
OM-04.4	Townsville City Council Planning Scheme Heritage Overlay Map - Cultural heritage	27 April 2018
OM-05	Townsville City Council Planning Scheme Natural Resources Overlay Map - Extractive resources	17 October 2014
OM-06.1	Townsville City Council Planning Scheme Development Constraints Overlay Map - Flood hazard	27 April 2018
OM-06.2	Townsville City Council Planning Scheme Development Constraints Overlay Map - Flood hazard	27 April 2018
OM-07.1	Townsville City Council Planning Scheme Development Constraints Overlay Map - Landslide hazard	17 October 2014
OM-07.2	Townsville City Council Planning Scheme Development Constraints Overlay Map - Landslide hazard	28 August 2015
OM-08	Townsville City Council Planning Scheme Environment Natural Assets Overlay Map - Environmental importance	28 April 2017
OM-09	Townsville City Council Planning Scheme Natural Resources Overlay Map - Water resource catchments	28 August 2015
OM-10.1	Townsville City Council Planning Scheme Infrastructure Overlay Map - Noise corridors - Roads	28 April 2017
OM-10.2	Townsville City Council Planning Scheme Infrastructure Overlay Map - Noise corridors - Railway	29 January 2016
Other plans maps		
OPM-01	Oonoonba Urban Development Area Development Scheme Map - Map 2: Oonoonba UDA structure and zoning plan	17 October 2014
OPM-02	Map No. PDA 7 - Townsville City Waterfront Priority Development Area	17 October 2014

SC2.2 Strategic framework maps



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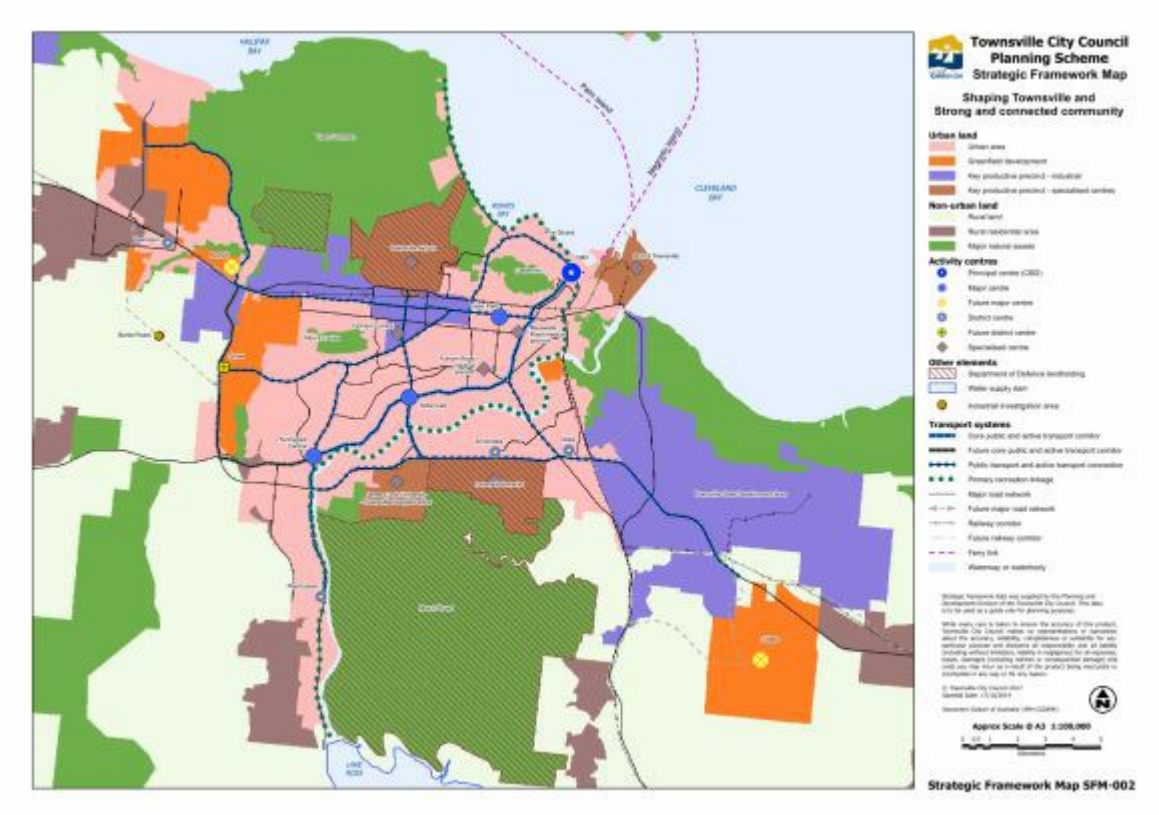
Shaping Townsville Strategic Framework Map SFM-001



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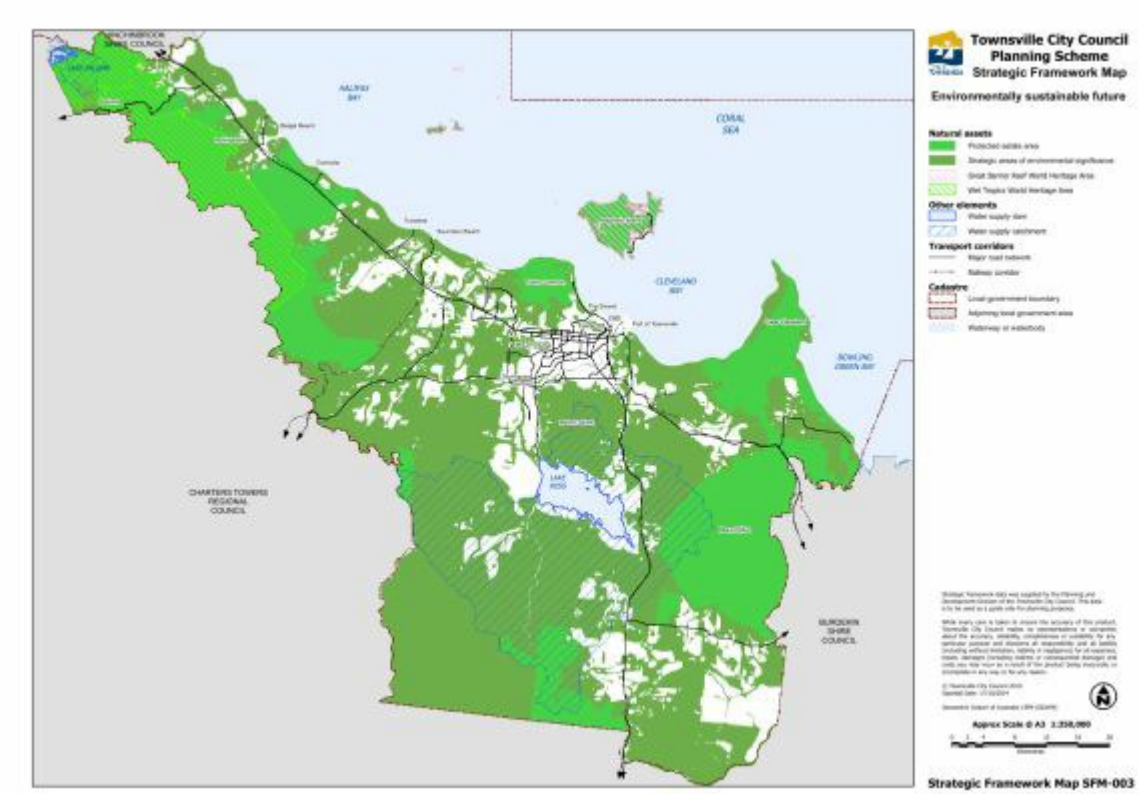
Shaping Townsville and Strong and Connected Community Strategic Framework Map



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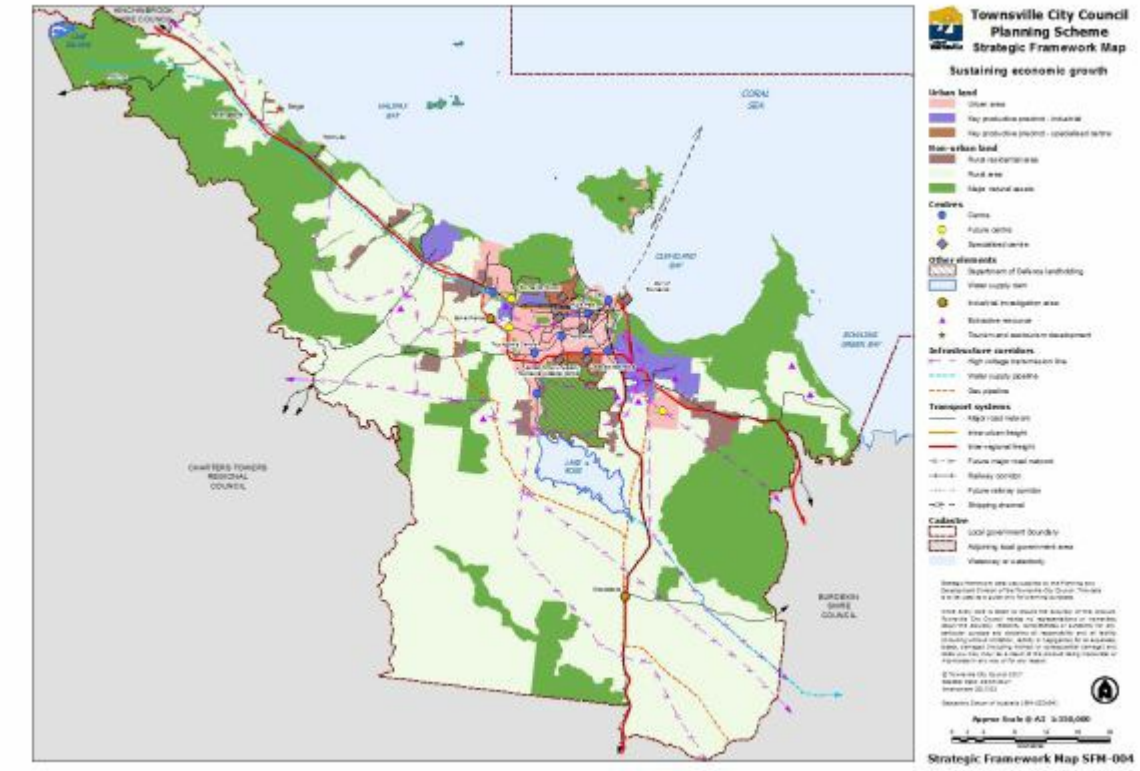
Environmentally sustainable future Strategic Framework Map SFM - 003



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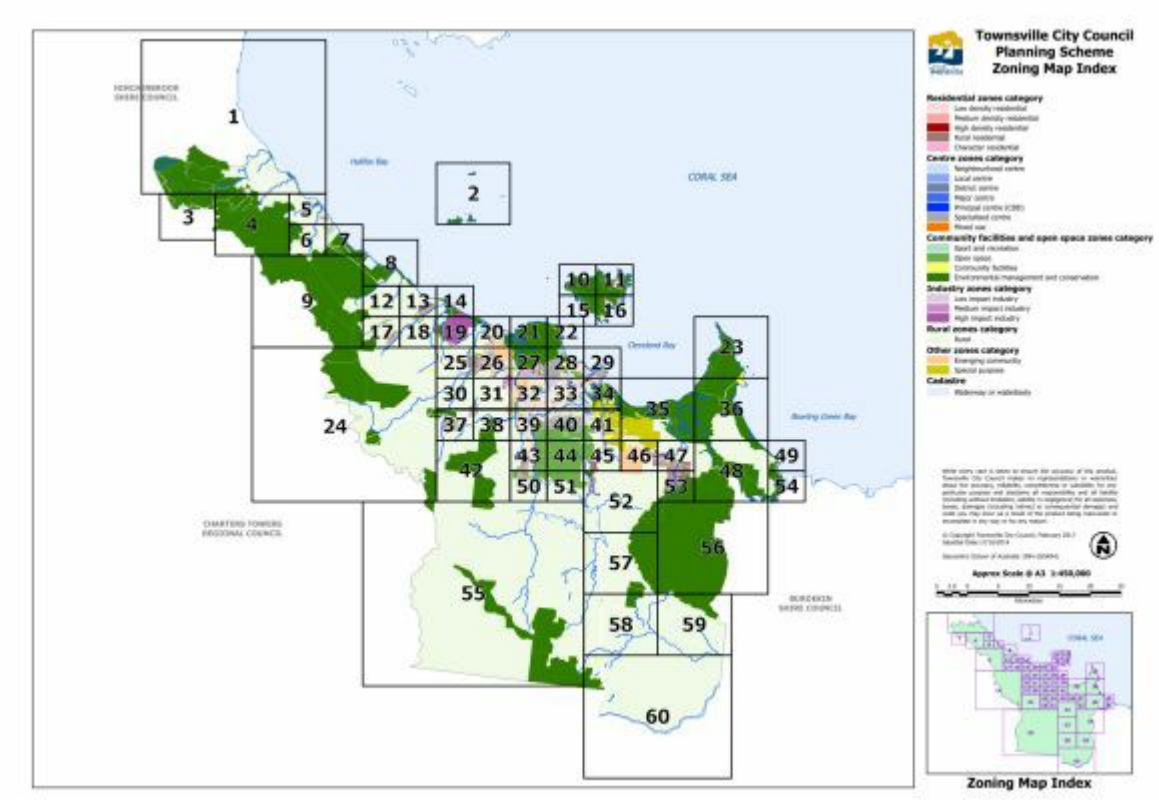
Sustaining economic growth Strategic Framework Map SFM-004

SC2.3 Zone maps



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Townsville City Council planning scheme zoning map index

PRECINCT AND SUB-PRECINCT LEGEND				
Precinct Code	**Precinct**	**Sub-Precinct Code**	**Sub-Precinct**	**Zone Category**
A	Townsville Airport			Specialised centre
AC	Arcadia Central			Mixed use
ADC	Annandale district centre			District centre
AMC	Aitkenvale major centre	**ACC**	Aitkenvale centre core	Major centre
AMC	Aitkenvale major centre	**ACF**	Aitkenvale centre frame	Major centre
AMD	Aitkenvale medium density			Medium density residential
AV	Aitkenvale village			Medium density residential
B	Breakwater			Mixed use
BBGC	Balgal Beach golf course			Sport and recreation
BRM	Bayswater Road medical			Specialised centre
C	Cungulla			Rural
CA	Civic and administration			Principal centre
CD	Cluden			Sport and recreation
CBDG	CBD gateway			Mixed use
CS	Churchill Street			Character residential

CTR	Charters Towers Road business			Mixed use
D	Domain Central			Specialised centre
DDC	Deeragun district centre			District centre
DHHC	1960s Defence Housing and1960s Housing Commission			Character residential
FRM	Fulham Road medical			Specialised centre
FS	French Street			Character residential
FSE	Flinders Street East			Principal centre
FSR	Flinders Street retail			Principal centre
FSW	Flinders Street West			High density residential
G	Grazing			Rural
GQ	Grand Queenslanders			Character residential
H	Horticulture			Rural
HPMC	Hyde Park major centre			Major centre
HPMD	Hyde Park medium density			Medium density residential
IAG	Interwar to 1950s Asymmetrical Gables			Character residential
IDC	Idalia district centre			District centre
IGQB	Interwar Gables and Queensland Bungalows			Character residential
J	Jensen			Rural
JCUTH	James Cook University Townsville Hospital			Specialised centre
KR	Kings Road			Mixed use
KRM D	Kings Road medium density			Medium density residential
KSQ	King Street quarter			Mixed use
KT	Kirwan Traders			Mixed use
LB	Lavarack Barracks			Specialised centre
MF	Mixed farming			Rural
M FP	Mixed 1950s			Character residential
MIMD	Magnetic Island medium density			Medium density residential
MIV	Magnetic Island villages	**HB**	Horseshoe Bay	Mixed use
MIV	Magnetic Island villages	**N B**	Nelly Bay	Mixed use
MIV	Magnetic Island villages	**PB**	Picnic Bay	Mixed use
MS	Marlow Street			Low density residential
NBG	Nelly Bay gateway			Mixed use
NBI	Nelly Bay low impact industry			Low impact industry
NBT	Nelly Bay tourist			Medium density residential
NW	North Ward local centre			Local centre
NWG	North Ward gateway			Medium density residential

N WMD	North Ward medium density			Medium density residential
N WV	North Ward villages			Medium density residential
PB	Picnic Bay			Medium density residential
PBCF	Picnic Bay community facilities			Community facilities
PS	Palmer Street			High density residential
PSP	Park Street			Character residential
PT	Port of Townsville			Specialised centre
PWE	1950s Post War Expansion			Character residential
Q	Queenslanders			Character residential
R	Riverway			Open space
RDC	Rasmussen district centre			District centre
RE	Railway Estate			High density residential
RMII	Roseneath medium impact industry			Medium impact industry
RP	Rossiter Park			Medium density residential
RRRC	Ross River Road corridor			Low density residential
RSLC	Rising Sun local centre			Local centre
S	The Strand			Medium density residential
ST	Stables			Low density residential
STP	South Townsville			Character residential
STRD	South Townsville railyards and Dean Park			Mixed use
TCMC	Thuringowa Central major centre	**TCS**	Thuringowa centre support	Major centre
TCMC	Thuringowa Central major centre	**TD**	Thuringowa Drive	Major centre
TCMC	Thuringowa Central major centre	**TTCH**	Thuringowa town centre heart	Major centre
TCMC	Thuringowa Central major centre	**W**	Willows	Major centre
TE	Thuringowa East			Medium density residential
TS	Thuringowa South			Medium density residential
WC	Workers Cottages			Character residential
WLS	Wills Street			Medium Density Residential
WS	Wotton Street			Mixed use

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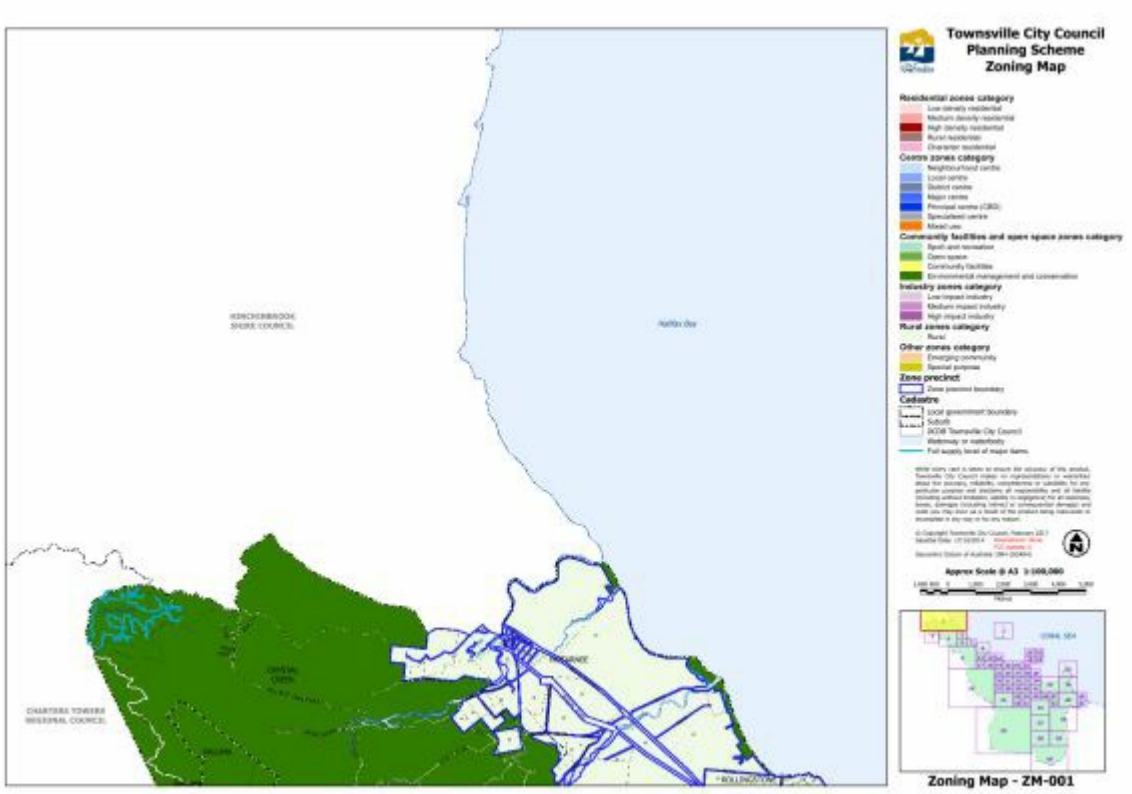

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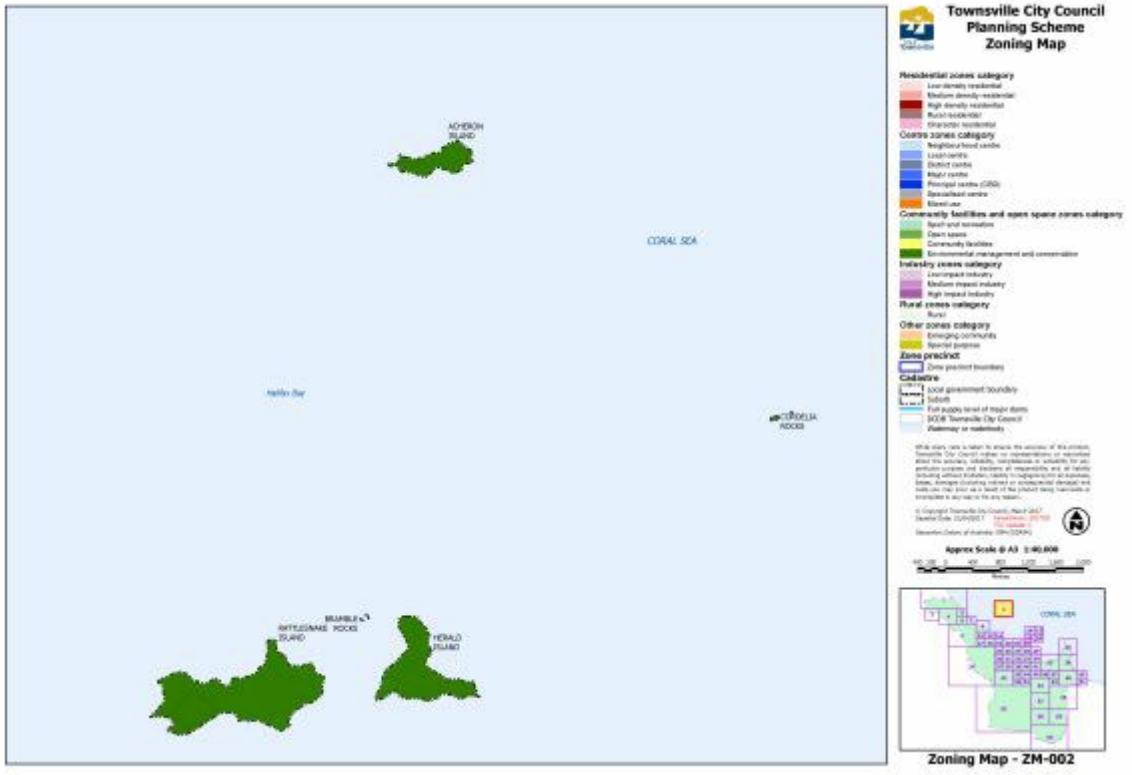
Zoning Map ZM-001



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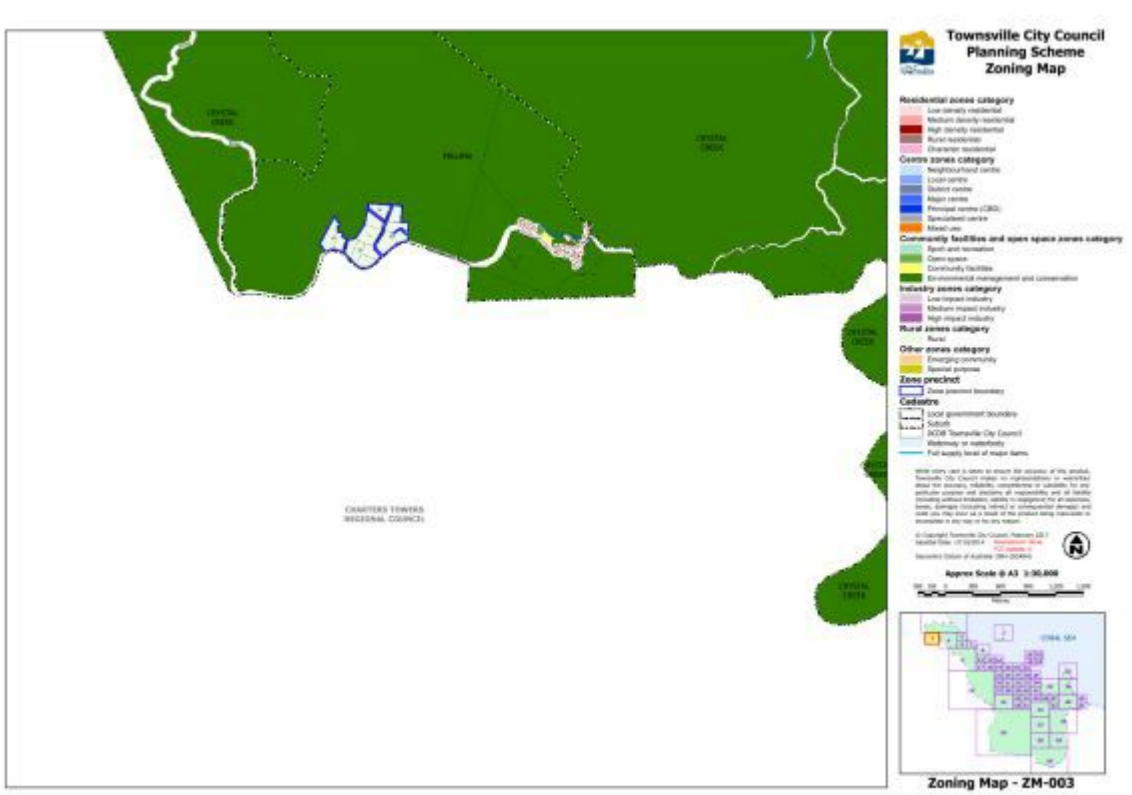
Zoning Map ZM-002



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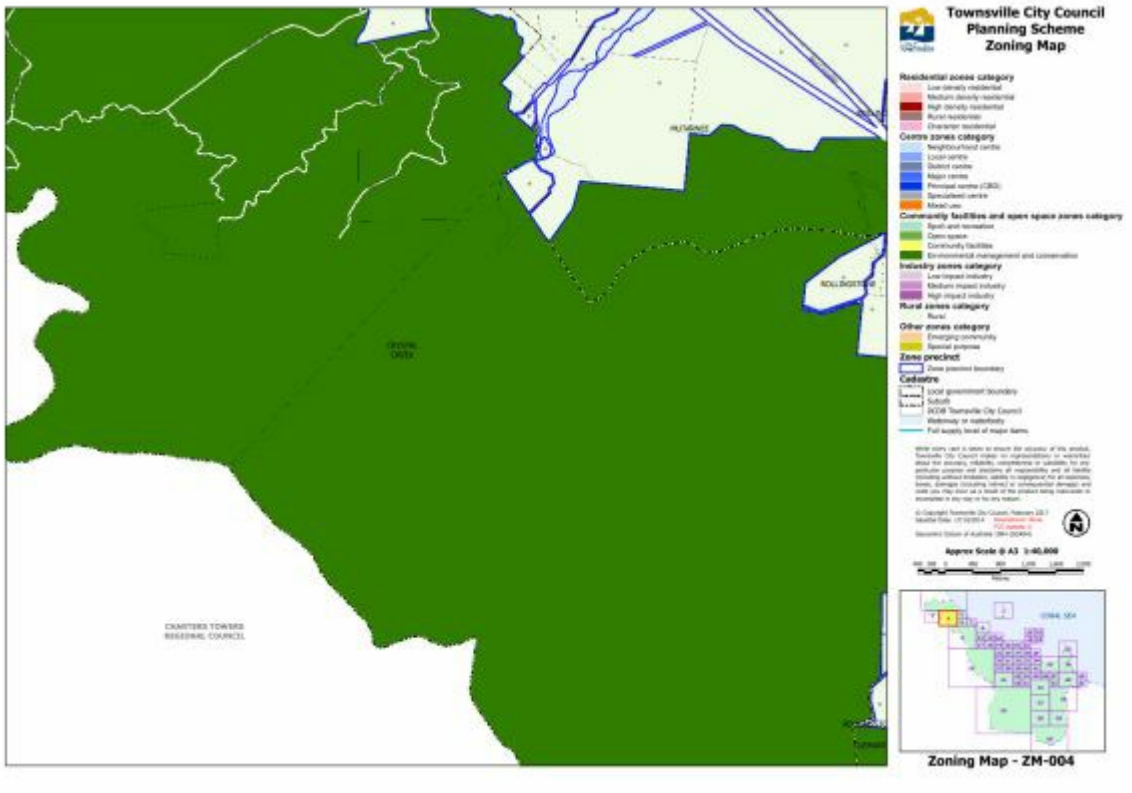
Zoning Map ZM-003



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Zoning Map ZM-004

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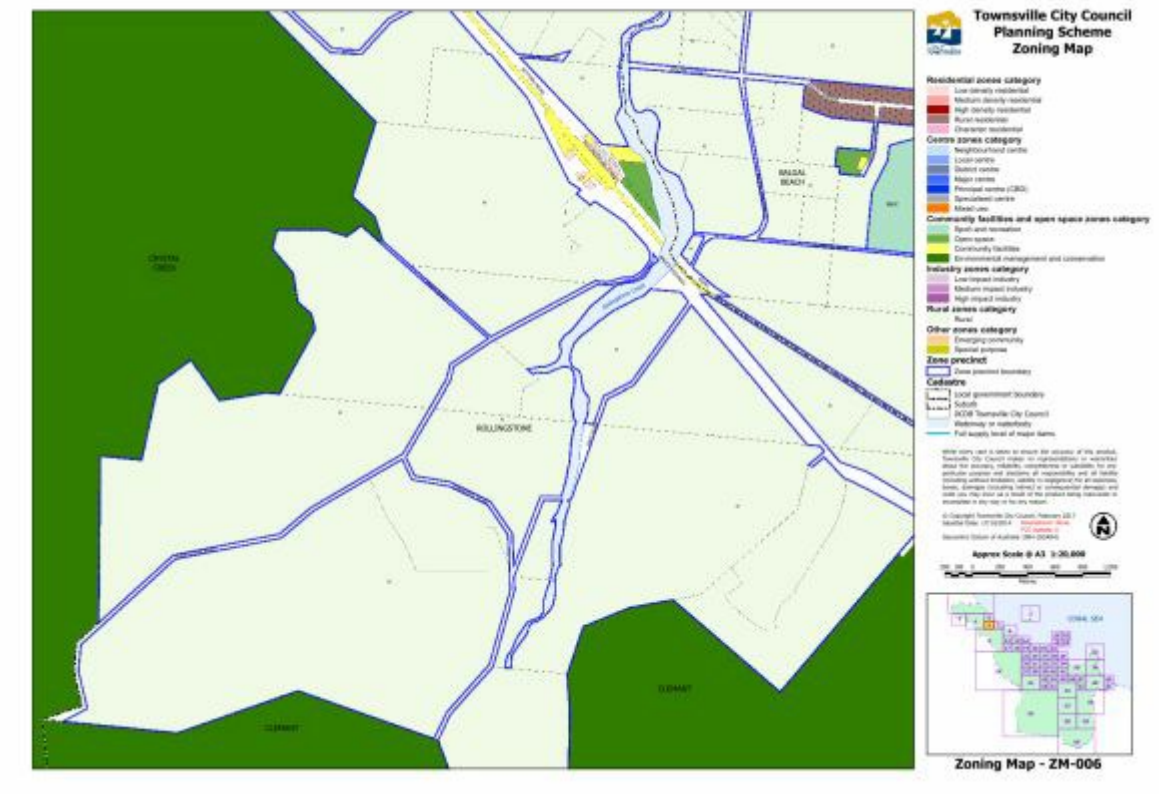
Zoning Map ZM-005



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Zoning Map ZM-006

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Zoning Map ZM-007

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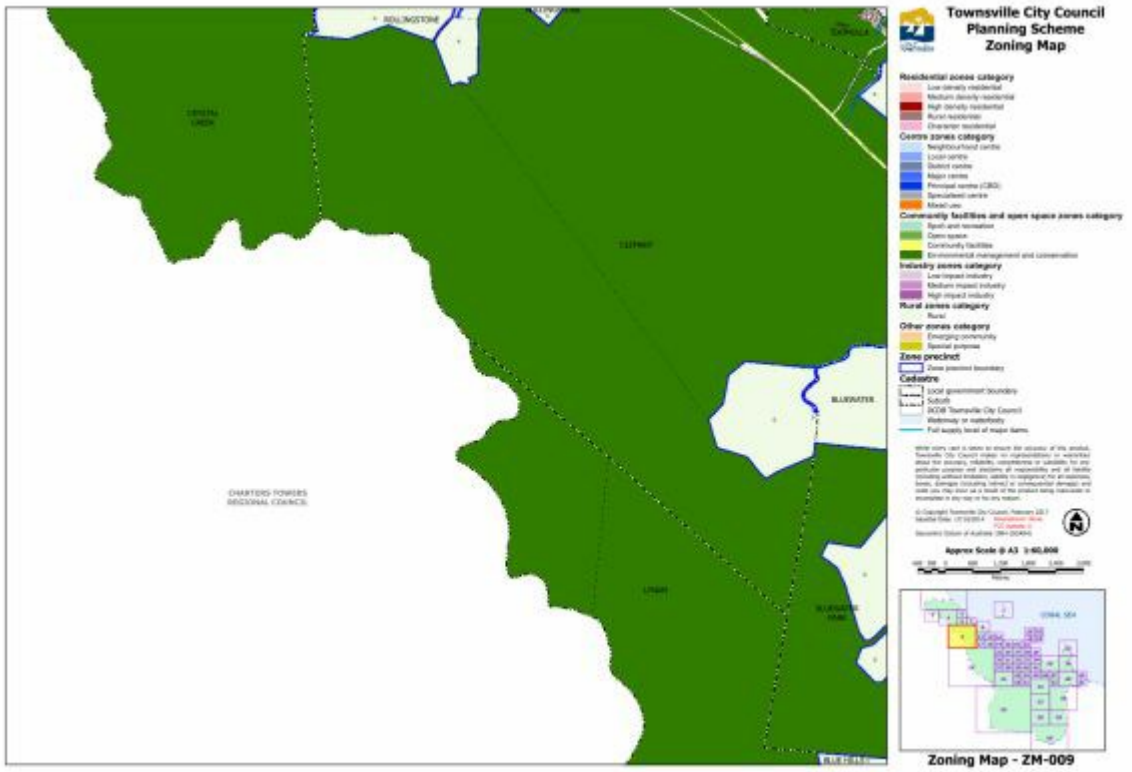
Zoning Map ZM-008



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Zoning Map ZM-009

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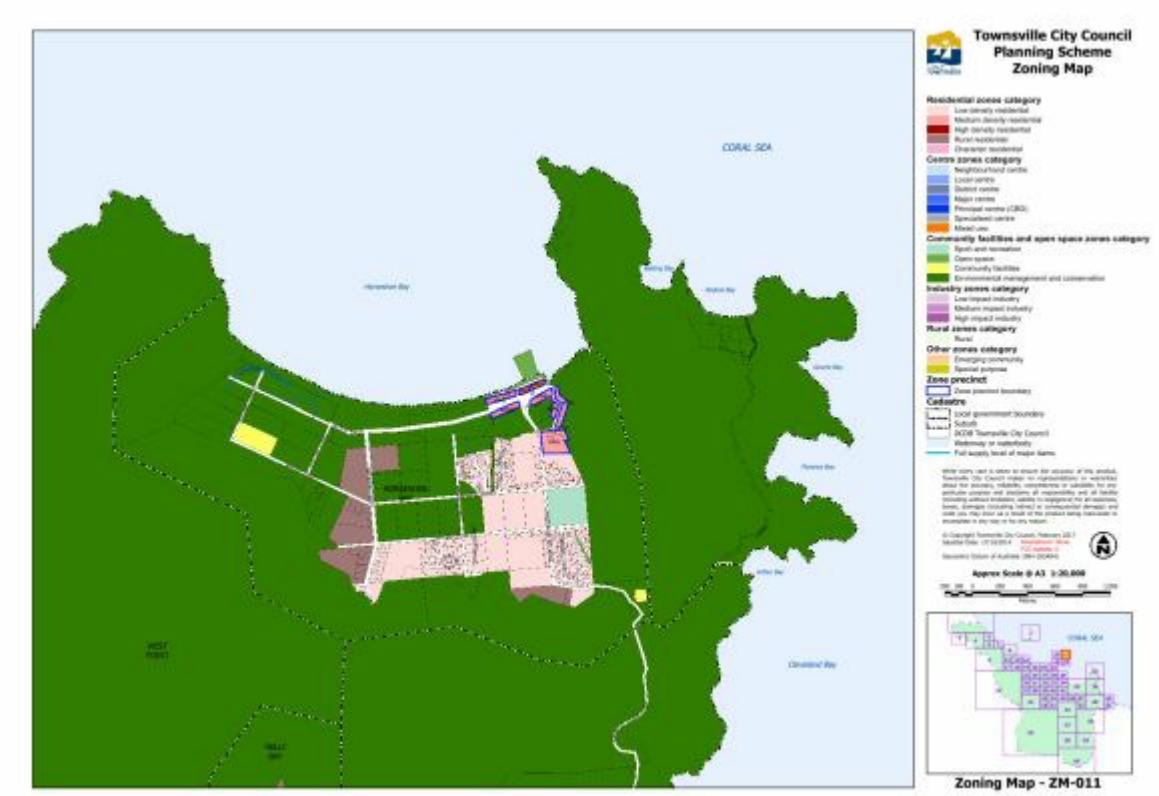
Zoning Map ZM-010



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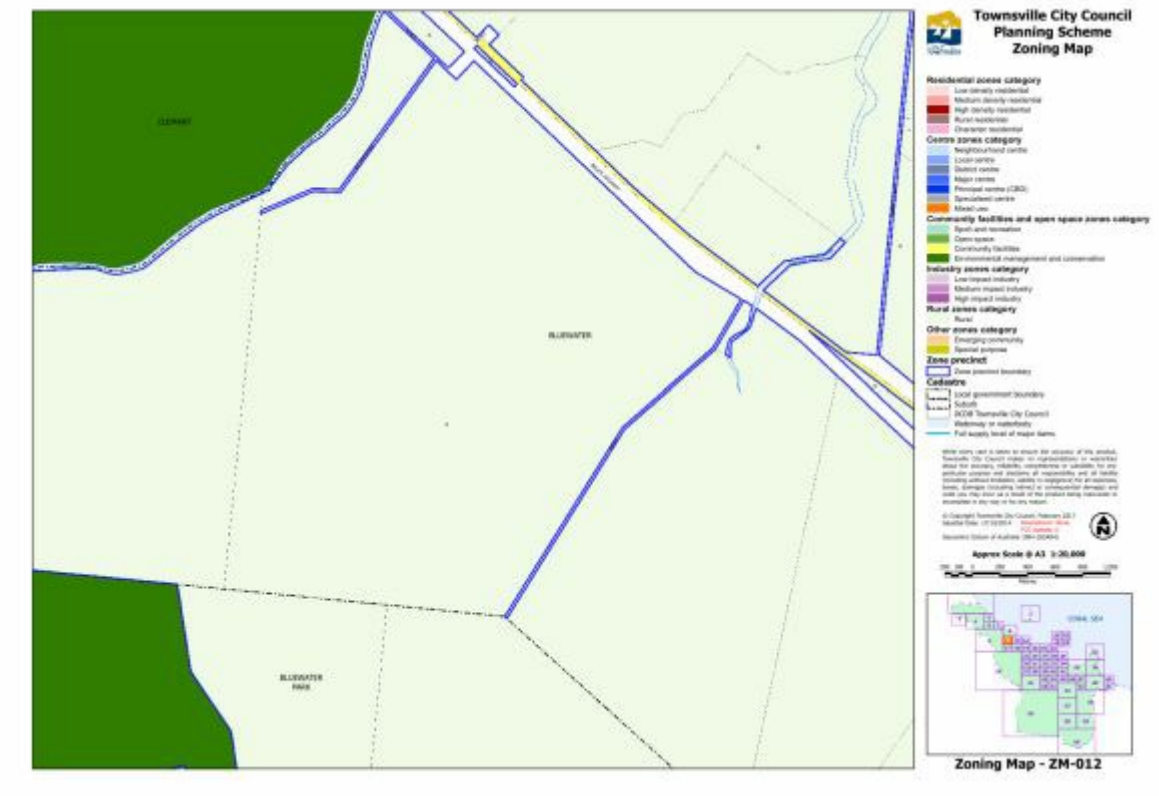

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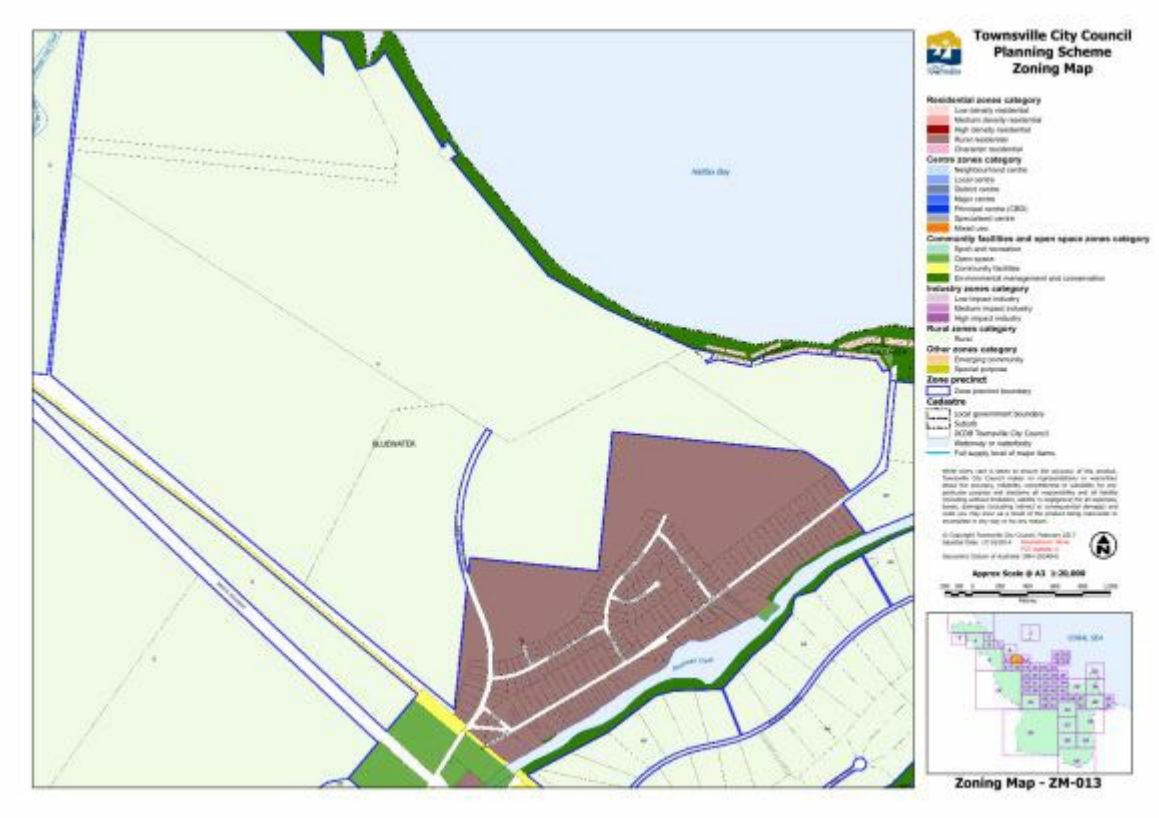

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Zoning Map ZM-013

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Zoning Map ZM-014

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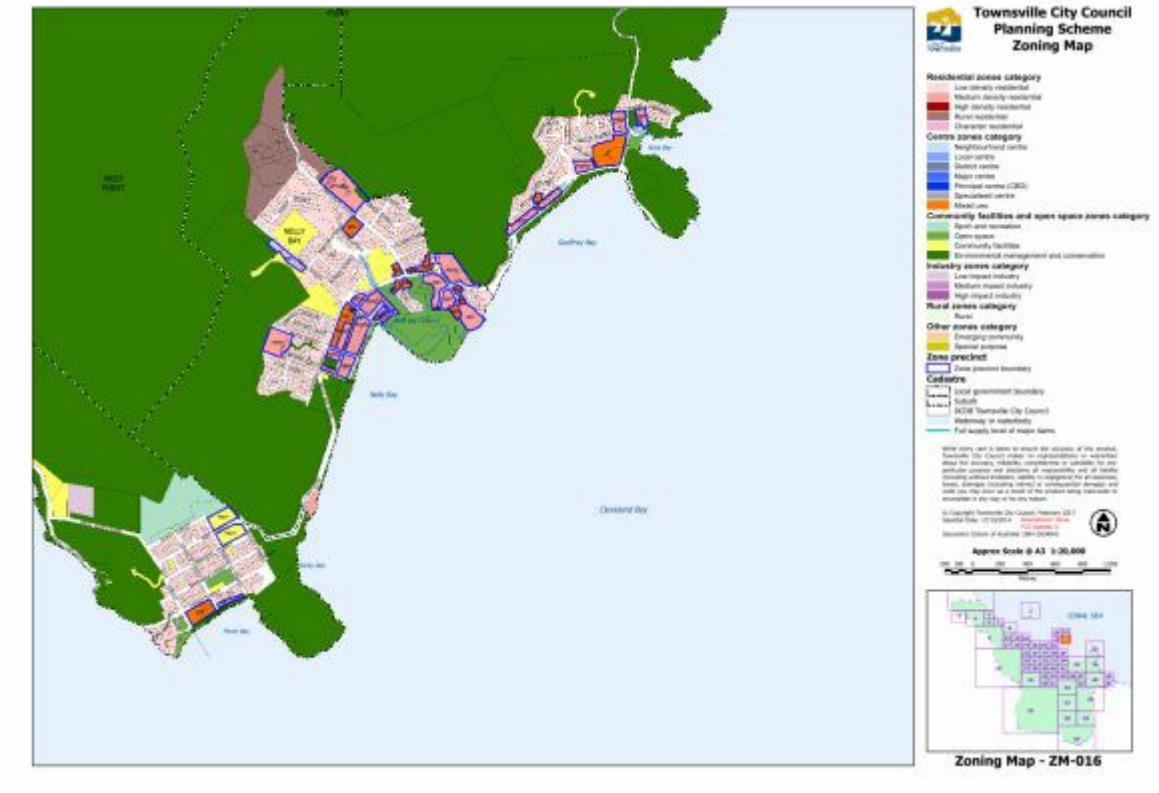
Zoning Map ZM-015



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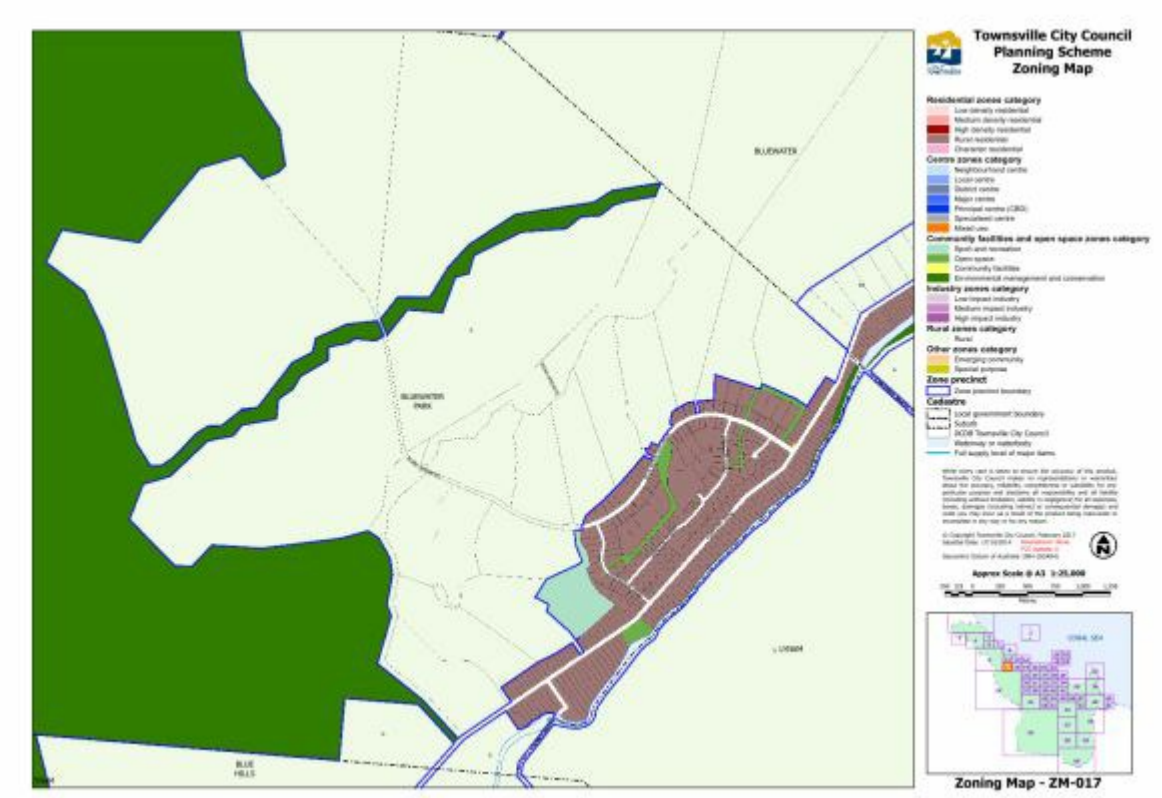

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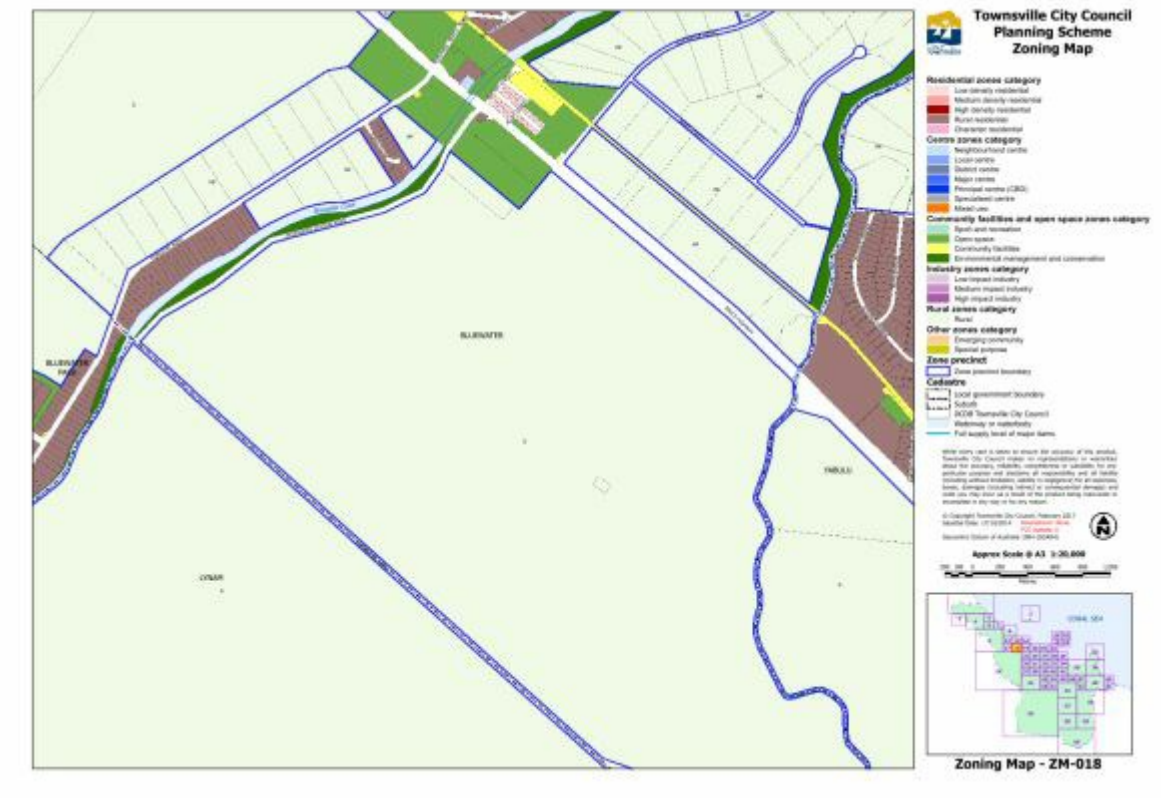

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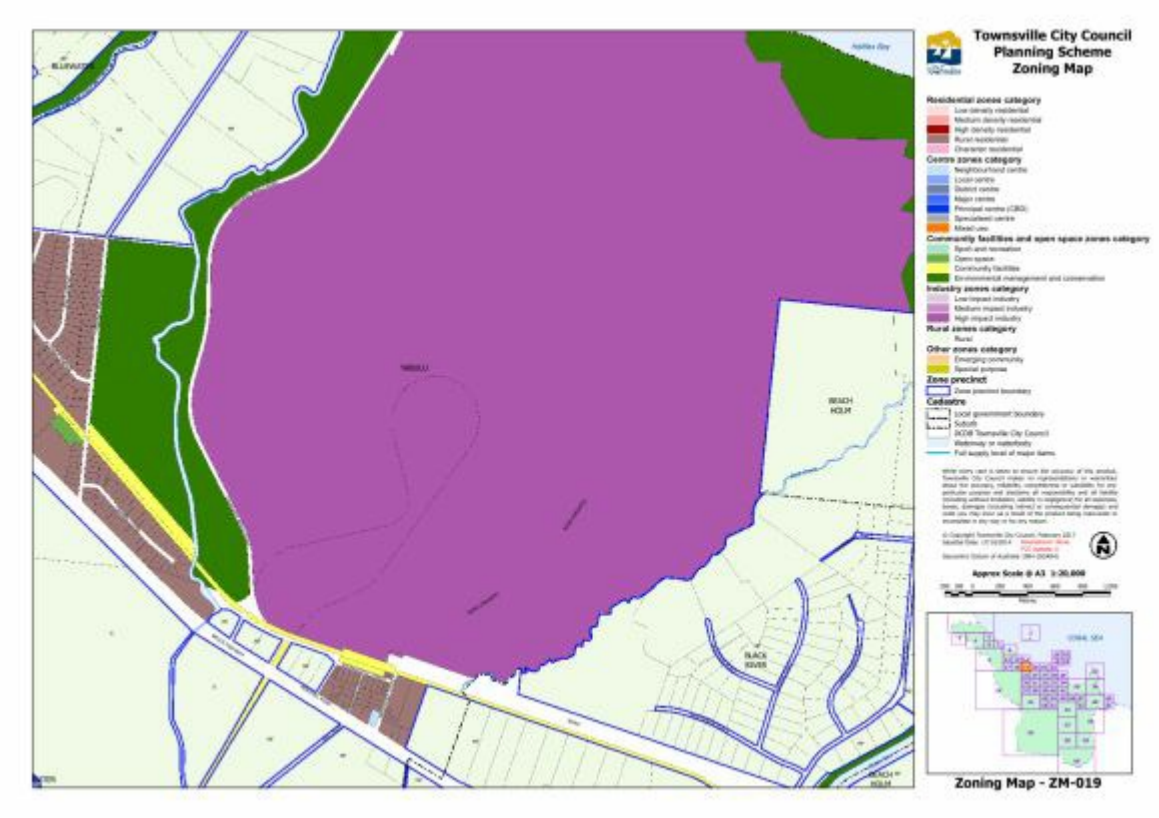

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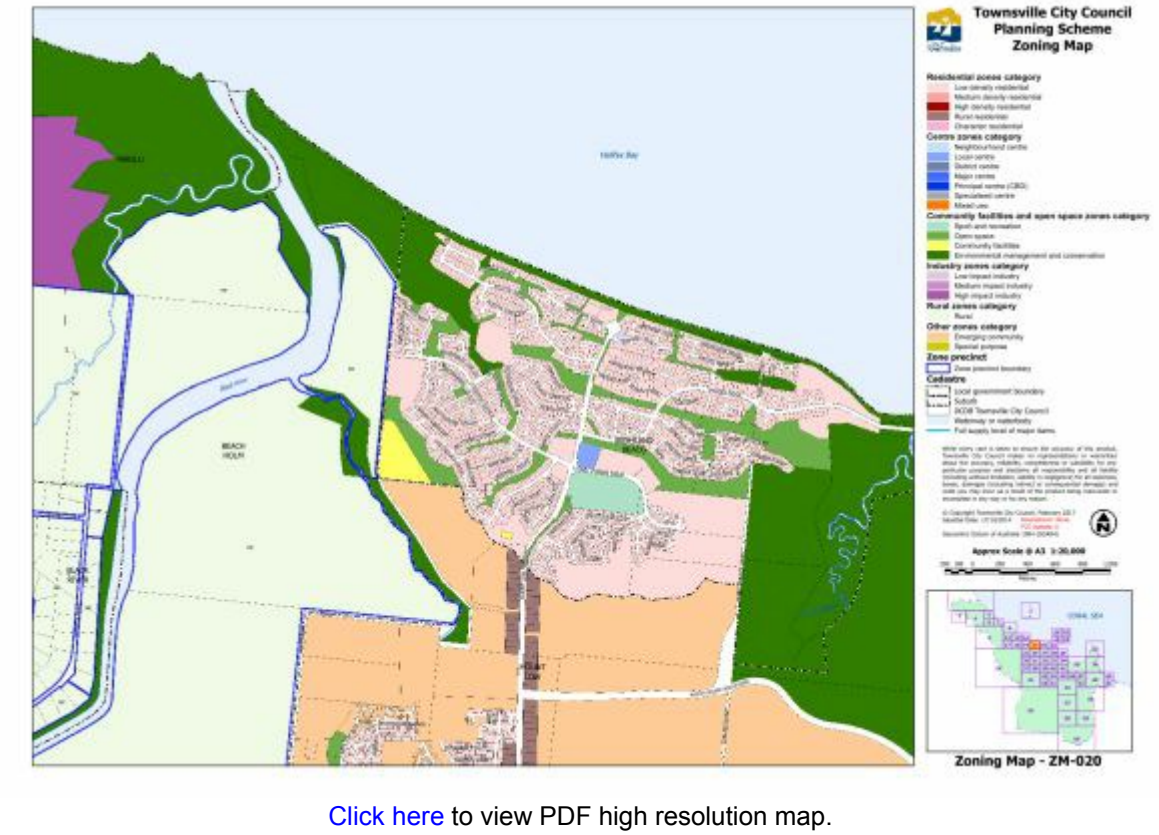

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Zoning Map ZM-020

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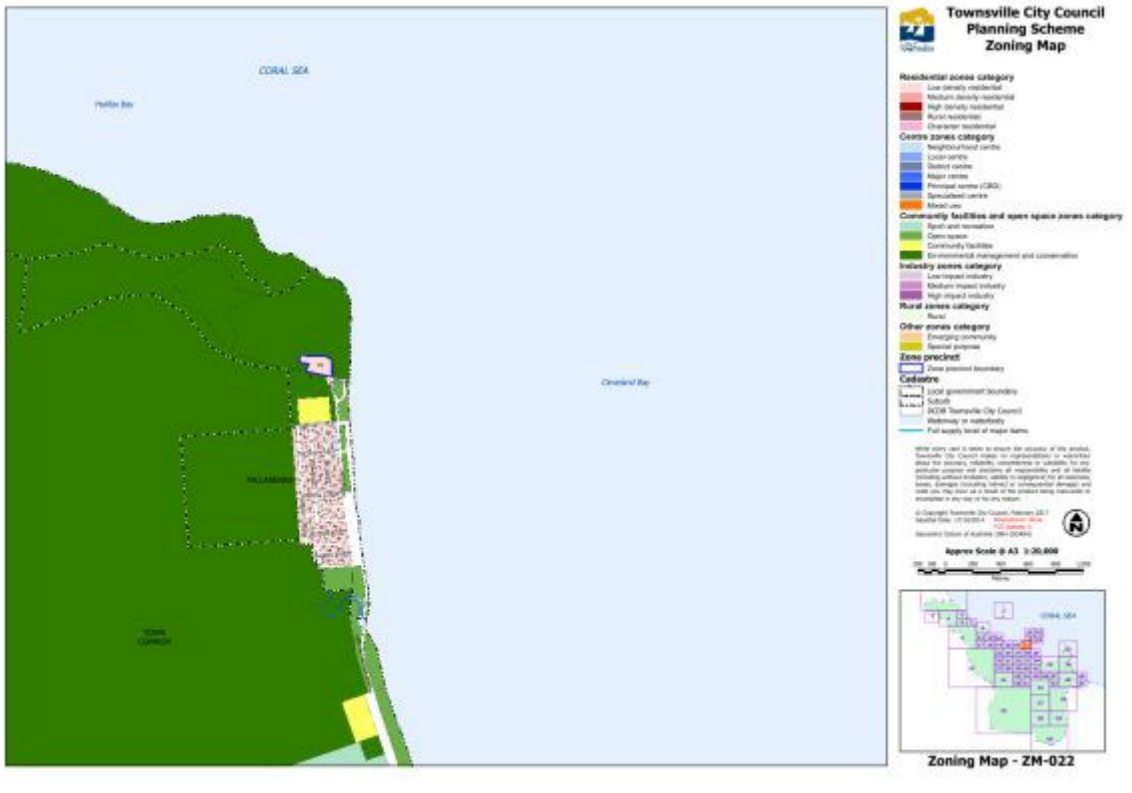

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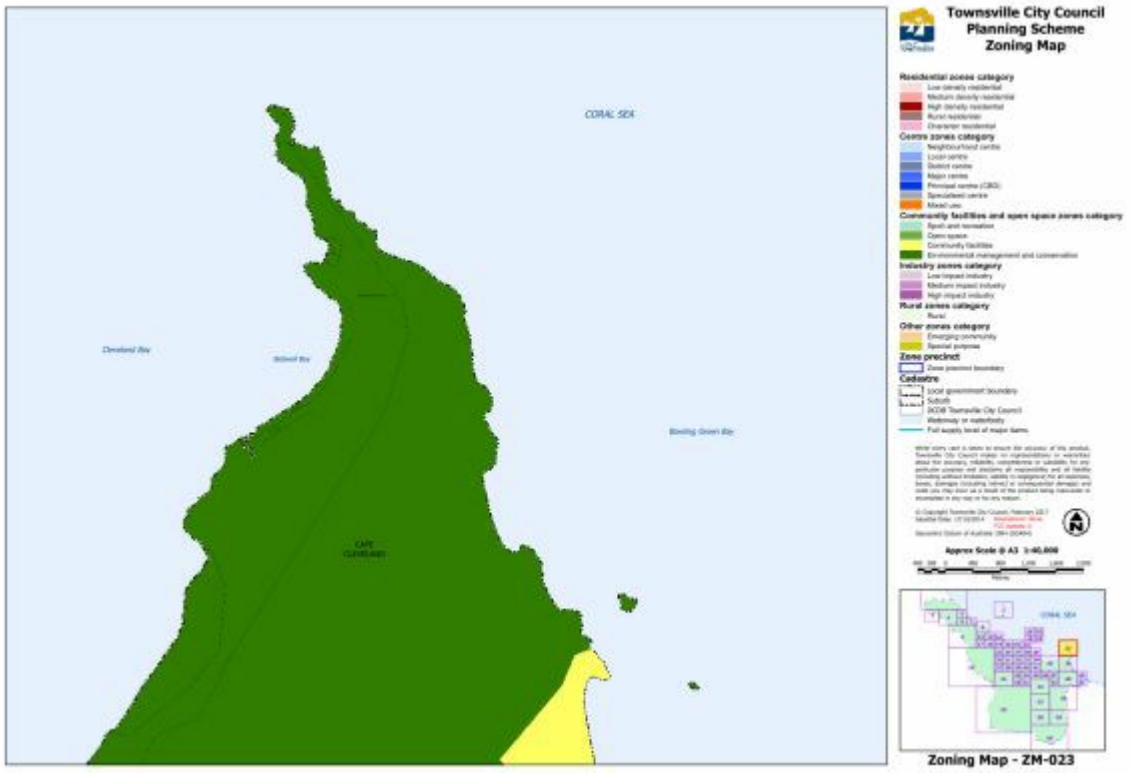

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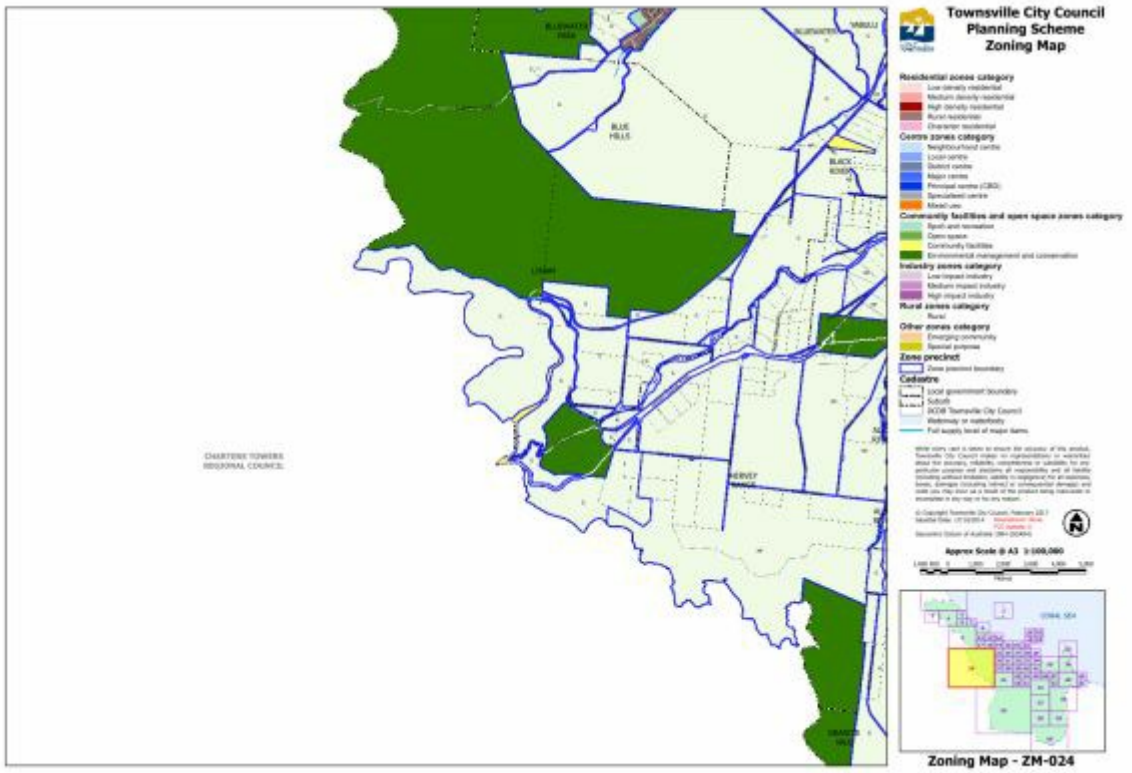

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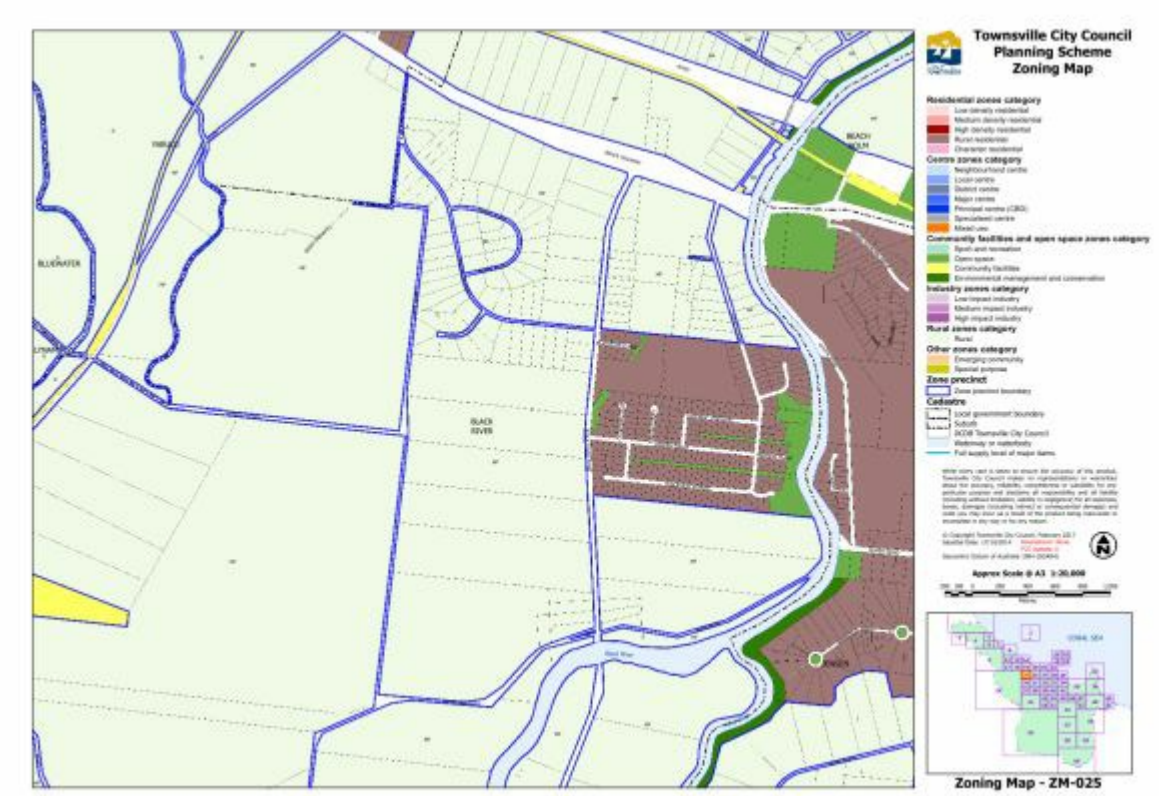
Zoning Map ZM-024



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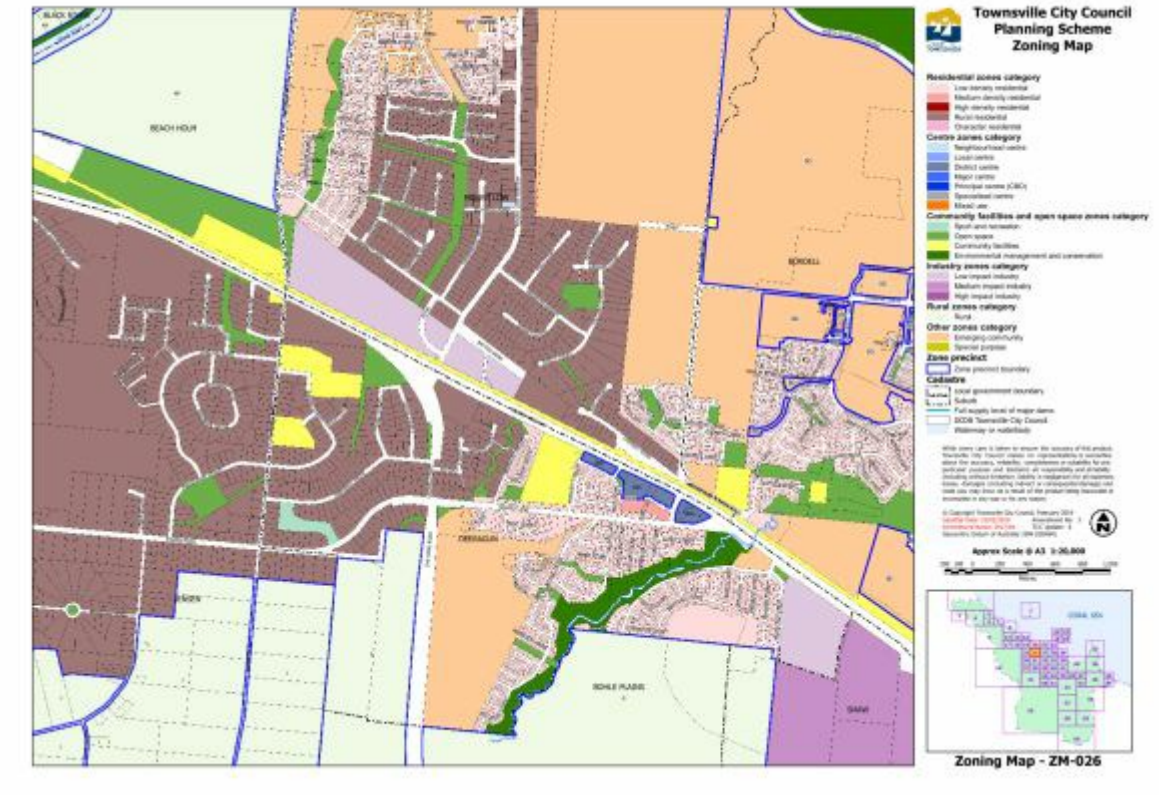
Zoning Map ZM-025



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Zoning Map ZM-026

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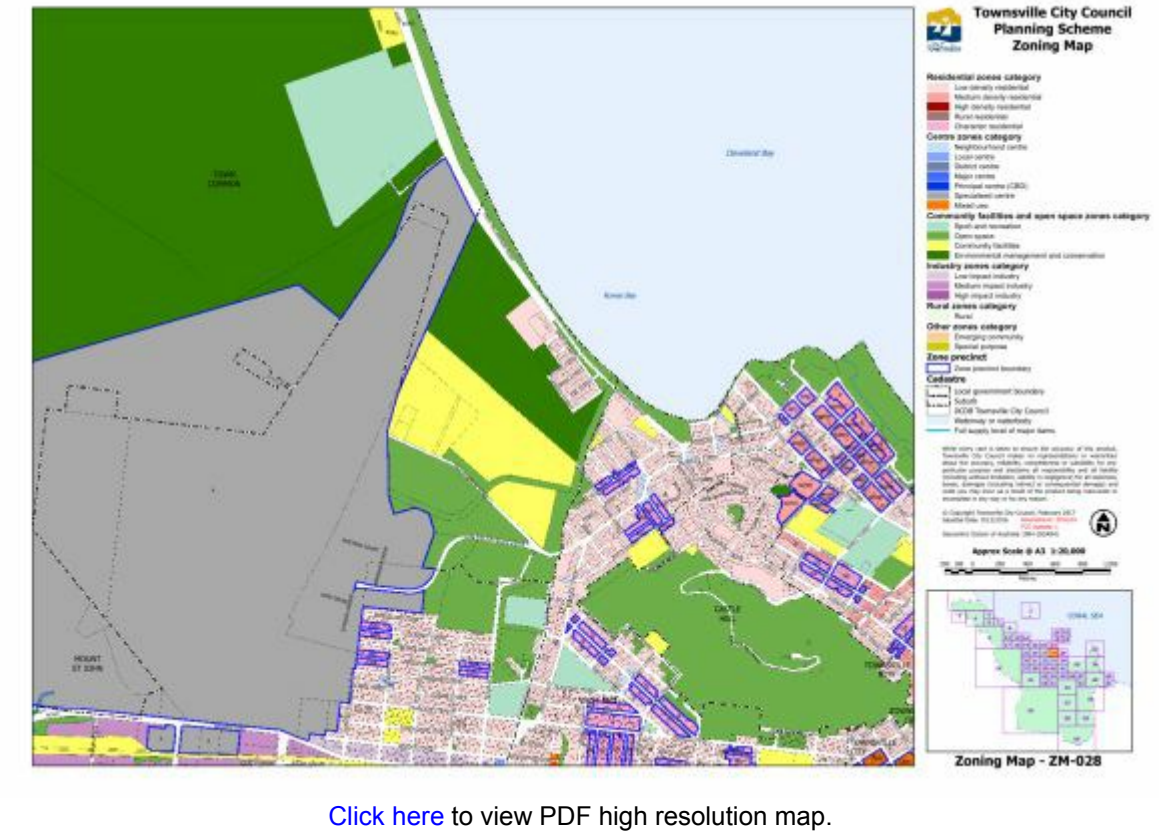
Zoning Map ZM-027



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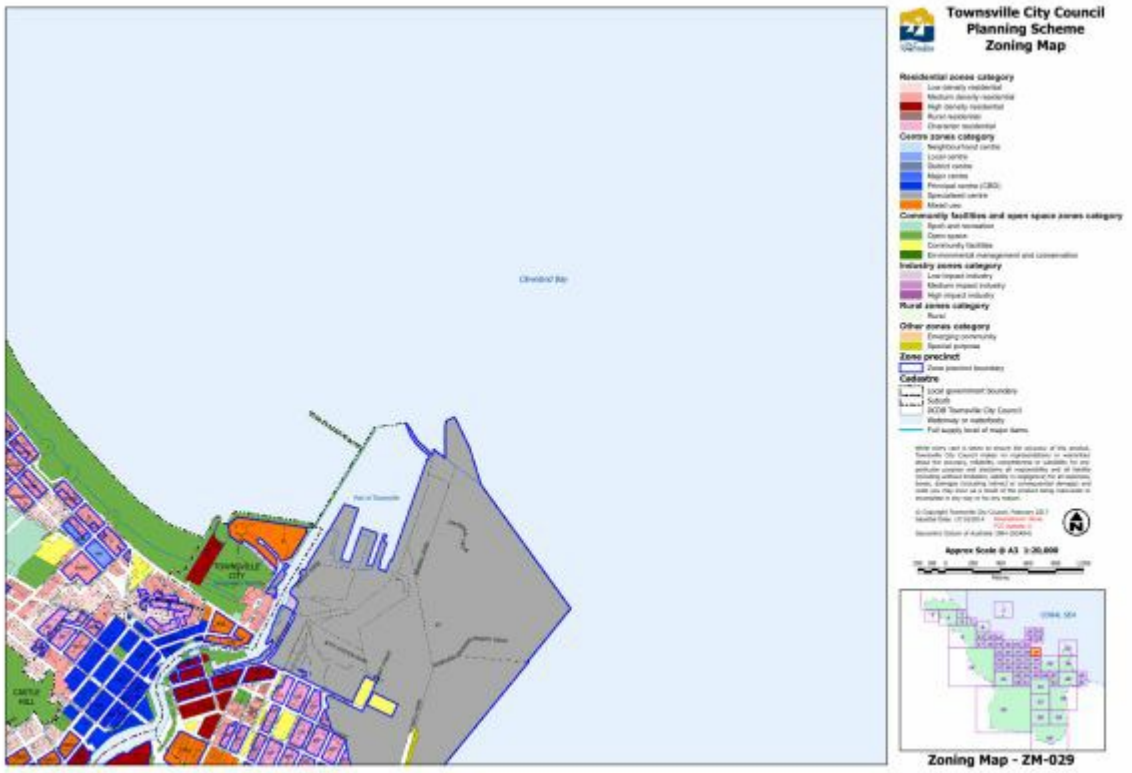
Zoning Map ZM-028



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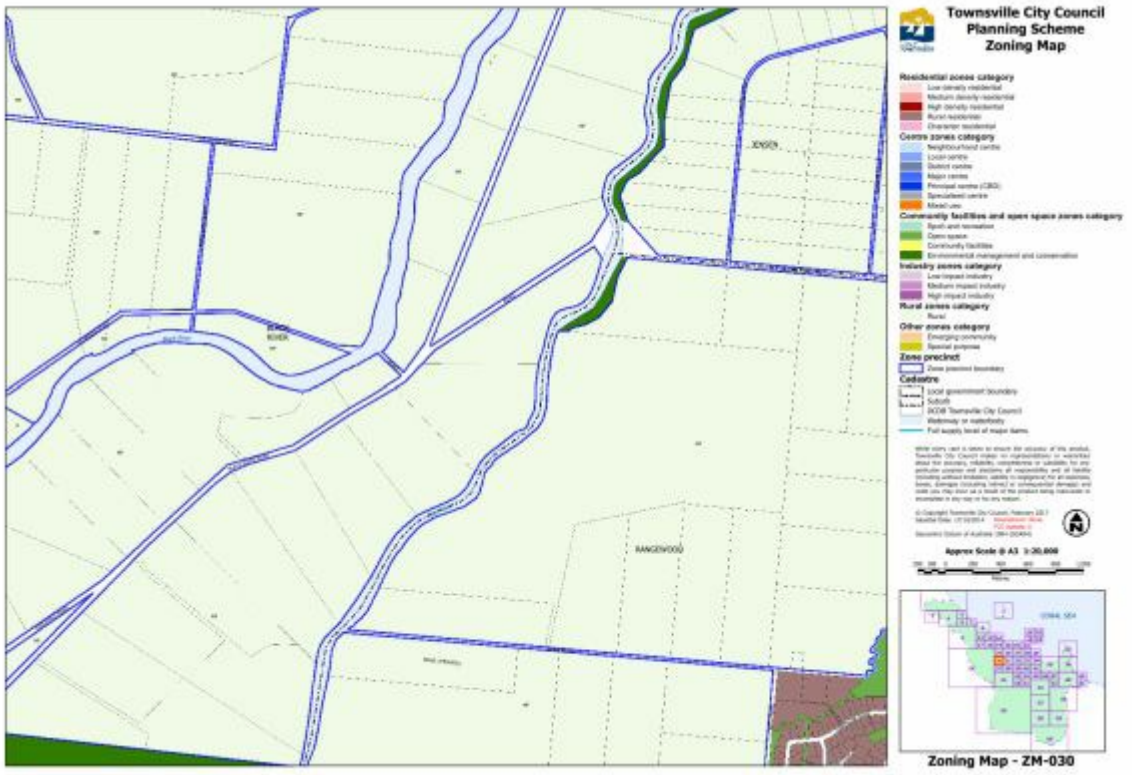

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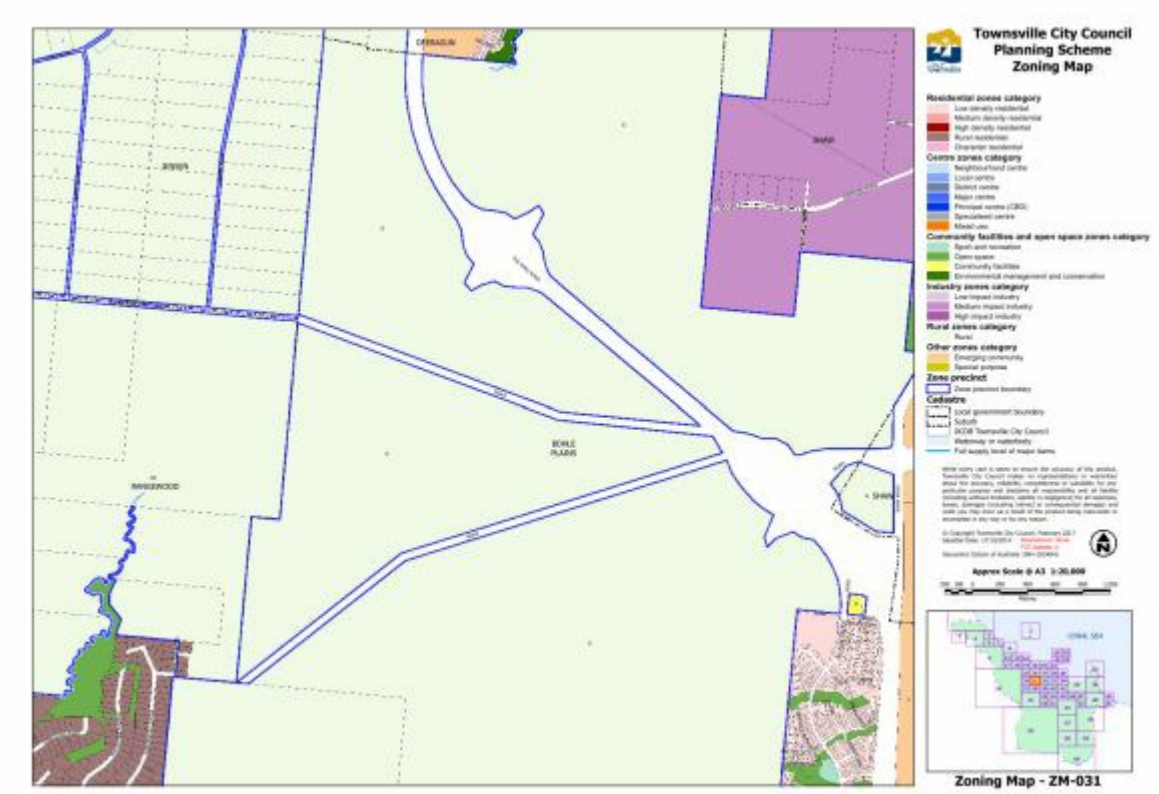
Zoning Map ZM-030



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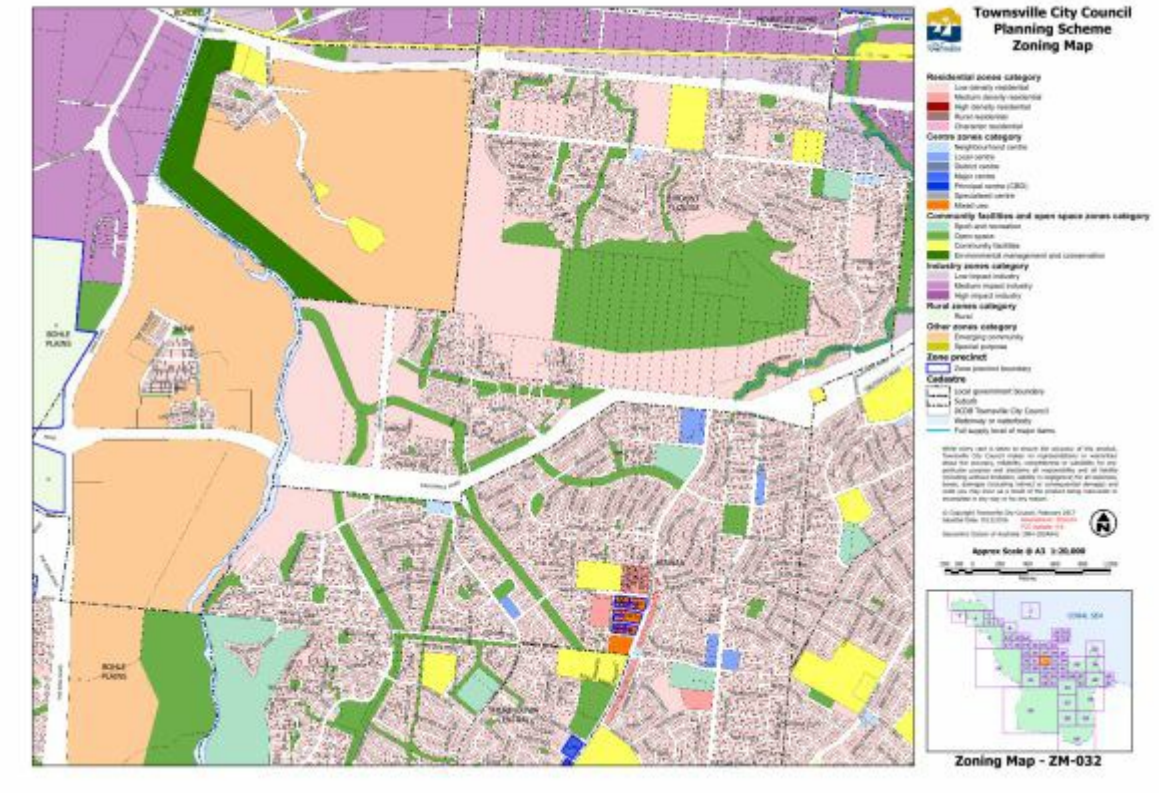
Zoning Map ZM-031



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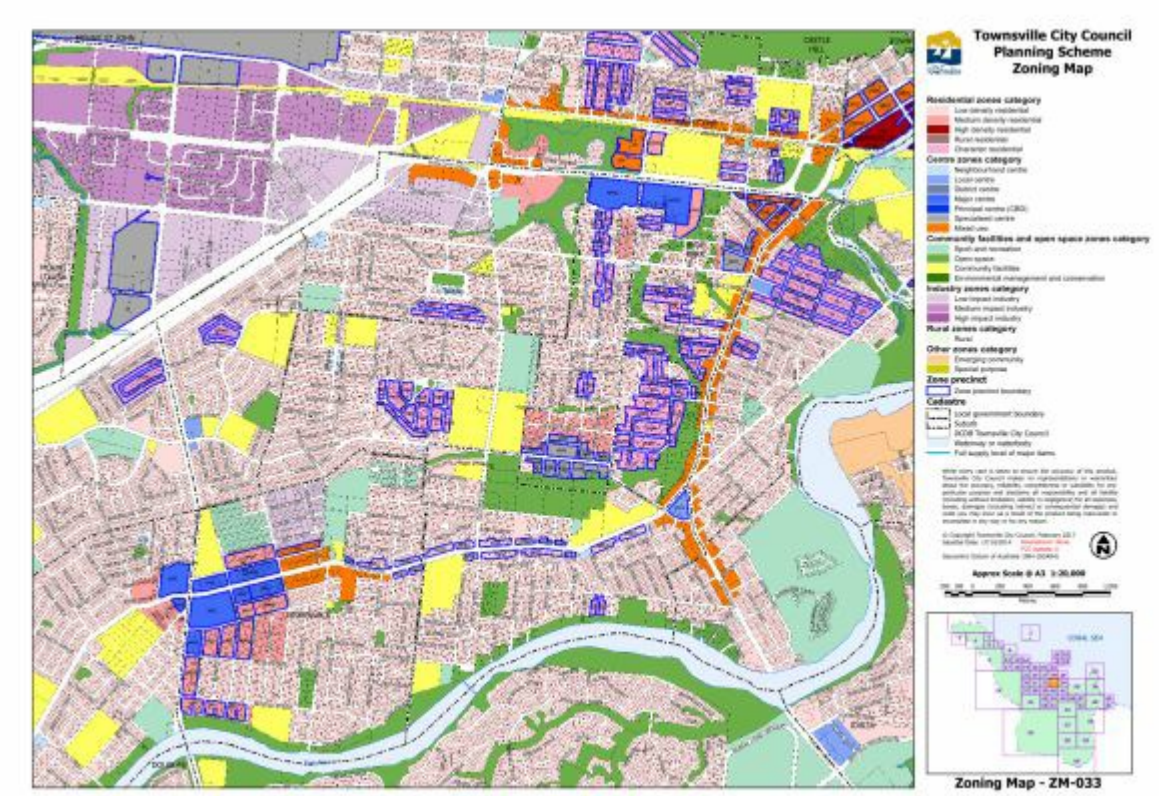
Zoning Map ZM-032



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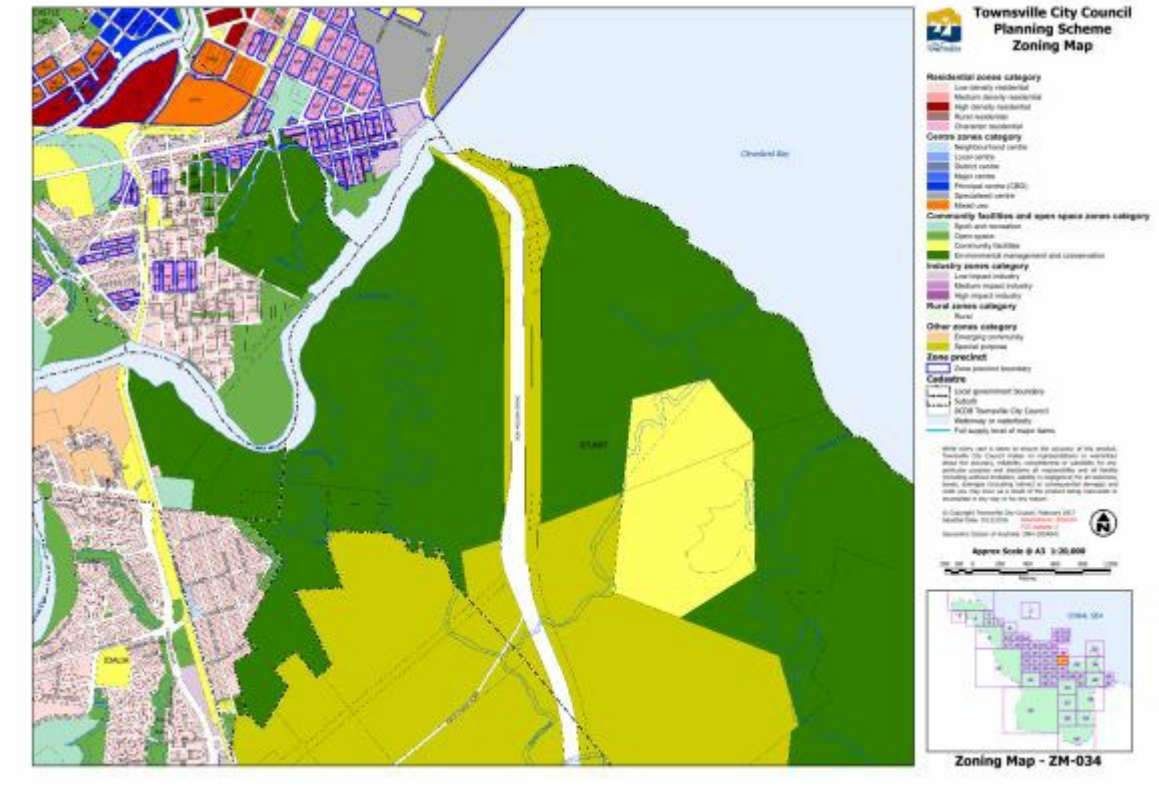
Zoning Map ZM-033



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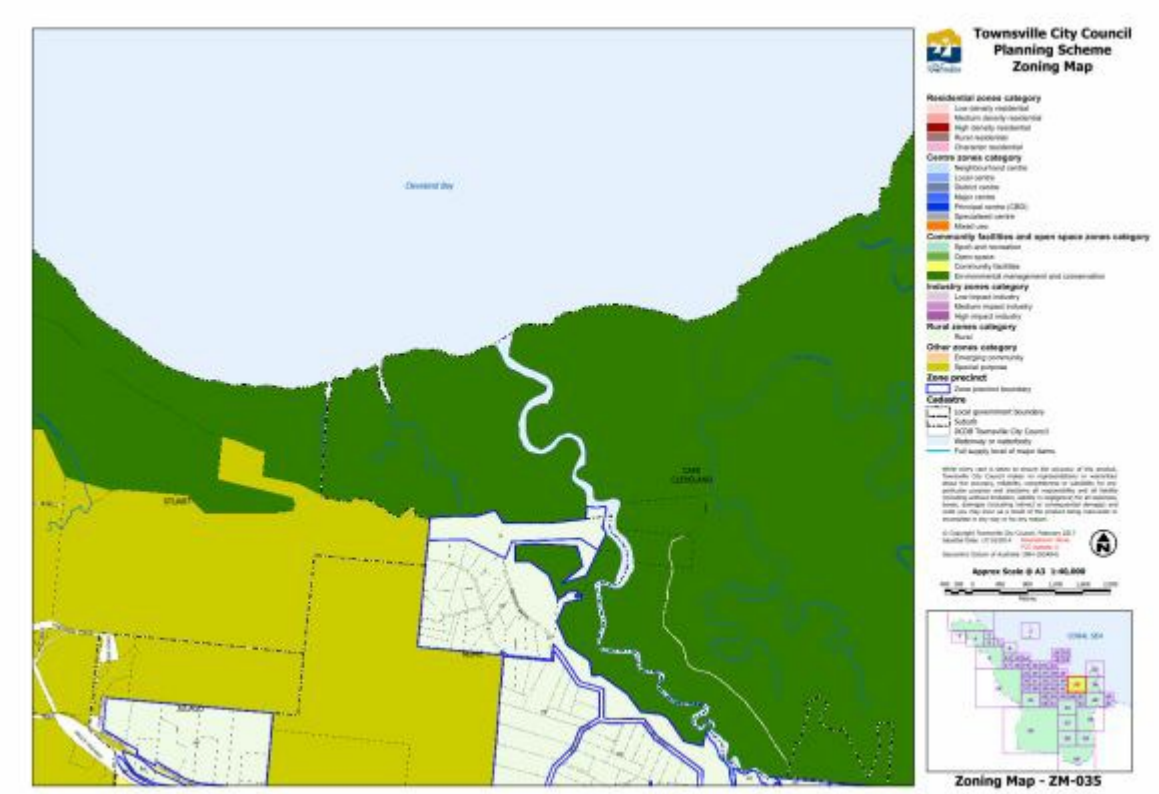
Zoning Map ZM-034



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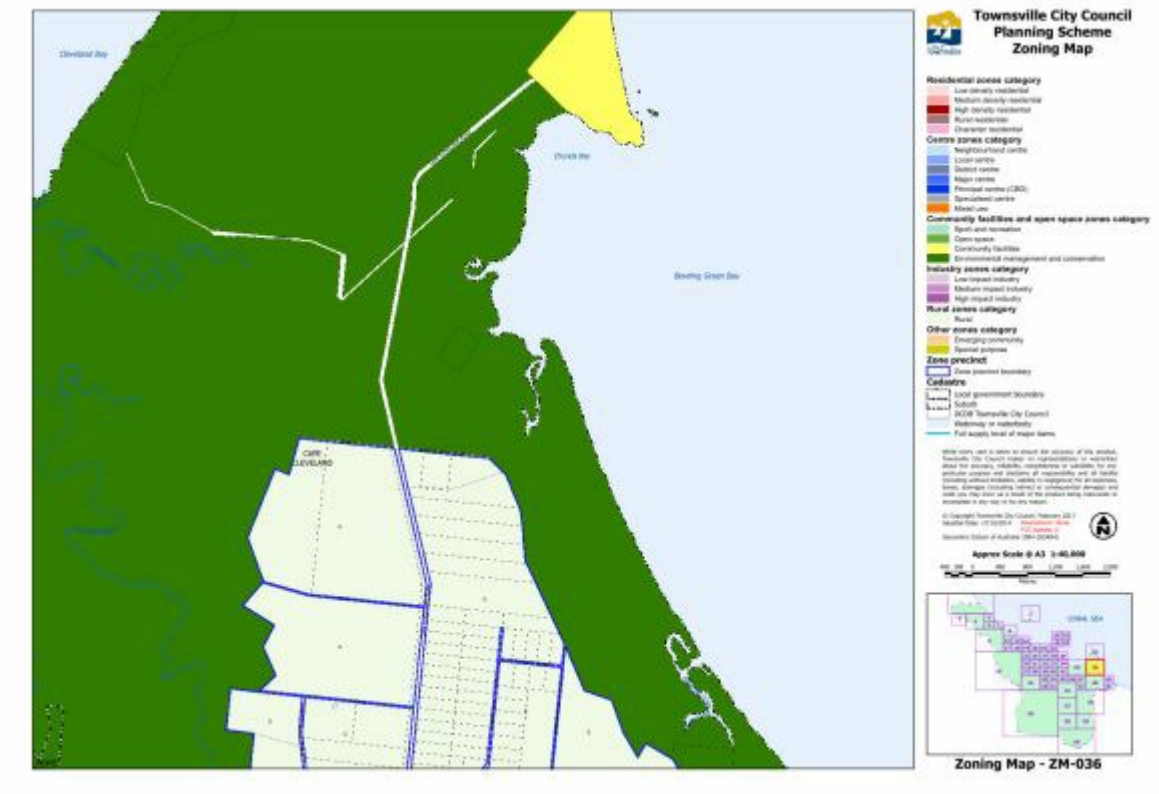

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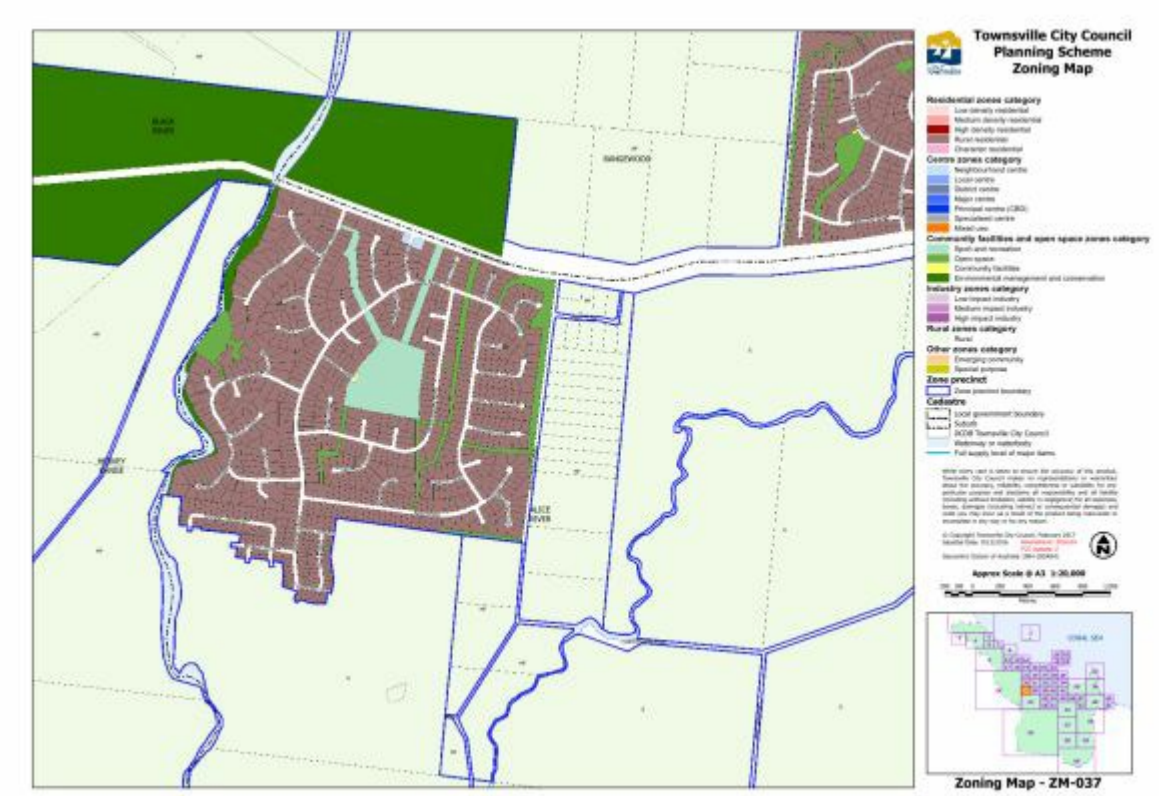

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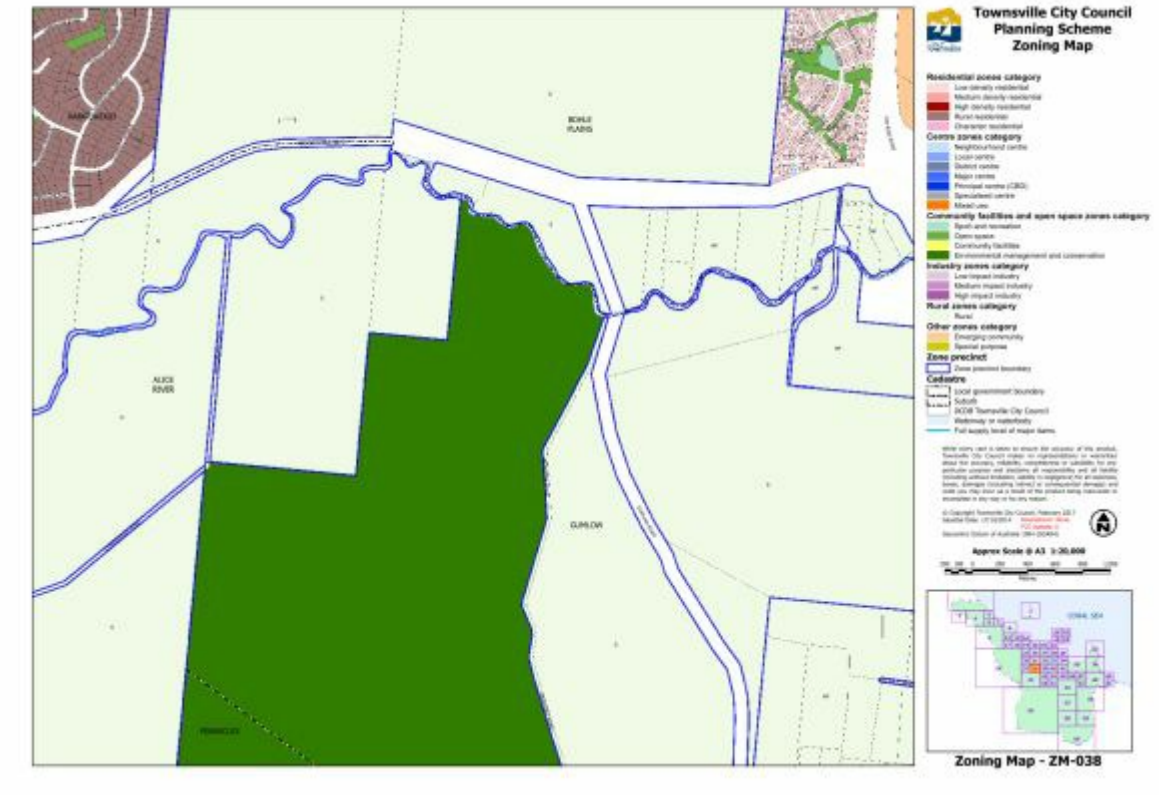

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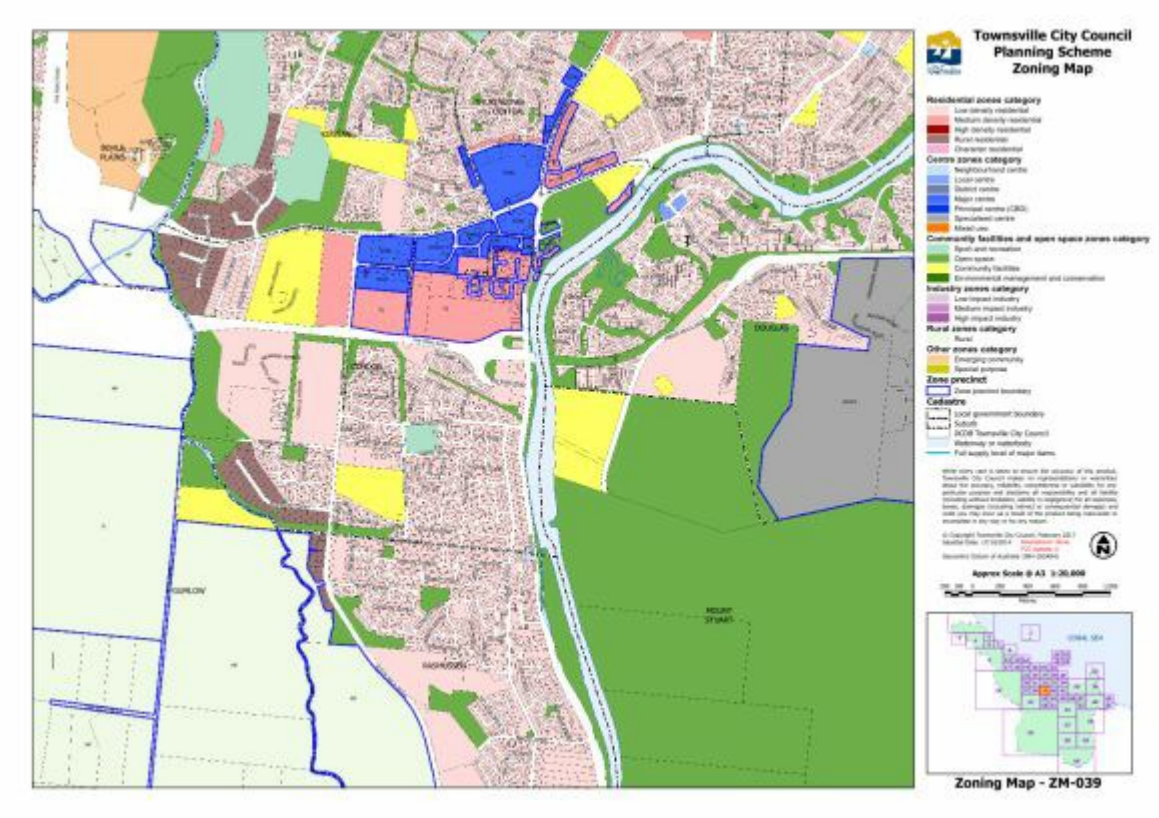

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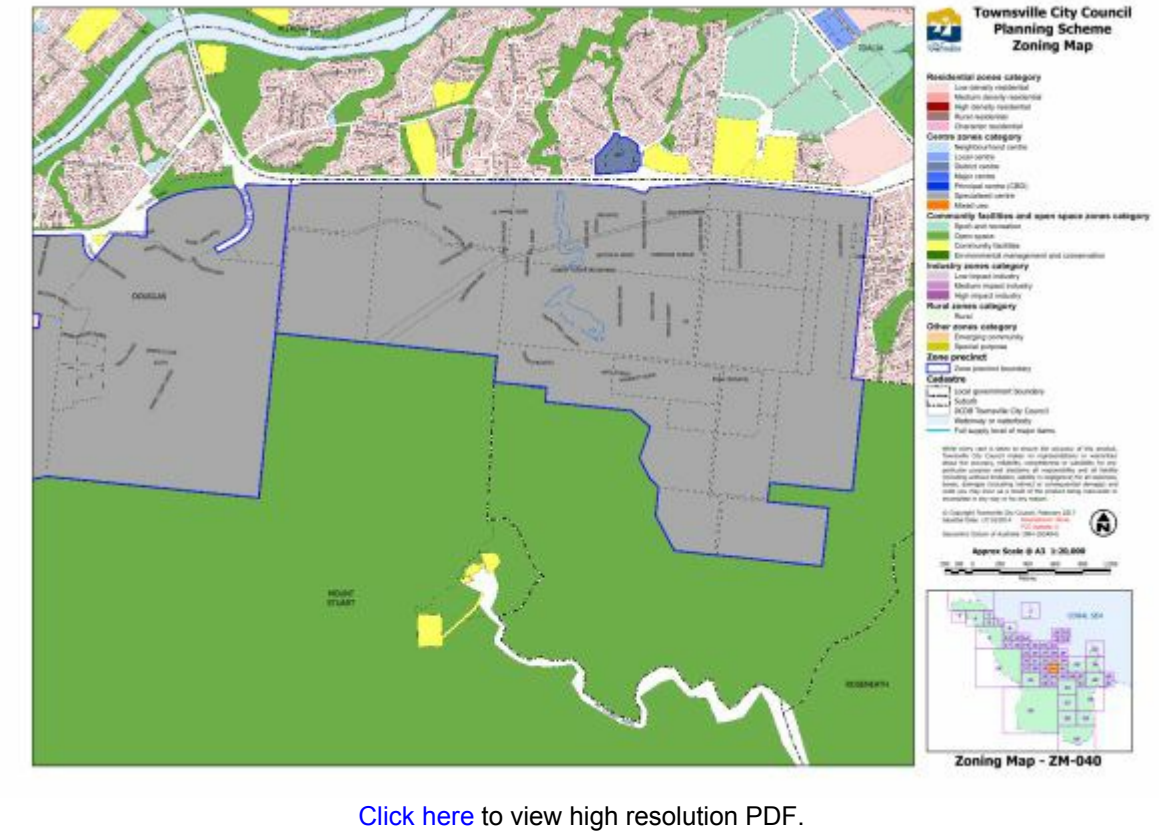

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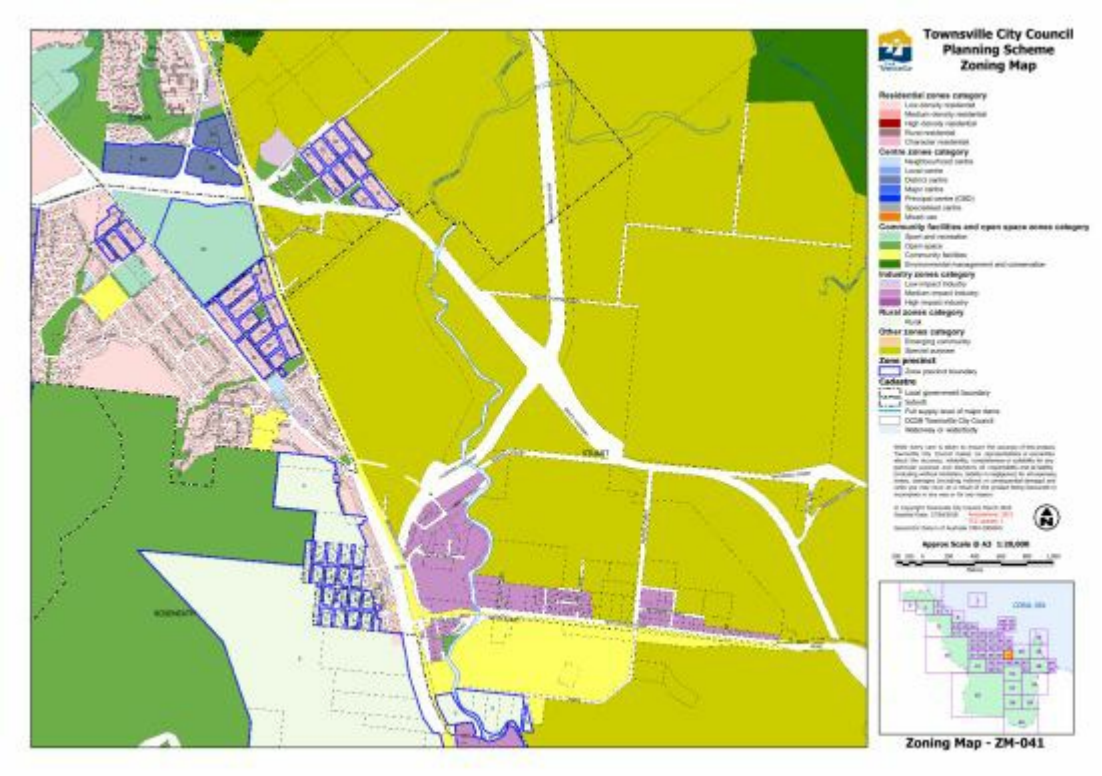

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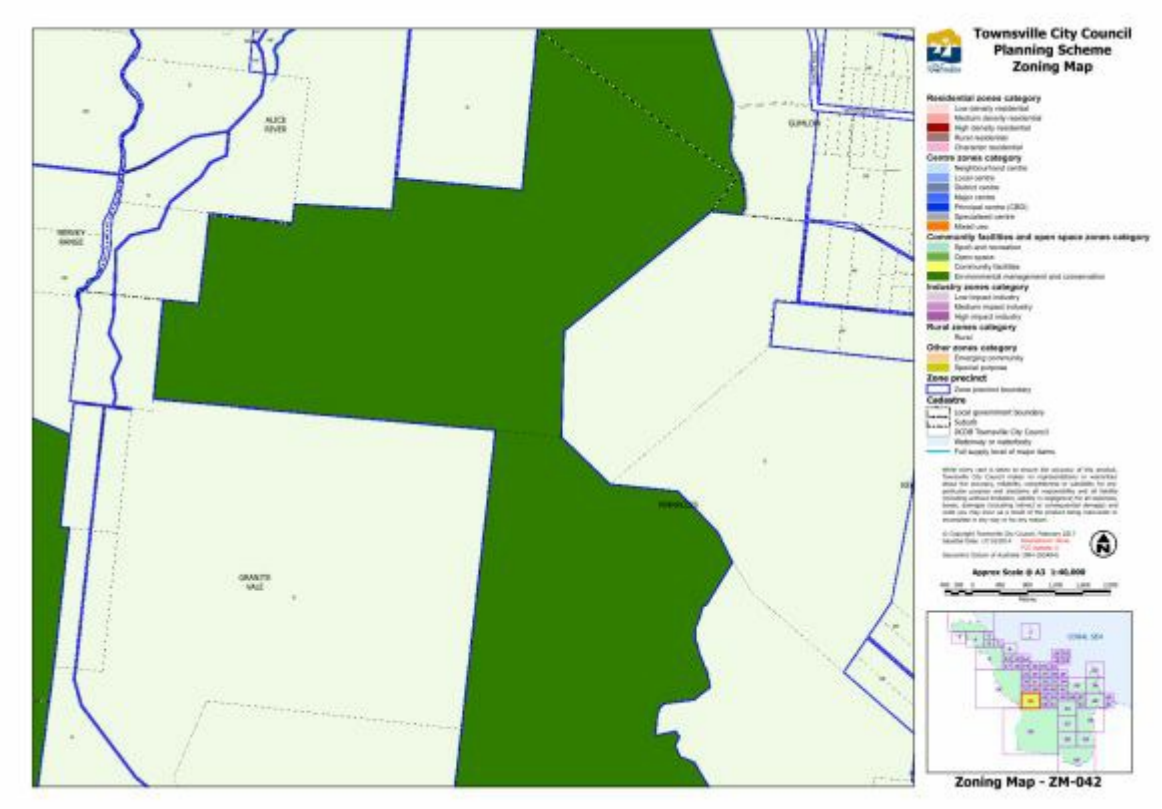

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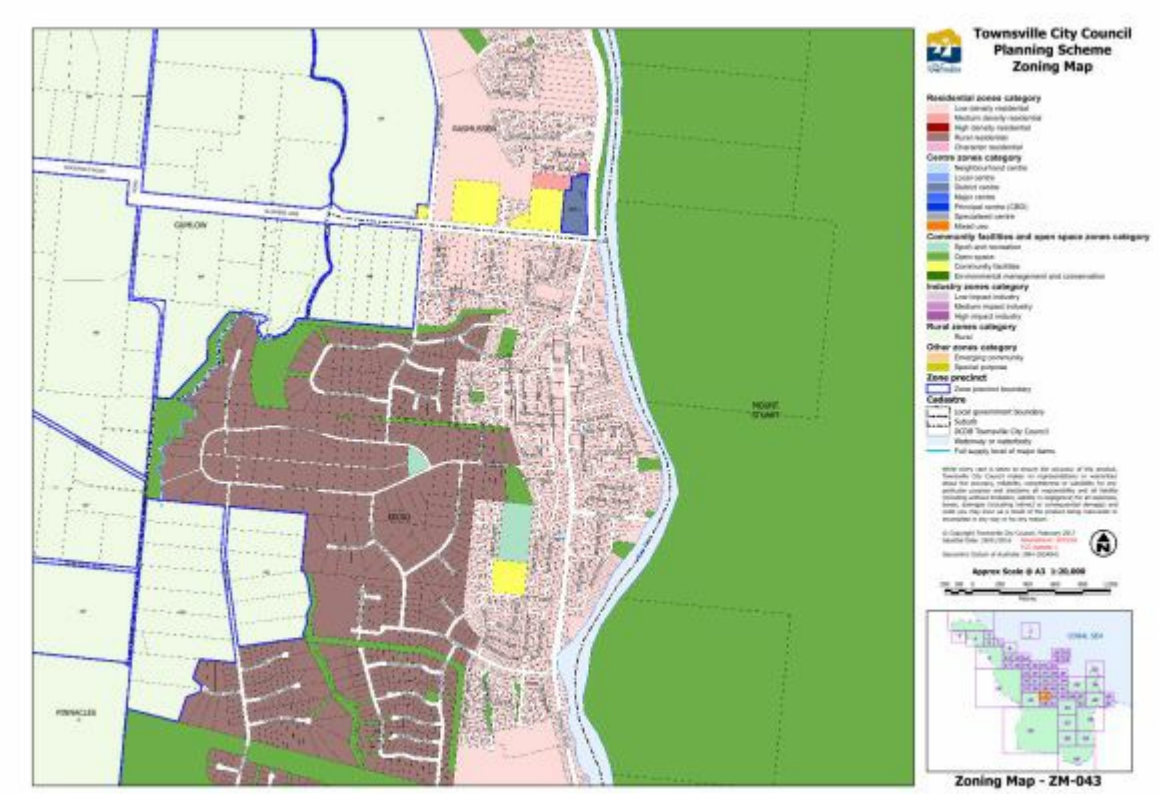

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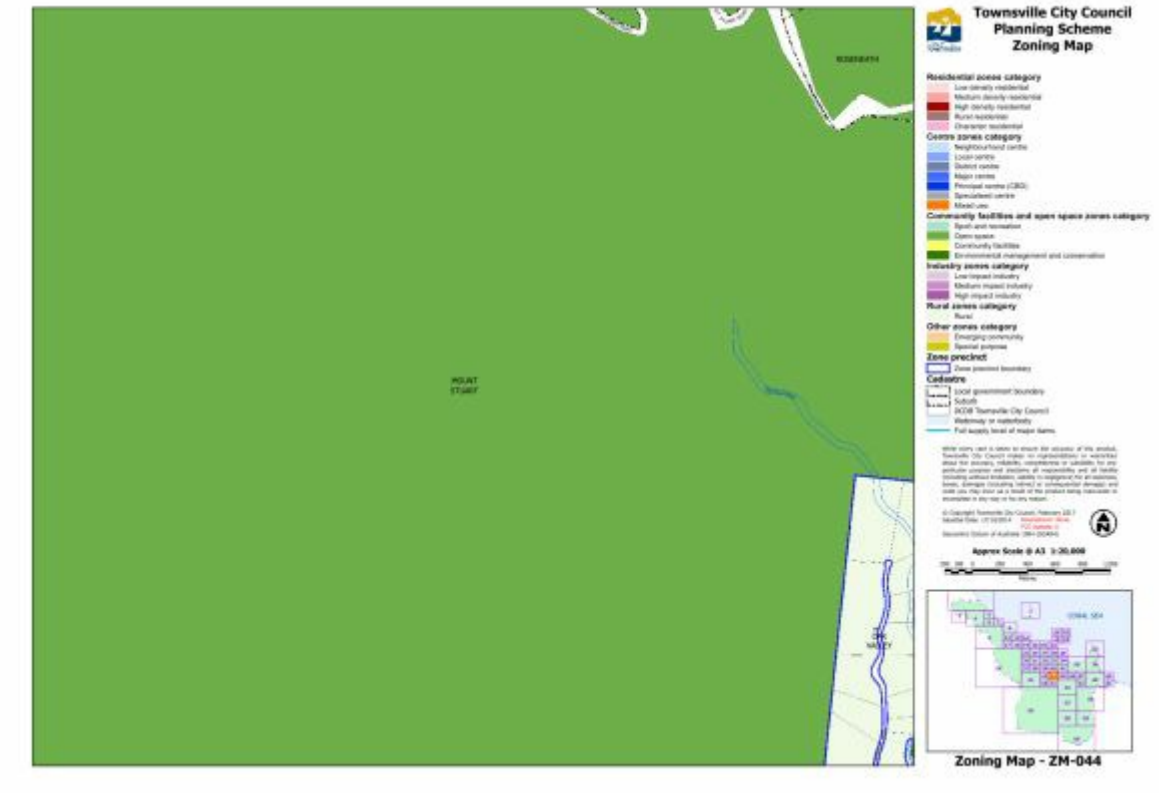

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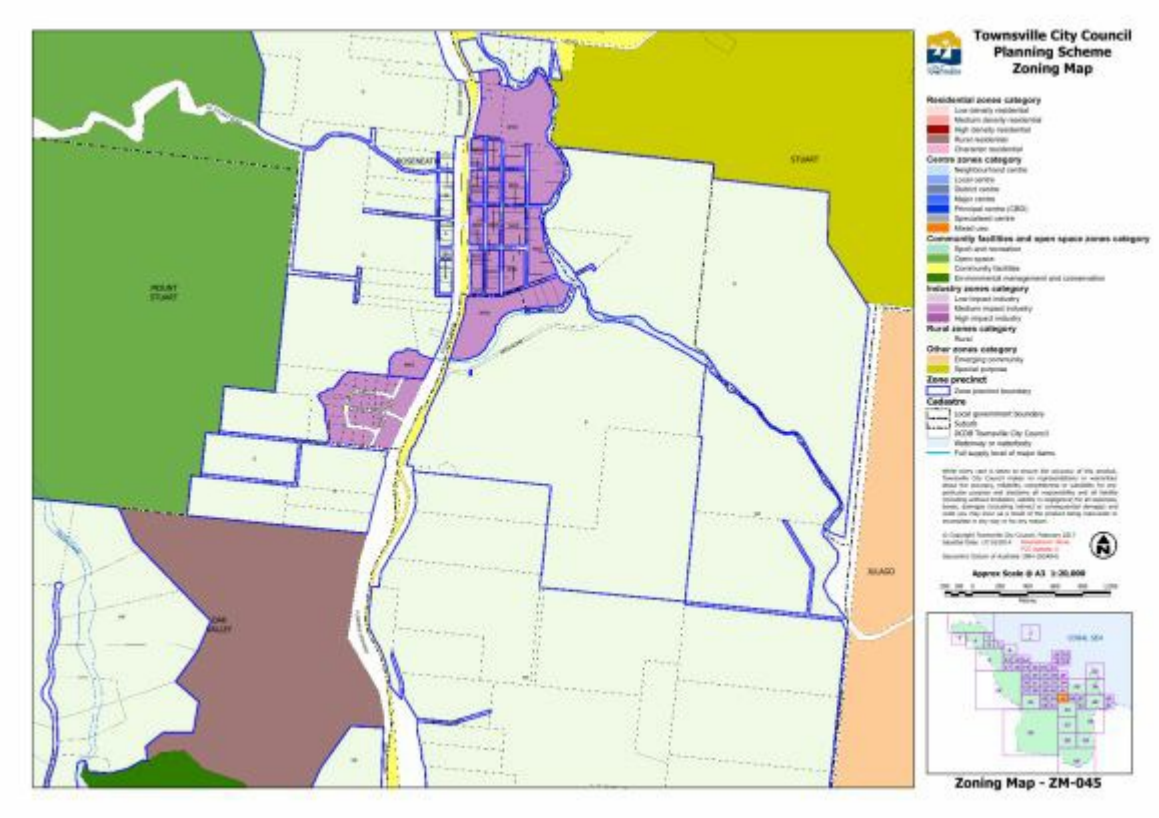

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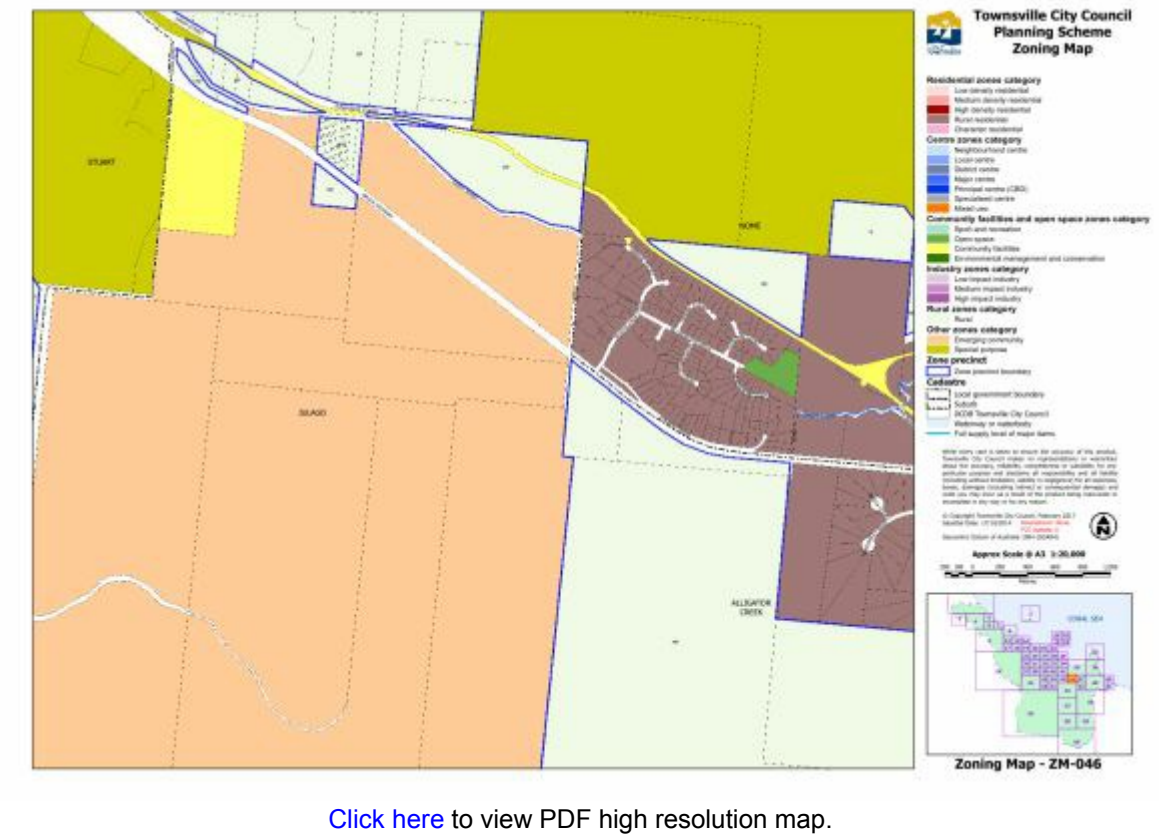

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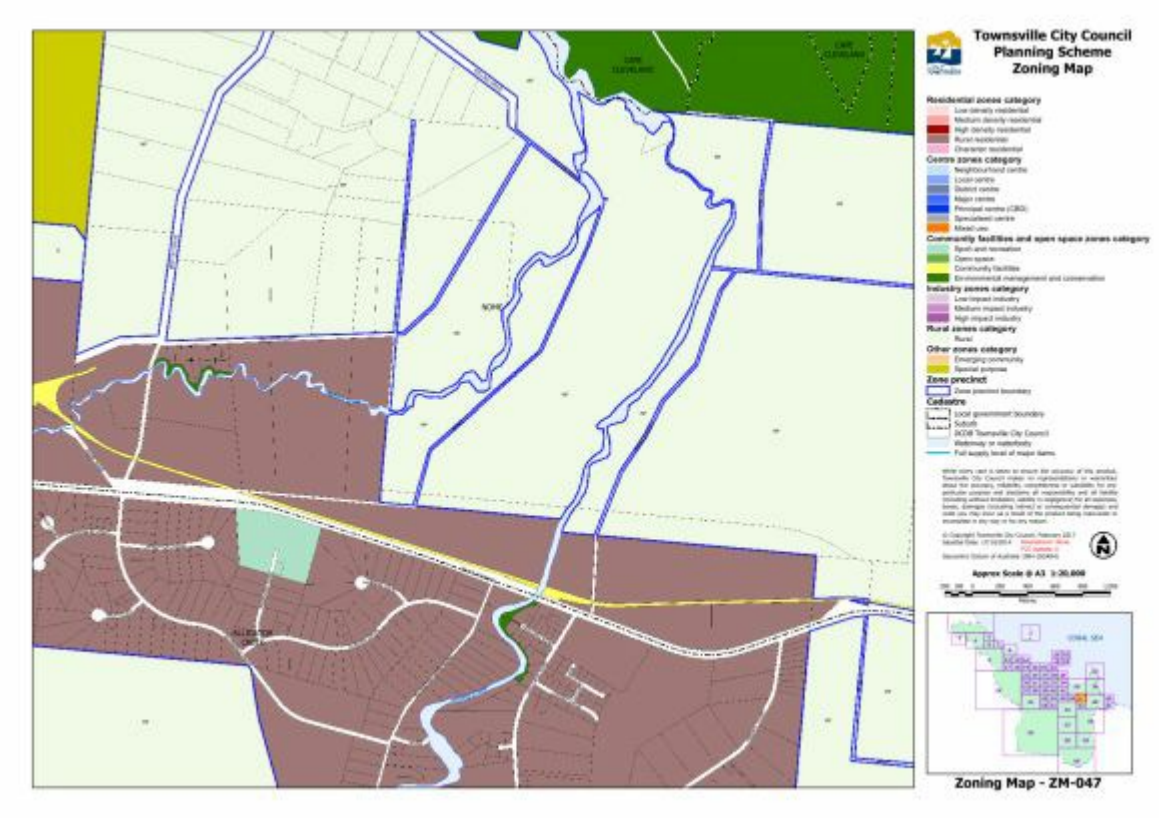

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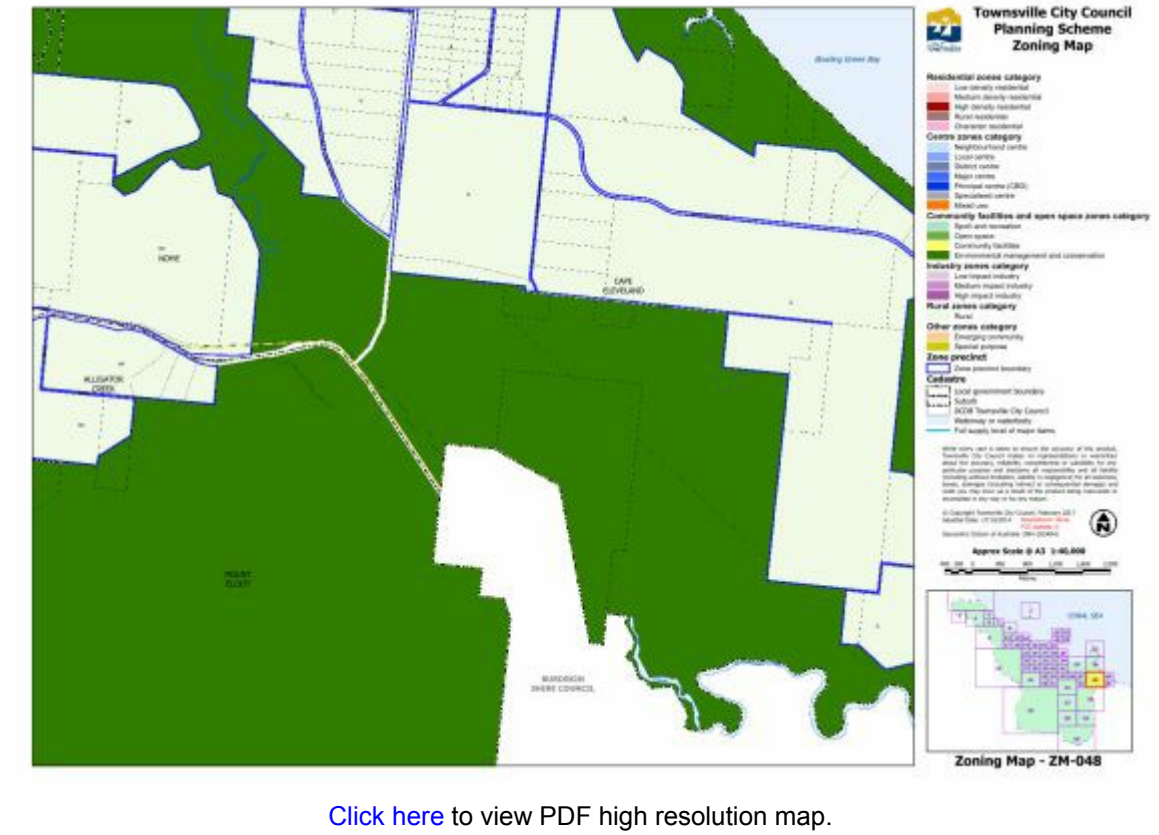

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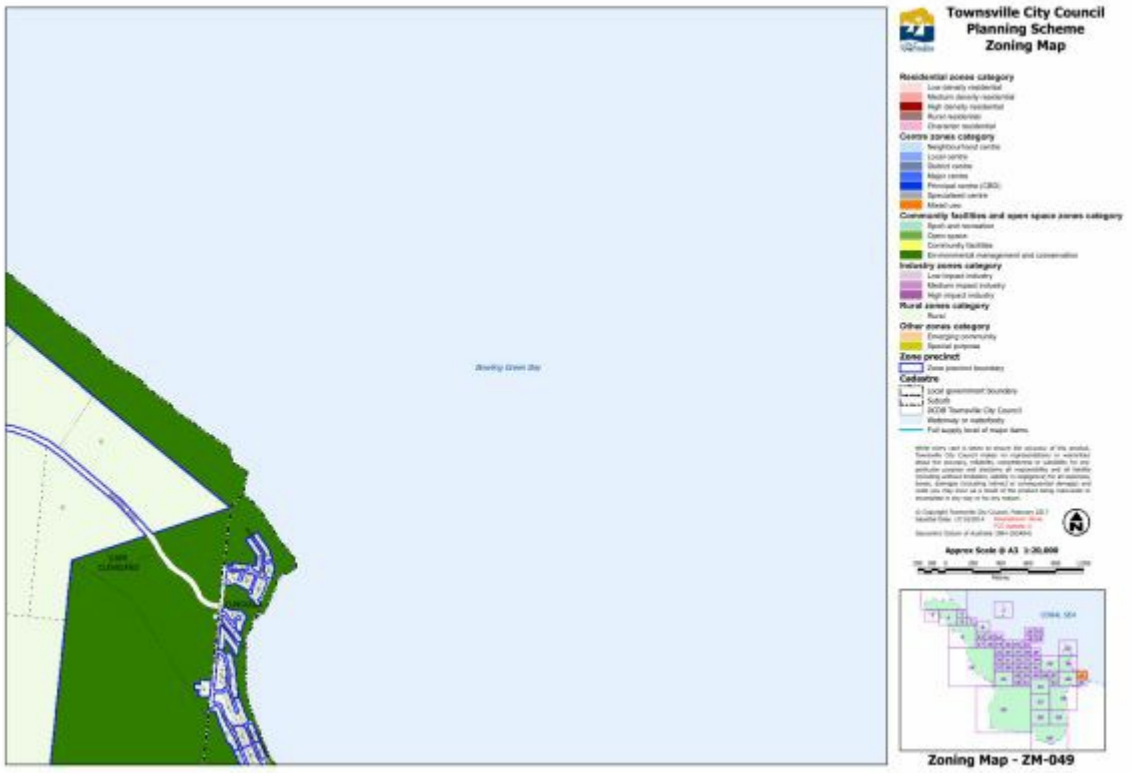

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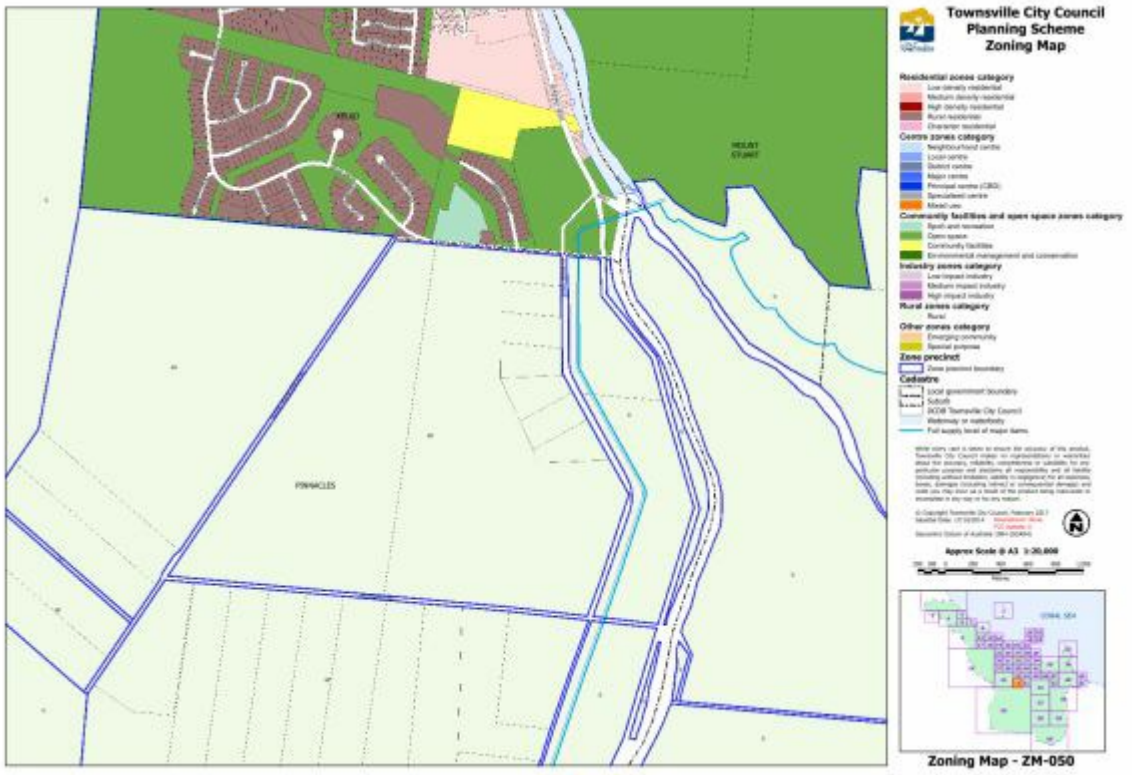

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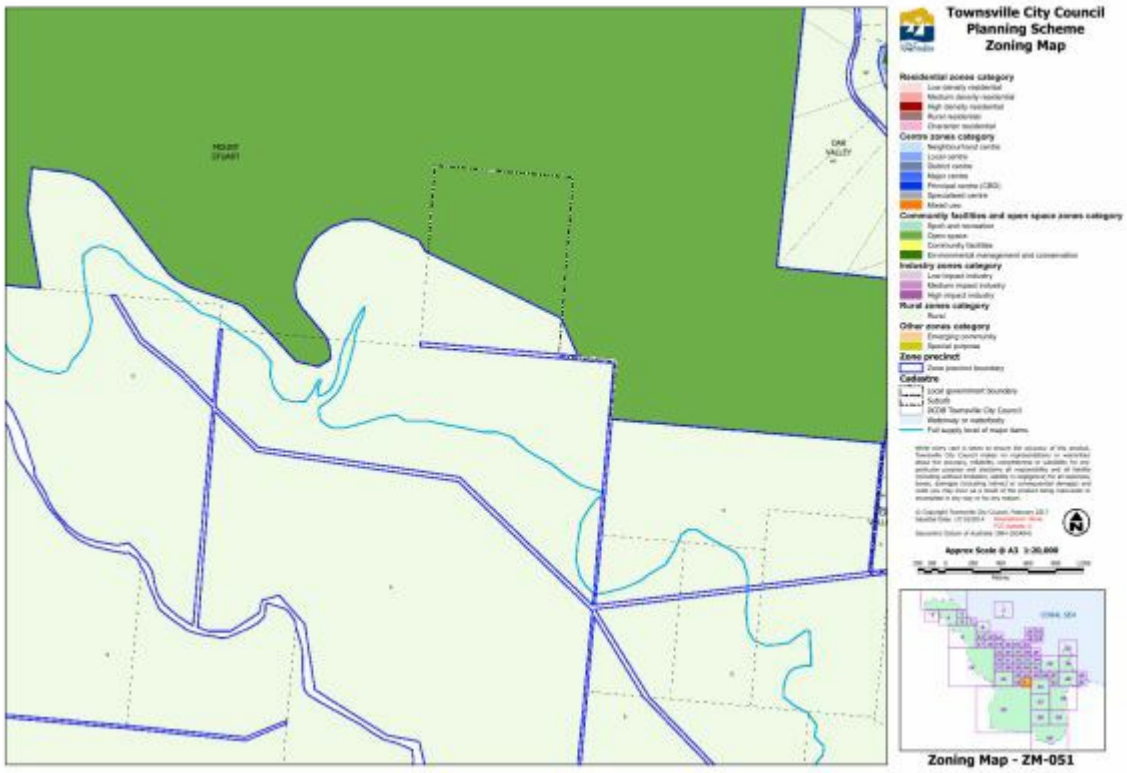

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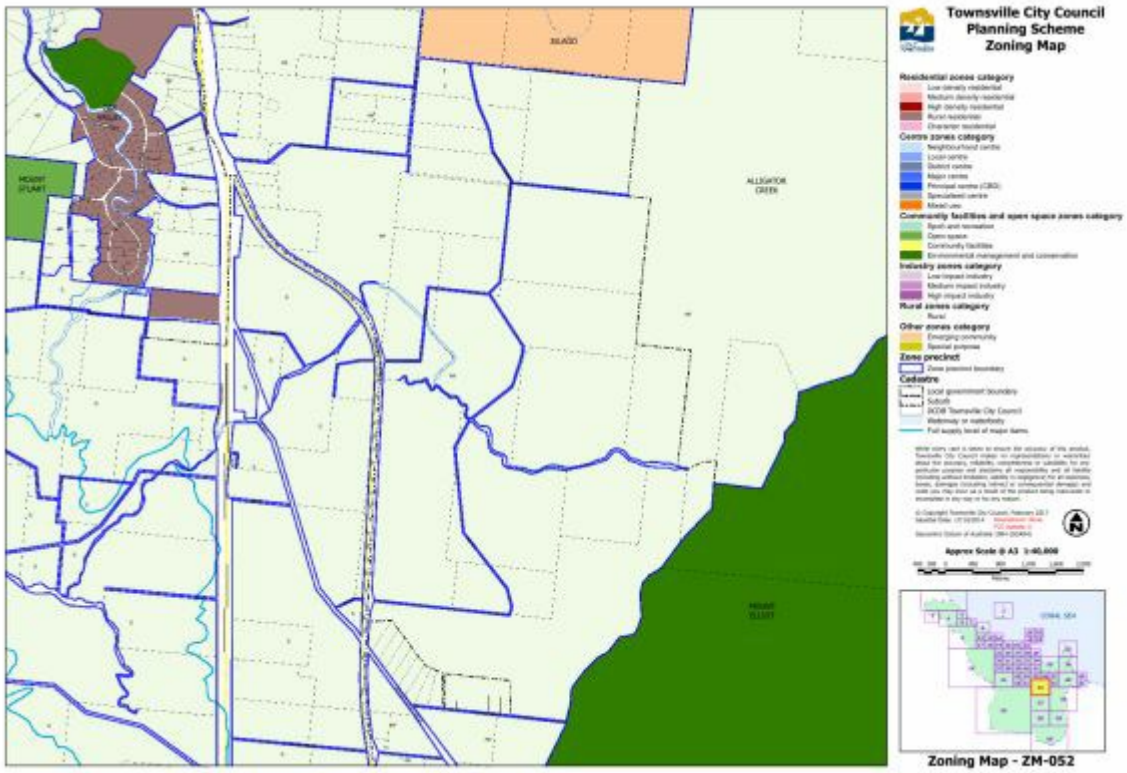

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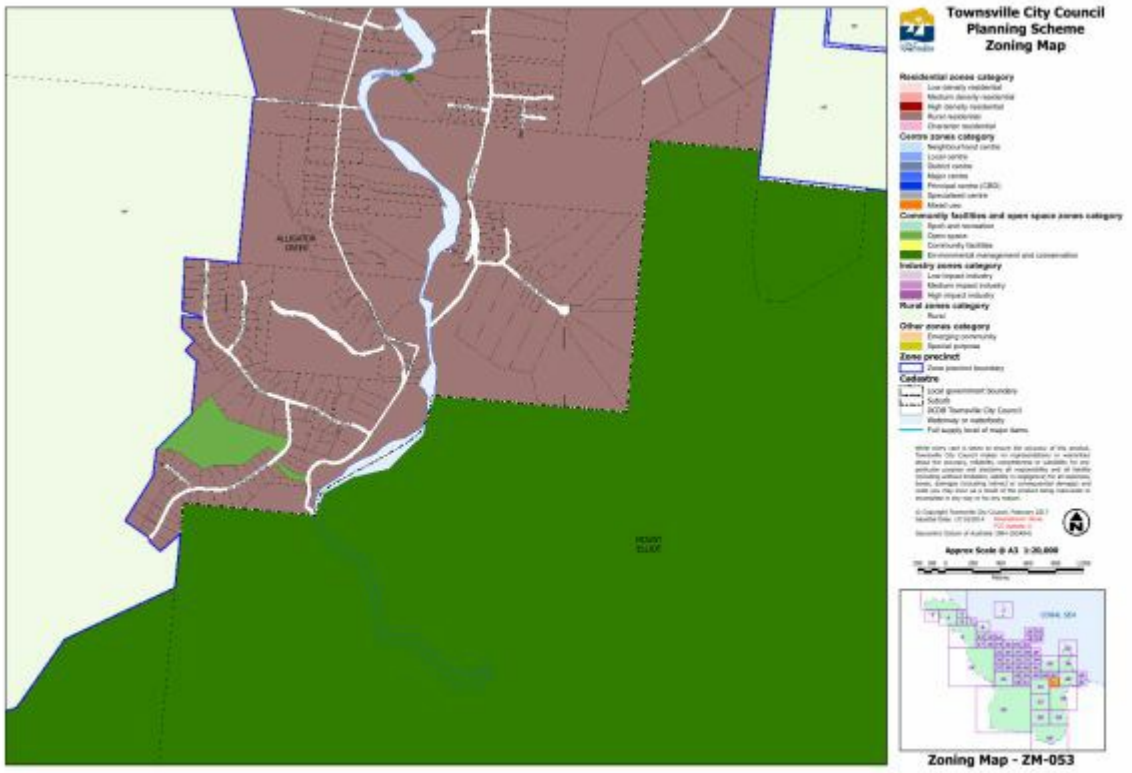

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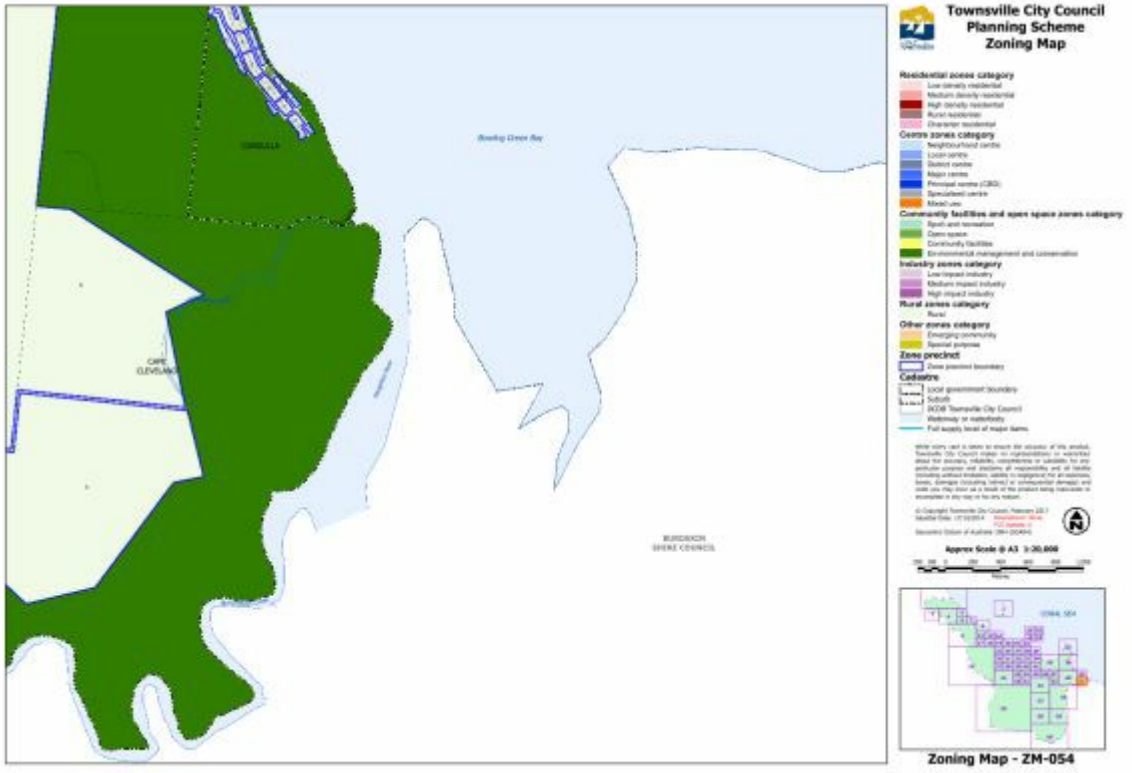

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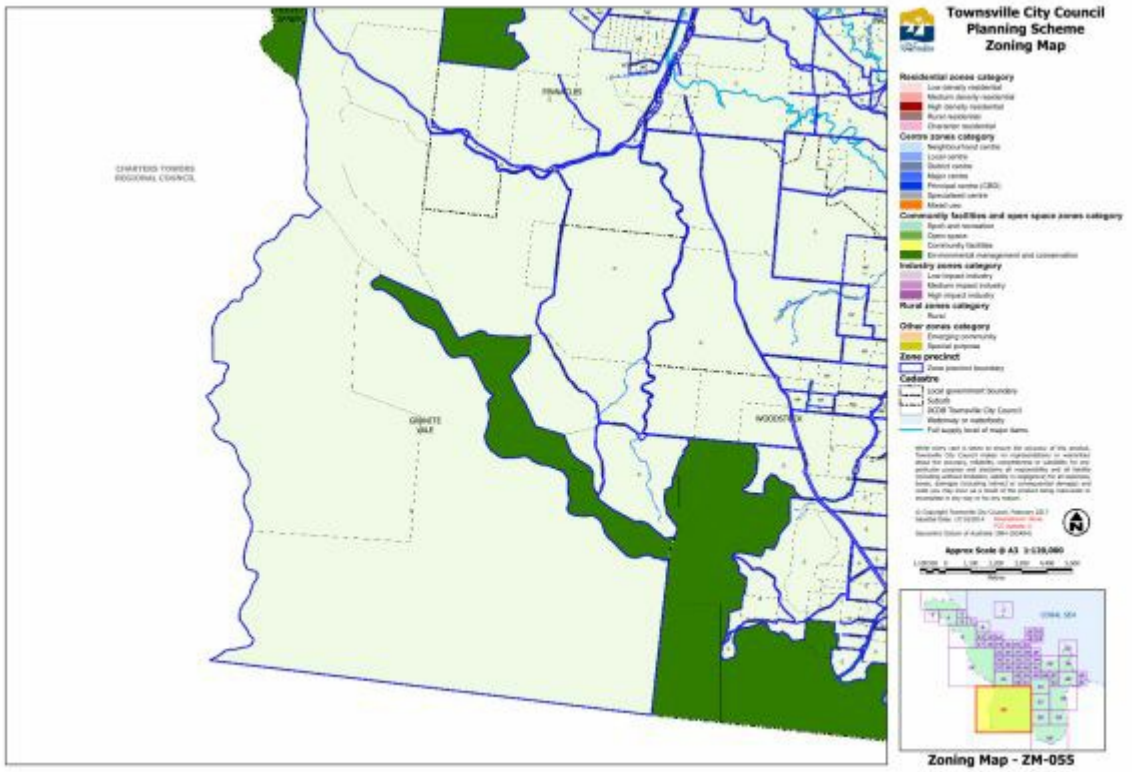

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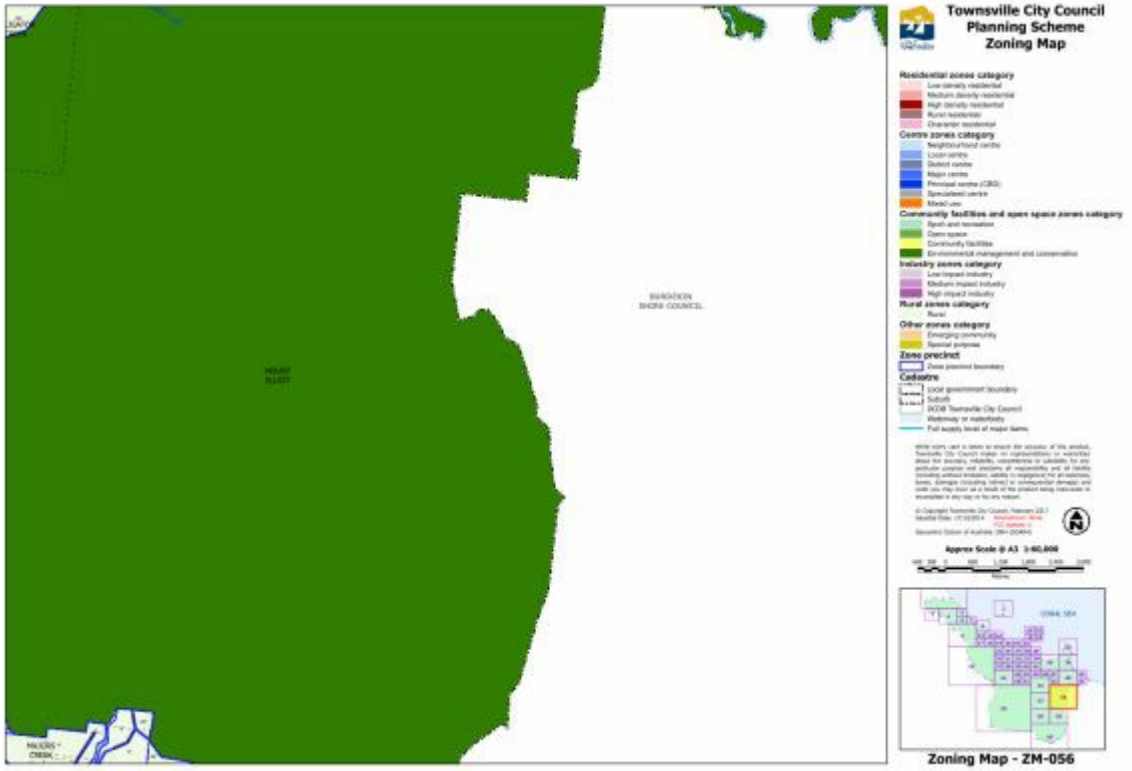

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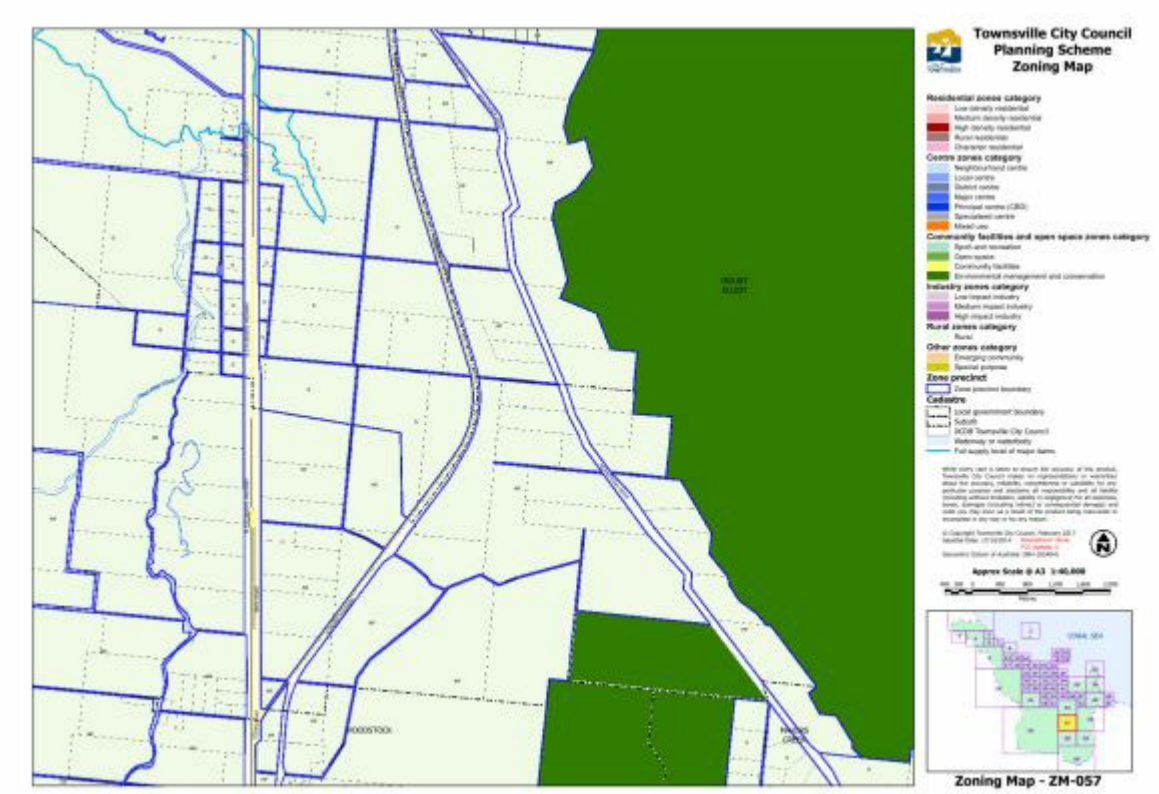

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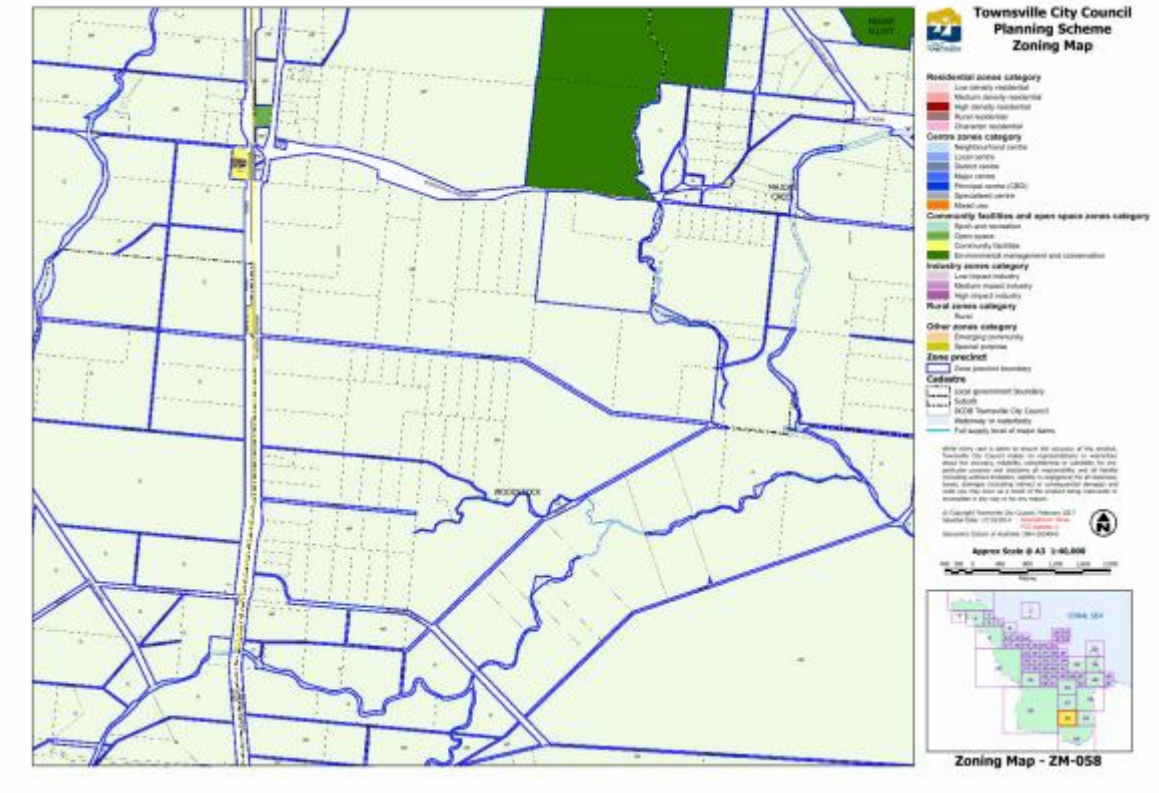

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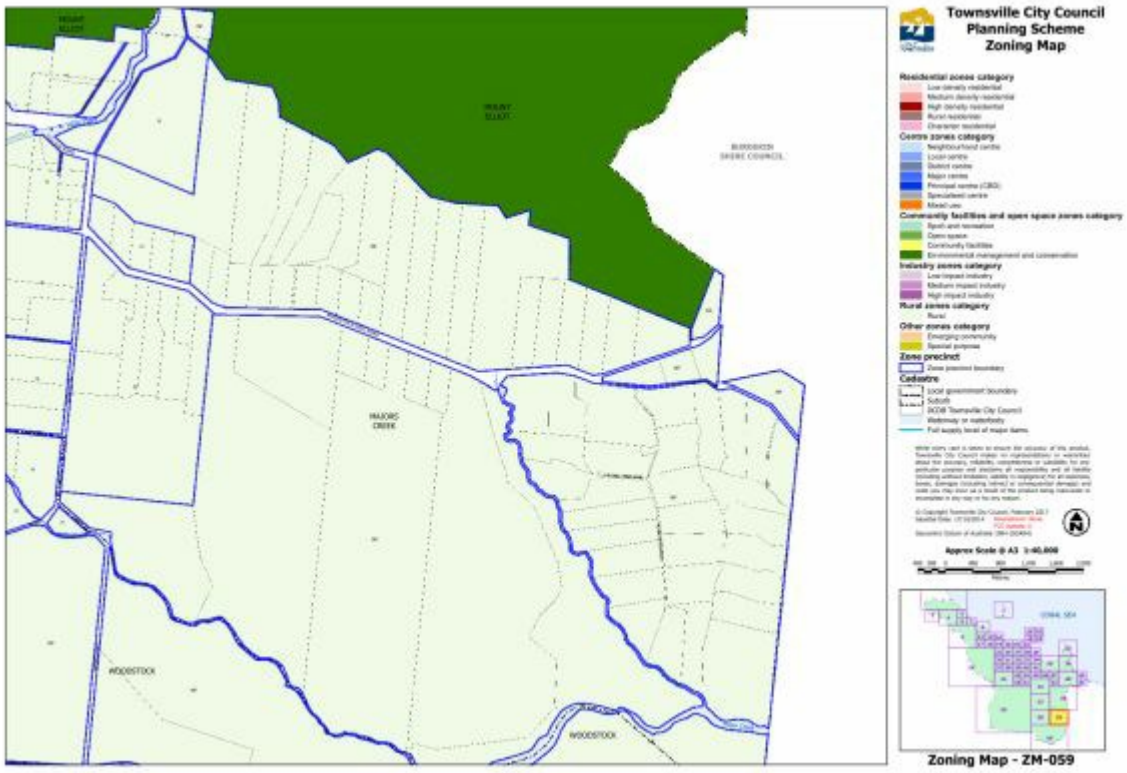

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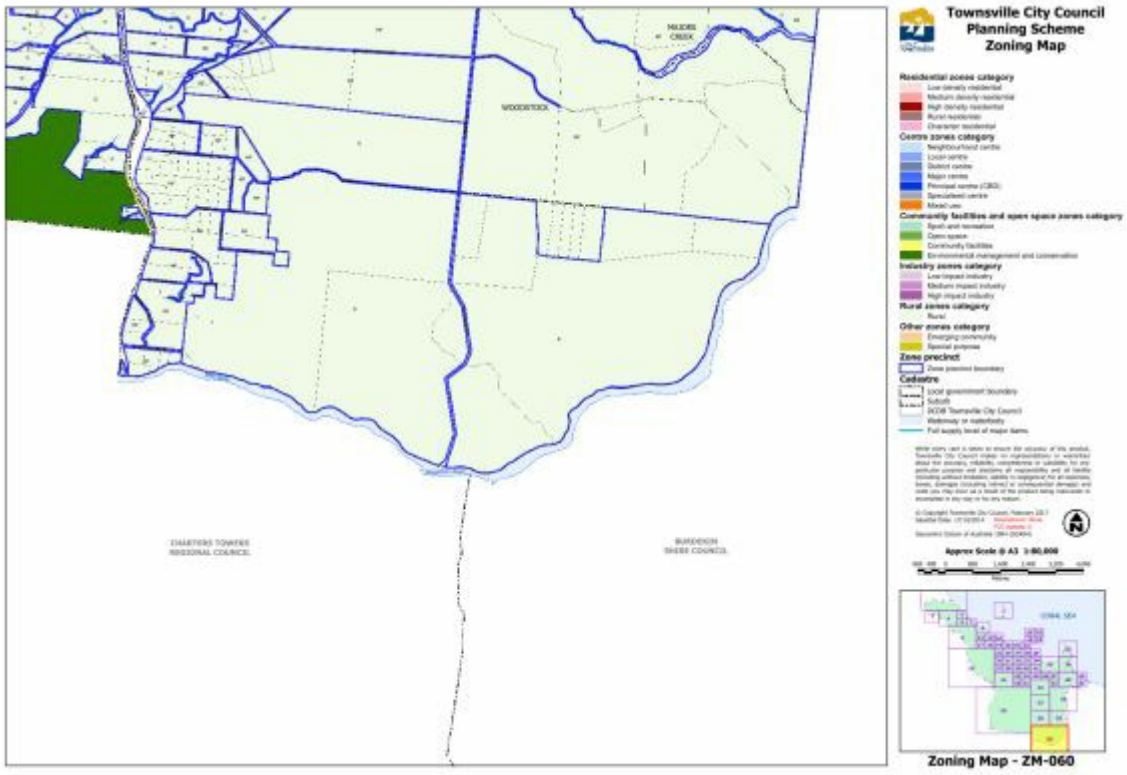

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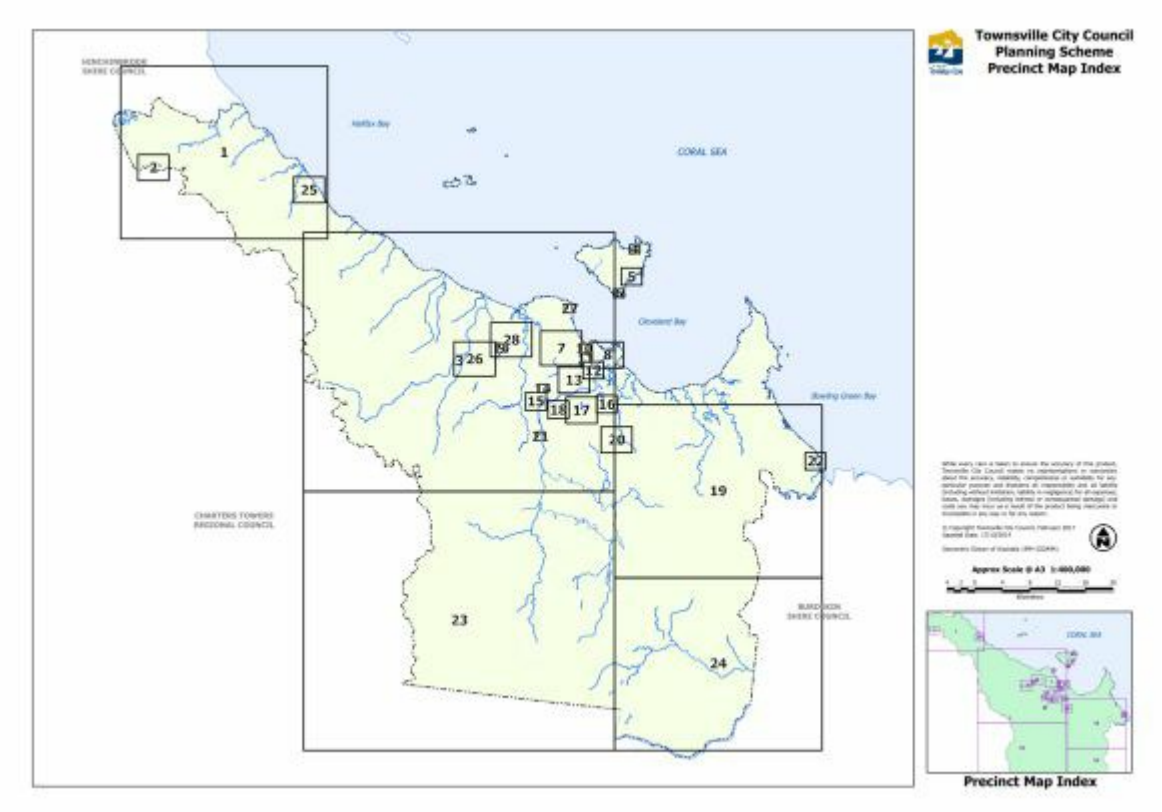

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Precinct Map Index

PRECINCT AND SUB-PRECINCT LEGEND				
Precinct Code	**Precinct**	**Sub-Precinct Code**	**Sub-Precinct**	**Zone Category**
A	Townsville Airport			Specialised centre
AC	Arcadia Central			Mixed use
ADC	Annandale district centre			District centre
AMC	Aitkenvale major centre	**ACC**	Aitkenvale centre core	Major centre
AMC	Aitkenvale major centre	**ACF**	Aitkenvale centre frame	Major centre
AMD	Aitkenvale medium density			Medium density residential
AV	Aitkenvale village			Medium density residential
B	Breakwater			Mixed use
BBGC	Balgal Beach golf course			Sport and recreation
BRM	Bayswater Road medical			Specialised centre
C	Cungulla			Rural
CA	Civic and administration			Principal centre
CD	Cluden			Sport and recreation
CBDG	CBD gateway			Mixed use
CS	Churchill Street			Character residential
CTR	Charters Towers Road business			Mixed use
D	Domain Central			Specialised centre

DDC	Deeragun district centre			District centre
DHHC	1960s Defence Housing and1960s Housing Commission			Character residential
FRM	Fulham Road medical			Specialised centre
FS	French Street			Character residential
FSE	Flinders Street East			Principal centre
FSR	Flinders Street retail			Principal centre
FSW	Flinders Street West			High density residential
G	Grazing			Rural
GQ	Grand Queenslanders			Character residential
H	Horticulture			Rural
HPMC	Hyde Park major centre			Major centre
HPMD	Hyde Park medium density			Medium density residential
IAG	Interwar to 1950s Asymmetrical Gables			Character residential
IDC	Idalia district centre			District centre
IGQB	Interwar Gables and Queensland Bungalows			Character residential
J	Jensen			Rural
JCUTH	James Cook University Townsville Hospital			Specialised centre
KR	Kings Road			Mixed use
KRM D	Kings Road medium density			Medium density residential
KSQ	King Street quarter			Mixed use
KT	Kirwan Traders			Mixed use
LB	Lavarack Barracks			Specialised centre
MF	Mixed farming			Rural
M FP	Mixed 1950s			Character residential
MIMD	Magnetic Island medium density			Medium density residential
MIV	Magnetic Island villages	**HB**	Horseshoe Bay	Mixed use
MIV	Magnetic Island villages	**N B**	Nelly Bay	Mixed use
MIV	Magnetic Island villages	**PB**	Picnic Bay	Mixed use
MS	Marlow Street			Low density residential
NBG	Nelly Bay gateway			Mixed use
NBI	Nelly Bay low impact industry			Low impact industry
NBT	Nelly Bay tourist			Medium density residential
NW	North Ward local centre			Local centre
NWG	North Ward gateway			Medium density residential
N WMD	North Ward medium density			Medium density residential
N WV	North Ward villages			Medium density residential

PB	Picnic Bay			Medium density residential
PBCF	Picnic Bay community facilities			Community facilities
PS	Palmer Street			High density residential
PSP	Park Street			Character residential
PT	Port of Townsville			Specialised centre
PWE	1950s Post War Expansion			Character residential
Q	Queenslanders			Character residential
R	Riverway			Open space
RDC	Rasmussen district centre			District centre
RE	Railway Estate			High density residential
RMII	Roseneath medium impact industry			Medium impact industry
RP	Rossiter Park			Medium density residential
RRRC	Ross River Road corridor			Low density residential
RSLC	Rising Sun local centre			Local centre
S	The Strand			Medium density residential
ST	Stables			Low density residential
STP	South Townsville			Character residential
STRD	South Townsville railyards and Dean Park			Mixed use
TCMC	Thuringowa Central major centre	**TCS**	Thuringowa centre support	Major centre
TCMC	Thuringowa Central major centre	**TD**	Thuringowa Drive	Major centre
TCMC	Thuringowa Central major centre	**TTCH**	Thuringowa town centre heart	Major centre
TCMC	Thuringowa Central major centre	**W**	Willows	Major centre
TE	Thuringowa East			Medium density residential
TS	Thuringowa South			Medium density residential
WC	Workers Cottages			Character residential
WLS	Wills Street			Medium Density Residential
WS	Wotton Street			Mixed use

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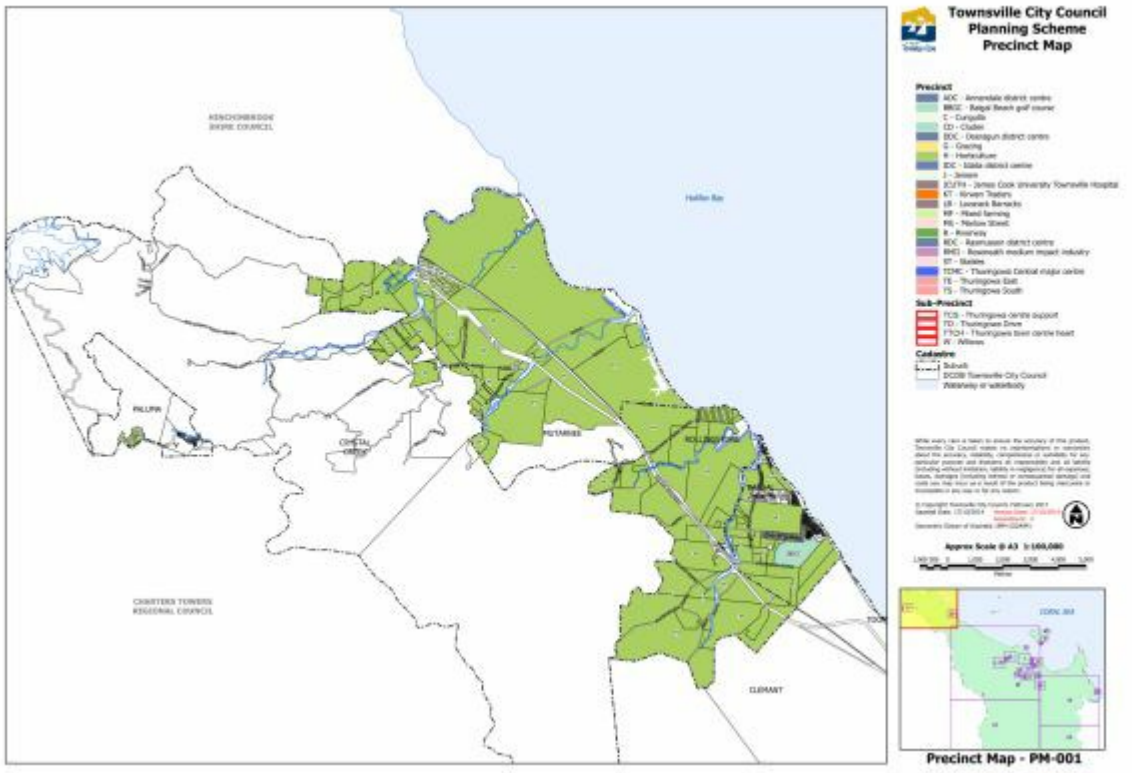

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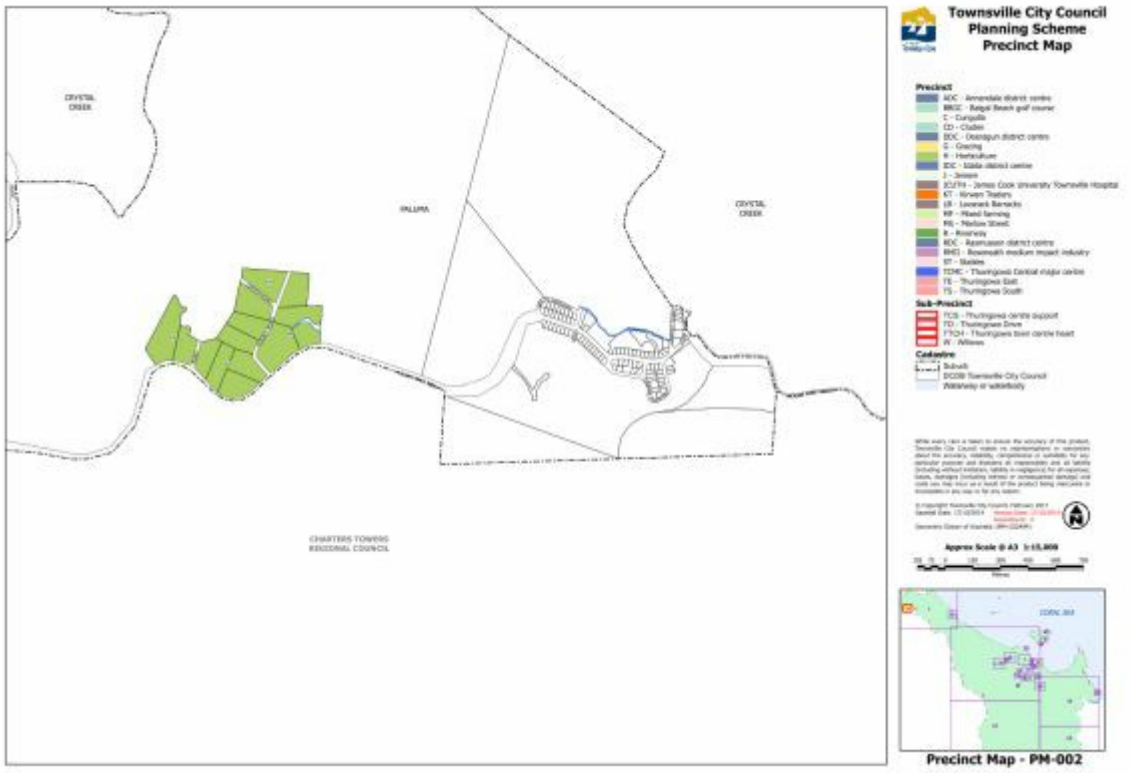
Precinct Map PM-001



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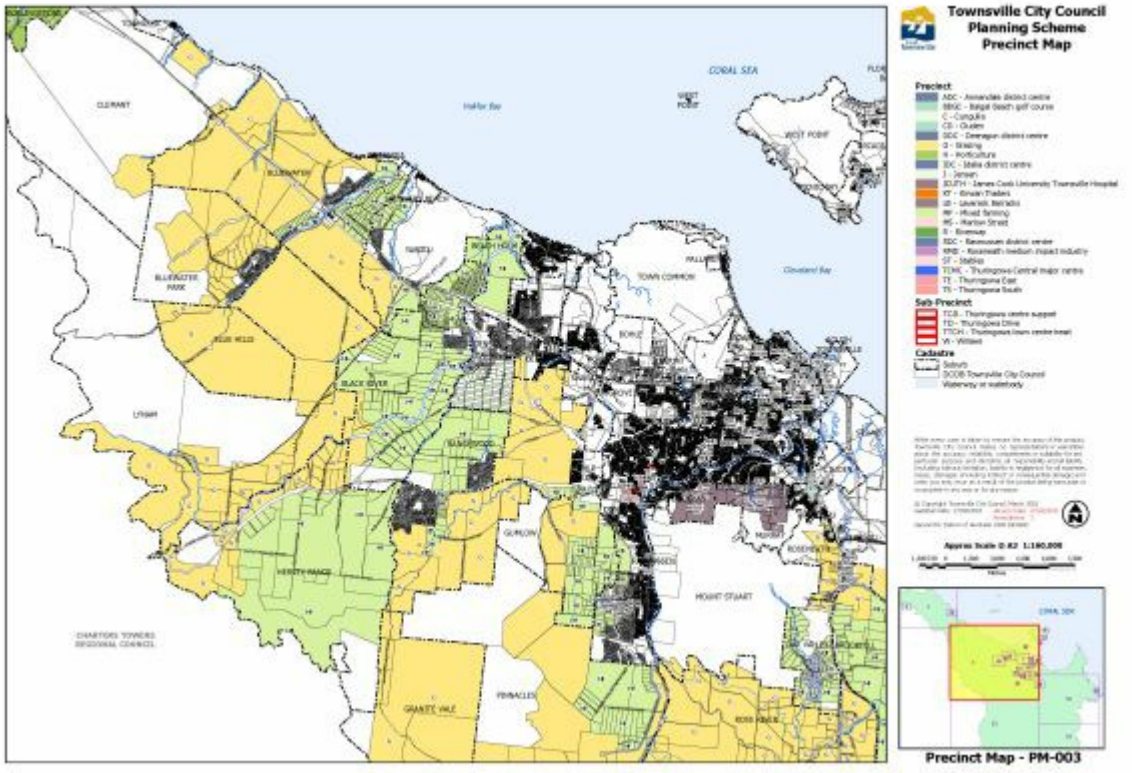

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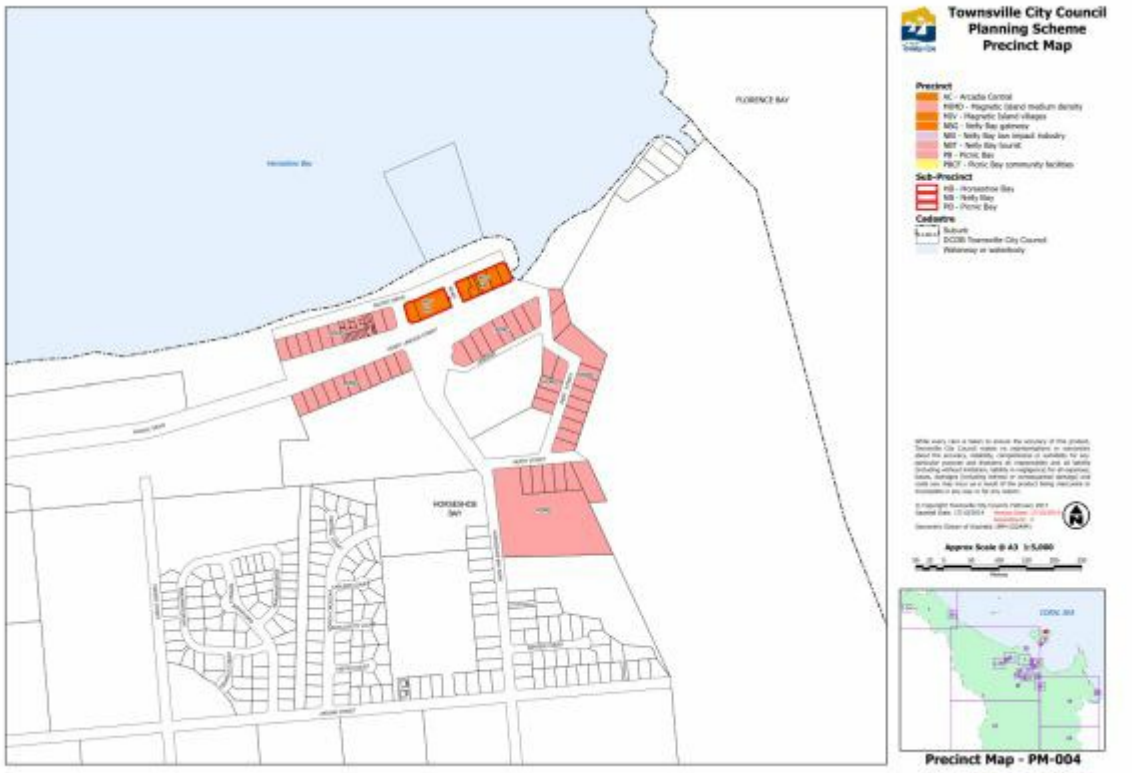

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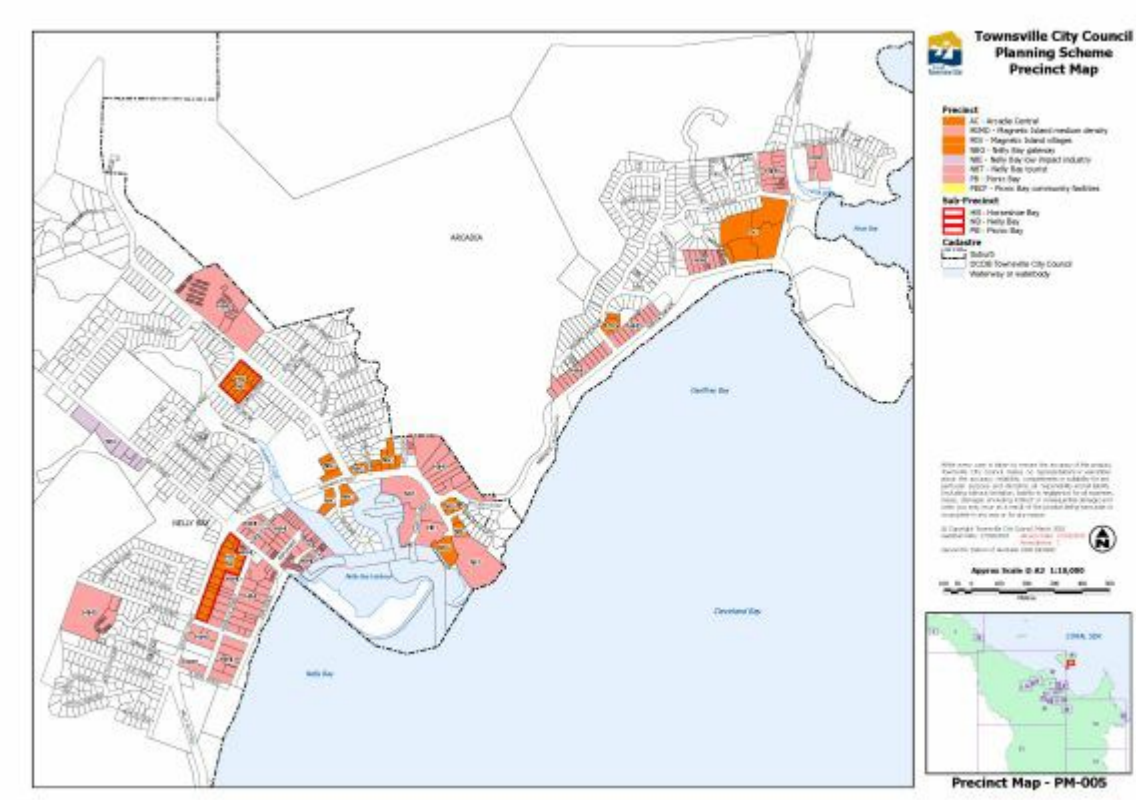

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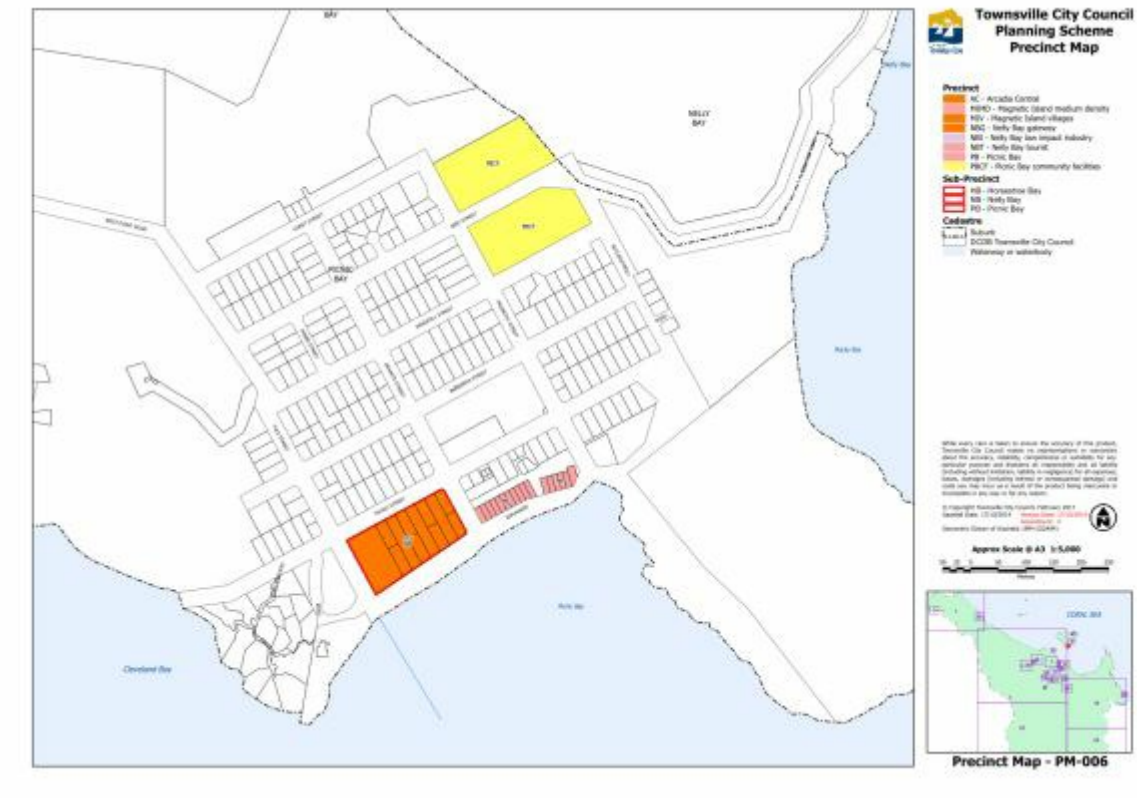

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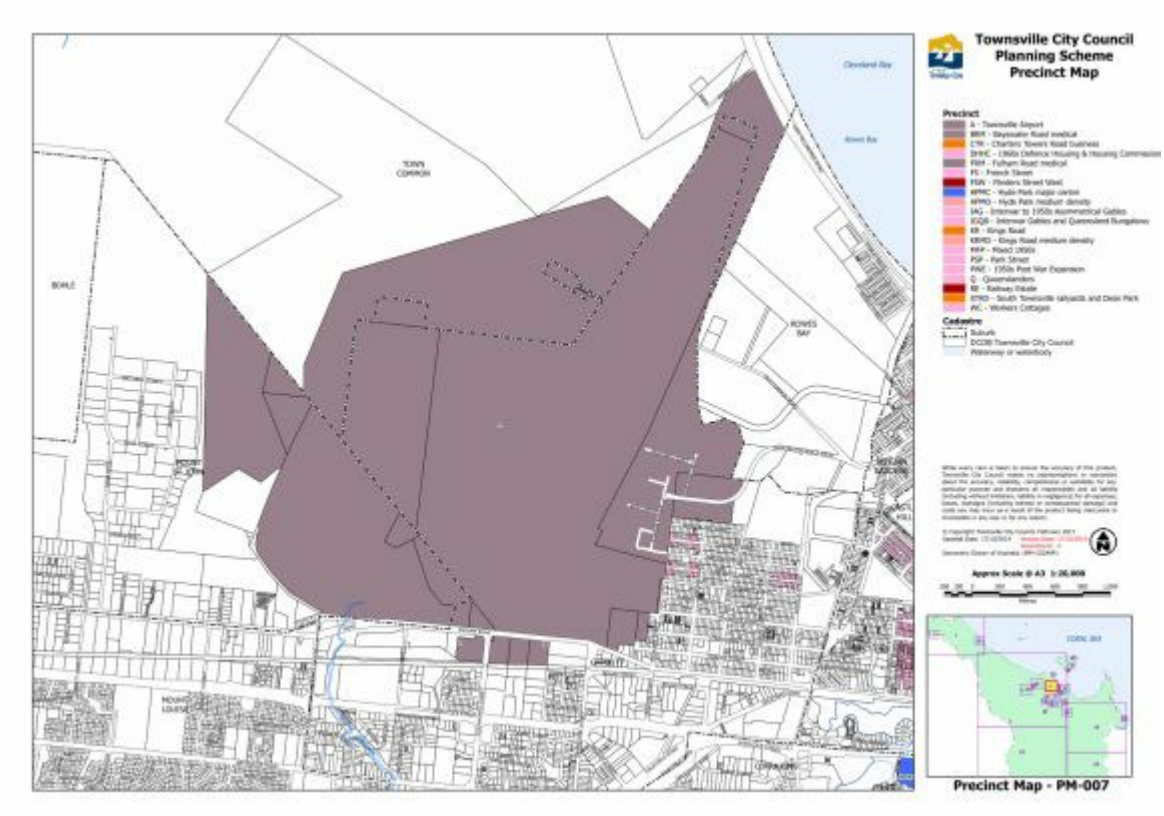

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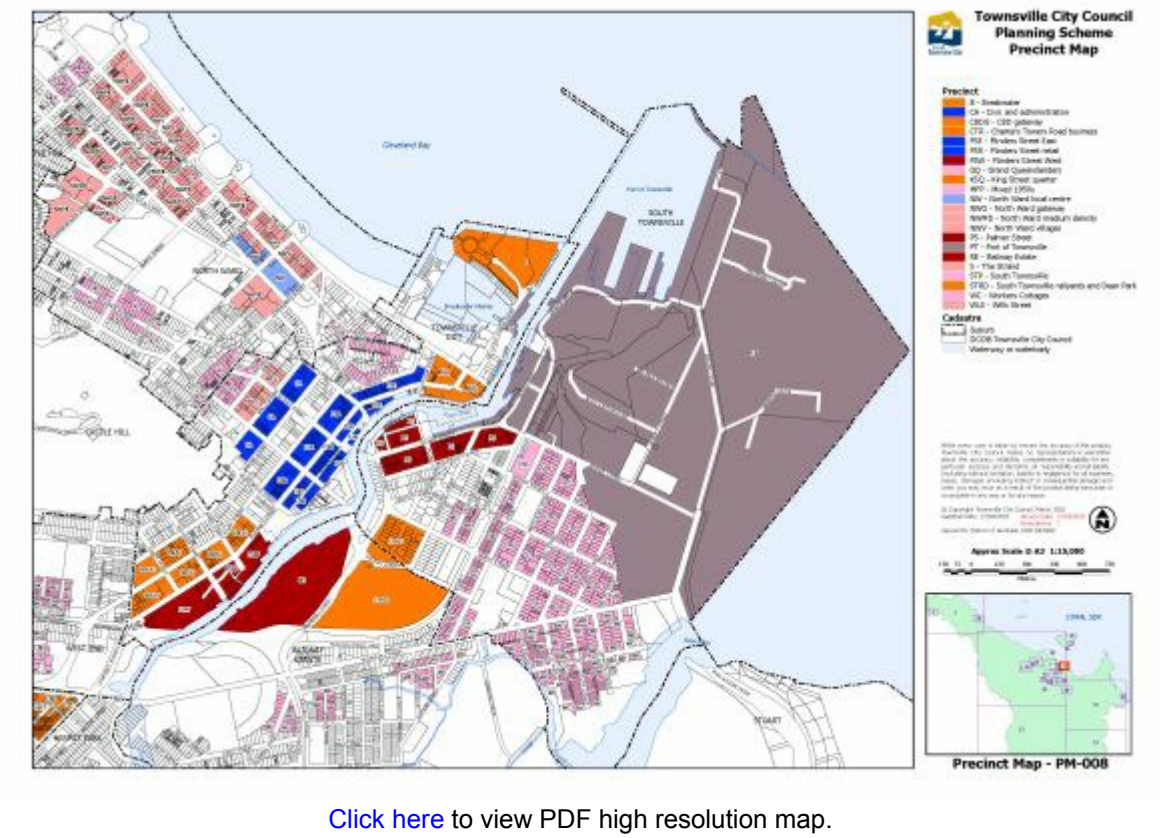

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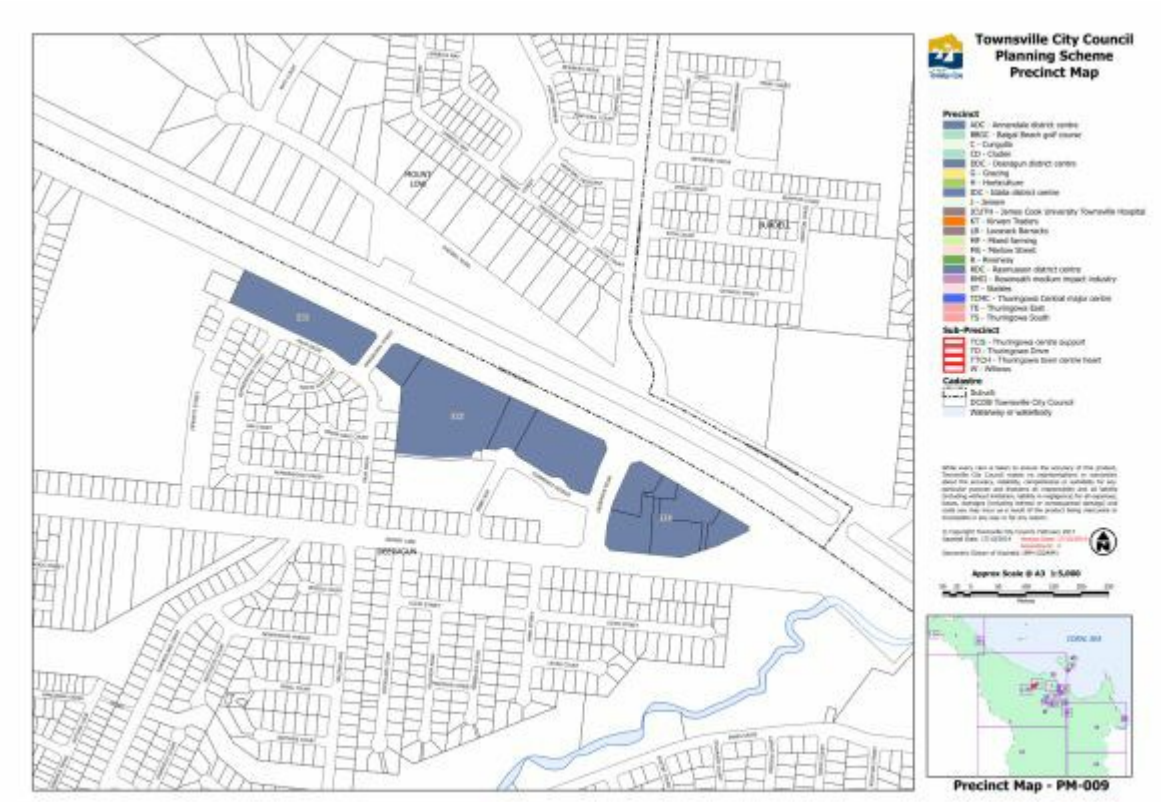

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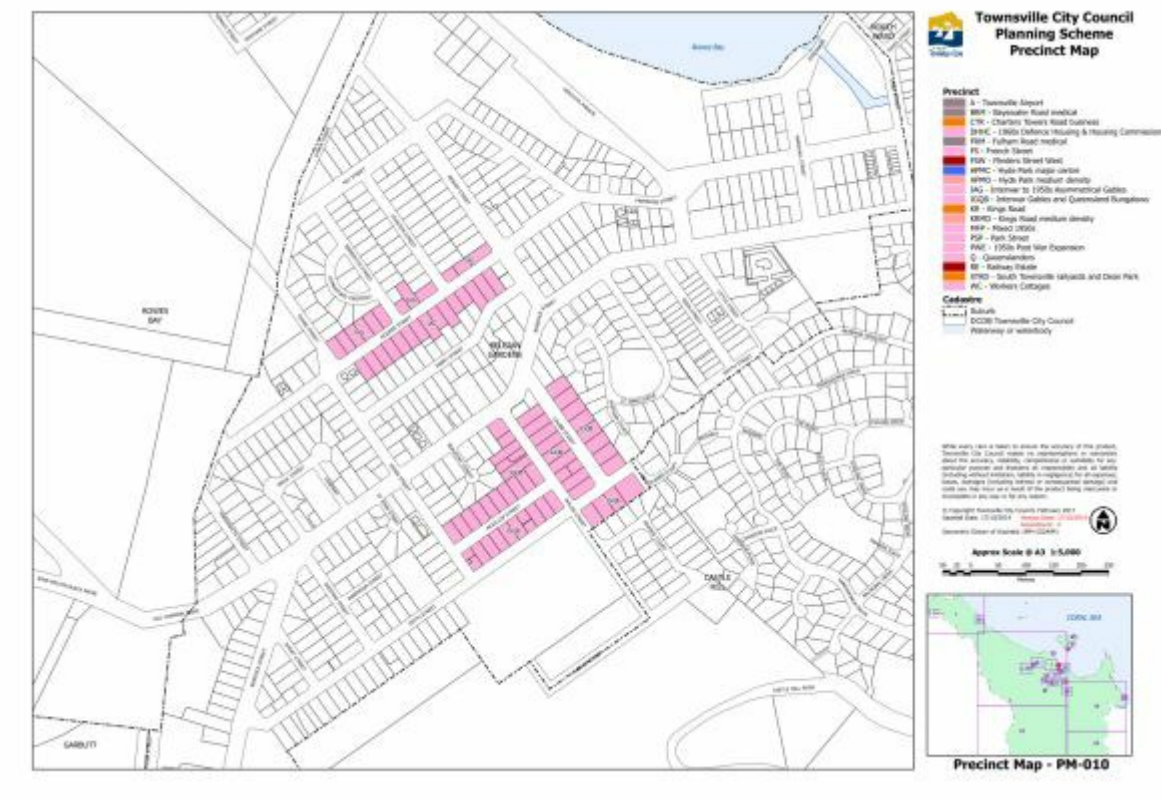

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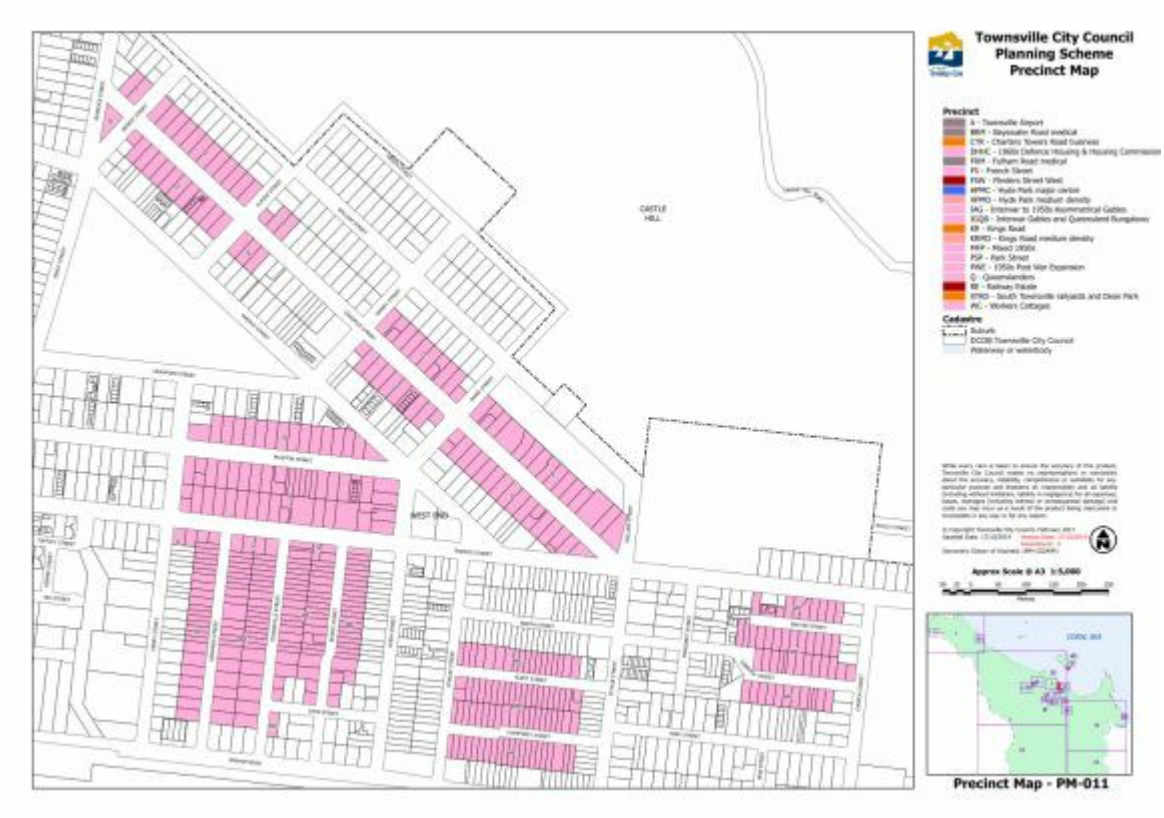

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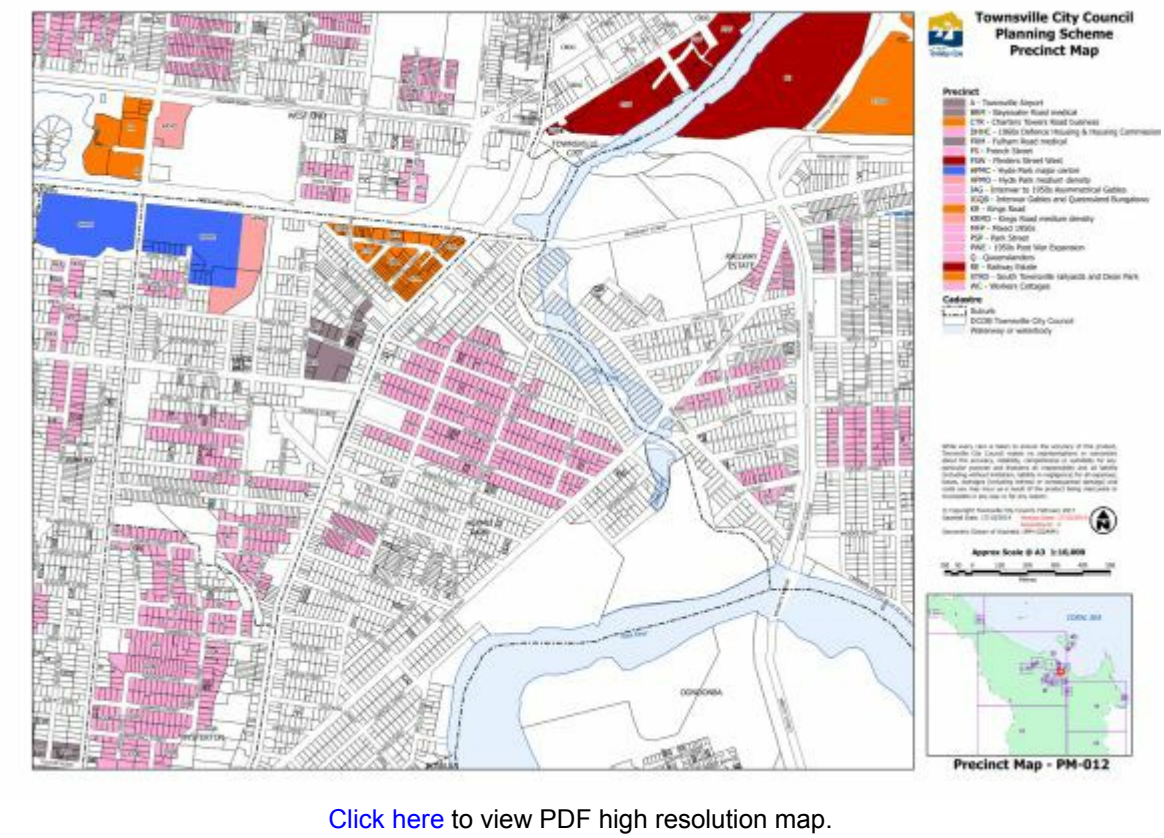

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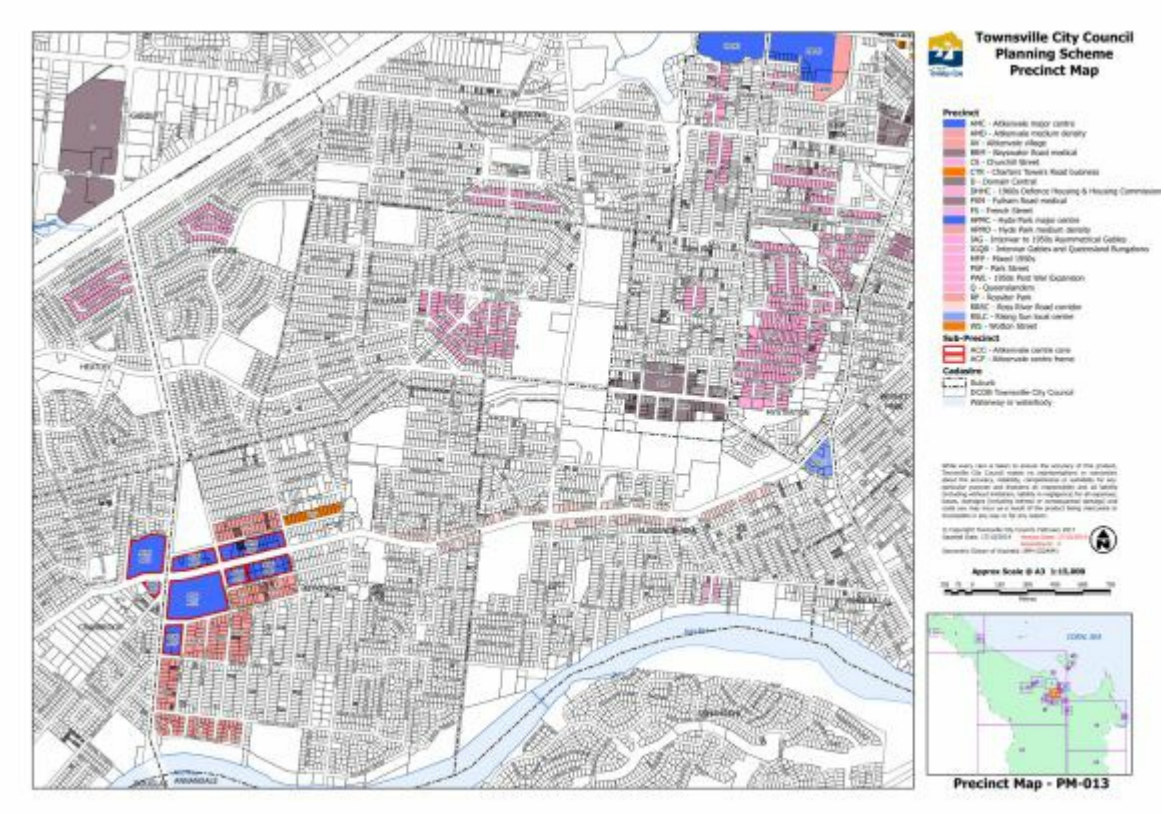
Precinct Map PM-012



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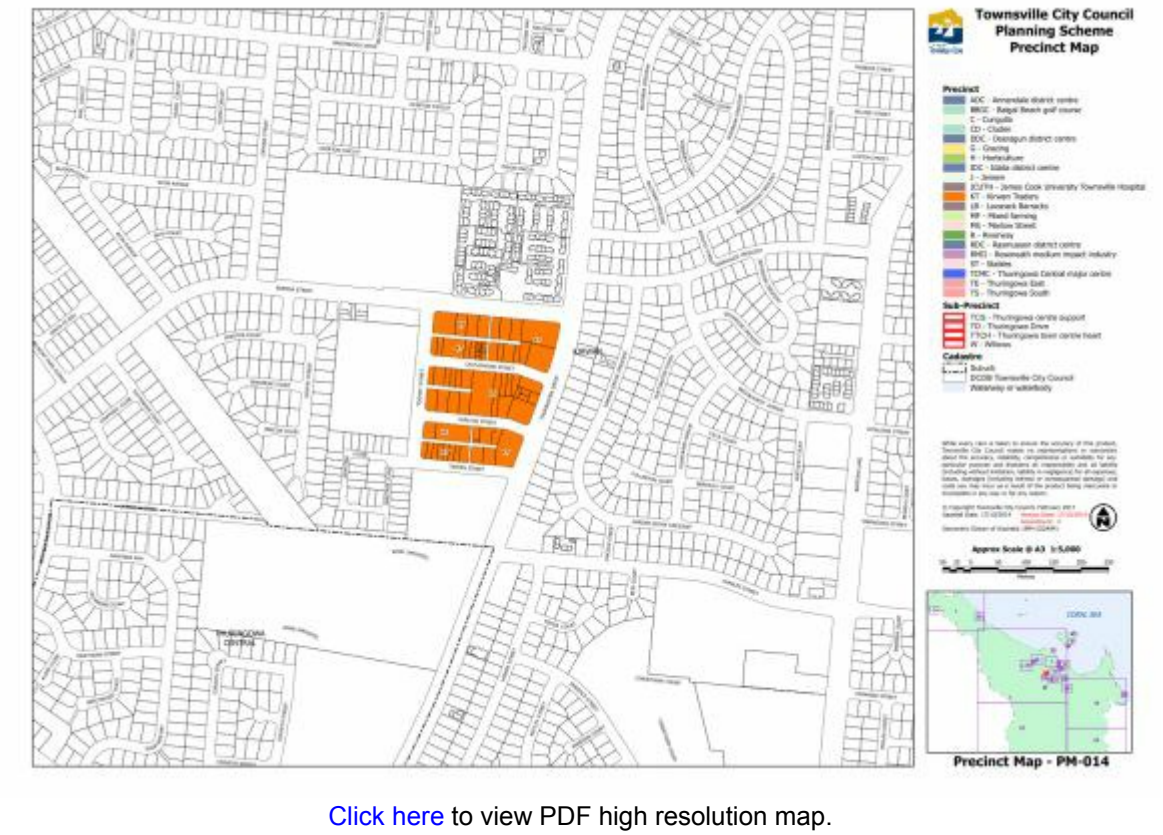
Precinct Map PM-013



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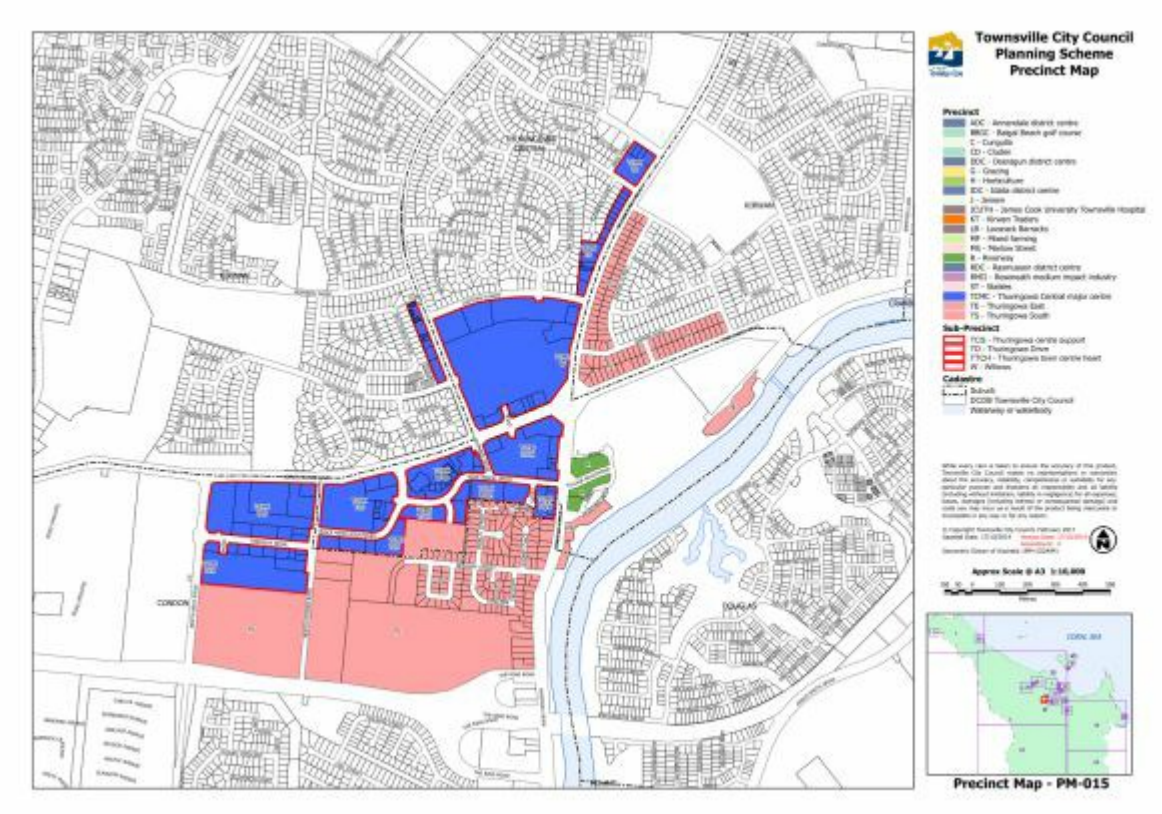

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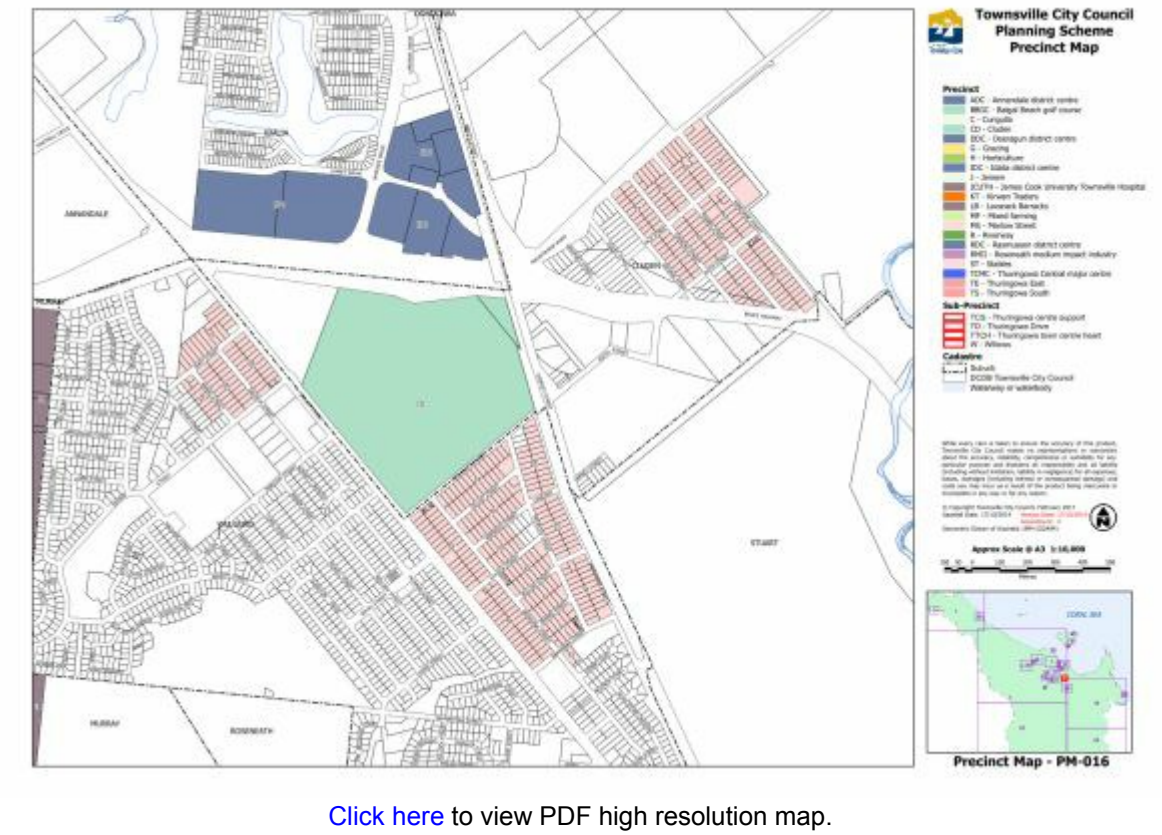

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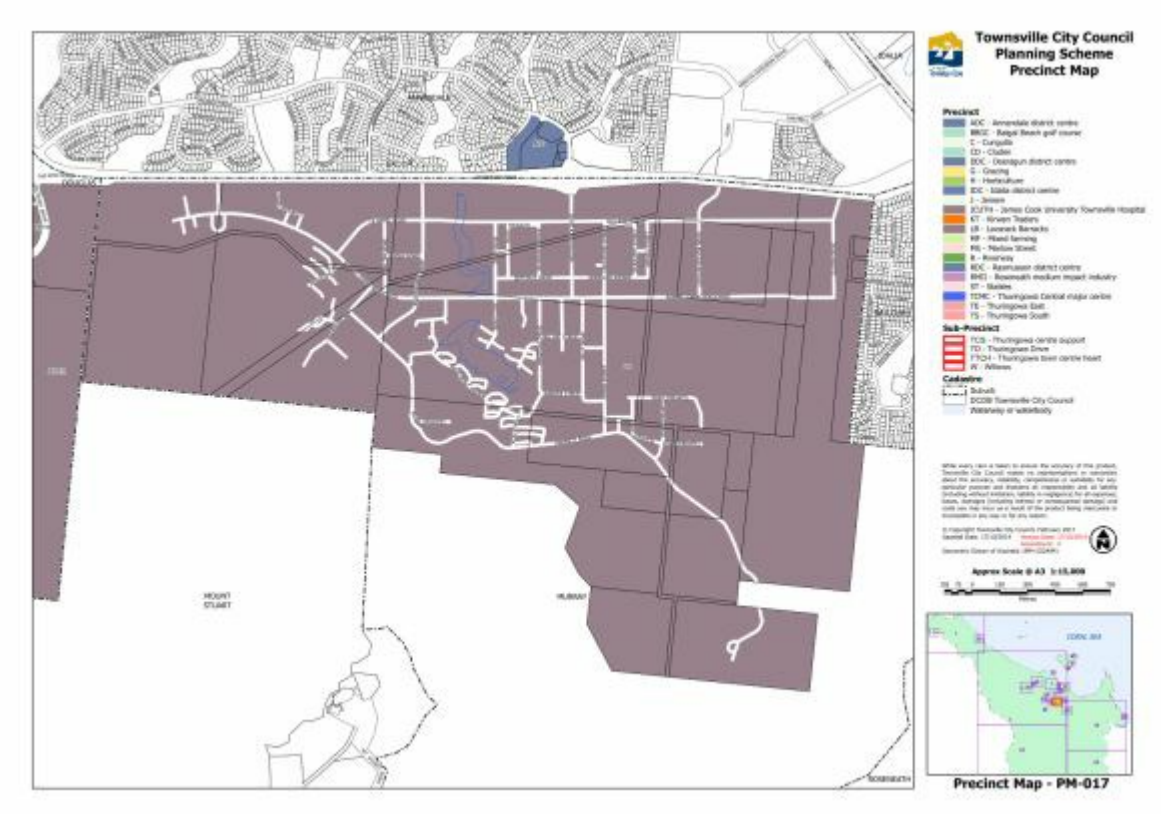

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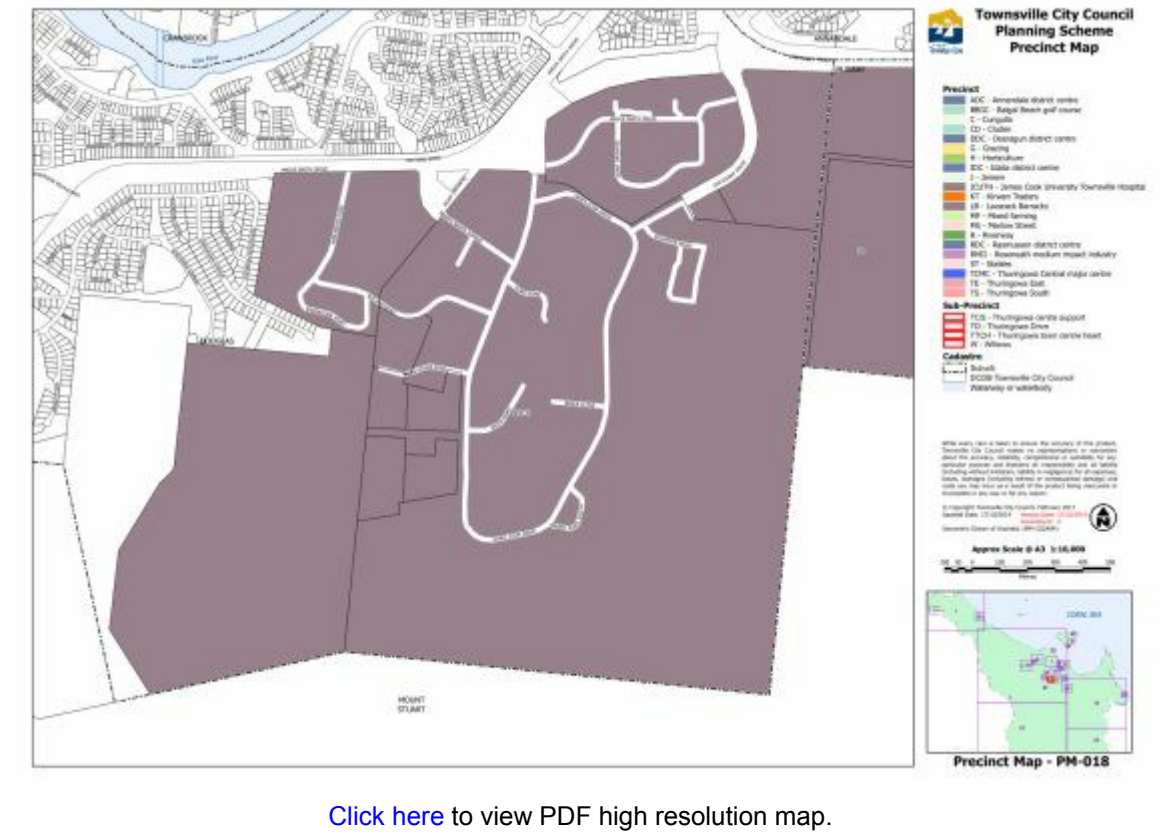

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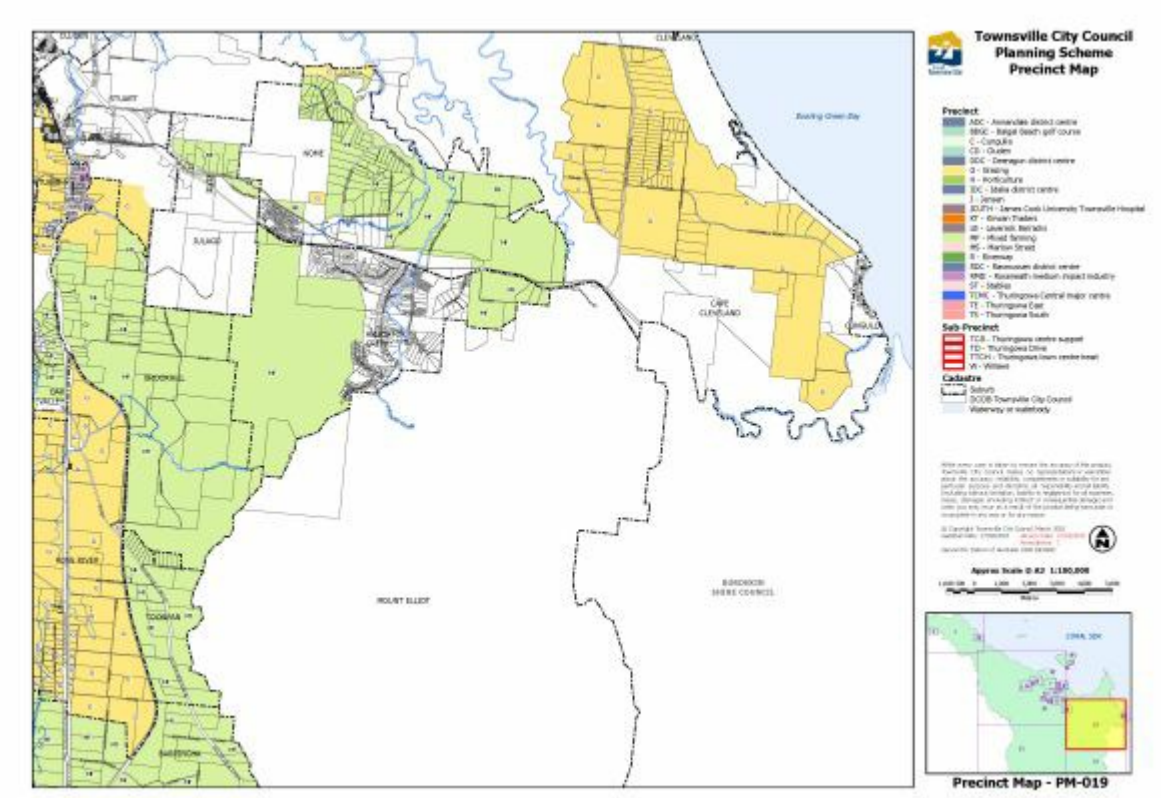

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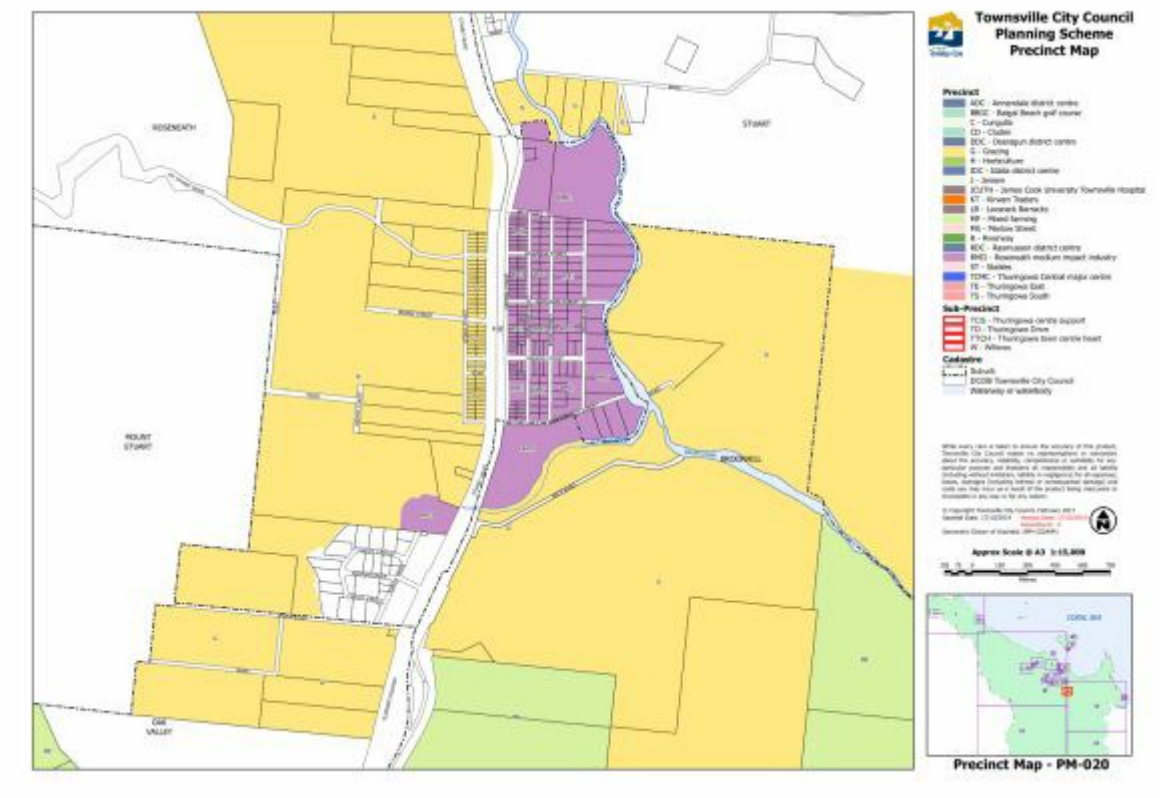

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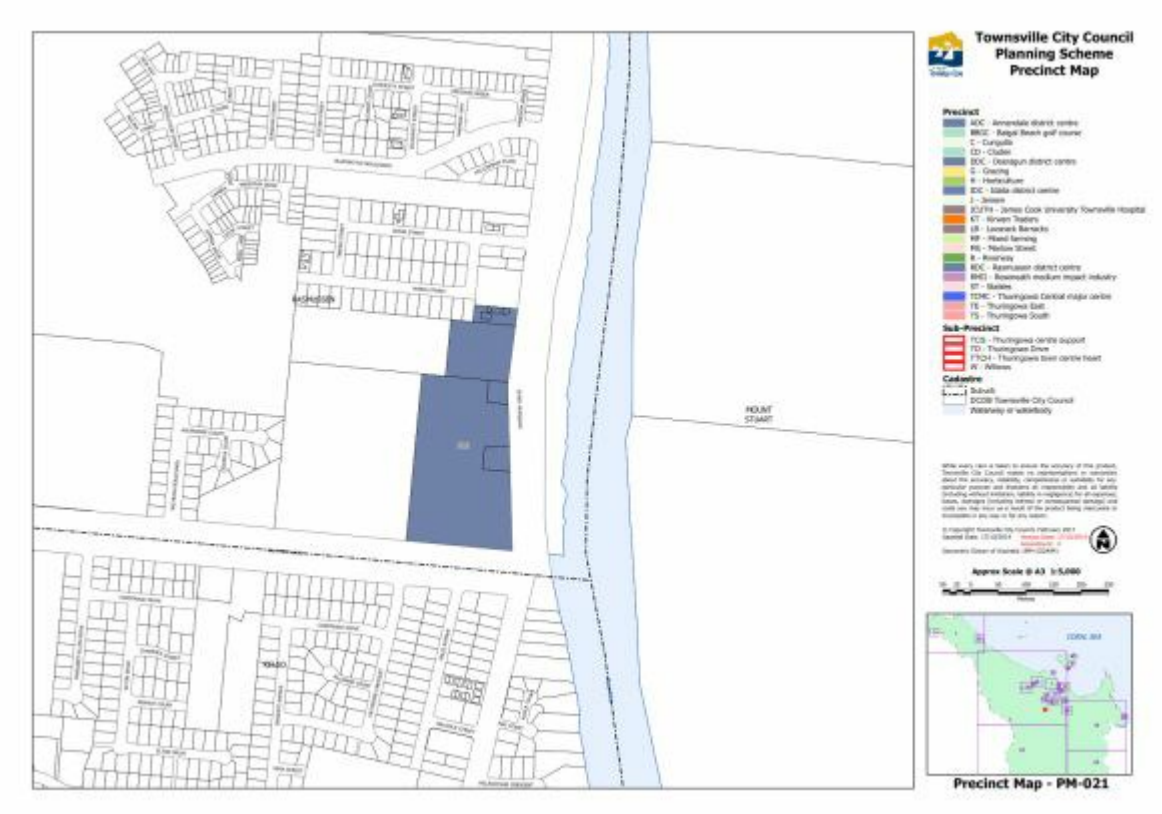

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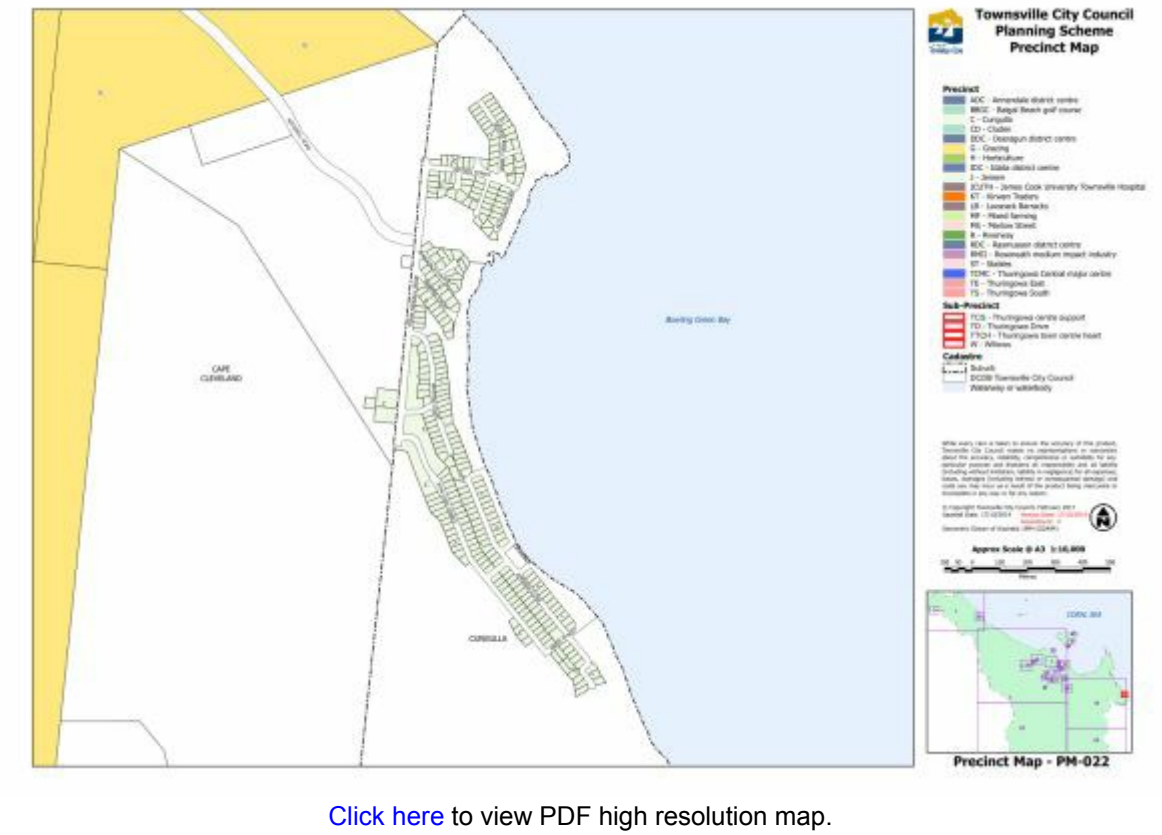

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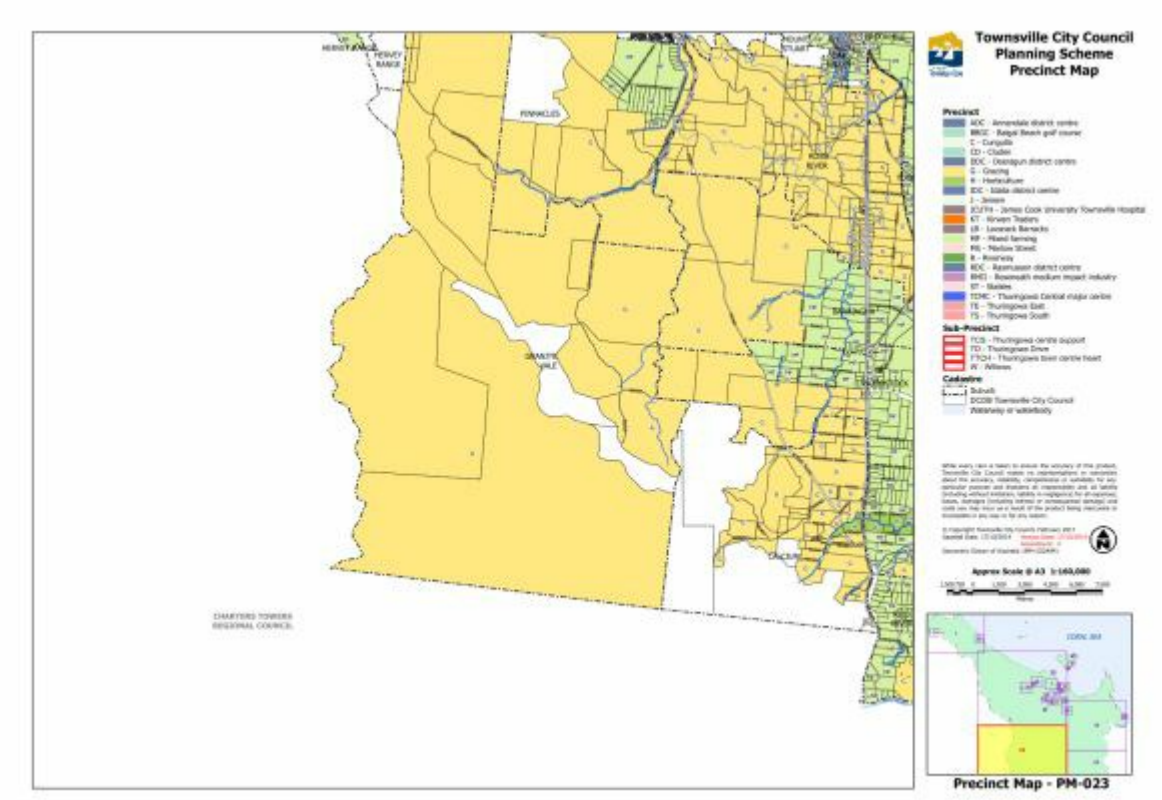

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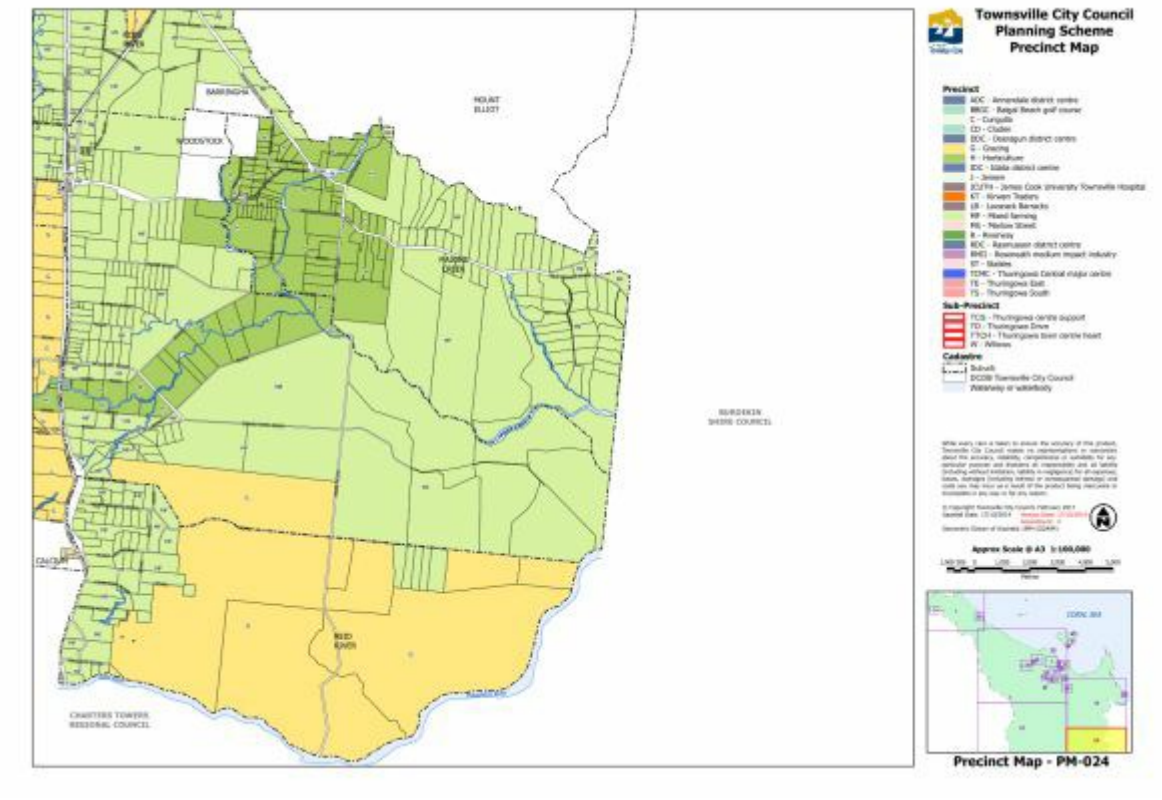

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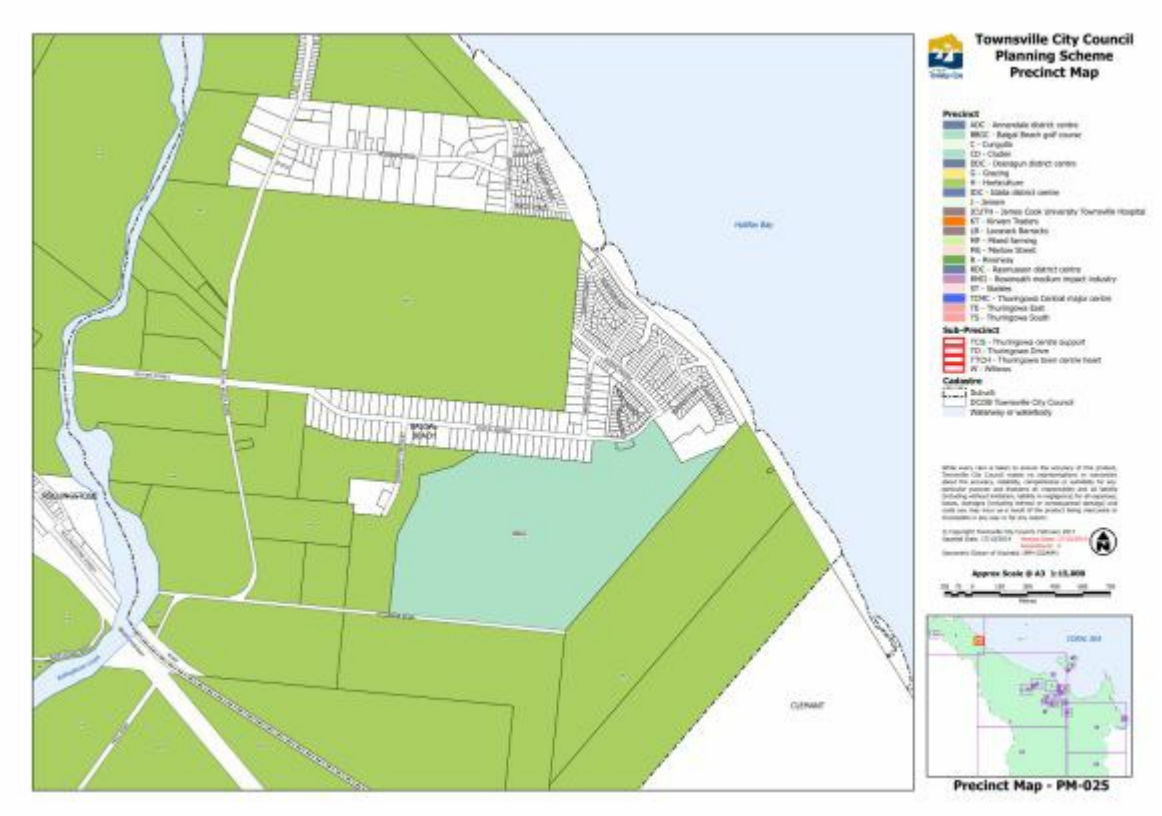

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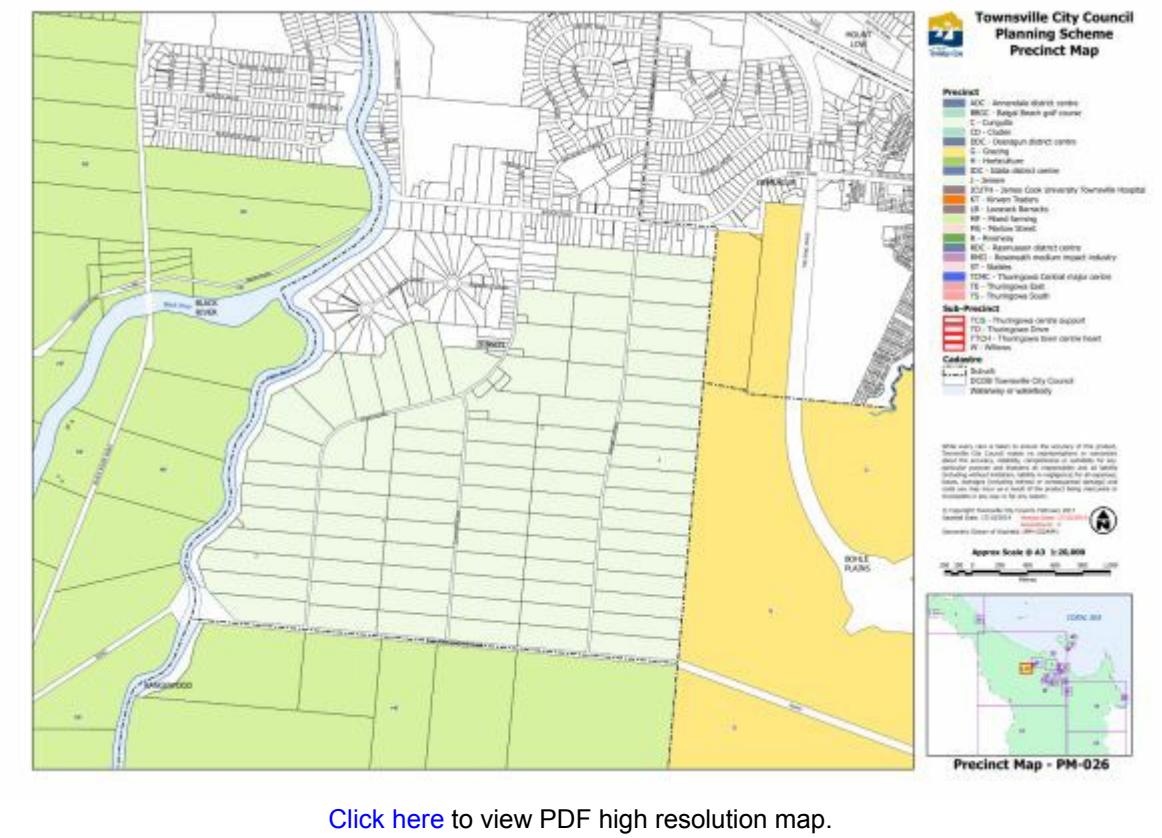
Precinct Map PM-025



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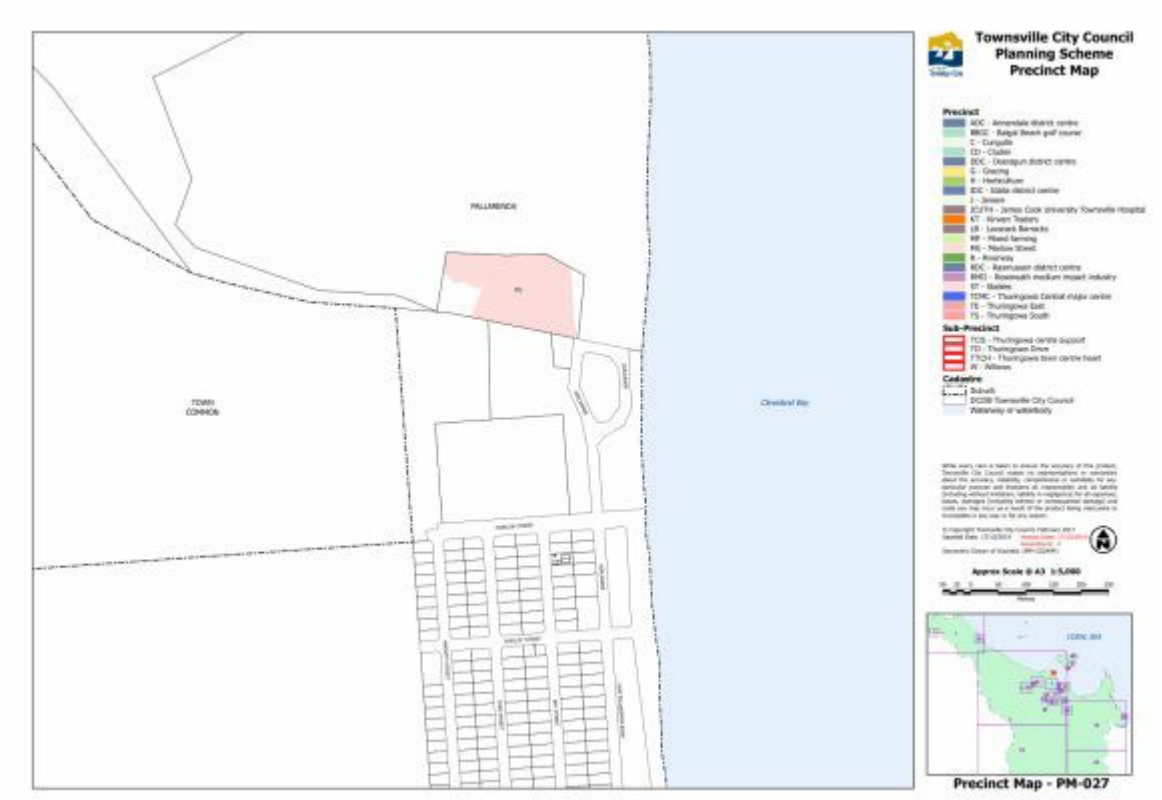

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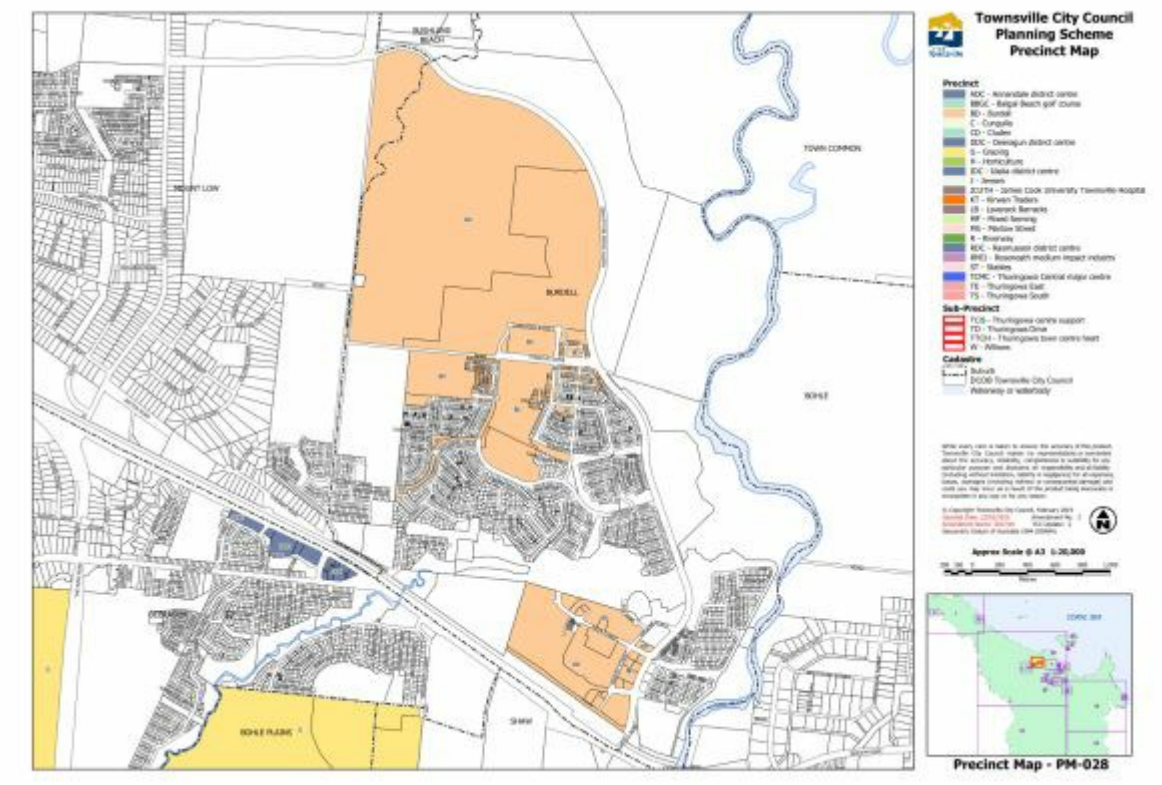
Precinct Map PM-027

Precinct Map PM-028



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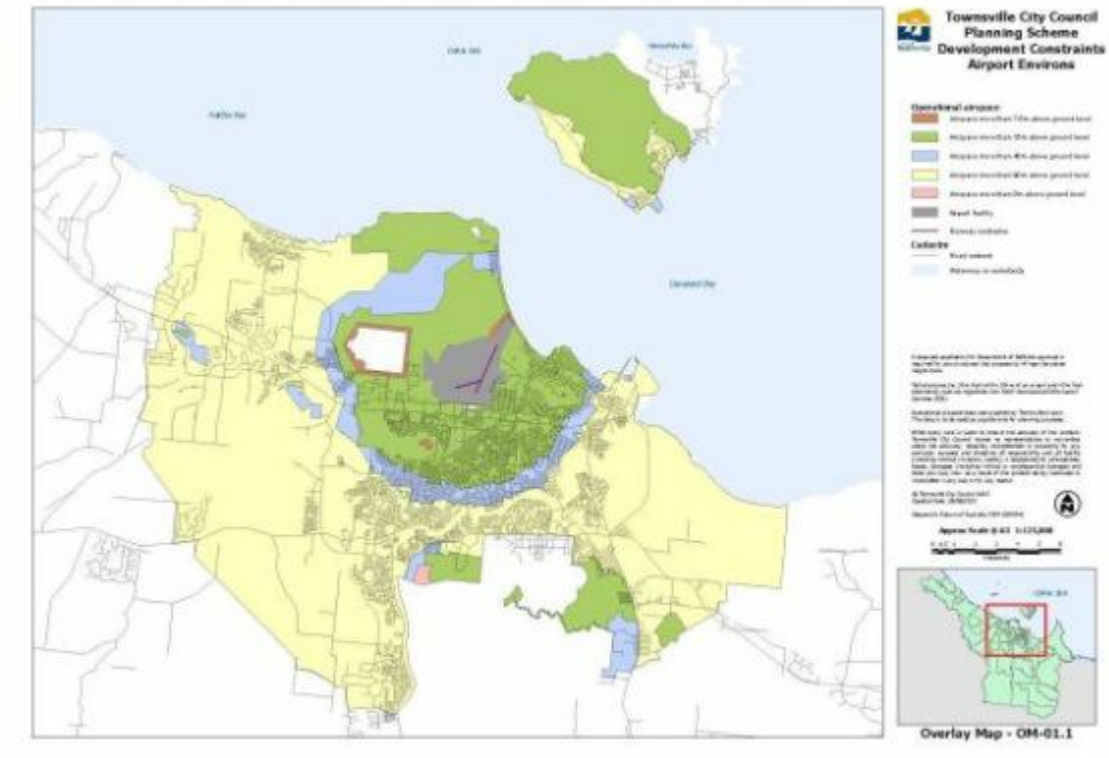
Precinct Map PM-028

SC2.4 Local plan maps

There are no local plan maps in this planning scheme.

SC2.5 Overlay maps



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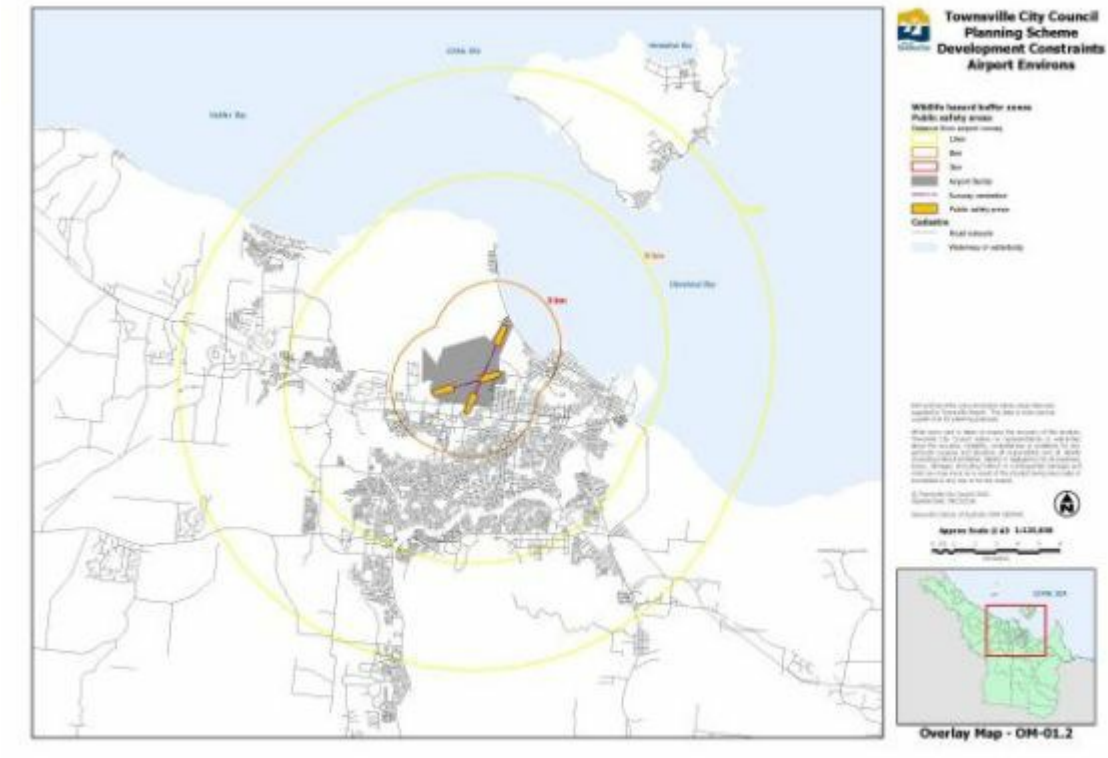
Development constraints airport environs overlay map OM-01.1 (Operational airspace)



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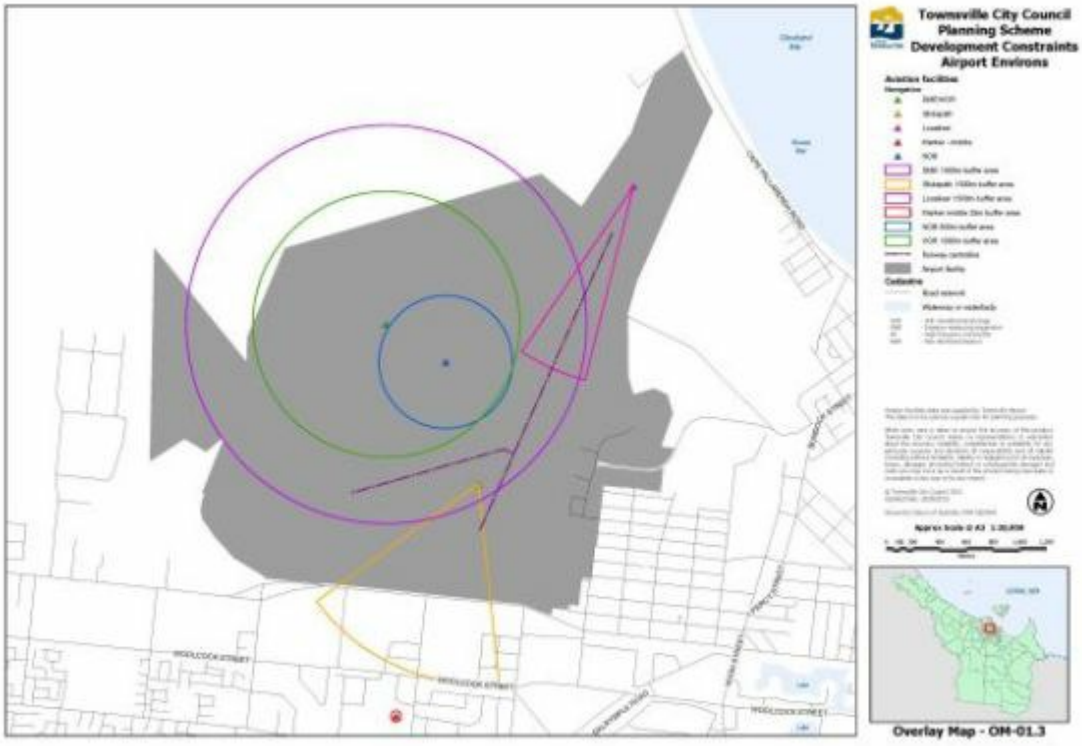
Development constraints airport environs overlay map OM-01.2 (Wildlife hazard buffer zones and Public safety areas)



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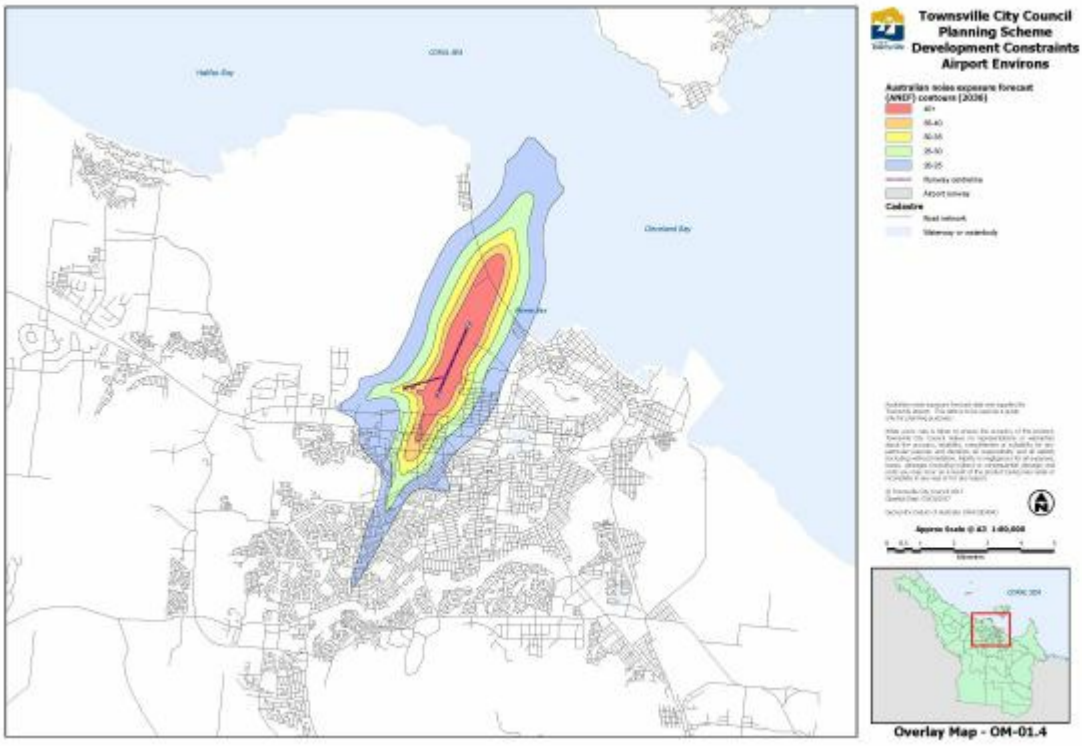
Development constraints airport environs overlay map OM-01.3 (Aviation facilities)



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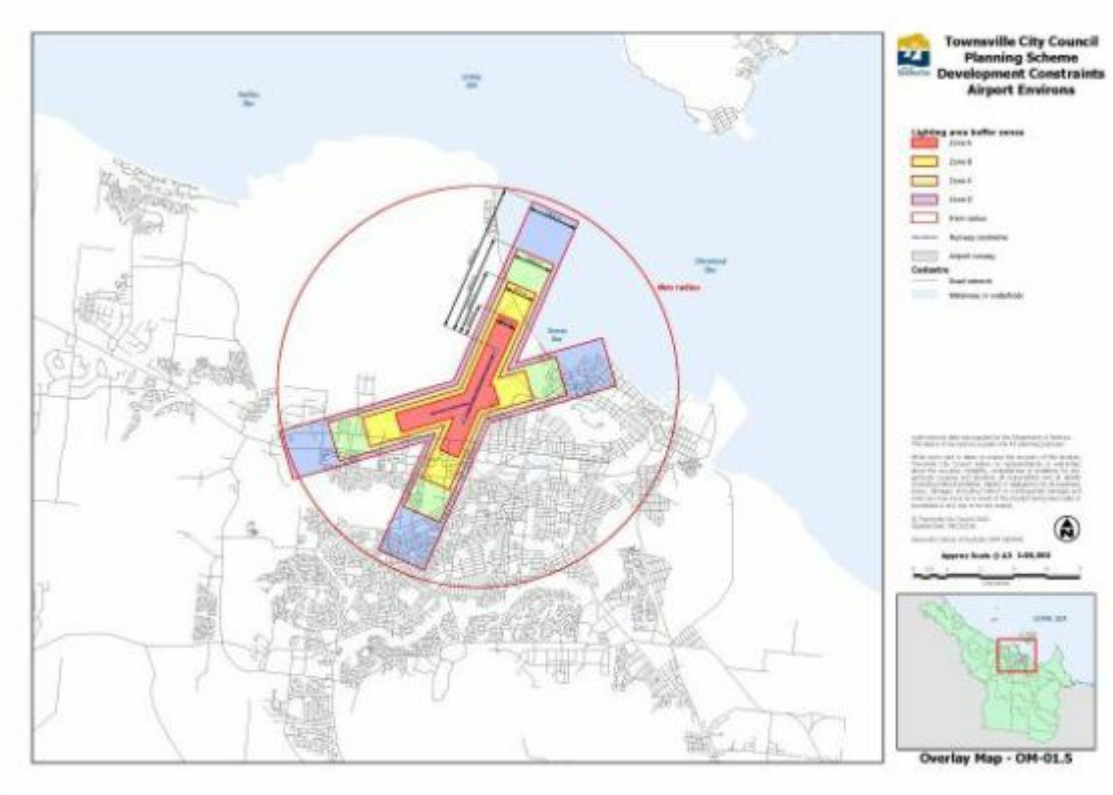
Development constraints airport environs overlay map OM-01.4 (Australian noise exposure forecast (ANEF) contours (2036))



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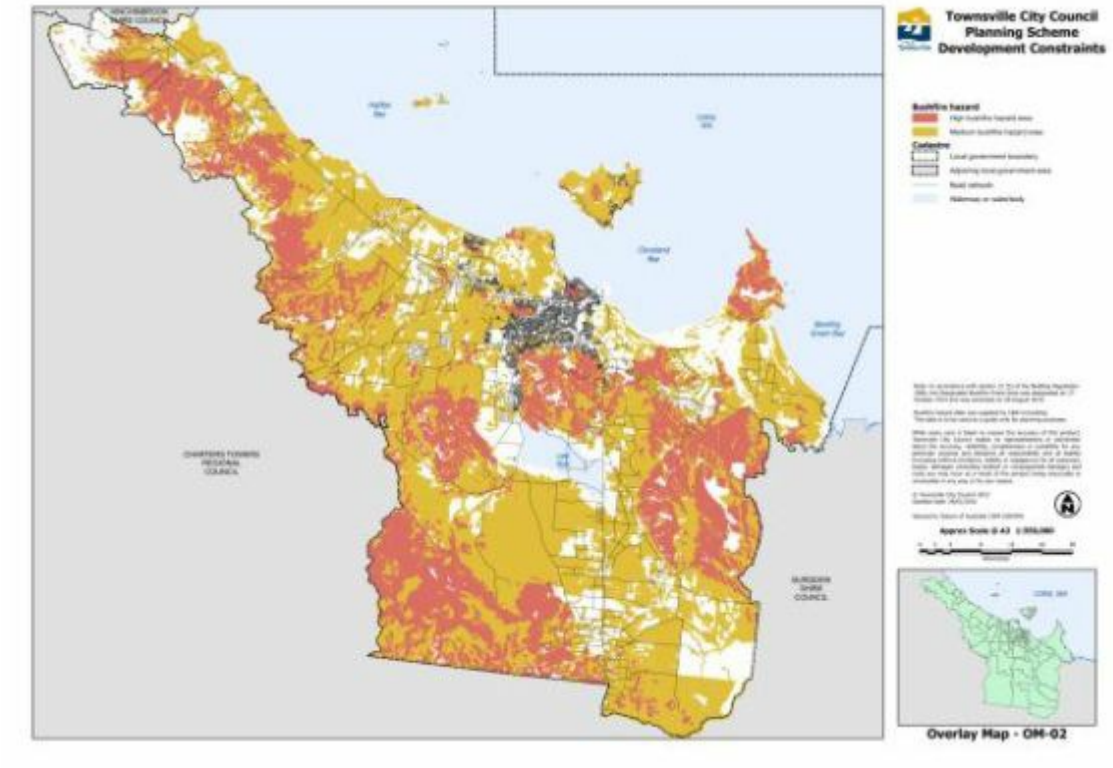
Development constraints airport environs overlay map OM-01.5 (Lighting area buffer zones)



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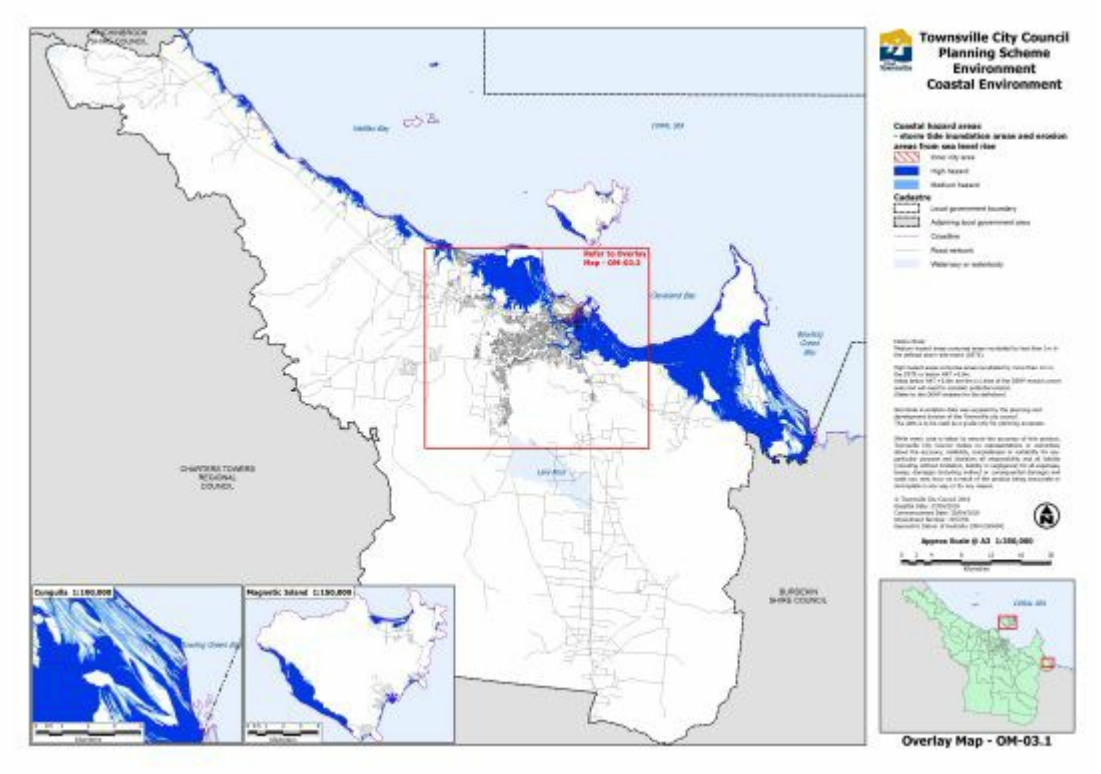
Development constraints overlay map OM-02 (Bushfire hazard)



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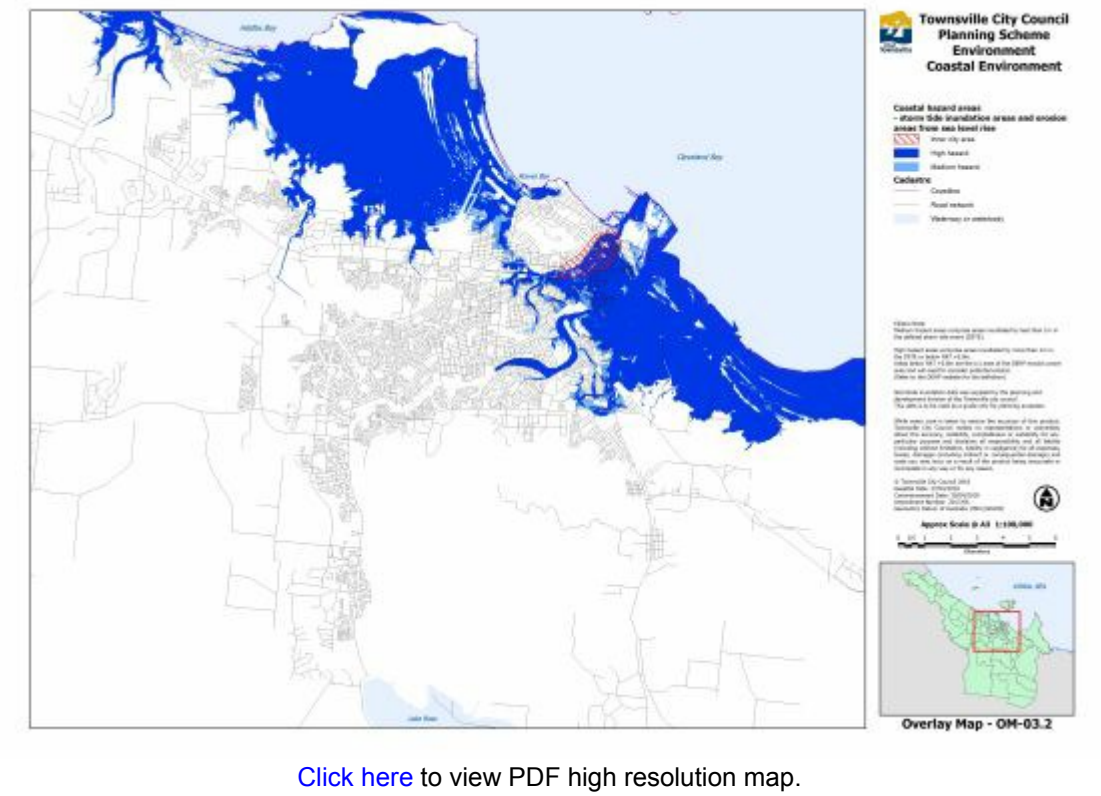
Coastal Environment overlay map OM-03.1 (Coastal hazard areas - storm tide inundation areas and erosion areas from sea level rise)



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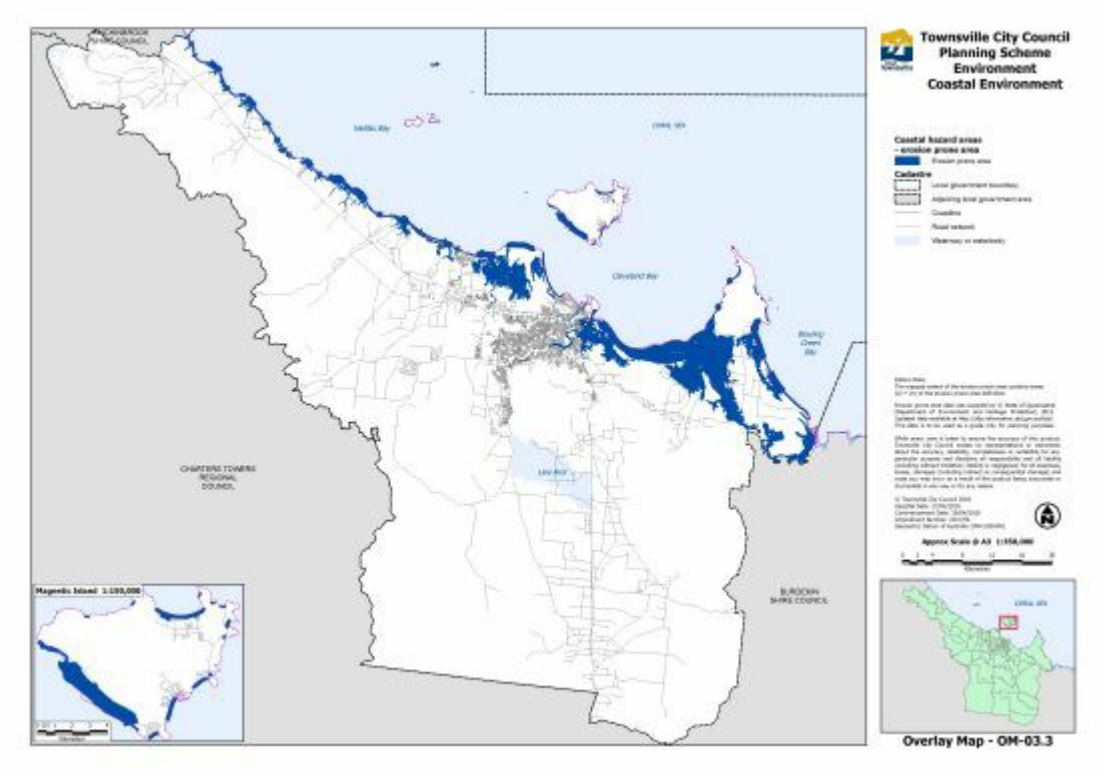
Coastal Environment overlay map OM-03.2 (Coastal hazard areas - storm tide inundation areas and erosion areas from sea level rise)



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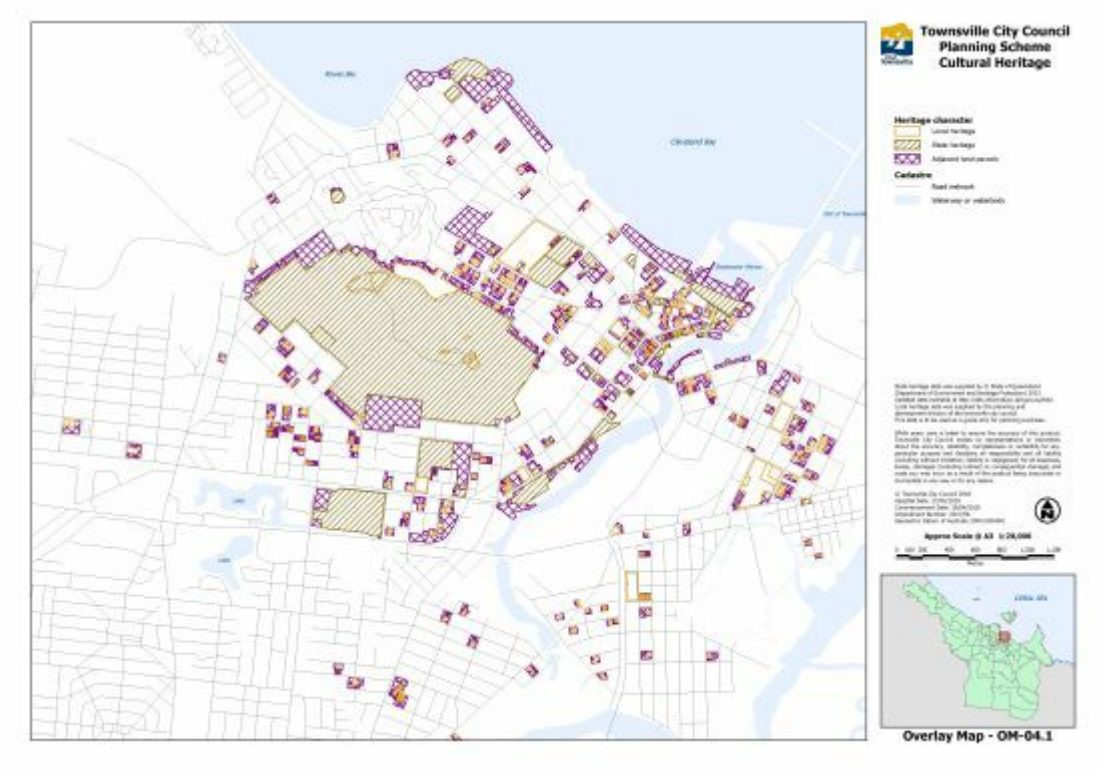
Coastal Environment overlay map OM-03.3 (Coastal hazard areas - erosion prone area)



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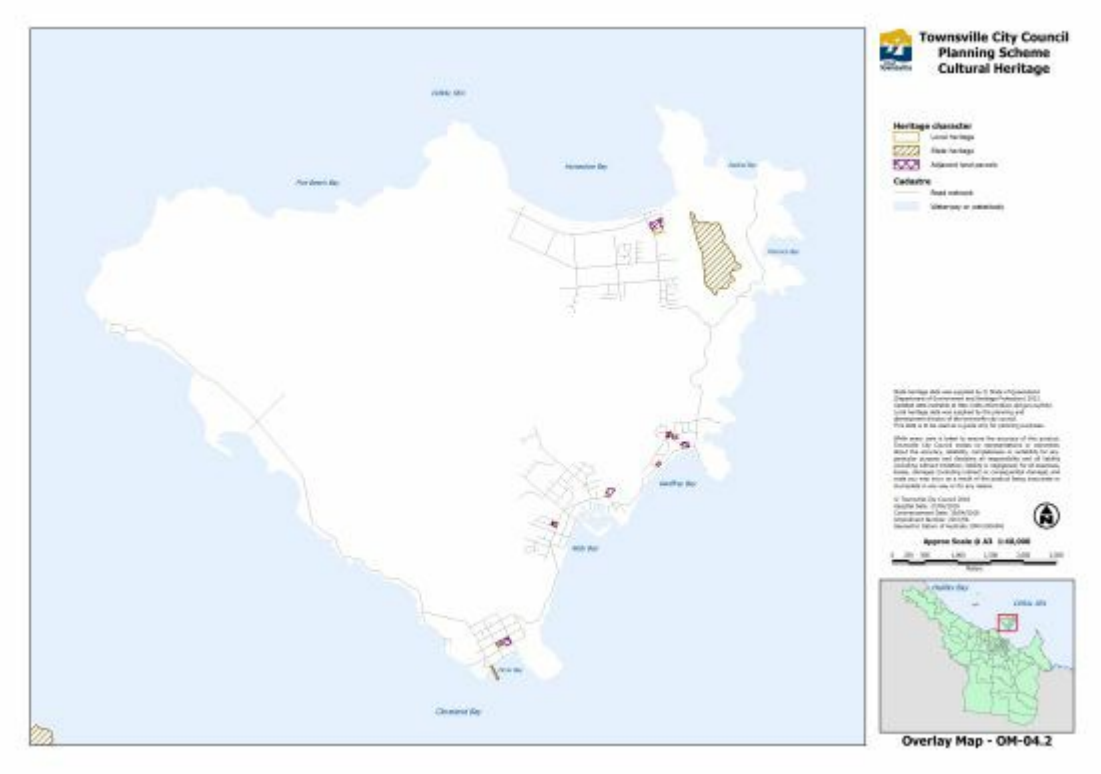
Cultural Heritage overlay map OM-04.1 (Heritage value)



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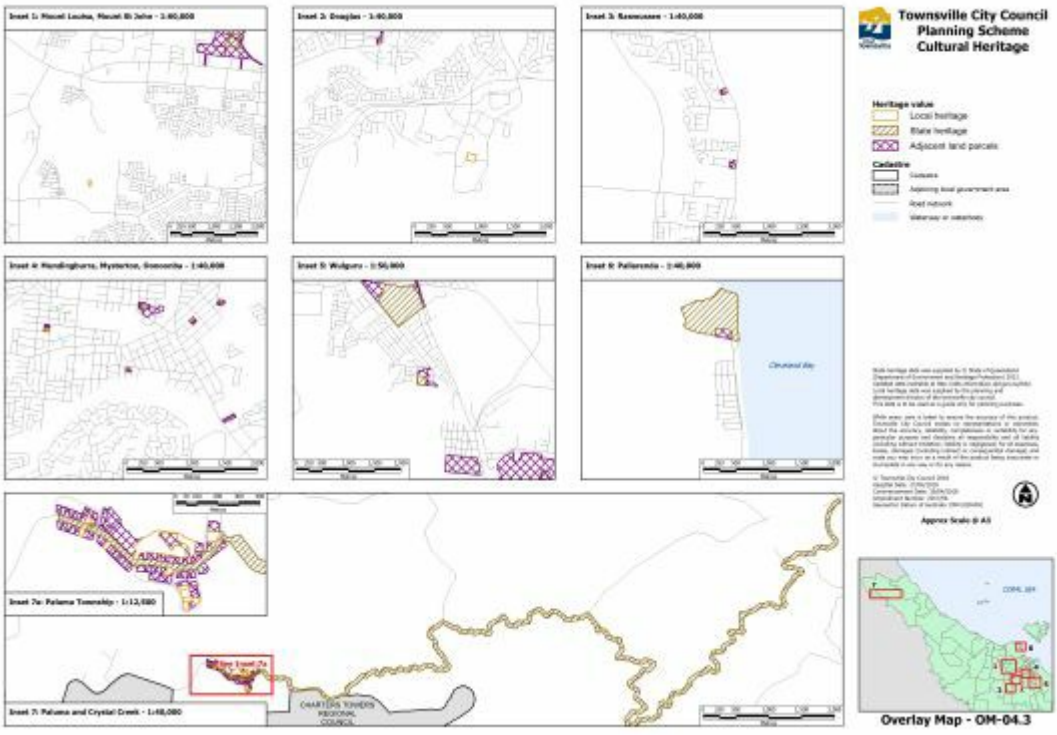
Cultural Heritage overlay map OM-04.2 (Heritage value)



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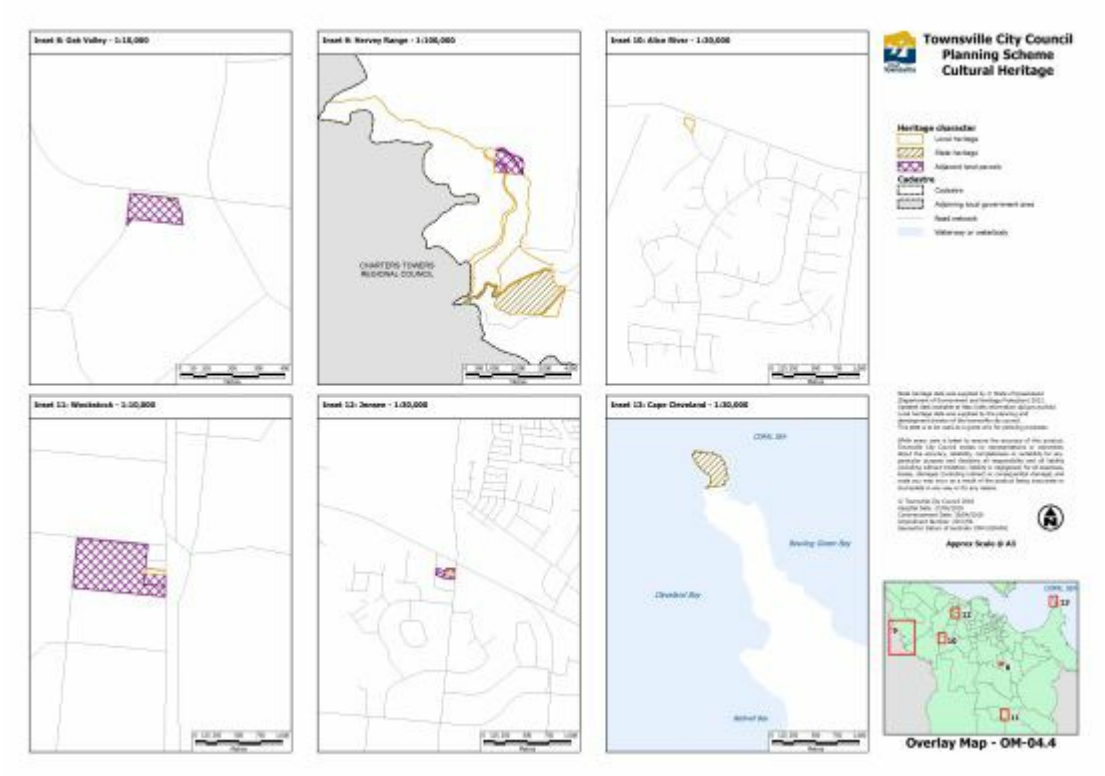
Cultural Heritage overlay map OM-04.3 (Heritage value)



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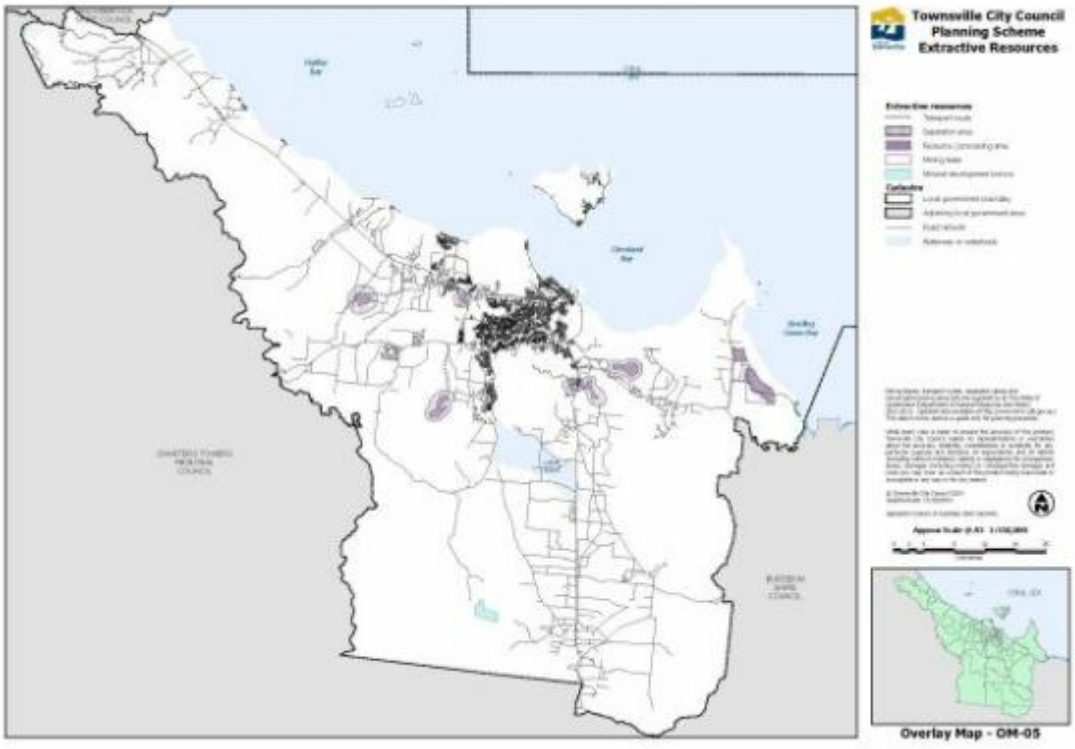
Cultural Heritage overlay map OM-04.4 (Heritage value)



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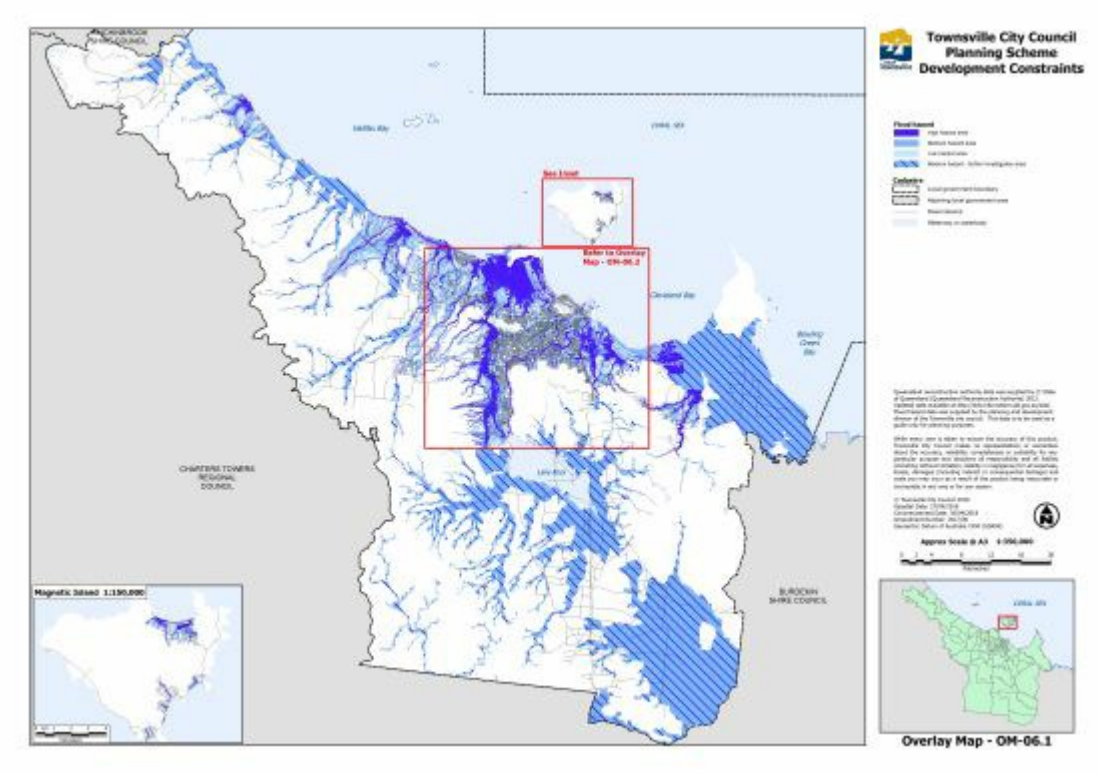
Natural assets overlay map OM-05 (Extractive Resources)



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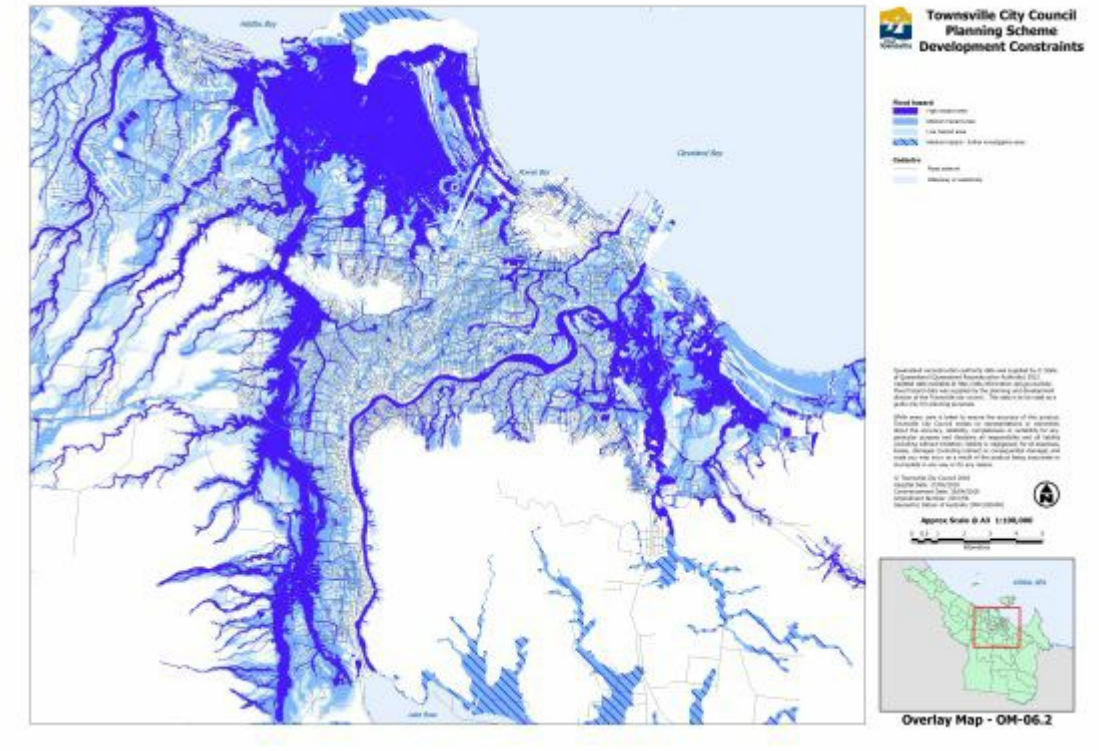
Development constraints overlay map OM-06.1 (Flood hazard)



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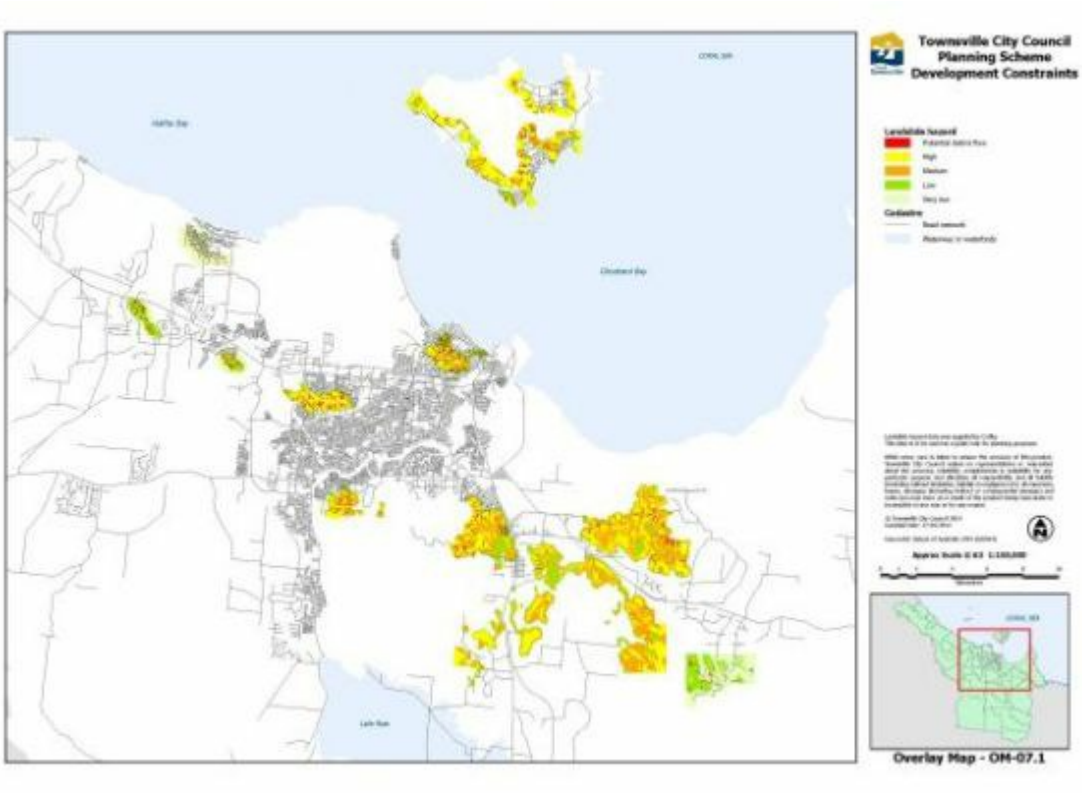
Development constraints overlay map OM-06.2 (Flood hazard)



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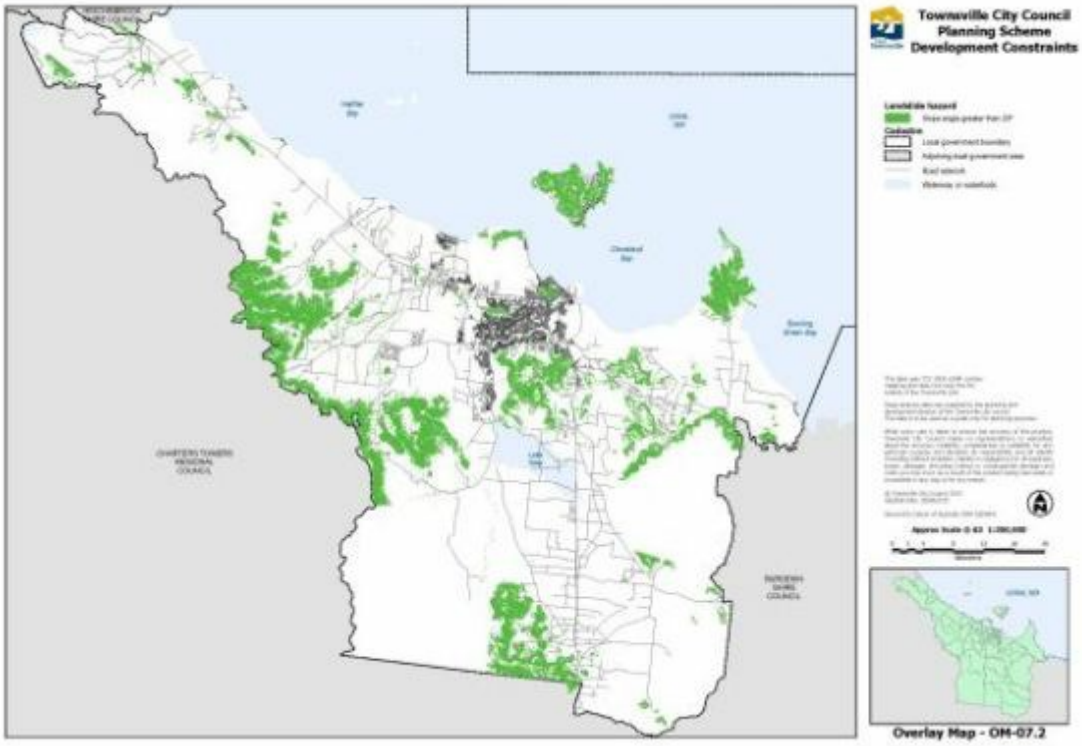
Development constraint overlay map OM-07.1 (Landslide hazard)



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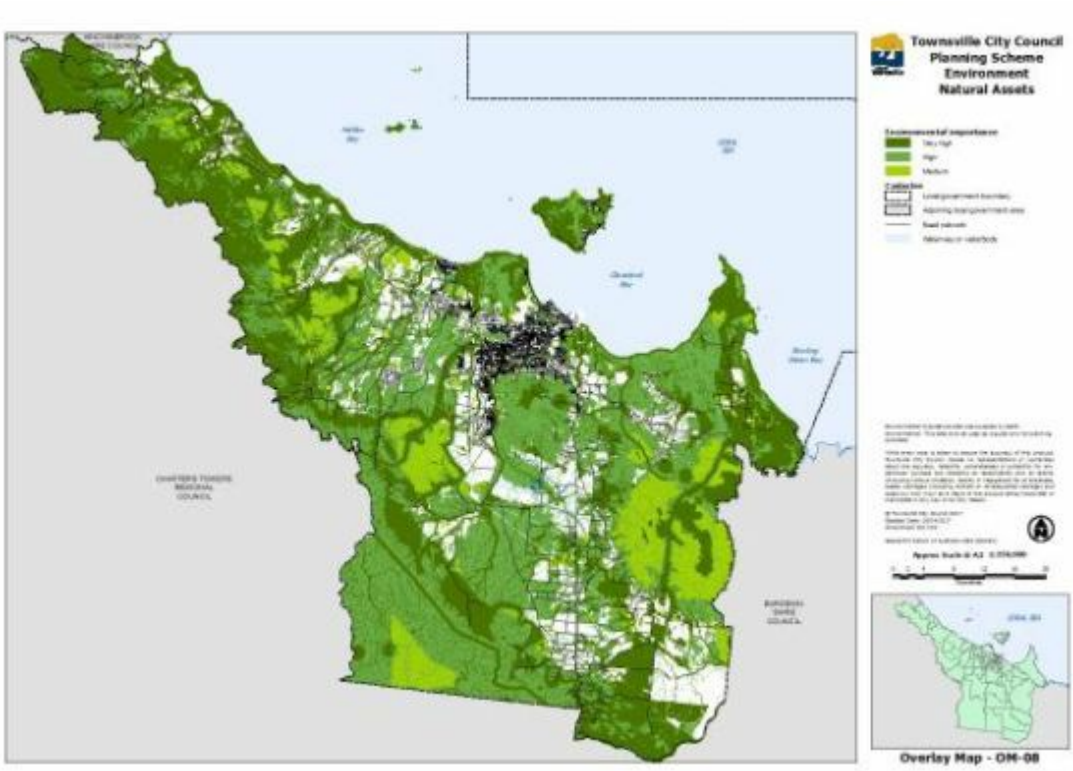
Development constraints overlay map OM-07.2 (Landslide hazard)



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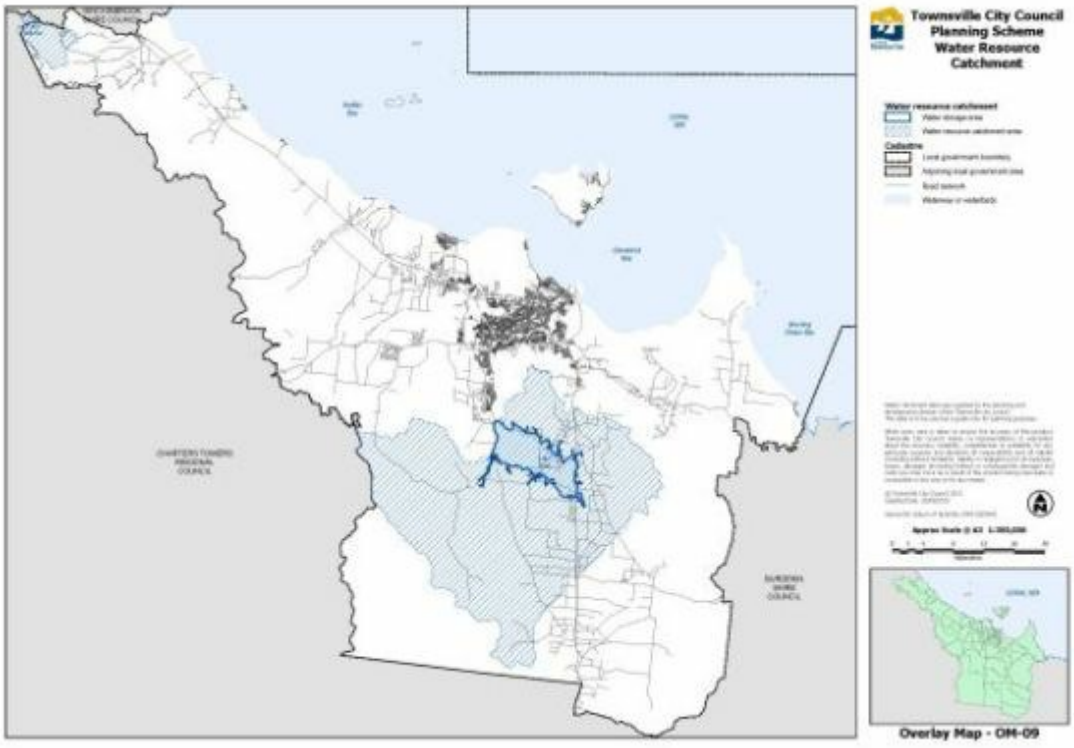
Natural assets environmental importance Overlay Map OM-08



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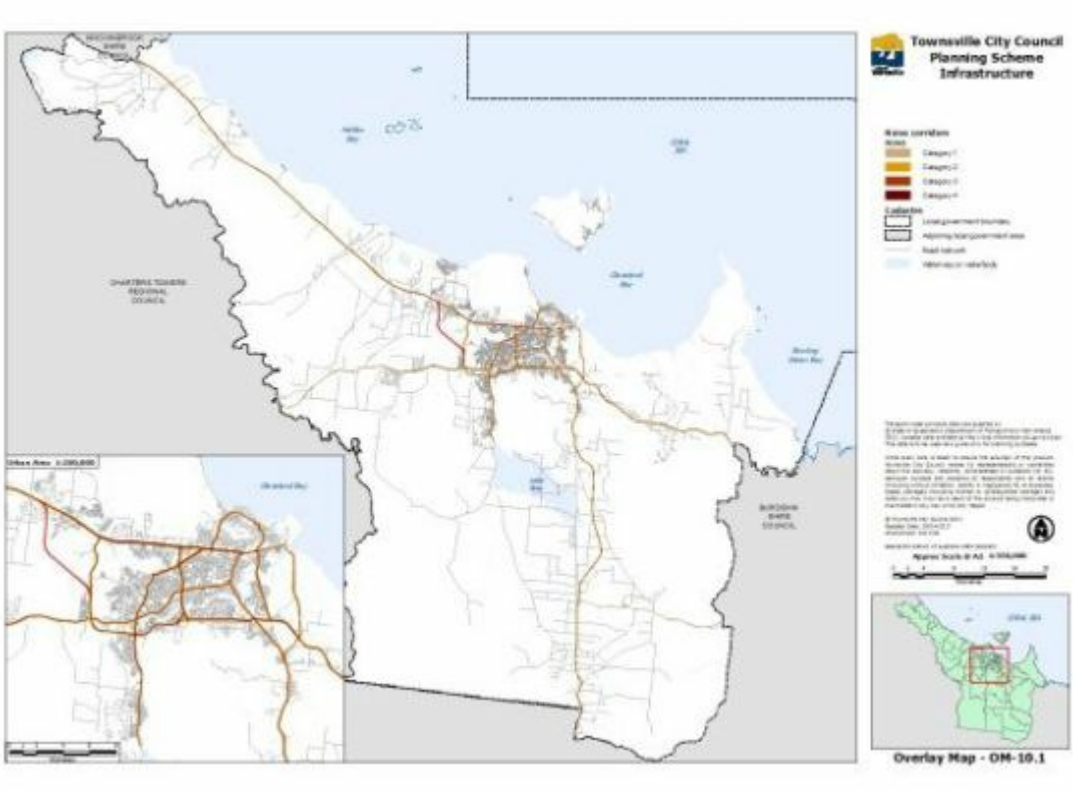
Natural resources overlay map OM-09 (Water resource catchments)



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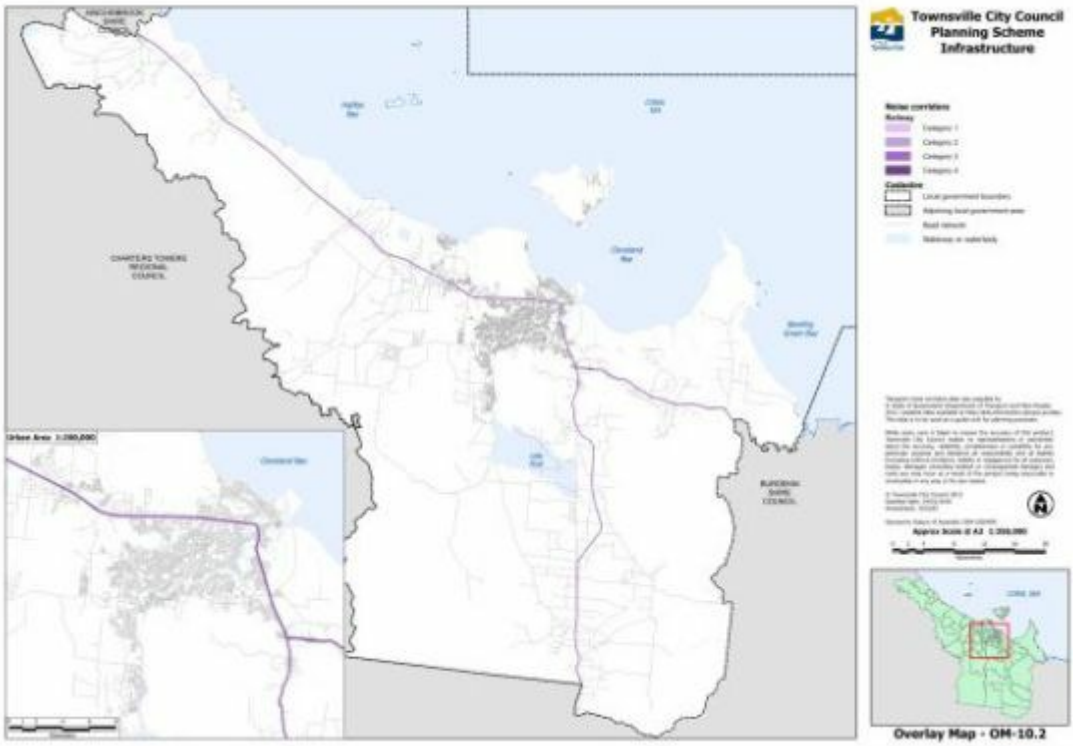
Infrastructure overlay map OM-10.1 (Noise corridors - Roads)



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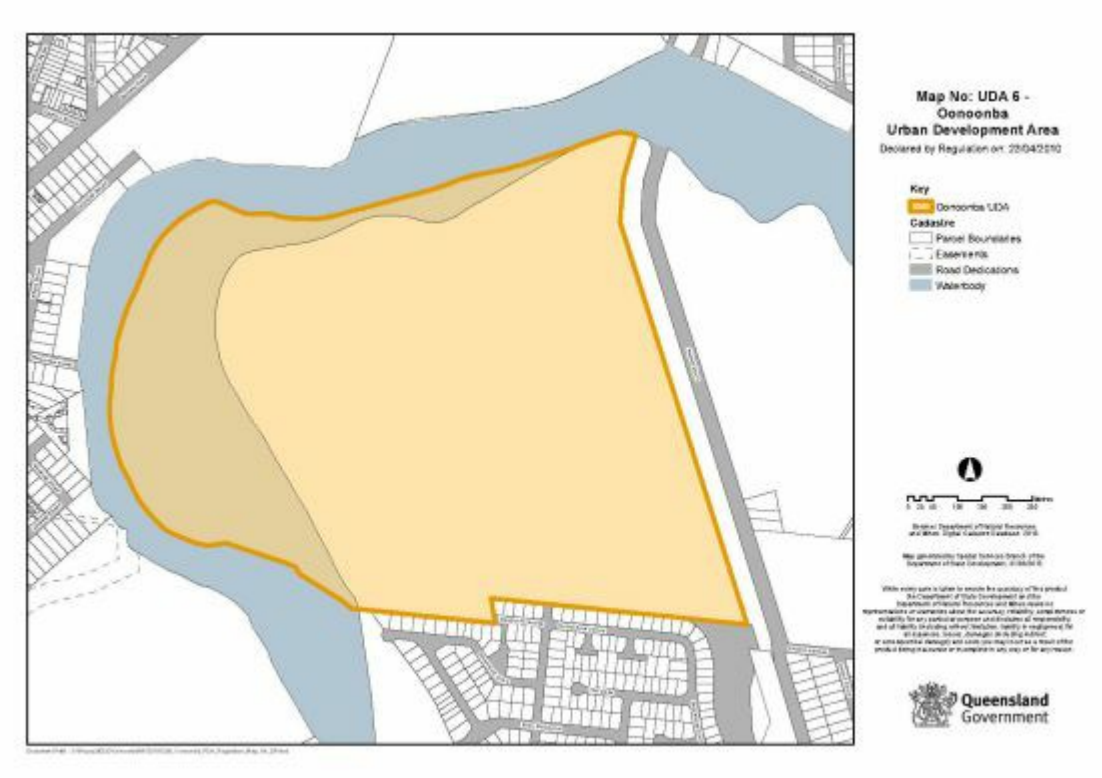
Infrastructure overlay map OM-10.2 (Noise corridors - Railway)

SC2.6 Other plans maps



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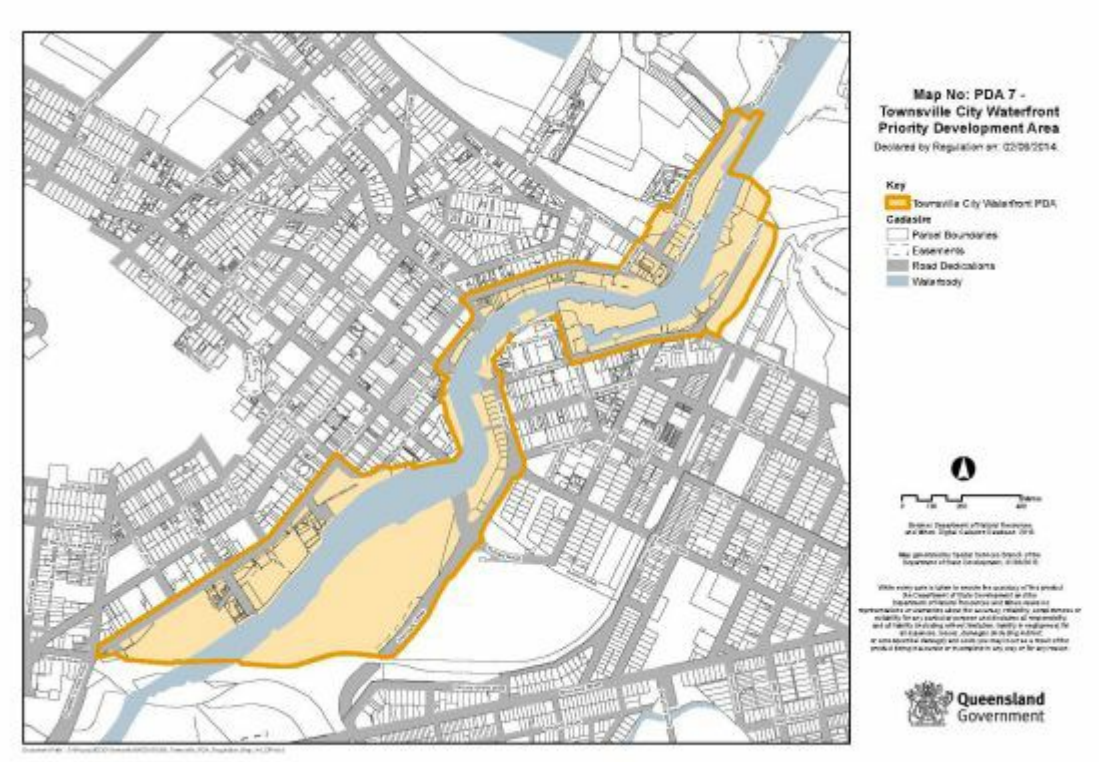
Oonoonba Urban Development Area Development Scheme Map OPM-01 (Map 2 - Oonoonba Urban Development Area)



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Townsville City Waterfront Priority Development Area OPM-02 (Map No. PDA 7 - Townsville City Waterfront Priority Development Area)

Schedule 3 Local government infrastructure plan mapping and supporting material

SC3.1 Planning assumption tables

Table SC3.1.1 - Existing and projected population

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected population					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
City to Pallarenda	1	Single dwelling	9,790	9,866	9,900	9,967	10,062	15,094
City to Pallarenda	1	Multiple dwelling	9,122	9,879	10,458	11,112	11,783	21,451
City to Pallarenda	1	Other dwelling	416	442	464	487	508	572
City to Pallarenda	1	Total	19,329	20,186	20,823	21,566	22,353	37,117
South Townsville	2	Single dwelling	5,855	5,838	5,807	5,787	5,786	8,133
South Townsville	2	Multiple dwelling	2,963	3,183	3,325	3,490	3,640	6,948
South Townsville	2	Other dwelling	79	79	79	78	78	78
South Townsville	2	Total	8,897	9,100	9,210	9,355	9,504	15,159
Central Suburbs	3	Single dwelling	27,126	26,971	26,810	26,686	26,613	35,482
Central Suburbs	3	Multiple dwelling	7,452	7,548	7,631	7,730	7,840	18,732
Central Suburbs	3	Other dwelling	278	278	278	278	277	278
Central Suburbs	3	Total	34,856	34,797	34,719	34,694	34,731	54,492
Bohle Mt Louisa	4	Single dwelling	8,011	10,125	11,692	13,296	14,738	21,003
Bohle Mt Louisa	4	Multiple dwelling	125	290	450	626	810	2,352
Bohle Mt Louisa	4	Other dwelling	261	261	261	261	261	261
Bohle Mt Louisa	4	Total	8,397	10,676	12,403	14,183	15,809	23,616
Kirwan	5	Single dwelling	23,124	23,138	23,034	22,936	22,844	24,749
Kirwan	5	Multiple dwelling	1,461	1,516	1,564	1,623	1,692	6,496
Kirwan	5	Other dwelling	15	15	15	15	15	12
Kirwan	5	Total	24,600	24,669	24,613	24,573	24,551	31,257
Bohle Plains	6	Single dwelling	1,261	2,510	4,019	5,541	6,892	11,517
Bohle Plains	6	Multiple dwelling	17	69	162	271	389	1,767
Bohle Plains	6	Other dwelling	4	4	4	4	4	4
Bohle Plains	6	Total	1,281	2,583	4,184	5,815	7,284	13,288
Northern beaches	7	Single dwelling	10,508	17,858	23,221	29,055	34,293	53,196
Northern beaches	7	Multiple dwelling	272	650	1,039	1,520	2,052	8,864
Northern beaches	7	Other dwelling	71	71	70	70	70	71
Northern beaches	7	Total	10,851	18,579	24,330	30,645	36,415	62,131
North Rural	8	Single dwelling	-	-	-	-	-	-
North Rural	8	Multiple dwelling	-	-	-	-	-	-
North Rural	8	Other dwelling	-	-	-	-	-	-
North Rural	8	Total	-	-	-	-	-	-
South Rural	9	Single dwelling	-	-	-	-	-	-
South Rural	9	Multiple dwelling	-	-	-	-	-	-
South Rural	9	Other dwelling	-	-	-	-	-	-
South Rural	9	Total	-	-	-	-	-	-
Upper Ross	10	Single dwelling	17,668	18,858	19,484	20,195	20,914	28,532
Upper Ross	10	Multiple dwelling	778	1,020	1,229	1,475	1,750	12,482
Upper Ross	10	Other dwelling	158	158	157	156	155	160
Upper Ross	10	Total	18,604	20,035	20,870	21,827	22,819	41,174
Southern Suburbs	11	Single dwelling	25,305	26,591	27,177	27,891	28,623	35,700
Southern Suburbs	11	Multiple dwelling	2,270	2,958	3,384	3,774	4,071	4,656
Southern Suburbs	11	Other dwelling	402	859	1,289	1,714	2,122	3,273
Southern Suburbs	11	Total	27,978	30,408	31,850	33,380	34,816	43,629
Eastern Rural	12	Single dwelling	-	-	-	-	3,529	29,509
Eastern Rural	12	Multiple dwelling	1	1	4	4	4	1

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected population					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Eastern Rural	12	Other dwelling	41	41	157	186	173	41
Eastern Rural	12	Total	42	42	160	190	3,706	29,551
Magnetic Island	13	Single dwelling	1,609	1,742	1,827	1,933	2,053	5,332
Magnetic Island	13	Multiple dwelling	532	570	602	640	682	2,819
Magnetic Island	13	Other dwelling	40	40	40	40	39	40
Magnetic Island	13	Total	2,182	2,352	2,469	2,612	2,775	8,191
Inside priority infrastructure area (total)		Single dwelling	130,257	143,496	152,972	163,286	176,346	268,247
		Multiple dwelling	24,994	27,683	29,846	32,266	34,715	86,568
		Other dwelling	1,766	2,249	2,813	3,289	3,702	4,790
		Total	157,017	173,427	185,631	198,840	214,763	359,605
Outside priority infrastructure area (total)		Single dwelling	22,120	23,414	25,861	28,204	28,115	43,310
		Multiple dwelling	121	132	142	153	166	555
		Other dwelling	856	856	853	851	848	856
		Total	23,097	24,403	26,857	29,209	29,130	44,721
Townsville City Council Local Government Area		Single dwelling	152,377	166,910	178,833	191,490	204,461	311,557
		Multiple dwelling	25,115	27,815	29,988	32,419	34,881	87,123
		Other dwelling	2,622	3,105	3,667	4,140	4,550	5,646
		Total	180,114	197,830	212,488	228,049	243,892	404,326

Table SC3.1.2 - Existing and projected employment

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected employees					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
City to Pallarenda	1	Retail	1,294	1,559	1,669	1,873	2,046	8,942
City to Pallarenda	1	Services	5,173	6,843	7,927	9,272	10,534	45,455
City to Pallarenda	1	Professional	7,908	9,170	10,044	11,117	12,185	40,854
City to Pallarenda	1	Industrial	2,562	2,591	2,616	2,639	2,662	3,049
City to Pallarenda	1	Other	354	385	401	424	444	1,485
City to Pallarenda	1	Total	17,292	20,548	22,656	25,325	27,870	99,785
South Townsville	2	Retail	802	878	941	1,056	1,123	5,366
South Townsville	2	Services	1,445	1,492	1,566	1,657	1,706	3,876
South Townsville	2	Professional	1,320	1,338	1,388	1,449	1,474	2,953
South Townsville	2	Industrial	1,863	2,034	2,163	2,279	2,306	3,320
South Townsville	2	Other	130	134	137	140	143	408
South Townsville	2	Total	5,559	5,877	6,195	6,581	6,753	15,923
Central Suburbs	3	Retail	3,632	3,941	4,046	4,236	4,389	7,569
Central Suburbs	3	Services	8,084	8,473	8,703	8,976	9,220	13,685
Central Suburbs	3	Professional	3,041	3,364	3,546	3,762	3,968	8,066
Central Suburbs	3	Industrial	2,172	2,233	2,276	2,315	2,349	2,737
Central Suburbs	3	Other	126	162	180	206	227	855
Central Suburbs	3	Total	17,055	18,173	18,751	19,494	20,152	32,912
Bohle Mt Louisa	4	Retail	3,819	3,913	3,953	4,028	4,093	12,982
Bohle Mt Louisa	4	Services	2,155	2,256	2,323	2,408	2,490	8,615
Bohle Mt Louisa	4	Professional	2,054	2,103	2,138	2,181	2,226	5,278
Bohle Mt Louisa	4	Industrial	7,489	8,304	8,993	9,686	10,362	40,971
Bohle Mt Louisa	4	Other	1,394	1,419	1,432	1,452	1,469	4,158
Bohle Mt Louisa	4	Total	16,911	17,994	18,839	19,755	20,640	72,004
Kirwan	5	Retail	1,587	1,776	1,839	1,948	2,028	3,638
Kirwan	5	Services	3,349	3,719	3,873	4,020	4,119	4,941
Kirwan	5	Professional	1,403	1,642	1,757	1,870	1,953	2,775
Kirwan	5	Industrial	652	652	652	652	652	654
Kirwan	5	Other	19	75	99	130	154	309

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected employees					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Kirwan	5	Total	7,010	7,864	8,222	8,621	8,905	12,317
Bohle Plains	6	Retail	26	29	30	33	35	2,312
Bohle Plains	6	Services	19	23	26	29	32	2,586
Bohle Plains	6	Professional	21	23	24	26	27	884
Bohle Plains	6	Industrial	90	123	152	181	210	10,833
Bohle Plains	6	Other	11	12	13	14	14	968
Bohle Plains	6	Total	168	210	245	282	319	17,583
Northern beaches	7	Retail	316	422	467	555	625	4,274
Northern beaches	7	Services	516	731	898	1,146	1,316	6,249
Northern beaches	7	Professional	200	272	323	385	447	2,000
Northern beaches	7	Industrial	363	490	593	693	787	2,323
Northern beaches	7	Other	11	34	48	70	86	1,068
Northern beaches	7	Total	1,405	1,948	2,328	2,848	3,261	15,914
North Rural	8	Retail	-	-	-	-	-	-
North Rural	8	Services	-	-	-	-	-	-
North Rural	8	Professional	-	-	-	-	-	-
North Rural	8	Industrial	-	-	-	-	-	-
North Rural	8	Other	-	-	-	-	-	-
North Rural	8	Total	-	-	-	-	-	-
South Rural	9	Retail	-	-	-	-	-	-
South Rural	9	Services	-	-	-	-	-	-
South Rural	9	Professional	-	-	-	-	-	-
South Rural	9	Industrial	-	-	-	-	-	-
South Rural	9	Other	-	-	-	-	-	-
South Rural	9	Total	-	-	-	-	-	-
Upper Ross	10	Retail	385	456	485	541	588	4,257
Upper Ross	10	Services	1,384	1,460	1,509	1,570	1,628	3,424
Upper Ross	10	Professional	374	424	458	501	545	2,251
Upper Ross	10	Industrial	507	508	508	508	509	520
Upper Ross	10	Other	32	44	50	58	66	426
Upper Ross	10	Total	2,683	2,891	3,011	3,180	3,336	10,878
Southern Suburbs	11	Retail	1,027	1,166	1,226	1,339	1,436	20,098
Southern Suburbs	11	Services	8,558	8,758	8,891	9,062	9,226	24,755
Southern Suburbs	11	Professional	4,883	4,988	5,063	5,157	5,253	14,620
Southern Suburbs	11	Industrial	2,761	3,159	3,499	3,842	4,179	25,873
Southern Suburbs	11	Other	126	171	195	230	261	6,828
Southern Suburbs	11	Total	17,356	18,242	18,874	19,629	20,356	92,174
Eastern Rural	12	Retail	7	7	46	167	425	1,959
Eastern Rural	12	Services	17	17	73	246	623	6,672
Eastern Rural	12	Professional	5	5	22	83	199	3,480
Eastern Rural	12	Industrial	38	38	39	97	237	116
Eastern Rural	12	Other	6	6	15	48	108	326
Eastern Rural	12	Total	74	74	195	641	1,591	12,553
Magnetic Island	13	Retail	126	127	127	127	127	805
Magnetic Island	13	Services	360	361	361	362	363	1,312
Magnetic Island	13	Professional	150	151	151	152	152	981
Magnetic Island	13	Industrial	155	155	155	155	156	307
Magnetic Island	13	Other	21	21	22	22	22	175
Magnetic Island	13	Total	813	815	816	818	819	3,580
		Retail	13,022	14,273	14,830	15,902	16,915	72,202

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected employees					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Inside priority infrastructure area (total)		Services	31,061	34,132	36,150	38,748	41,256	121,570
		Professional	21,359	23,479	24,915	26,682	28,429	84,142
		Industrial	18,652	20,288	21,646	23,048	24,408	90,703
		Other	2,230	2,463	2,591	2,793	2,994	17,006
		Total	86,325	94,635	100,131	107,174	114,002	385,623
Outside priority infrastructure area (total)		Retail	171	217	237	274	305	8,412
		Services	740	797	835	881	926	6,948
		Professional	583	622	649	682	716	4,253
		Industrial	1,800	2,176	2,482	2,778	3,057	7,882
		Other	438	467	483	506	525	4,917
		Total	3,732	4,280	4,686	5,121	5,529	32,412
Townsville City Council Local Government Area		Retail	13,193	14,491	15,067	16,176	17,220	80,614
		Services	31,801	34,929	36,985	39,629	42,182	128,518
		Professional	21,943	24,101	25,564	27,365	29,145	88,395
		Industrial	20,452	22,464	24,128	25,826	27,465	98,585
		Other	2,668	2,930	3,074	3,299	3,519	21,923
		Total	90,057	98,915	104,817	112,295	119,531	418,035

Table SC3.1.3 - Existing and projected residential dwellings

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected dwellings					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
City to Pallarenda	1	Single dwelling	3,761	3,840	3,908	3,987	4,070	5,391
City to Pallarenda	1	Multiple dwelling	5,068	5,488	5,810	6,173	6,546	11,917
City to Pallarenda	1	Other dwelling	231	245	258	271	282	318
City to Pallarenda	1	Total	9,060	9,574	9,976	10,431	10,899	17,626
South Townsville	2	Single dwelling	2,187	2,212	2,233	2,257	2,287	2,905
South Townsville	2	Multiple dwelling	1,646	1,768	1,847	1,939	2,022	3,860
South Townsville	2	Other dwelling	44	44	44	44	43	43
South Townsville	2	Total	3,877	4,024	4,124	4,240	4,352	6,808
Central Suburbs	3	Single dwelling	10,179	10,273	10,367	10,468	10,575	12,672
Central Suburbs	3	Multiple dwelling	4,140	4,193	4,239	4,294	4,356	10,407
Central Suburbs	3	Other dwelling	155	155	154	154	154	154
Central Suburbs	3	Total	14,474	14,620	14,761	14,917	15,085	23,233
Bohle Mt Louisa	4	Single dwelling	2,776	3,603	4,250	4,929	5,550	7,501
Bohle Mt Louisa	4	Multiple dwelling	69	161	250	348	450	1,307
Bohle Mt Louisa	4	Other dwelling	145	145	145	145	145	145
Bohle Mt Louisa	4	Total	2,990	3,909	4,645	5,422	6,145	8,953
Kirwan	5	Single dwelling	8,149	8,286	8,383	8,480	8,575	8,839
Kirwan	5	Multiple dwelling	812	842	869	902	940	3,609
Kirwan	5	Other dwelling	8	8	8	8	8	7
Kirwan	5	Total	8,969	9,136	9,260	9,390	9,524	12,454
Bohle Plains	6	Single dwelling	390	858	1,437	2,039	2,579	4,113
Bohle Plains	6	Multiple dwelling	9	39	90	150	216	982
Bohle Plains	6	Other dwelling	2	2	2	2	2	2
Bohle Plains	6	Total	402	899	1,529	2,191	2,797	5,097
Northern beaches	7	Single dwelling	3,517	6,279	8,390	10,743	12,891	18,999
Northern beaches	7	Multiple dwelling	151	361	577	845	1,140	4,924
Northern beaches	7	Other dwelling	39	39	39	39	39	39
Northern beaches	7	Total	3,708	6,679	9,006	11,627	14,069	23,962
North Rural	8	Single dwelling	-	-	-	-	-	-
North Rural	8	Multiple dwelling	-	-	-	-	-	-

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected dwellings					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
North Rural	8	Other dwelling	-	-	-	-	-	-
North Rural	8	Total	-	-	-	-	-	-
South Rural	9	Single dwelling	-	-	-	-	-	-
South Rural	9	Multiple dwelling	-	-	-	-	-	-
South Rural	9	Other dwelling	-	-	-	-	-	-
South Rural	9	Total	-	-	-	-	-	-
Upper Ross	10	Single dwelling	6,156	6,697	7,043	7,428	7,798	10,190
Upper Ross	10	Multiple dwelling	432	566	683	820	972	6,934
Upper Ross	10	Other dwelling	88	88	87	87	86	89
Upper Ross	10	Total	6,676	7,351	7,813	8,334	8,857	17,213
Southern Suburbs	11	Single dwelling	8,952	9,555	9,933	10,362	10,791	12,750
Southern Suburbs	11	Multiple dwelling	1,261	1,643	1,880	2,097	2,262	2,587
Southern Suburbs	11	Other dwelling	223	477	716	952	1,179	1,818
Southern Suburbs	11	Total	10,437	11,676	12,529	13,411	14,232	17,155
Eastern Rural	12	Single dwelling	-	-	-	-	1,328	10,539
Eastern Rural	12	Multiple dwelling	1	1	2	2	2	1
Eastern Rural	12	Other dwelling	23	23	87	103	96	23
Eastern Rural	12	Total	24	24	89	106	1,427	10,562
Magnetic Island	13	Single dwelling	660	718	759	808	872	1,904
Magnetic Island	13	Multiple dwelling	296	316	334	355	379	1,566
Magnetic Island	13	Other dwelling	22	22	22	22	22	22
Magnetic Island	13	Total	978	1,057	1,115	1,186	1,273	3,493
Inside priority infrastructure area (total)		Single dwelling	46,728	52,321	56,703	61,501	67,317	95,803
		Multiple dwelling	13,885	15,379	16,581	17,925	19,286	48,093
		Other dwelling	981	1,249	1,563	1,827	2,057	2,661
		Total	61,595	68,949	74,847	81,254	88,660	146,557
Outside priority infrastructure area (total)		Single dwelling	8,159	8,757	9,803	10,822	10,954	15,468
		Multiple dwelling	67	73	79	85	92	308
		Other dwelling	476	476	474	473	471	476
		Total	8,702	9,306	10,357	11,380	11,518	16,252
Townsville City Council Local Government Area		Single dwelling	54,888	61,077	66,506	72,323	78,272	111,270
		Multiple dwelling	13,953	15,453	16,660	18,011	19,378	48,402
		Other dwelling	1,457	1,725	2,037	2,300	2,528	3,137
		Total	70,297	78,255	85,203	92,634	100,178	162,809

Table SC3.1.4 - Existing and projected non-residential floorspace (m2 GFA)

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected floorspace					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
City to Pallarenda	1	Retail	45,291	54,578	58,428	65,564	71,606	312,970
City to Pallarenda	1	Services	87,946	116,324	134,751	157,619	179,075	772,735
City to Pallarenda	1	Professional	142,353	165,057	180,783	200,105	219,330	735,372
City to Pallarenda	1	Industrial	230,542	233,223	235,408	237,532	239,536	274,410
City to Pallarenda	1	Other	7,086	7,694	8,015	8,476	8,875	29,700
City to Pallarenda	1	Total	513,218	576,876	617,385	669,297	718,422	2,125,187
South Townsville	2	Retail	28,069	30,736	32,926	36,977	39,315	187,810
South Townsville	2	Services	24,558	25,370	26,630	28,164	28,999	65,892
South Townsville	2	Professional	23,756	24,082	24,989	26,077	26,532	53,154
South Townsville	2	Industrial	167,627	183,084	194,643	205,093	207,552	298,800
South Townsville	2	Other	2,595	2,687	2,736	2,806	2,868	8,160
South Townsville	2	Total	246,604	265,960	281,924	299,117	305,268	613,816

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected floorspace					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Central Suburbs	3	Retail	127,134	137,922	141,612	148,254	153,600	264,915
Central Suburbs	3	Services	137,430	144,042	147,945	152,594	156,747	232,645
Central Suburbs	3	Professional	54,735	60,560	63,830	67,712	71,419	145,188
Central Suburbs	3	Industrial	195,463	200,937	204,876	208,365	211,390	246,330
Central Suburbs	3	Other	2,516	3,237	3,601	4,110	4,538	17,100
Central Suburbs	3	Total	517,278	546,698	561,864	581,035	597,694	906,178
Bohle Mt Louisa	4	Retail	133,654	136,940	138,343	140,976	143,254	454,370
Bohle Mt Louisa	4	Services	36,641	38,345	39,486	40,931	42,322	146,455
Bohle Mt Louisa	4	Professional	36,968	37,849	38,477	39,265	40,069	95,004
Bohle Mt Louisa	4	Industrial	674,032	747,334	809,402	871,761	932,613	3,687,390
Bohle Mt Louisa	4	Other	27,882	28,379	28,648	29,038	29,383	83,160
Bohle Mt Louisa	4	Total	909,176	988,848	1,054,357	1,121,972	1,187,641	4,466,379
Kirwan	5	Retail	55,544	62,147	64,376	68,183	70,977	127,330
Kirwan	5	Services	56,932	63,220	65,845	68,344	70,016	83,997
Kirwan	5	Professional	25,259	29,555	31,634	33,655	35,150	49,950
Kirwan	5	Industrial	58,706	58,706	58,706	58,706	58,706	58,860
Kirwan	5	Other	375	1,507	1,989	2,609	3,071	6,180
Kirwan	5	Total	196,816	215,134	222,549	231,497	237,921	326,317
Bohle Plains	6	Retail	918	1,018	1,061	1,142	1,213	80,920
Bohle Plains	6	Services	328	391	436	492	548	43,962
Bohle Plains	6	Professional	382	412	433	460	488	15,912
Bohle Plains	6	Industrial	8,085	11,072	13,656	16,301	18,932	974,970
Bohle Plains	6	Other	225	245	256	272	286	19,360
Bohle Plains	6	Total	9,938	13,138	15,842	18,668	21,468	1,135,124
Northern beaches	7	Retail	11,072	14,762	16,353	19,408	21,884	149,590
Northern beaches	7	Services	8,766	12,419	15,259	19,481	22,374	106,233
Northern beaches	7	Professional	3,593	4,902	5,810	6,929	8,044	36,000
Northern beaches	7	Industrial	32,667	44,093	53,367	62,350	70,793	209,070
Northern beaches	7	Other	210	677	953	1,397	1,717	21,360
Northern beaches	7	Total	56,309	76,853	91,742	109,564	124,812	522,253
North Rural	8	Retail	-	-	-	-	-	-
North Rural	8	Services	-	-	-	-	-	-
North Rural	8	Professional	-	-	-	-	-	-
North Rural	8	Industrial	-	-	-	-	-	-
North Rural	8	Other	-	-	-	-	-	-
North Rural	8	Total	-	-	-	-	-	-
South Rural	9	Retail	-	-	-	-	-	-
South Rural	9	Services	-	-	-	-	-	-
South Rural	9	Professional	-	-	-	-	-	-
South Rural	9	Industrial	-	-	-	-	-	-
South Rural	9	Other	-	-	-	-	-	-
South Rural	9	Total	-	-	-	-	-	-
Upper Ross	10	Retail	13,484	15,947	16,987	18,928	20,592	148,995
Upper Ross	10	Services	23,535	24,823	25,660	26,698	27,674	58,208
Upper Ross	10	Professional	6,735	7,626	8,251	9,025	9,804	40,518
Upper Ross	10	Industrial	45,638	45,683	45,721	45,759	45,796	46,800
Upper Ross	10	Other	637	870	993	1,170	1,322	8,520
Upper Ross	10	Total	90,029	94,950	97,612	101,580	105,188	303,041
Southern Suburbs	11	Retail	35,937	40,825	42,918	46,851	50,261	703,430
Southern Suburbs	11	Services	145,493	148,878	151,154	154,047	156,842	420,835
Southern Suburbs	11	Professional	87,899	89,781	91,129	92,825	94,562	263,160
Southern Suburbs	11	Industrial	248,526	284,343	314,891	345,777	376,110	2,328,570

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected floorspace					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Southern Suburbs	11	Other	2,521	3,415	3,899	4,605	5,228	136,560
Southern Suburbs	11	Total	520,377	567,242	603,991	644,103	683,004	3,852,555
Eastern Rural	12	Retail	262	262	1,597	5,857	14,872	68,565
Eastern Rural	12	Services	296	296	1,243	4,188	10,590	113,424
Eastern Rural	12	Professional	84	84	405	1,493	3,579	62,640
Eastern Rural	12	Industrial	3,462	3,462	3,483	8,698	21,298	10,440
Eastern Rural	12	Other	115	115	306	952	2,153	6,520
Eastern Rural	12	Total	4,218	4,218	7,033	21,187	52,491	261,589
Magnetic Island	13	Retail	4,419	4,430	4,436	4,445	4,453	28,175
Magnetic Island	13	Services	6,119	6,132	6,141	6,153	6,165	22,304
Magnetic Island	13	Professional	2,705	2,716	2,724	2,733	2,744	17,658
Magnetic Island	13	Industrial	13,939	13,955	13,968	13,982	13,996	27,630
Magnetic Island	13	Other	428	430	431	432	433	3,500
Magnetic Island	13	Total	27,610	27,663	27,699	27,746	27,791	99,267
Inside priority infrastructure area (total)		Retail	455,785	499,569	519,037	556,585	592,028	2,527,070
		Services	528,042	580,239	614,550	658,712	701,351	2,066,690
		Professional	384,470	422,624	448,465	480,280	511,722	1,514,556
		Industrial	1,678,685	1,825,891	1,948,121	2,074,324	2,196,723	8,163,270
		Other	44,592	49,256	51,825	55,865	59,874	340,120
		Total	3,091,573	3,377,580	3,581,999	3,825,767	4,061,699	14,611,706
Outside priority infrastructure area (total)		Retail	5,978	7,612	8,300	9,581	10,678	294,420
		Services	12,573	13,551	14,190	14,985	15,735	118,116
		Professional	10,502	11,197	11,683	12,284	12,886	76,554
		Industrial	162,005	195,848	223,355	250,033	275,142	709,380
		Other	8,766	9,350	9,662	10,114	10,509	98,340
		Total	199,824	237,558	267,189	296,997	324,950	1,296,810
Townsville City Council Local Government Area		Retail	461,763	507,181	527,337	566,167	602,706	2,821,490
		Services	540,616	593,790	628,740	673,697	717,086	2,184,806
		Professional	394,972	433,821	460,149	492,564	524,608	1,591,110
		Industrial	1,840,690	2,021,739	2,171,477	2,324,357	2,471,865	8,872,650
		Other	53,358	58,606	61,486	65,979	70,384	438,460
		Total	3,291,397	3,615,138	3,849,188	4,122,764	4,386,648	15,908,516

Table SC3.1.5 - Existing and projected education enrolments

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected enrolments					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
City to Pallarenda	1	Pre & primary	1,407	1,368	1,334	1,334	1,336	1,503
City to Pallarenda	1	Secondary	1,365	1,380	1,427	1,412	1,457	1,502
City to Pallarenda	1	Tertiary	-	-	-	-	-	-
City to Pallarenda	1	Total	2,772	2,748	2,760	2,746	2,793	3,005
South Townsville	2	Pre & primary	272	263	248	244	241	269
South Townsville	2	Secondary	675	781	778	801	819	983
South Townsville	2	Tertiary	-	-	-	-	-	-
South Townsville	2	Total	947	1,044	1,026	1,045	1,060	1,251
Central Suburbs	3	Pre & primary	6,057	5,794	5,641	5,609	5,757	6,431
Central Suburbs	3	Secondary	4,347	4,544	4,600	4,582	4,643	4,805
Central Suburbs	3	Tertiary	1,340	1,473	1,577	1,686	1,792	1,855
Central Suburbs	3	Total	11,744	11,810	11,818	11,877	12,191	13,090
Bohle Mt Louisa	4	Pre & primary	563	536	834	1,187	1,219	1,227
Bohle Mt Louisa	4	Secondary	279	329	347	344	359	540
Bohle Mt Louisa	4	Tertiary	420	462	494	528	562	582

Column 1		Column 2	Column 3					
Projection area		LGIP development type	Existing and projected enrolments					
Location	LRA		2011	2016	2021	2026	2031	Ultimate
Bohle Mt Louisa	4	Total	1,262	1,326	1,676	2,059	2,139	2,349
Kirwan	5	Pre & primary	2,713	2,627	2,549	2,546	2,562	2,668
Kirwan	5	Secondary	3,144	3,042	2,972	2,950	2,934	2,750
Kirwan	5	Tertiary	-	-	-	-	-	-
Kirwan	5	Total	5,857	5,668	5,521	5,496	5,496	5,417
Bohle Plains	6	Pre & primary	-	1,088	1,177	1,281	1,356	1,476
Bohle Plains	6	Secondary	-	-	-	-	-	-
Bohle Plains	6	Tertiary	-	-	-	-	-	-
Bohle Plains	6	Total	-	1,088	1,177	1,281	1,356	1,476
Northern beaches	7	Pre & primary	889	1,489	1,808	1,820	1,832	1,935
Northern beaches	7	Secondary	495	799	890	1,008	1,105	1,288
Northern beaches	7	Tertiary	-	-	-	-	-	-
Northern beaches	7	Total	1,384	2,288	2,699	2,828	2,937	3,223
North Rural	8	Pre & primary	-	-	-	-	-	-
North Rural	8	Secondary	-	-	-	-	-	-
North Rural	8	Tertiary	-	-	-	-	-	-
North Rural	8	Total	-	-	-	-	-	-
South Rural	9	Pre & primary	-	-	-	-	-	-
South Rural	9	Secondary	-	-	-	-	-	-
South Rural	9	Tertiary	-	-	-	-	-	-
South Rural	9	Total	-	-	-	-	-	-
Upper Ross	10	Pre & primary	2,309	2,274	2,218	2,237	2,260	2,378
Upper Ross	10	Secondary	739	827	846	878	908	974
Upper Ross	10	Tertiary	-	-	-	-	-	-
Upper Ross	10	Total	3,048	3,101	3,063	3,115	3,168	3,352
Southern Suburbs	11	Pre & primary	3,340	3,210	3,212	3,288	3,365	3,753
Southern Suburbs	11	Secondary	1,154	1,230	1,214	1,219	1,257	1,632
Southern Suburbs	11	Tertiary	12,015	13,203	14,144	15,115	16,068	16,710
Southern Suburbs	11	Total	16,509	17,642	18,570	19,622	20,690	22,095
Eastern Rural	12	Pre & primary	-	-	290	393	585	650
Eastern Rural	12	Secondary	-	-	-	287	296	325
Eastern Rural	12	Tertiary	-	-	-	-	-	-
Eastern Rural	12	Total	-	-	290	680	881	975
Magnetic Island	13	Pre & primary	164	172	171	179	189	283
Magnetic Island	13	Secondary	-	-	-	-	-	-
Magnetic Island	13	Tertiary	-	-	-	-	-	-
Magnetic Island	13	Total	164	172	171	179	189	283
Inside priority infrastructure area (total)		Pre & primary	17,714	18,820	19,481	20,119	20,702	22,573
		Secondary	12,198	12,931	13,074	13,481	13,777	14,798
		Tertiary	13,775	15,137	16,216	17,329	18,422	19,147
		Total	43,687	46,888	48,771	50,929	52,900	56,518
Outside priority infrastructure area (total)		Pre & primary	998	975	990	1,022	1,056	1,179
		Secondary	694	707	731	724	747	800
		Tertiary	-	-	-	-	-	-
		Total	1,692	1,682	1,721	1,745	1,803	1,979
Townsville City Council Local Government Area		Pre & primary	18,712	19,795	20,471	21,140	21,757	23,752
		Secondary	12,892	13,638	13,806	14,205	14,524	15,598
		Tertiary	13,775	15,137	16,216	17,329	18,422	19,147
		Total	45,379	48,569	50,492	52,674	54,703	58,497

Table SC3.1.6a - Planned demand generation rate for a trunk infrastructure network
(Lots less than threshold)

Column 1 – Area			Column 2 (n/a)	Column 3 – Planned density			Column 4 - Demand generation rate for a trunk infrastructure network (per net developable Ha)				
Zone	Zone	Precinct		Plot ratio (Non-residential)	Plot ratio (Residential)	Dwelling density (no./Ha)	Water (EP)	Sewerage (EP)	Roads (trip ends/day)	Pathways (trip ends/day)	Parks (ERP)
CF	Community Facilities	All		-	-	-	-	-	-	-	-
CR	Character Residential	All		-	-	16.7	46.7	46.7	121.2	7.2	191.3
DC	District Centre	All		0.45	-	-	81.6	103.5	1,128.5	13.2	-
EC	Emerging Communities	MCF2		0.35	-	-	63.5	80.5	877.7	10.2	-
EC	Emerging Communities	MCNS		0.80	-	-	145.1	184.0	2,006.1	23.4	-
EC	Emerging Communities	Other		0.50	0.50	21.5	56.8	57.3	181.0	9.7	225.7
HDR	High Density Residential	PS		6.90	6.90	590.6	1,273.2	1,335.7	4,694.2	265.8	4,252.6
HDR	High Density Residential	Other		1.08	1.08	80.0	164.1	168.2	694.3	36.5	576.1
HII	High Impact Industry	All		0.65	-	-	9.5	9.7	687.0	7.0	-
LC	Local Centre	All		0.45	-	-	81.6	103.5	1,128.5	13.2	-
LDR	Low Density Residential	MCF1		0.35	-	0	63.5	80.5	877.7	10.2	-
LDR	Low Density Residential	MHF1		0.53	-	-	66.6	81.1	2,026.9	24.4	-
LDR	Low Density Residential	RRRC		0.50	0.50	20.9	57.1	57.4	165.1	9.3	230.8
LDR	Low Density Residential	ST		-	-	10.0	28.0	28.0	72.7	4.3	114.8
LDR	Low Density Residential	Other		0.50	0.50	21.0	57.0	57.2	156.6	9.2	232.0
LII	Low Impact Industry	All		0.56	-	-	35.6	44.0	871.5	9.5	-
MC	Major Centre	ACC		0.80	1.80	36.0	180.9	212.0	1,777.7	33.6	259.2
MC	Major Centre	ACF		0.50	-	-	90.7	115.0	1,253.8	14.6	-
MC	Major Centre	HPMC(MCC)		0.80	-	-	145.1	184.0	2,006.1	23.4	-
MC	Major Centre	HPMC(Other)		0.80	-	-	145.1	184.0	2,006.1	23.4	-
MC	Major Centre	MCF3		0.35	-	-	63.5	80.5	877.7	10.2	-
MC	Major Centre	TCMC(TD)		0.73	0.73	21.9	132.1	157.0	1,386.5	24.0	157.7
MC	Major Centre	TCMC(TCS)		0.73	0.73	21.9	132.1	157.0	1,386.5	24.0	157.7
MC	Major Centre	Other		0.80	1.80	18.0	163.0	198.0	1,891.9	28.5	129.6
MDR	Medium Density Residential	AV		1.97	1.97	137.9	355.4	384.2	2,144.0	74.3	992.9
MDR	Medium Density Residential	AMD		0.35	2.24	221.3	398.9	399.0	1,072.3	91.7	1,594.0
MDR	Medium Density Residential	HPMD		0.35	2.24	222.3	400.7	400.8	1,073.7	92.0	1,600.7
MDR	Medium Density Residential	PB		0.50	0.50	21.0	57.0	57.2	156.6	9.2	232.0
MDR	Medium Density Residential	NBT		0.84	0.84	42.0	145.9	163.5	1,380.6	31.2	302.4
MDR	Medium Density Residential	NWV		0.35	1.30	75.4	147.2	147.3	401.8	31.6	589.6
MDR	Medium Density Residential	S		0.35	1.30	72.3	143.3	144.3	437.8	31.0	565.8
MDR	Medium Density Residential	Other		0.35	1.97	108.8	207.2	207.4	559.1	45.4	830.5

Column 1 – Area			Column 2 (n/a)	Column 3 – Planned density			Column 4 - Demand generation rate for a trunk infrastructure network (per net developable Ha)				
Zone	Zone	Precinct		Plot ratio (Non-residential)	Plot ratio (Residential)	Dwelling density (no./Ha)	Water (EP)	Sewerage (EP)	Roads (trip ends/day)	Pathways (trip ends/day)	Parks (ERP)
MII	Medium Impact Industry	All		0.62	-	-	23.4	28.2	798.6	8.5	-
MU	Mixed Use	AC		0.84	0.84	42.0	145.9	163.5	1,380.6	31.2	302.4
MU	Mixed Use	BRM		0.53	-	-	66.6	81.1	2,026.9	24.4	-
MU	Mixed Use	CTR		0.73	0.73	24.3	128.2	156.4	1,582.1	28.6	175.0
MU	Mixed Use	KT		0.65	-	-	77.9	94.2	1,833.4	21.3	-
MU	Mixed Use	KR		0.35	1.97	108.8	207.2	207.4	559.1	45.4	830.5
MU	Mixed Use	NBG		0.84	0.84	42.0	145.9	163.5	1,380.6	31.2	302.4
MU	Mixed Use	CBDG		0.73	0.73	21.9	118.2	136.3	1,683.1	27.5	157.7
MU	Mixed Use	STRD		4.40	4.40	341.0	823.1	885.3	3,489.2	162.4	2,455.2
MU	Mixed Use	WS		0.35	1.30	75.5	147.4	147.5	399.5	31.6	591.1
MU	Mixed Use	Other		0.73	0.73	21.9	118.2	136.3	1,683.1	27.5	157.7
NC	Neighbourhood Centre	All		0.35	-	-	63.5	80.5	877.7	10.2	-
OS	Open Space	R		0.65	-	-	77.1	93.5	1,833.4	21.3	-
OS	Open Space	Other		-	-	-	-	-	-	-	-
PC	Principal Centre	CA		6.50	-	-	835.2	987.5	23,601.5	277.5	-
PC	Principal Centre	FSR		9.70	9.70	357.0	1,483.3	1,652.1	22,848.1	395.9	2,570.1
PC	Principal Centre	Other		9.50	9.50	399.0	1,431.1	1,562.5	21,818.8	399.0	2,872.8
RR	Rural Residential	RRRD		-	-	0.025	0.1	0.1	0.2	0.0	0.3
RR	Rural Residential	Other		-	-	1.6	4.6	4.6	12.0	0.7	18.9
RUR	Rural	H		-	-	0.025	0.1	0.1	0.2	0.0	0.3
RUR	Rural	C		-	-	0.003	0.0	0.0	0.0	0.0	0.0
RUR	Rural	J		-	-	0.100	0.3	0.3	0.7	0.0	1.1
RUR	Rural	RRRD		-	-	0.003	0.0	0.0	0.0	0.0	0.0
RUR	Rural	Other		-	-	0.003	0.0	0.0	0.0	0.0	0.0
SC	Specialised Centre	Other		-	-	-	-	-	-	-	-
SC	Specialised Centre	BRM		0.53	-	-	66.6	81.1	2,026.9	24.4	-
SC	Specialised Centre	D		0.35	-	-	74.0	96.0	654.9	7.6	-
SC	Specialised Centre	FRM		0.67	0.67	33.5	110.7	129.1	1,397.8	29.9	241.2
SC	Specialised Centre	MH		1.20	-	-	150.7	183.5	4,589.1	55.3	-
SC	Specialised Centre	MHF2		0.53	-	-	66.6	81.1	2,026.9	24.4	-
SP	Special Purpose	TSDA (B, EC, ECO)		-	-	-	-	-	-	-	-
SP	Special Purpose	TSDA (HIIP)		0.35	-	-	15.1	17.8	454.1	4.8	-
SP	Special Purpose	TSDA (LMI)		0.56	-	-	31.2	39.6	506.3	5.8	-
SP	Special Purpose	TSDA (Other)		0.62	-	-	17.1	21.9	285.6	3.3	-
SR	Sport and Recreation	BBGC		0.50	0.50	7.7	21.9	22.1	61.5	3.4	87.9
SR	Sport and Recreation	Other		-	-	-	-	-	-	-	-

Table SC3.1.6b - Planned demand generation rate for a trunk infrastructure network

(Lots greater than threshold)

Column 1 – Area			Column 2 (n/a)	Column 3 – Planned density			Column 4 - Demand generation rate for a trunk infrastructure network (per net developable Ha)				
Zone	Zone	Precinct		Plot ratio (Non-residential)	Plot ratio (Residential)	Dwelling density (no./Ha)	Water (EP)	Sewerage (EP)	Roads (trip ends/day)	Pathways (trip ends/day)	Parks (ERP)

Column 1 – Area			Column 2 (n/a)	Column 3 – Planned density			Column 4 - Demand generation rate for a trunk infrastructure network (per net developable Ha)				
Zone	Zone	Precinct		Plot ratio (Non-residential)	Plot ratio (Residential)	Dwelling density (no./Ha)	Water (EP)	Sewerage (EP)	Roads (trip ends/day)	Pathways (trip ends/day)	Parks (ERP)
CF	Community Facilities	All		-	-	-	-	-	-	-	-
CR	Character Residential	All		-	-	11.3	31.7	31.7	82.4	4.9	130.1
DC	District Centre	All		0.45	-	-	81.6	103.5	1,128.5	13.2	-
EC	Emerging Communities	MCF2		0.23	-	-	40.8	51.8	564.2	6.6	-
EC	Emerging Communities	MCNS		0.52	-	-	94.3	119.6	1,304.0	15.2	-
EC	Emerging Communities	Other		0.33	0.33	14.0	36.9	37.3	117.7	6.3	146.7
HDR	High Density Residential	PS		6.90	6.90	590.6	1,273.2	1,335.7	4,694.2	265.8	4,252.6
HDR	High Density Residential	Other		0.70	0.70	51.9	106.4	109.0	450.0	23.7	373.4
HII	High Impact Industry	All		0.16	-	-	2.4	2.4	171.7	1.8	-
LC	Local Centre	All		0.45	-	-	81.6	103.5	1,128.5	13.2	-
LDR	Low Density Residential	MCF1		0.23	-	-	40.8	51.8	564.2	6.6	-
LDR	Low Density Residential	MHF1		0.53	-	-	66.6	81.1	2,026.9	24.4	-
LDR	Low Density Residential	RRRC		0.33	0.33	13.6	37.1	37.3	107.3	6	150
LDR	Low Density Residential	ST		-	-	-	18.2	18.2	47.3	2.8	74.6
LDR	Low Density Residential	Other		0.33	0.33	-	37.1	37.2	101.8	6.0	150.8
LII	Low Impact Industry	All		0.36	-	-	22.9	28.3	560.2	6.1	-
MC	Major Centre	ACC		0.52	1.17	-	117.6	137.8	1,155.5	21.8	168.5
MC	Major Centre	ACF		0.33	-	-	59.0	74.8	815.0	9.5	-
MC	Major Centre	HPMC(MCC)		0.65	-	-	117.9	149.5	1,630.0	19.0	-
MC	Major Centre	HPMC(Other*)		0.52	-	-	94.3	119.6	1,304.0	15.2	-
MC	Major Centre	MCF3		0.23	-	-	40.8	51.8	564.2	6.6	-
MC	Major Centre	TCMC(TD)		0.47	0.47	14.2	85.9	102.0	901.2	15.6	102.5
MC	Major Centre	TCMC(TCS)		0.47	0.47	14.2	85.9	102.0	901.2	15.6	102.5
MC	Major Centre	Other		0.52	1.17	11.7	106.0	128.7	1,229.7	18.5	84.2
MDR	Medium Density Residential	AV		1.28	1.28	89.6	231.0	249.7	1,393.6	48.3	645.4
MDR	Medium Density Residential	AMD		0.23	1.46	144.3	260.0	260.1	698.9	59.7	1,038.9
MDR	Medium Density Residential	HPMD		0.23	1.46	144.9	261.1	261.2	699.9	60.0	1,043.3
MDR	Medium Density Residential	PB		0.33	0.33	13.6	37.1	37.2	101.8	6.0	150.8
MDR	Medium Density Residential	NBT		0.55	0.55	-	94.8	106.3	897.4	20.3	196.6
MDR	Medium Density Residential	NWV		0.23	0.85	49.0	95.7	95.8	261.2	20.5	383.2
MDR	Medium Density Residential	S		0.23	0.85	-	93.2	93.8	284.5	20.1	367.8
MDR	Medium Density Residential	Other		0.23	1.28	70.7	134.7	134.8	363.4	29.5	539.6
MII	Medium Impact Industry	All		0.40	-	-	15.1	20.2	515.2	5.5	-
MU	Mixed Use	AC		0.55	0.55	27.5	95.5	107.0	904.0	20.4	198.0
MU	Mixed Use	BRM		0.53	-	-	66.6	81.1	2,026.9	24.4	-

Column 1 – Area			Column 2 (n/a)	Column 3 – Planned density			Column 4 - Demand generation rate for a trunk infrastructure network (per net developable Ha)				
Zone	Zone	Precinct		Plot ratio (Non-residential)	Plot ratio (Residential)	Dwelling density (no./Ha)	Water (EP)	Sewerage (EP)	Roads (trip ends/day)	Pathways (trip ends/day)	Parks (ERP)
MU	Mixed Use	CTR		0.48	0.48	15.8	83.4	101.7	1,029.4	18.6	113.9
MU	Mixed Use	KT		0.42	-	-	50.2	61.3	1,193.1	13.9	-
MU	Mixed Use	KR		0.23	1.28	70.7	134.7	134.8	363.4	29.5	539.6
MU	Mixed Use	NBG		0.55	0.55	27.3	94.8	106.3	897.4	20.3	196.6
MU	Mixed Use	CBDG		0.48	0.48	-	76.9	88.7	1,095.2	17.9	102.6
MU	Mixed Use	STRD		4.40	4.40	-	823.1	885.3	3,489.2	162.4	2,455.2
MU	Mixed Use	WS		0.23	0.85	-	95.8	95.9	259.7	20.5	384.2
MU	Mixed Use	Other		0.48	0.48	-	76.9	88.7	1,095.2	17.9	102.6
NC	Neighbourhood Centre	All		0.35	-	-	63.5	80.5	877.7	10.2	-
OS	Open Space	R		0.42	-	-	50.1	60.7	1,191.7	13.8	-
OS	Open Space	Other		-	-	0.0	-	-	-	-	-
PC	Principal Centre	CA		6.50	-	-	835.2	987.5	23,601.5	277.5	-
PC	Principal Centre	FSR		9.70	9.70	357.0	1,483.3	1,652.1	22,848.1	395.9	2,570.1
PC	Principal Centre	Other		9.50	9.50	399.0	1,431.1	1,562.5	21,818.8	399.0	2,872.8
RR	Rural Residential	RRRD		-	-	0.021	0.1	0.1	0.1	0.0	0.2
RR	Rural Residential	Other		-	-	1.3	3.6	3.6	9.5	0.6	14.9
RUR	Rural	H		-	-	0.021	0.1	0.1	0.2	0.0	0.2
RUR	Rural	C		-	-	0.002	0.0	0.0	0.0	0.0	0.0
RUR	Rural	J		-	-	0.085	0.2	0.2	0.6	0.0	1.0
RUR	Rural	RRRD		-	-	0.002	0.0	0.0	0.0	0.0	0.0
RUR	Rural	Other		-	-	0.002	0.0	0.0	0.0	0.0	0.0
SC	Specialised Centre	Other		-	-	-	-	-	-	-	-
SC	Specialised Centre	BRM		0.53	-	-	66.6	81.1	2,026.9	24.4	-
SC	Specialised Centre	D		0.35	-	-	74.0	96.0	654.9	7.6	-
SC	Specialised Centre	FRM		0.44	0.44	21.8	71.9	83.9	907.7	19.4	156.8
SC	Specialised Centre	MH		1.20	-	-	150.7	183.5	4,589.1	55.3	-
SC	Specialised Centre	MHF2		0.53	-	-	66.6	81.1	2,026.9	24.4	-
SP	Special Purpose	TSDA (B, EC, ECO)		-	-	-	-	-	-	-	-
SP	Special Purpose	TSDA (HIIP)		0.19	-	-	7.3	8.8	249.1	2.6	-
SP	Special Purpose	TSDA (LMI)		0.36	-	-	20.0	25.4	325.5	3.7	-
SP	Special Purpose	TSDA (Other)		0.40	-	-	11.0	14.2	184.3	2.1	-
SR	Sport and Recreation	BBGC		0.33	0.33	5.0	14.2	14.3	40.0	2.2	57.1
SR	Sport and Recreation	Other		-	-	-	-	-	-	-	-

SC3.2 Schedule of works

Editor's note - the schedules of future works are located immediately after the plans for trunk infrastructure for which they are cross referenced. These schedules, and those identifying the existing works, are also located in the extrinsic material.

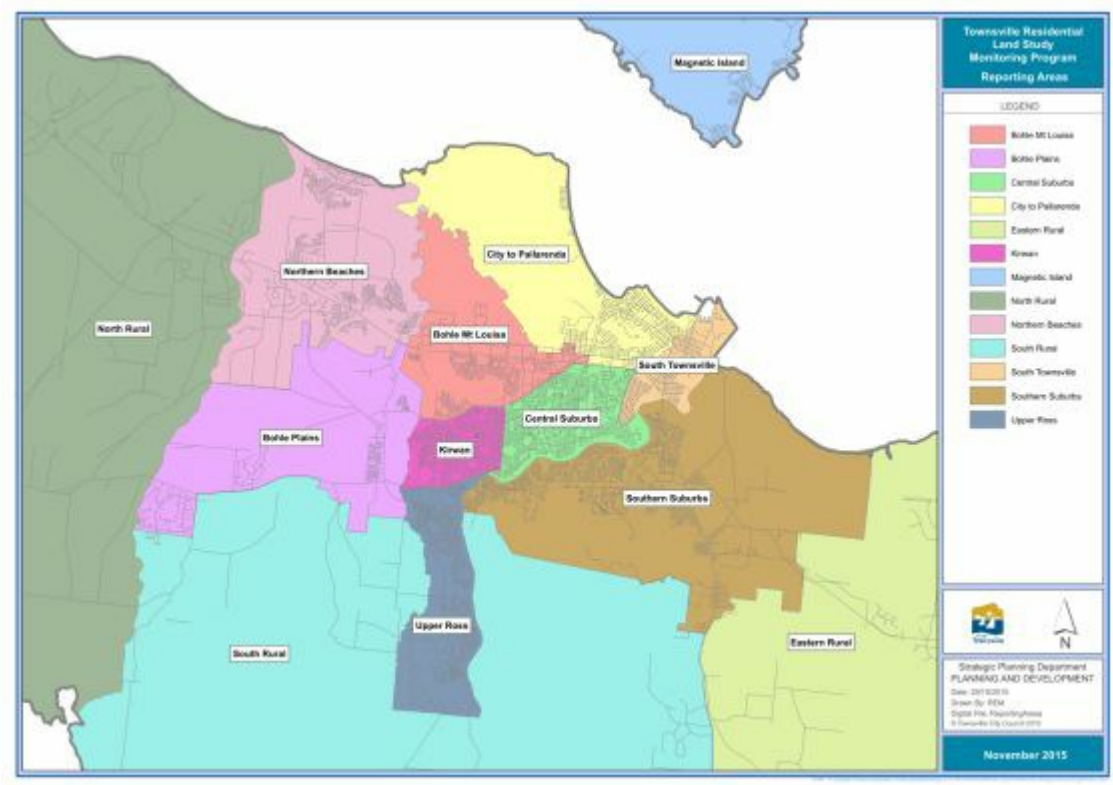
These schedules only provide one map reference for any given infrastructure element. In some cases, the infrastructure element may span multiple maps, and care should be taken when cross-referencing the map and schedule in this manner. The maps are also loaded in a GIS environment, whereupon the information in the schedules are able to be interrogated directly from the infrastructure element, regardless of mapping references. TownsvilleMaps is the current in-service GIS platform for this purpose, which can be publicly viewed at council, or privately accessed via subscription.

The costs represented in these schedules are 'establishment cost', used for network valuation purposes, and do not necessarily represent the costs involved in the capital works program for acquiring land or embellishment. This information can be found in the Schedule of Works model. Where a negative value is evident, it represents a credit value of works that are being upgraded, and are to be deducted from the value of the upgraded profile associated with the new item (having the same LGIP ID and year of provision).

SC3.3 Local government infrastructure plan maps

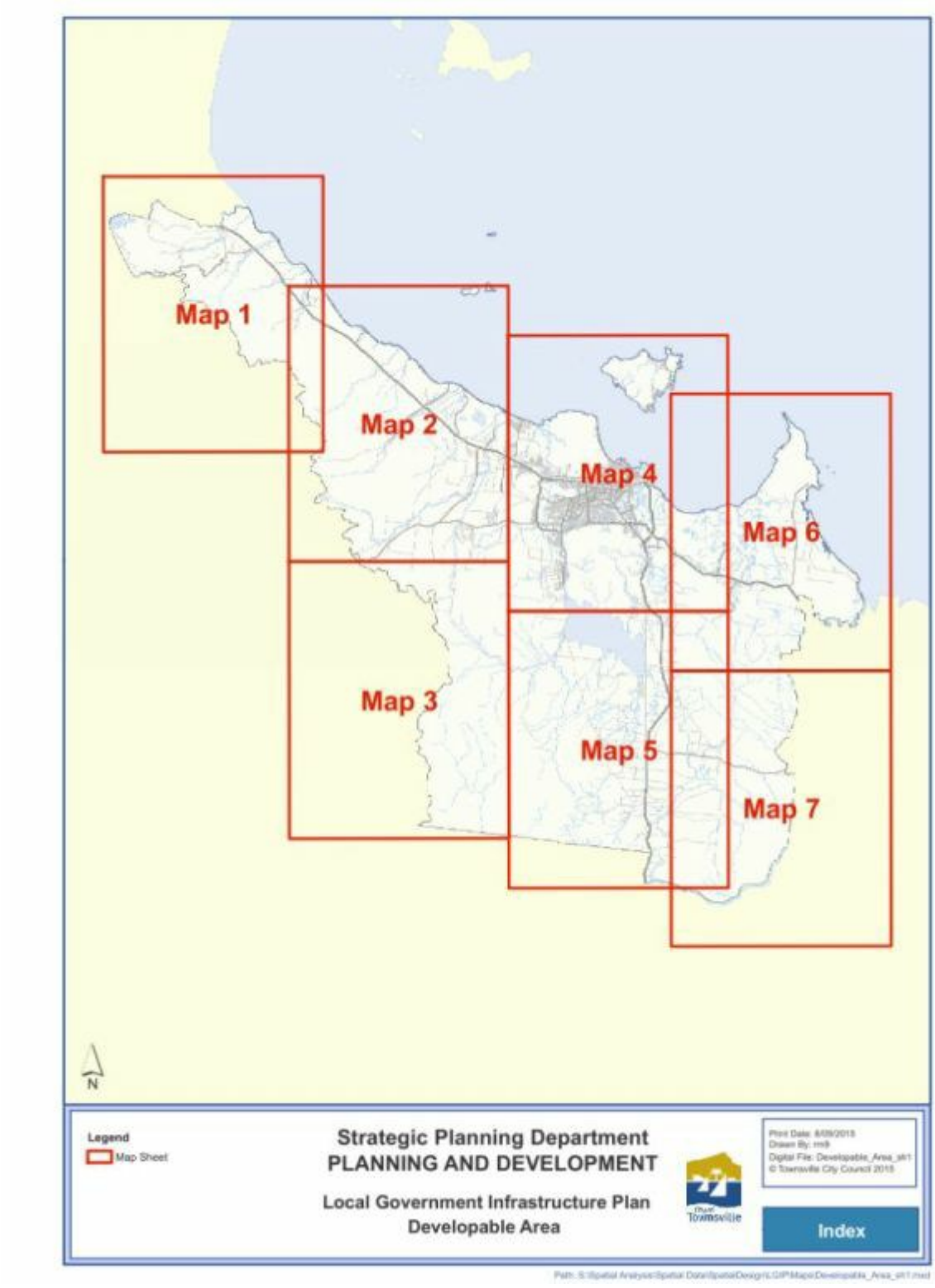
SC3.3.1 - Reporting area map
SC3.3.2 - Developable area maps
SC3.3.3 - Service catchment maps
SC3.3.4 - Priority infrastructure area maps
SC3.3.5 - Plan for trunk water supply infrastructure
SC3.3.6 - Plan for trunk sewerage infrastructure
SC3.3.7 - Plan for trunk roads infrastructure
SC3.3.8 - Plan for trunk footpaths and cycleways infrastructure
SC3.3.9 - Plan for trunk parks and land for community facilities infrastructure

SC3.3.1 - Reporting area map



Click here to view PDF high resolution map.

SC3.3.2 - Developable area maps



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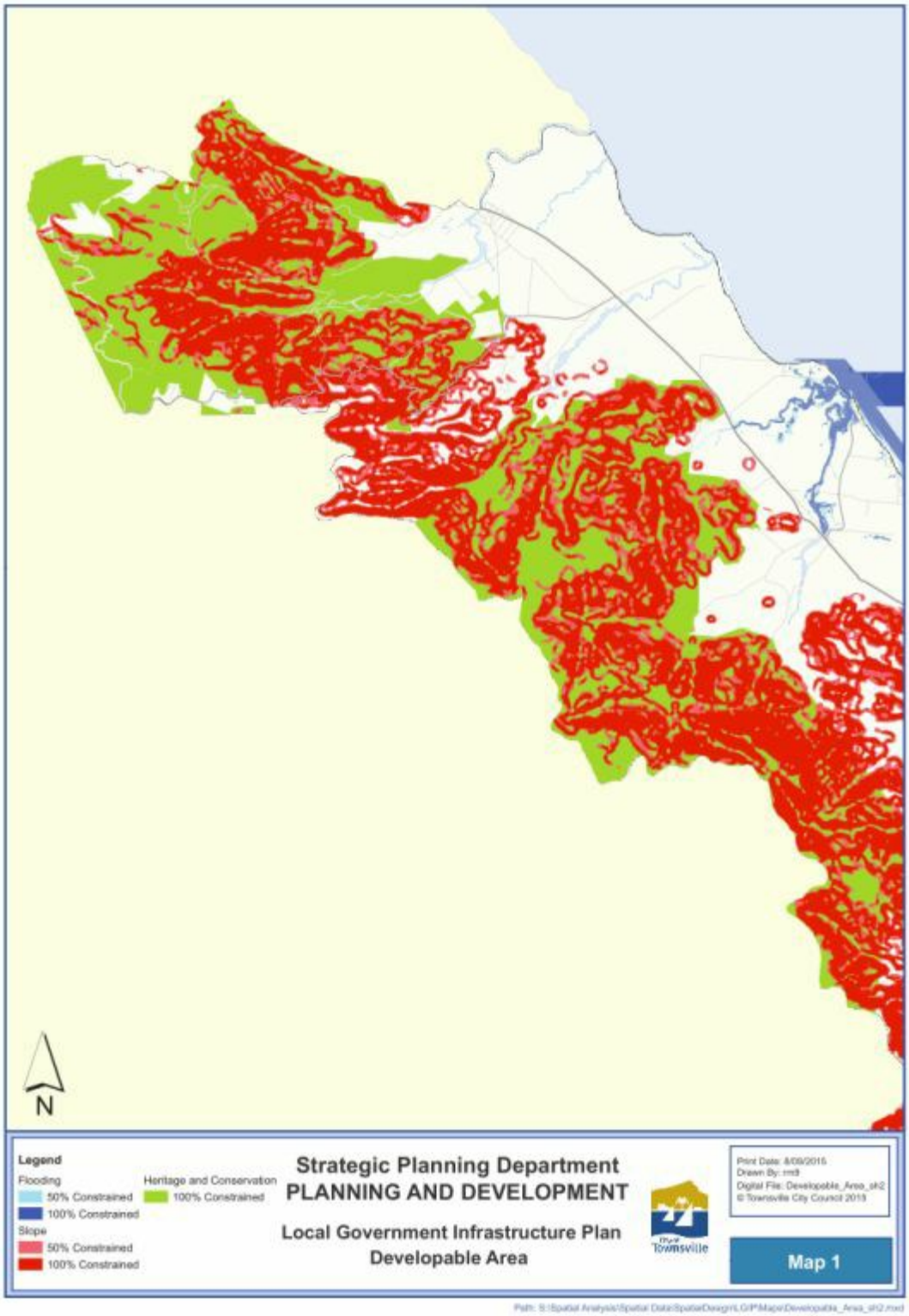

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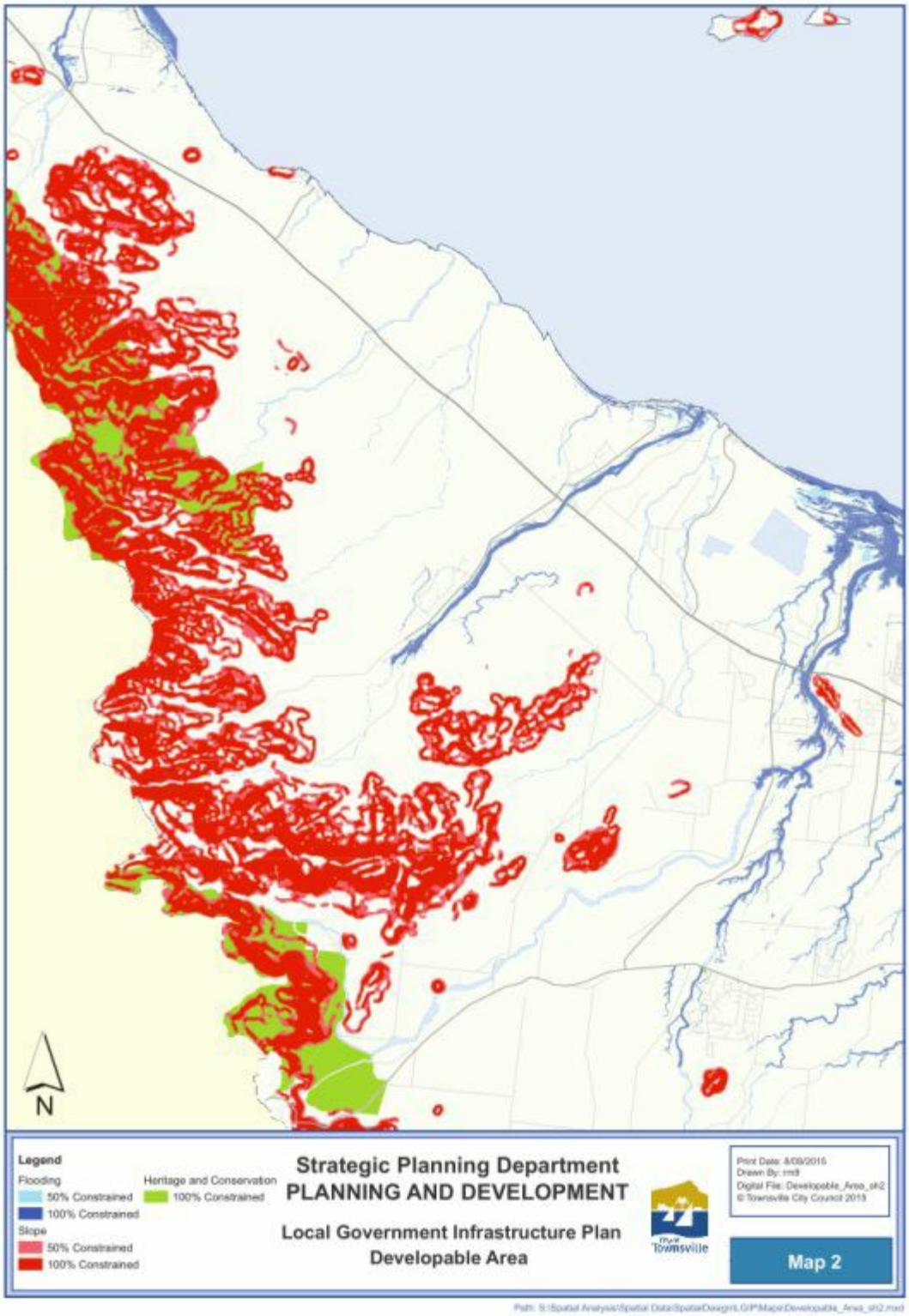

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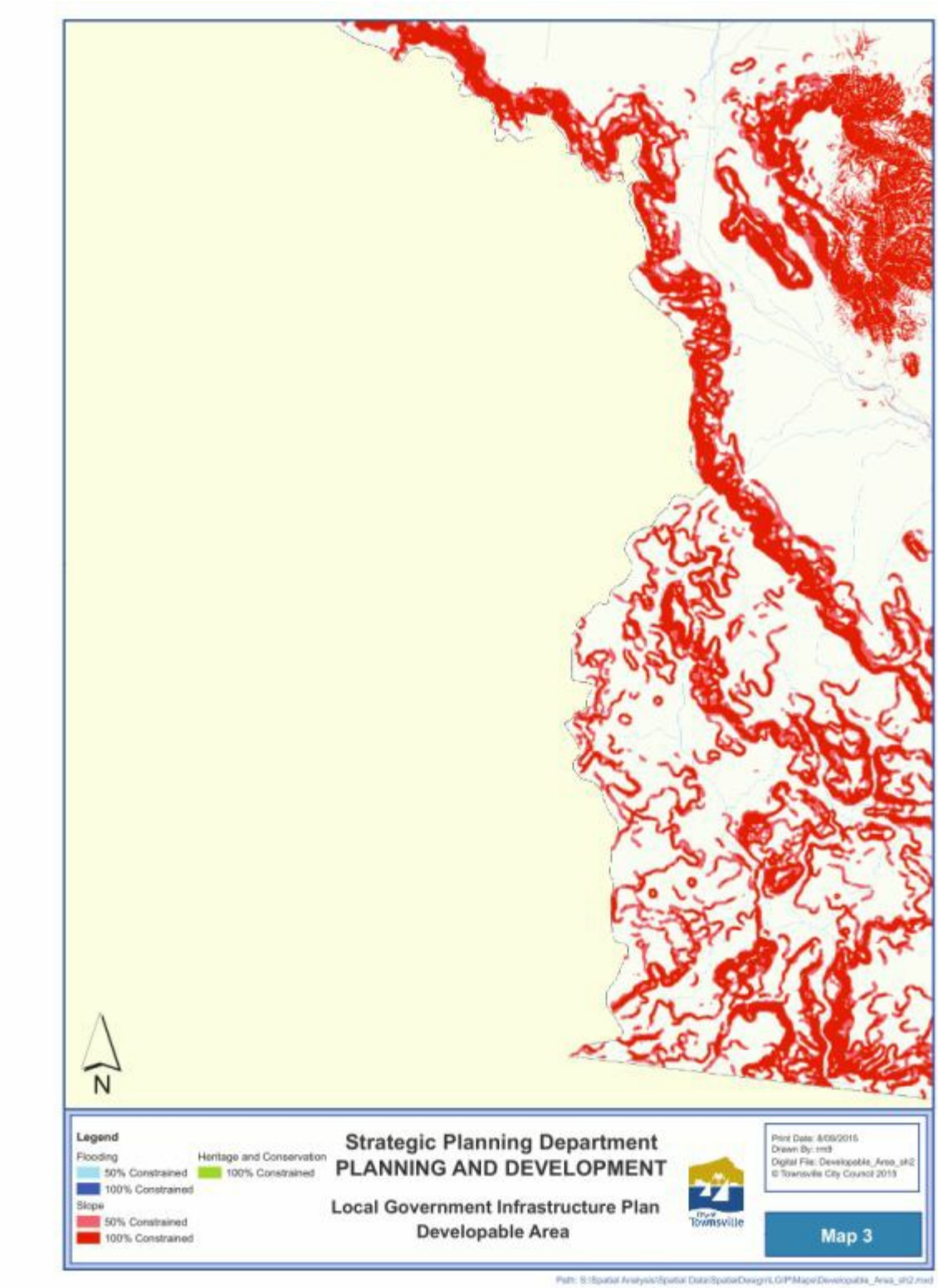

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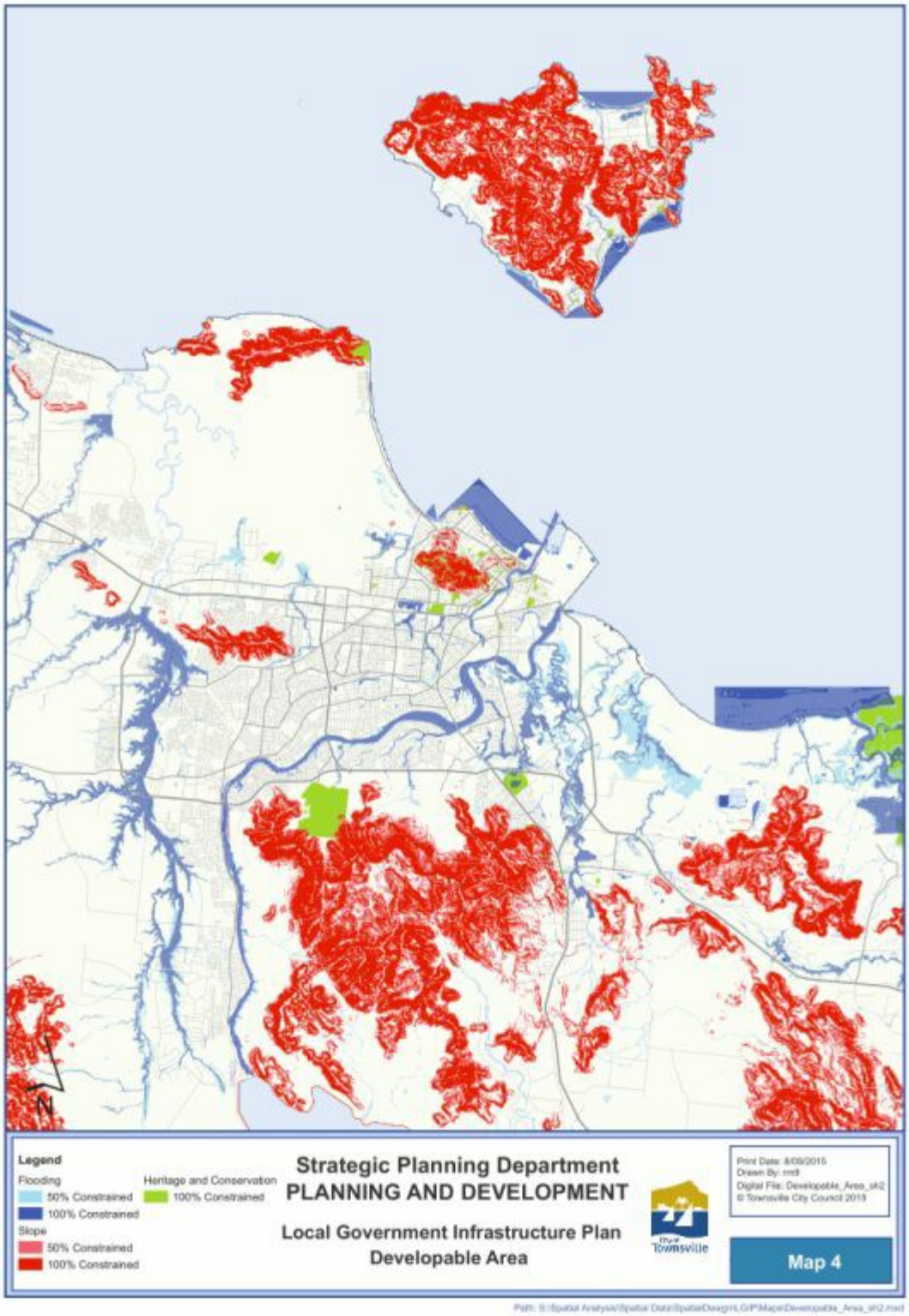

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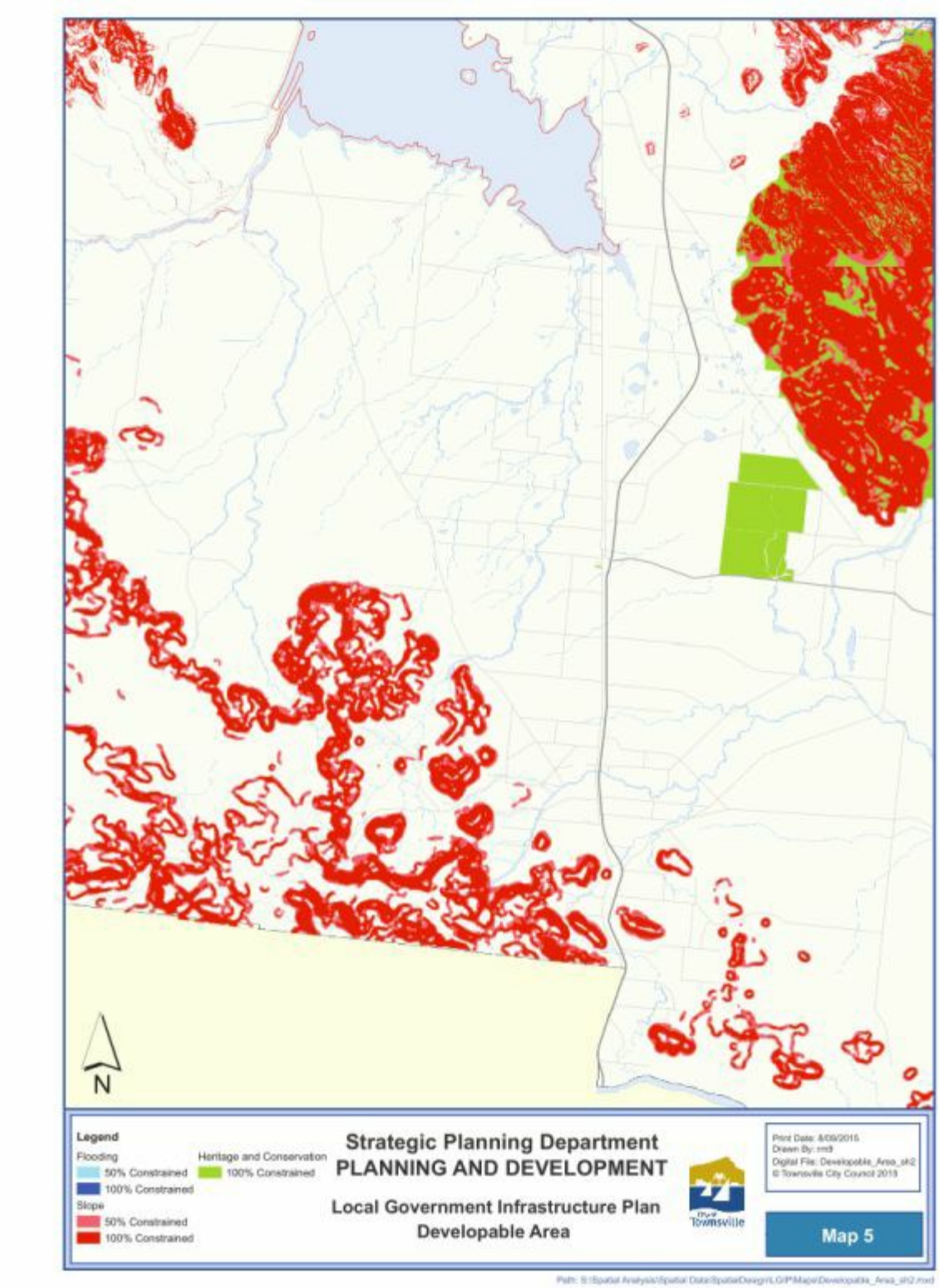

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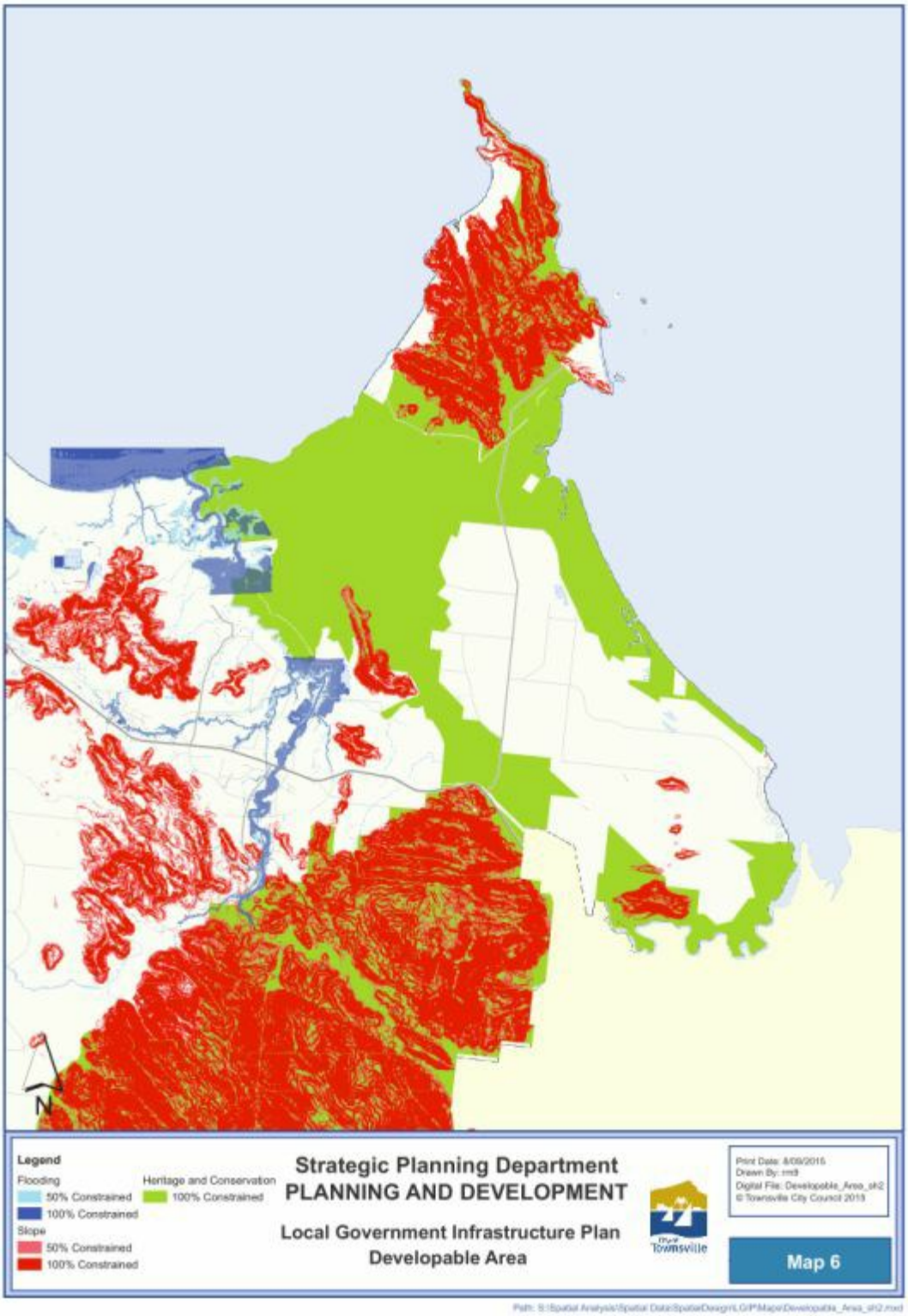

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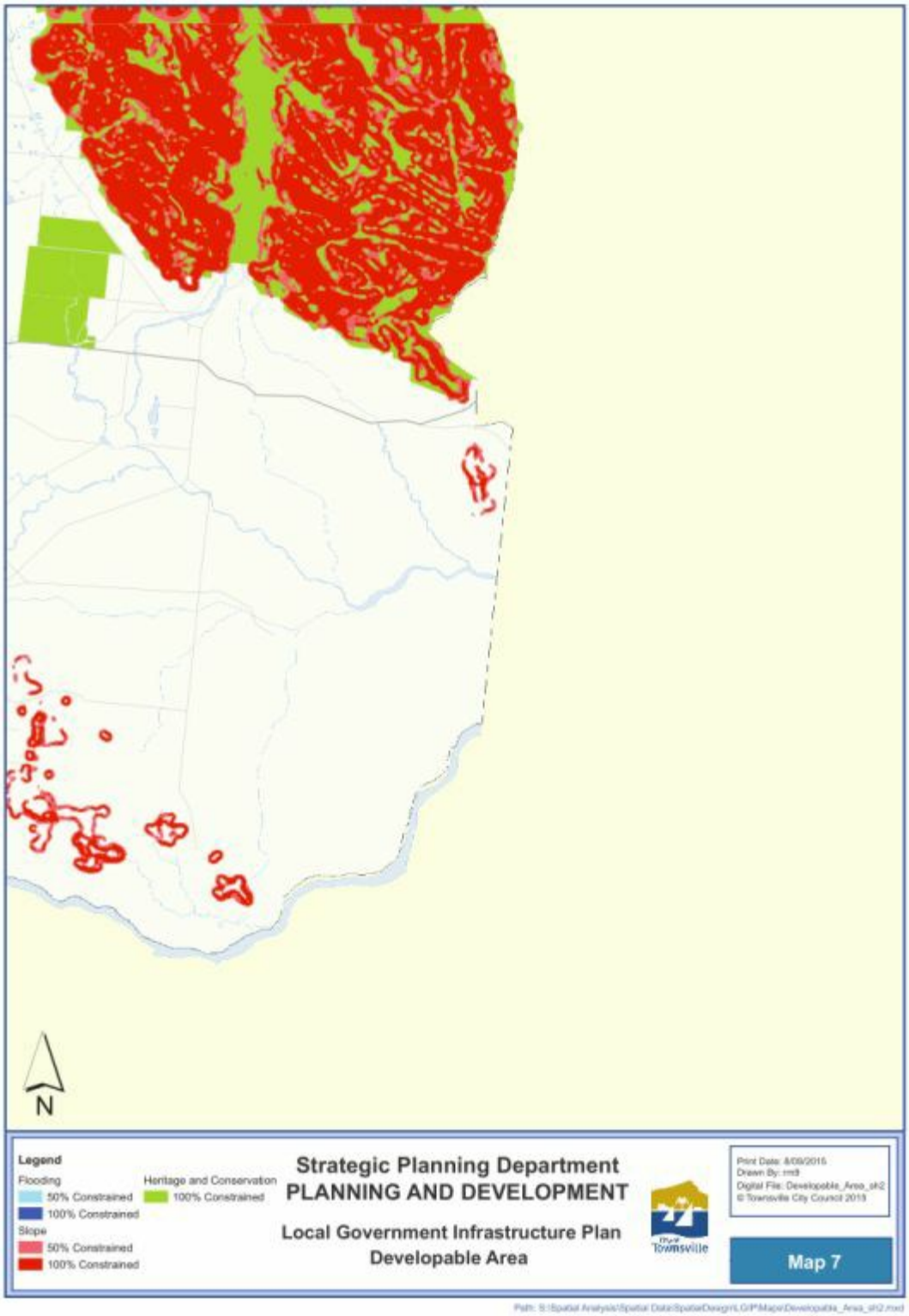

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SC3.3.3 – Service catchment maps

Water service areas

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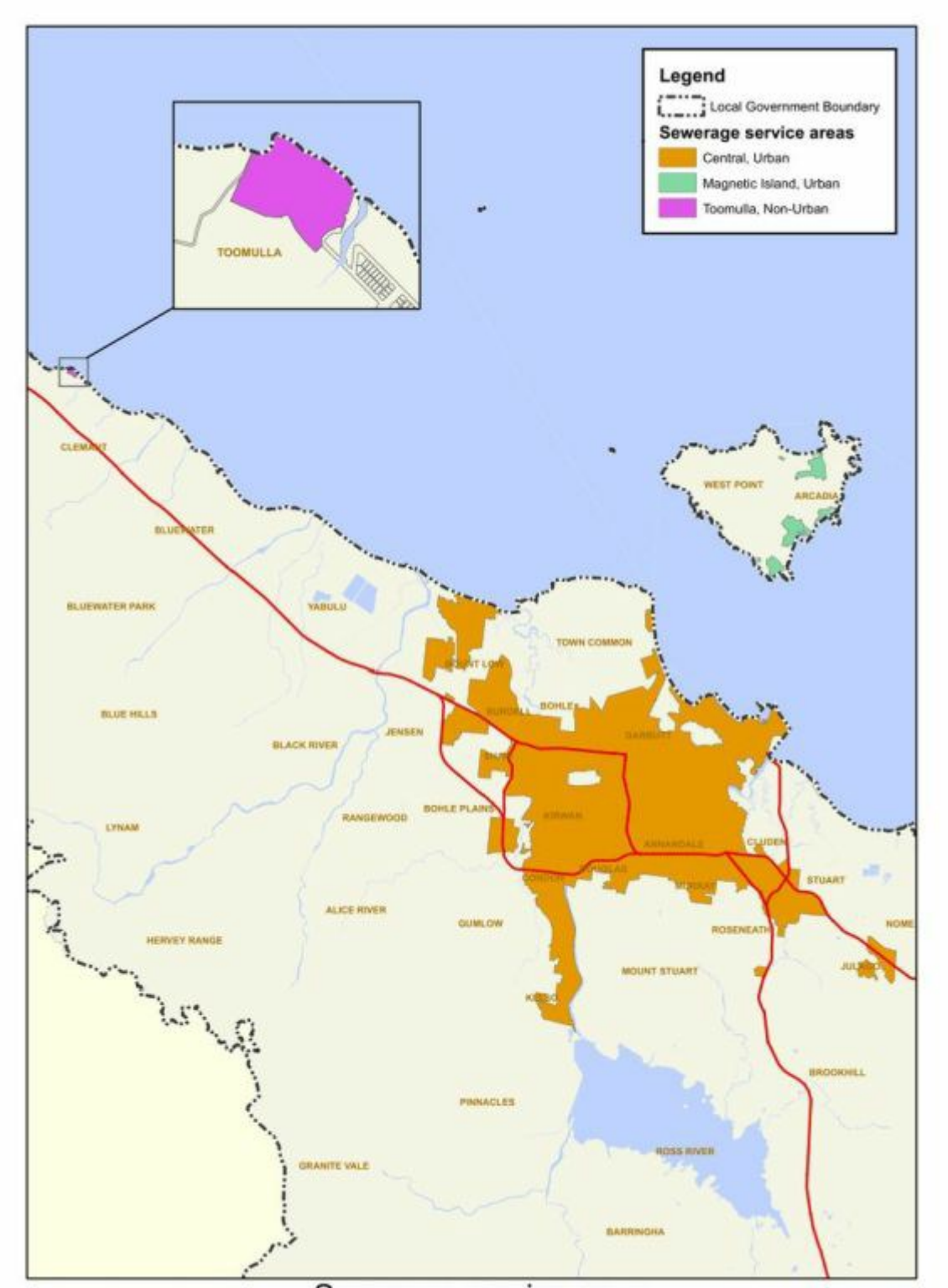

Sewerage service areas

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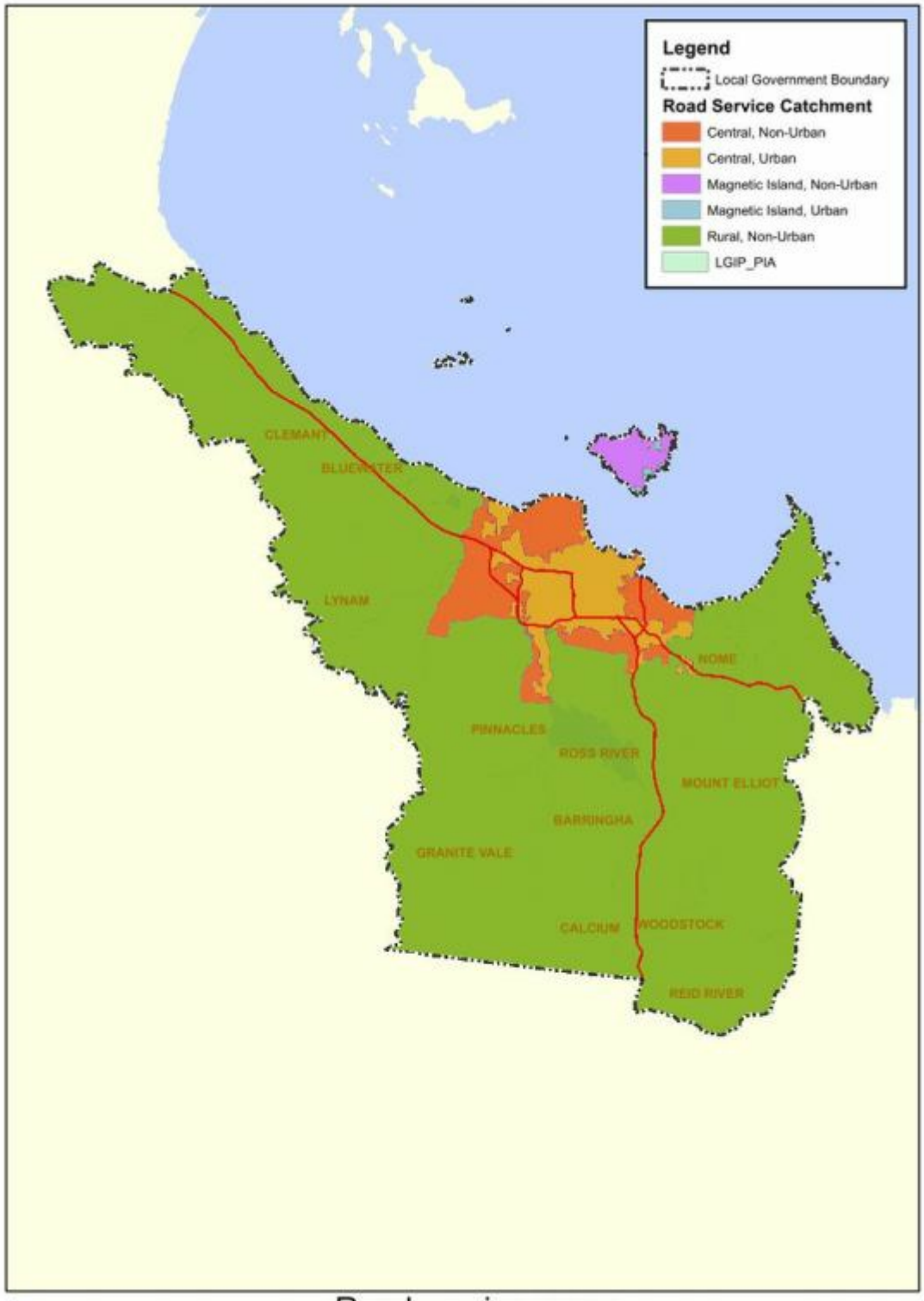

Road service areas

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Footpaths and cycleways service areas

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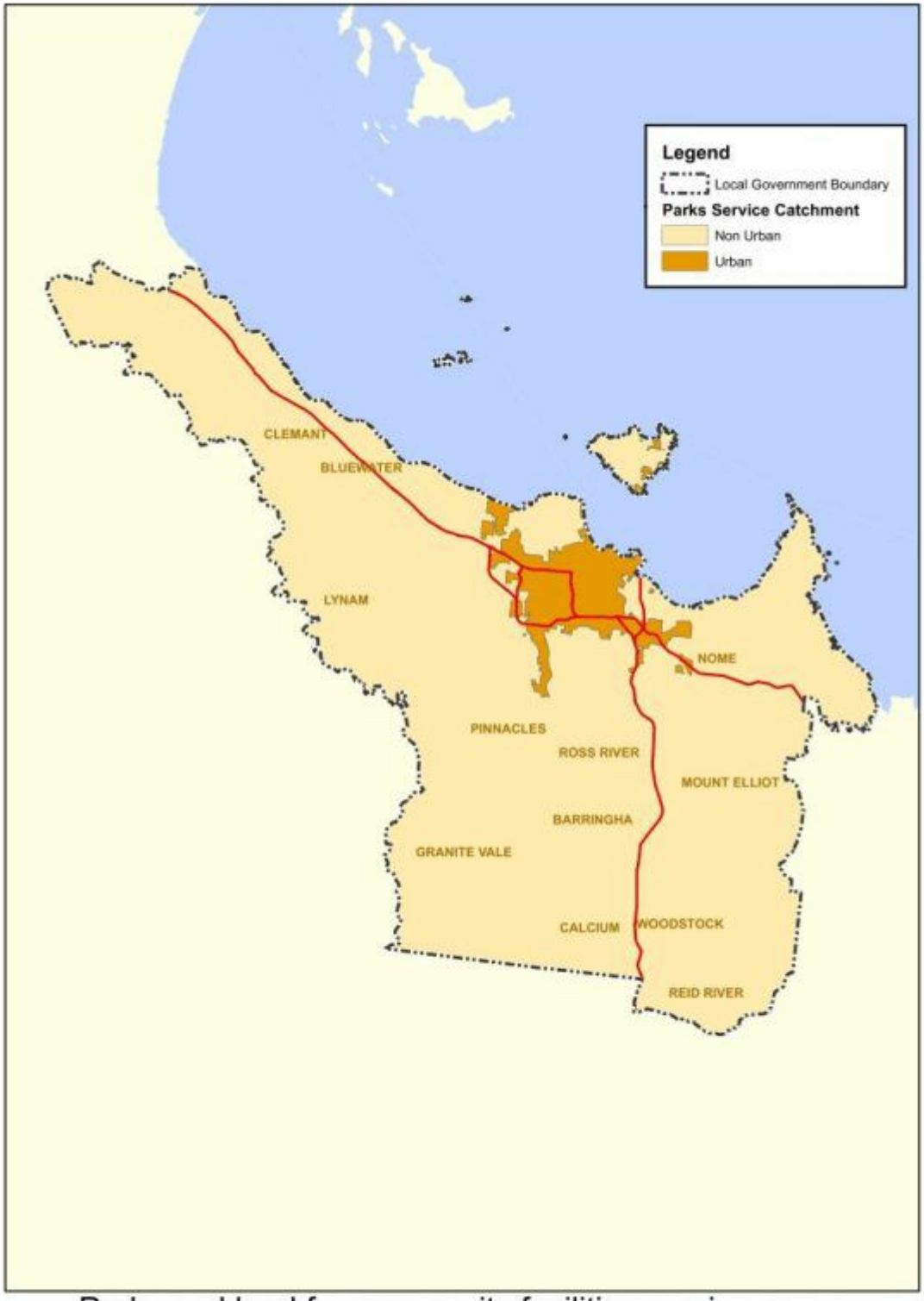


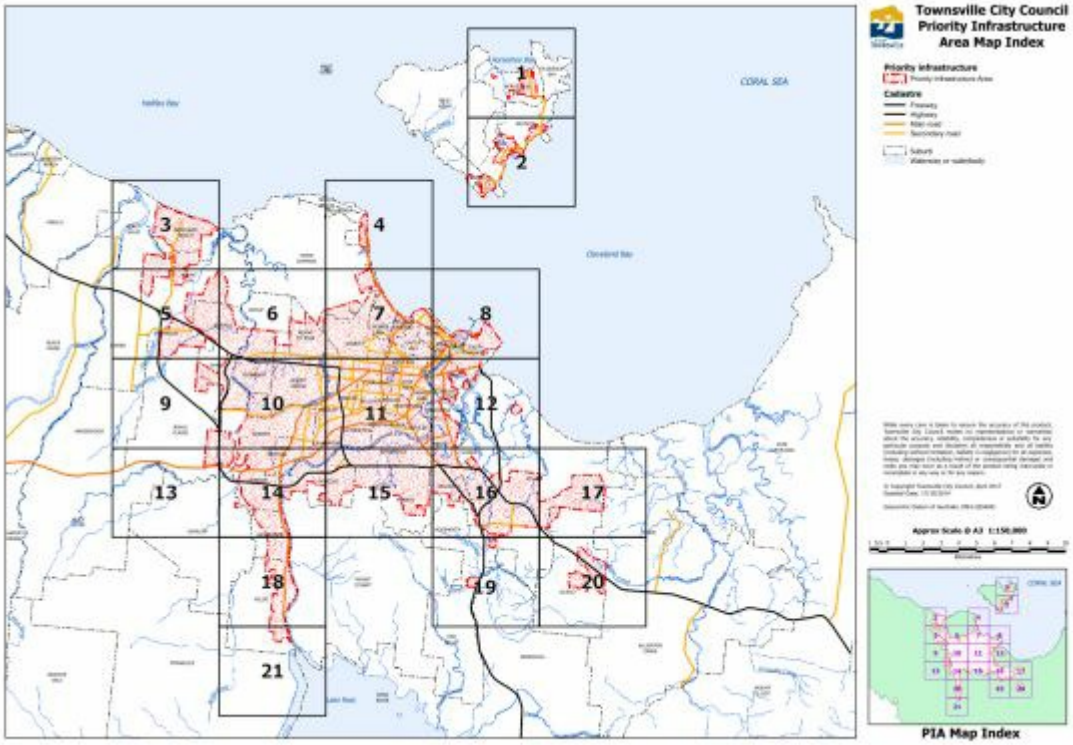
Parks and land for community facilities service areas

Click here to view PDF high resolution map

SC3.3.4 - Priority infrastructure area maps

Editor's note—This document is intended to function in an electronic environment whereupon hyperlinks to detailed PDF maps allow for closer examination of mapping information. The following images are true copies of such maps, but at a coarser scale. Notwithstanding this, the priority infrastructure area is also shown in finer detail on the plans for trunk infrastructure.

The maps are also loaded in a GIS environment. TownsvilleMaps is the current in-service GIS platform for this purpose, which can be publicly viewed at council, or privately accessed via subscription.



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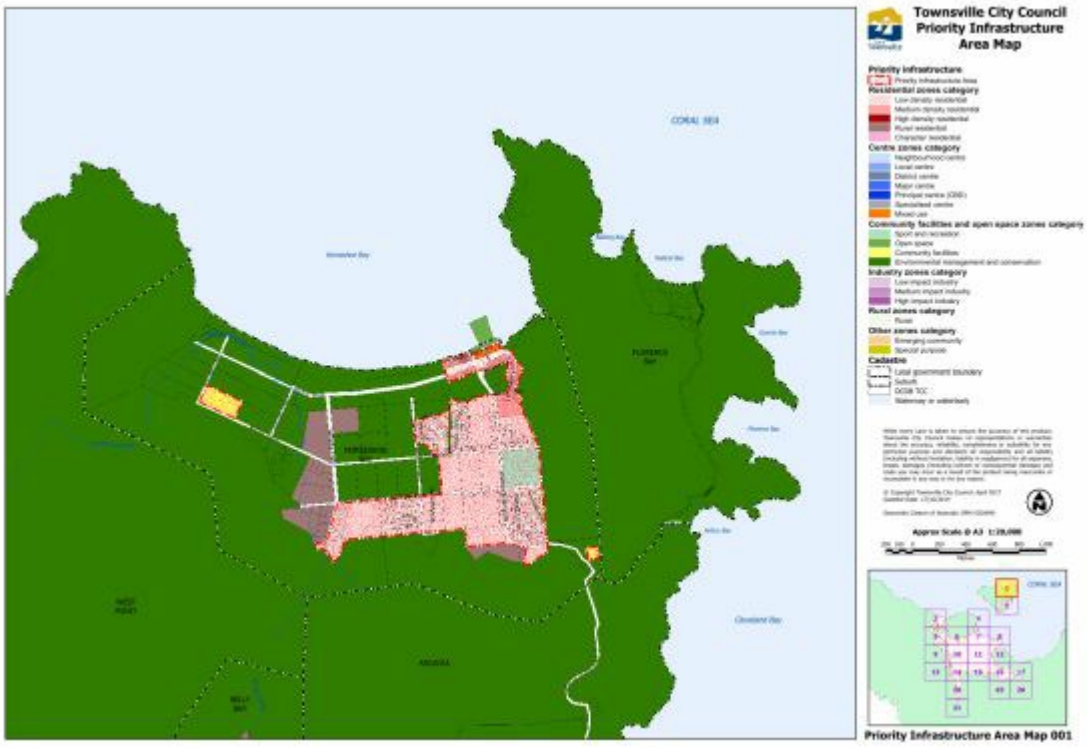

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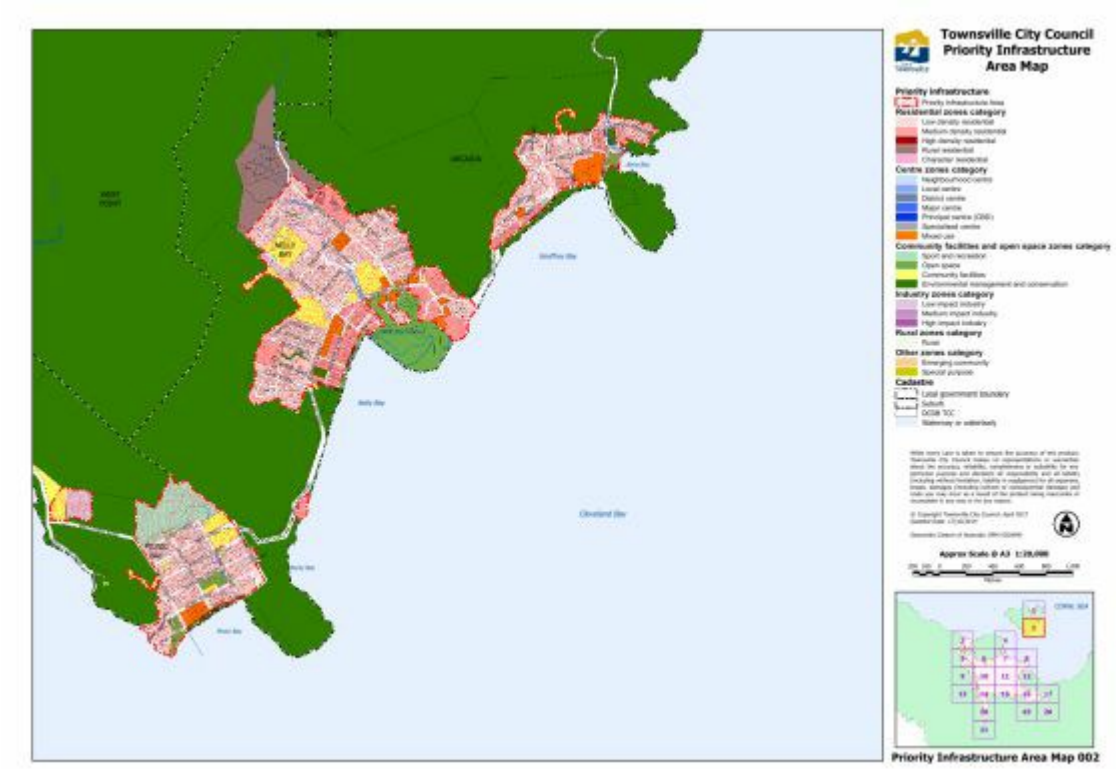

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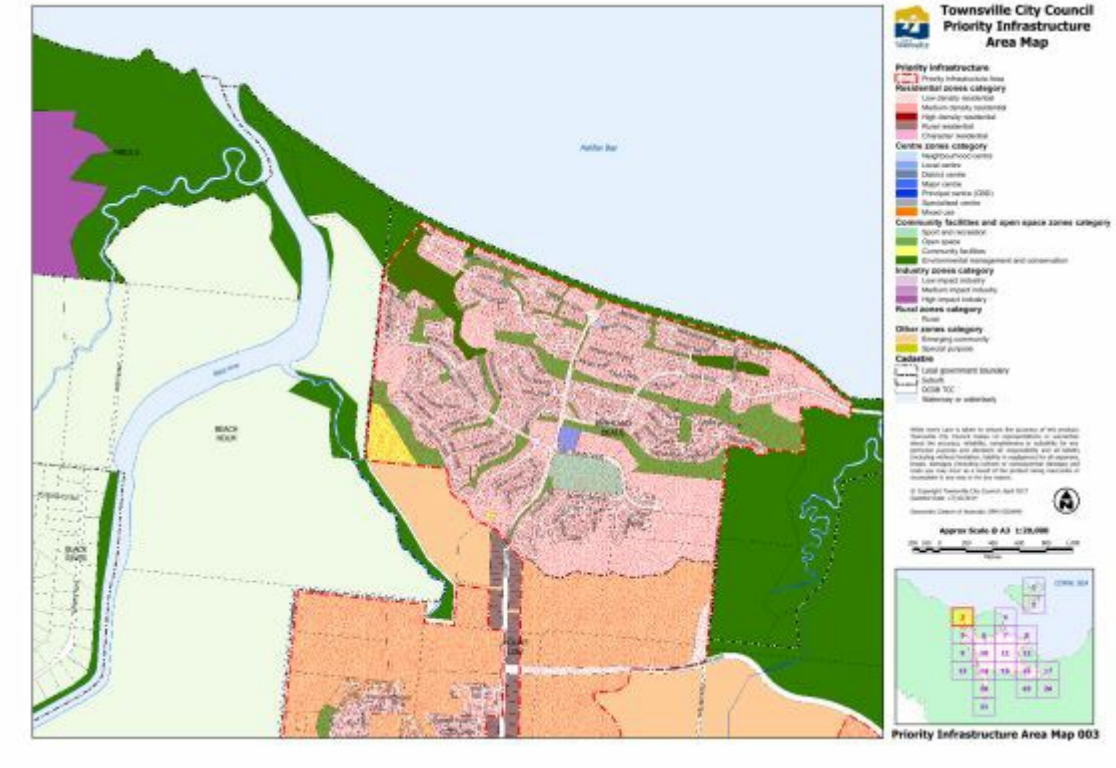

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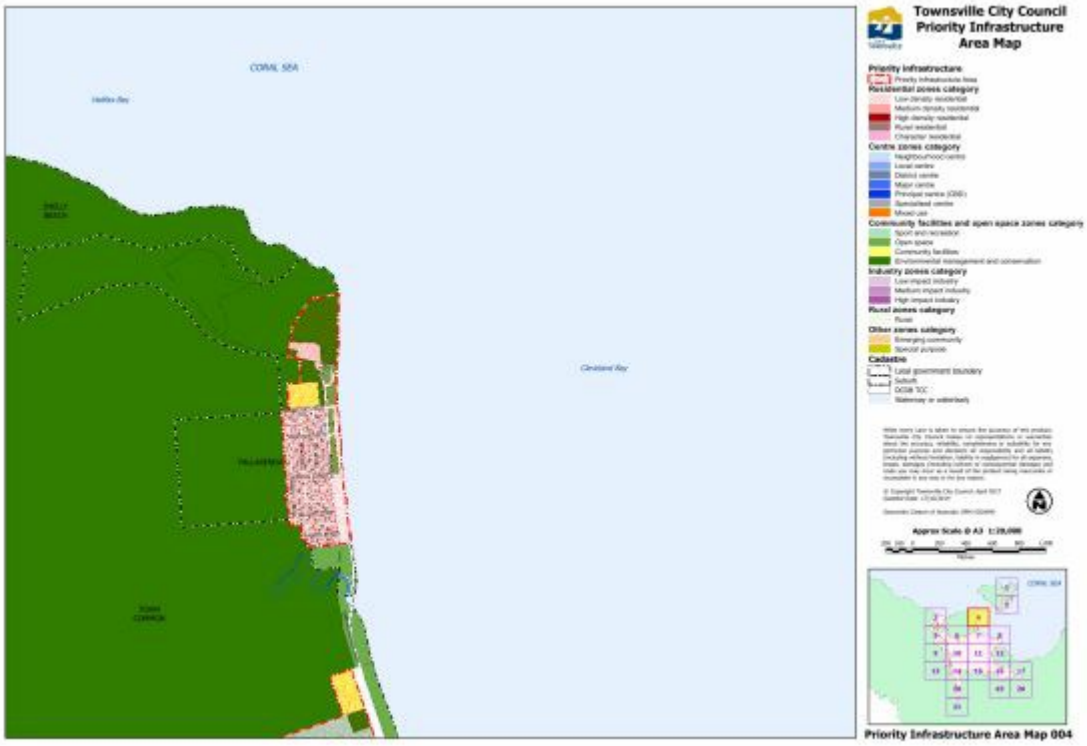

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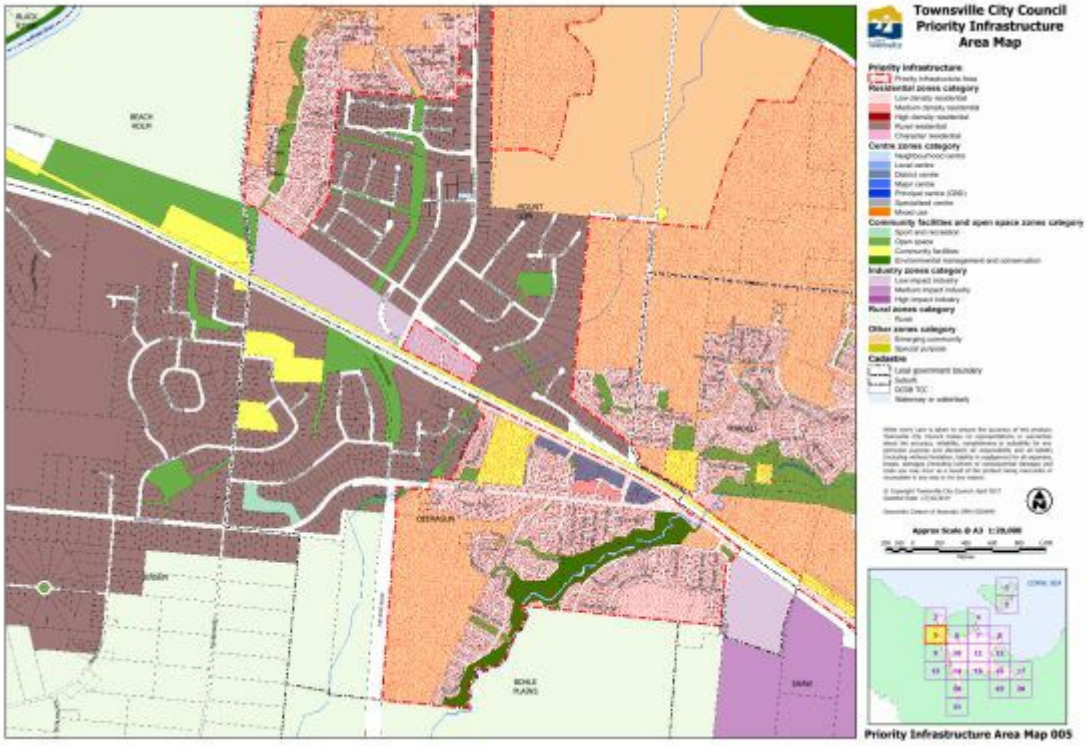

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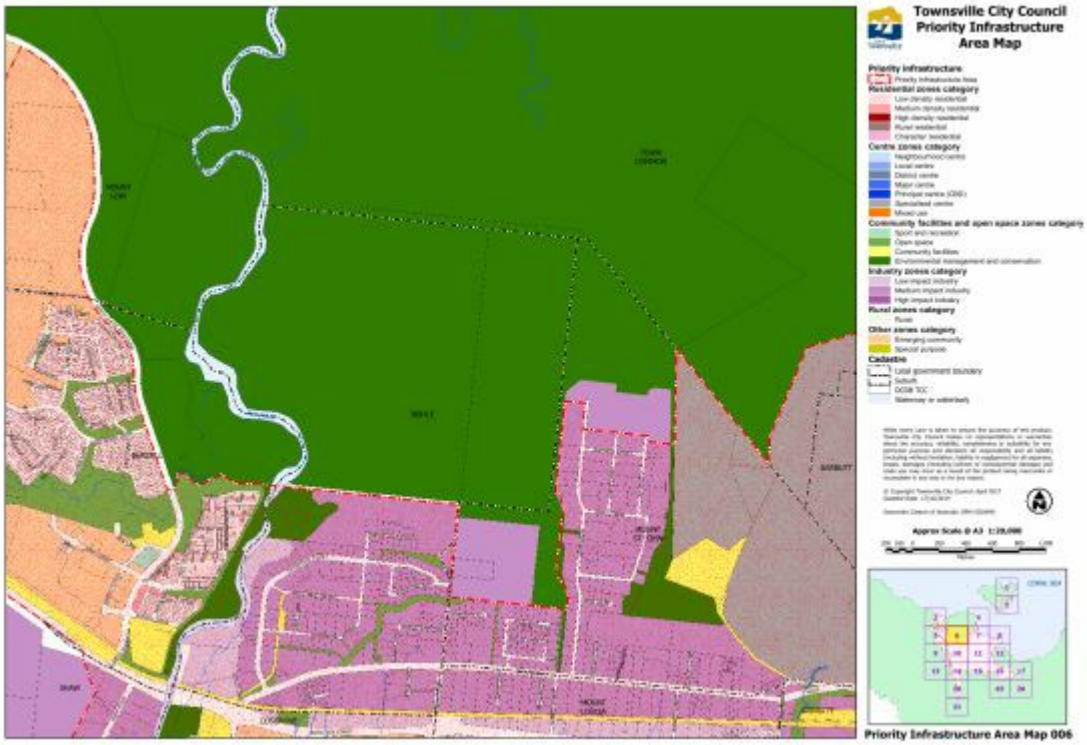

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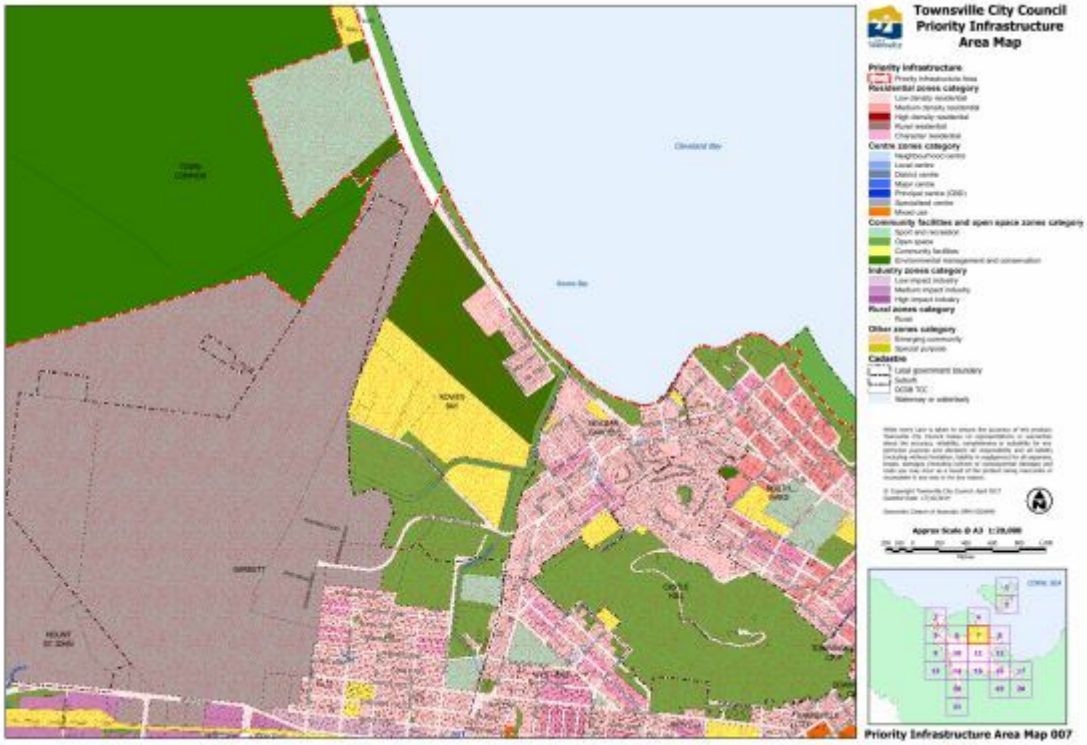

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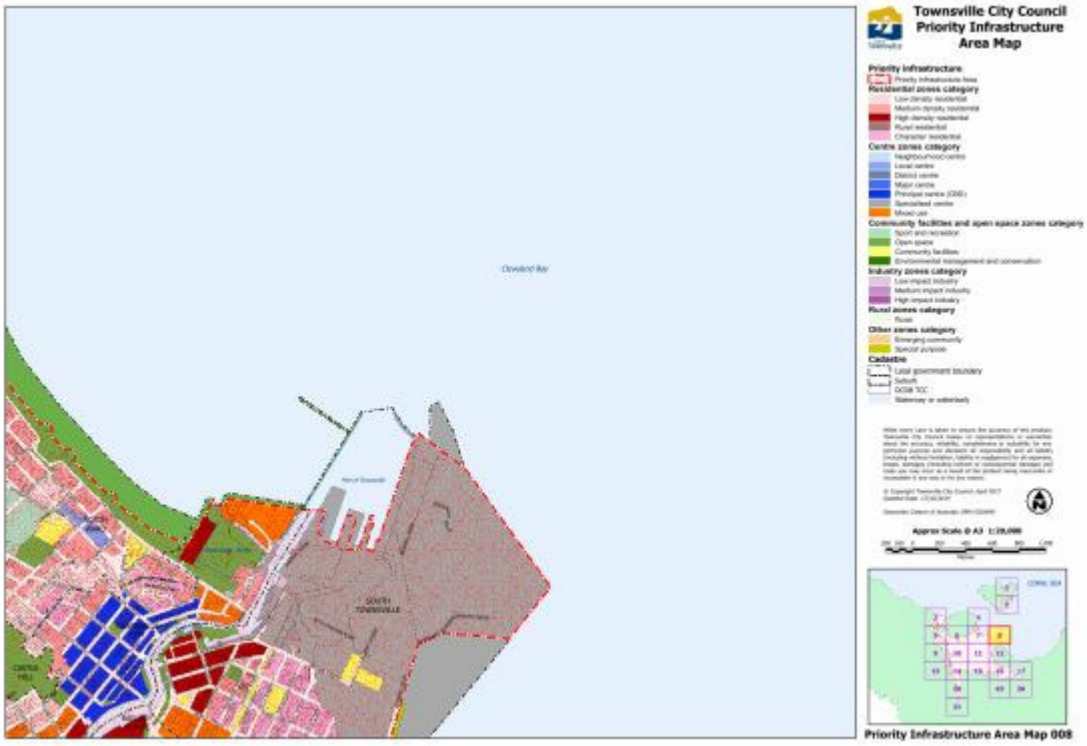

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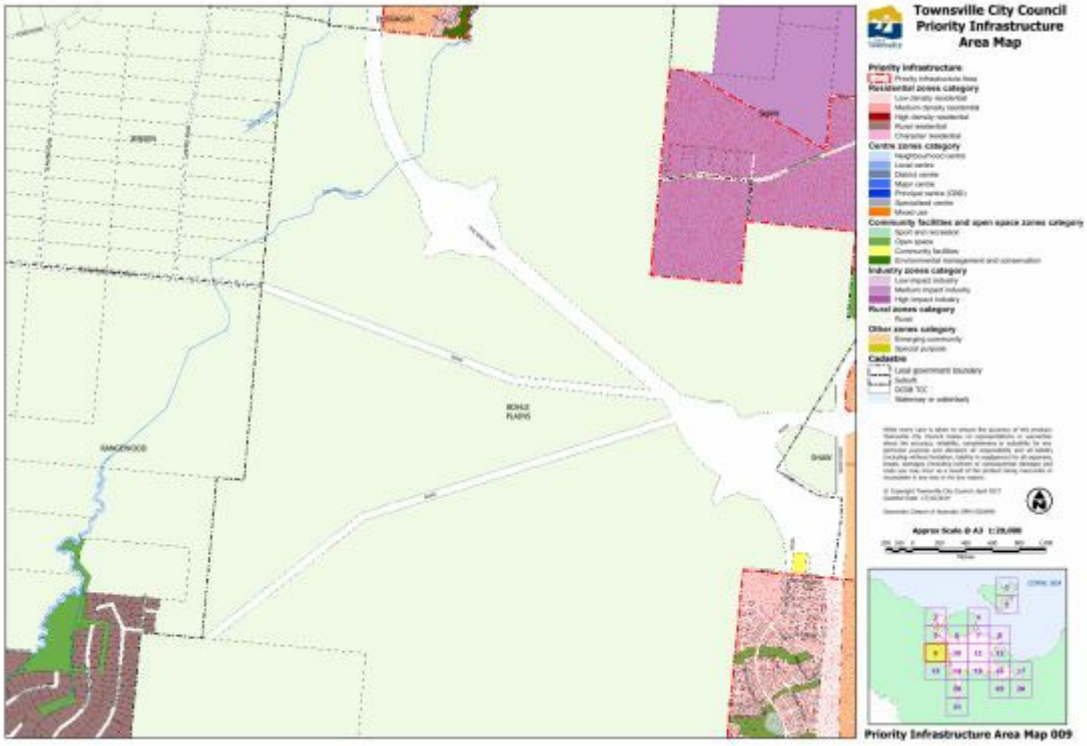

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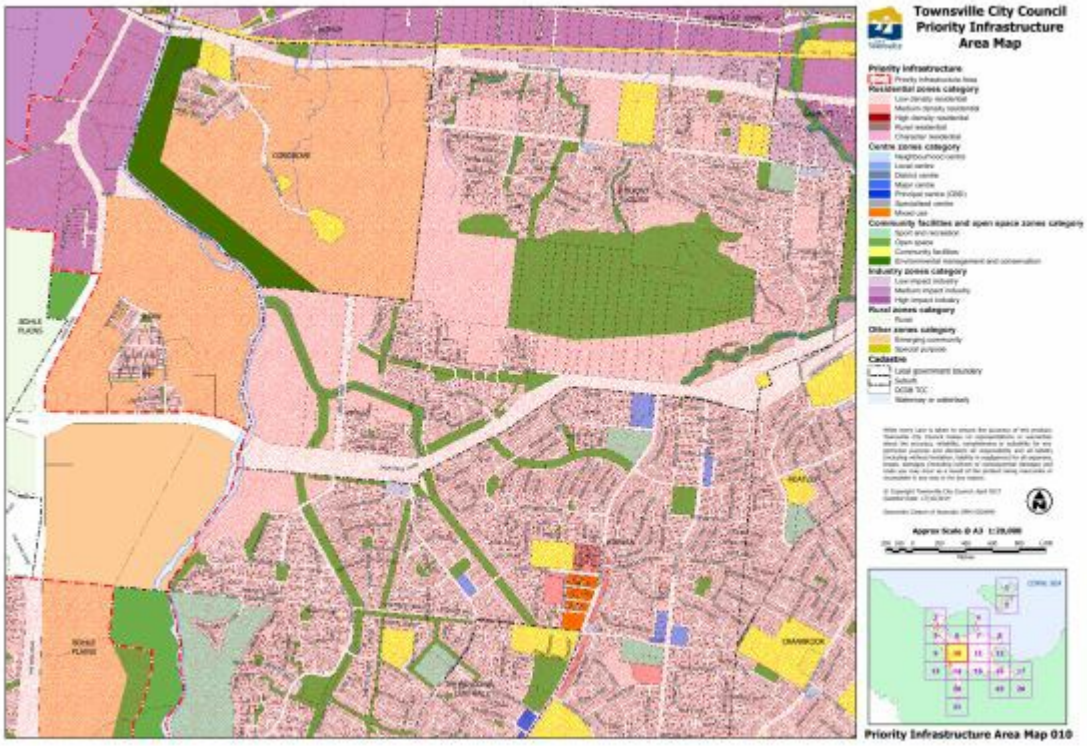

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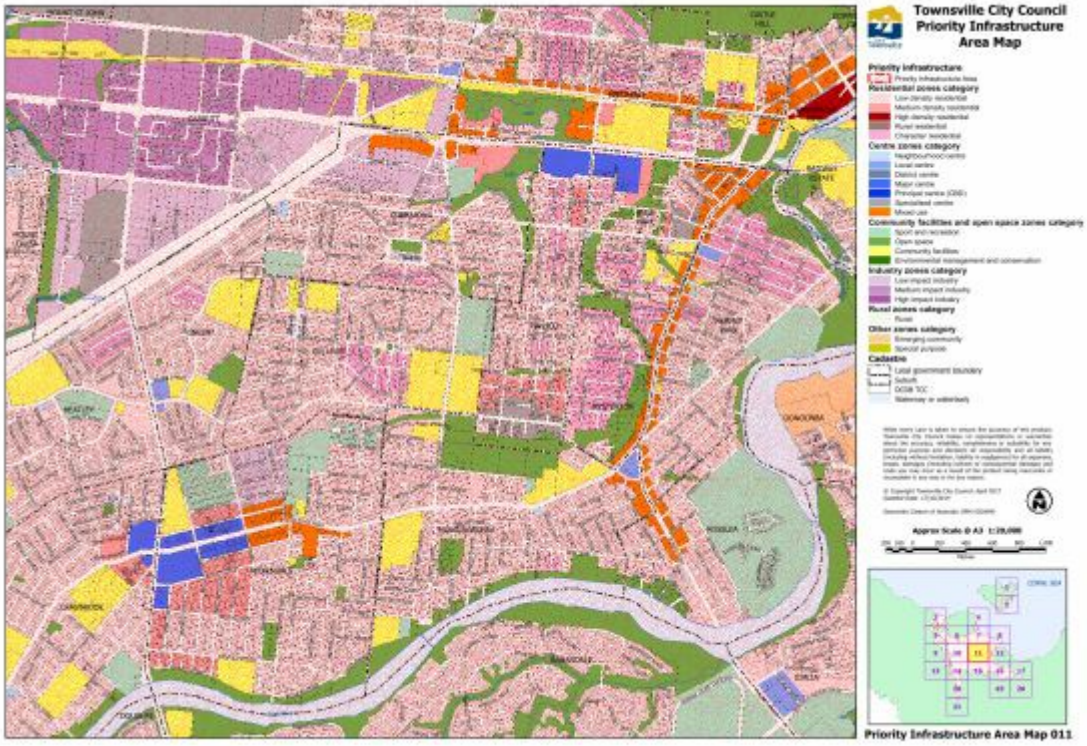

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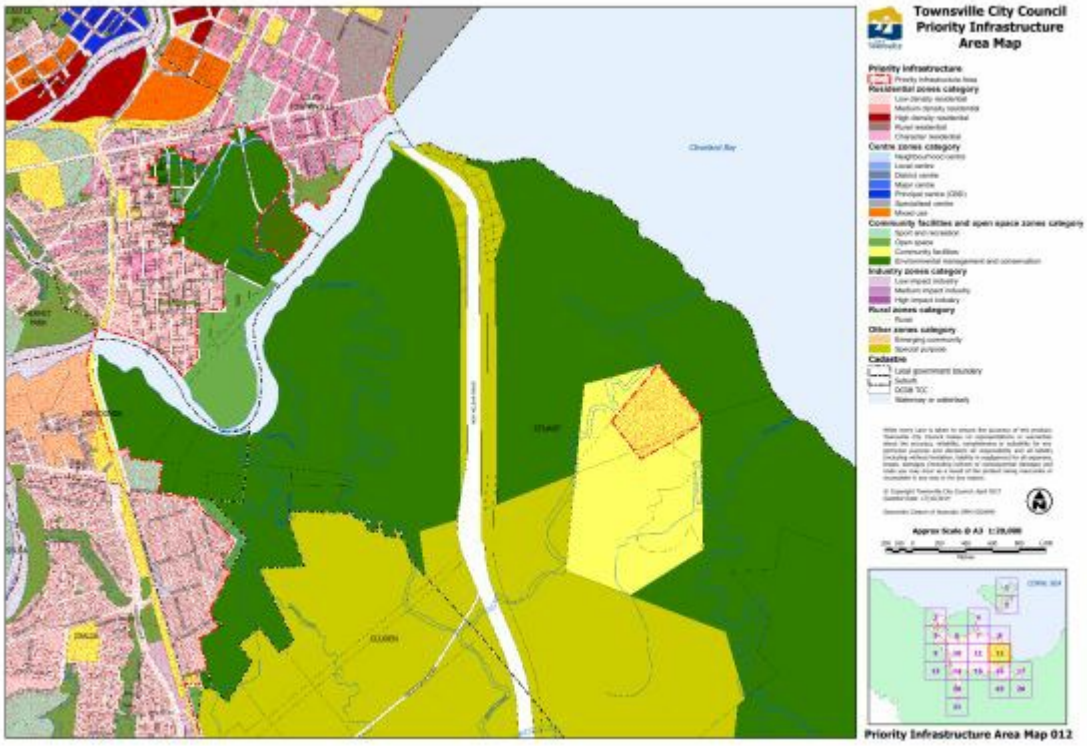

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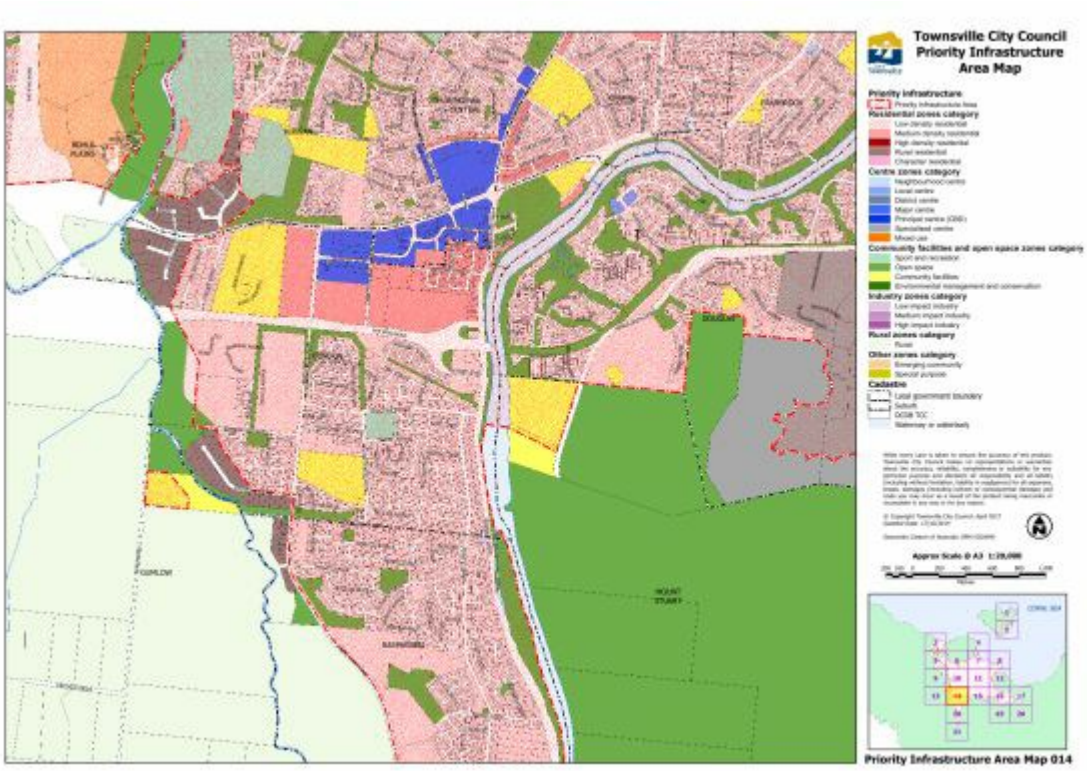

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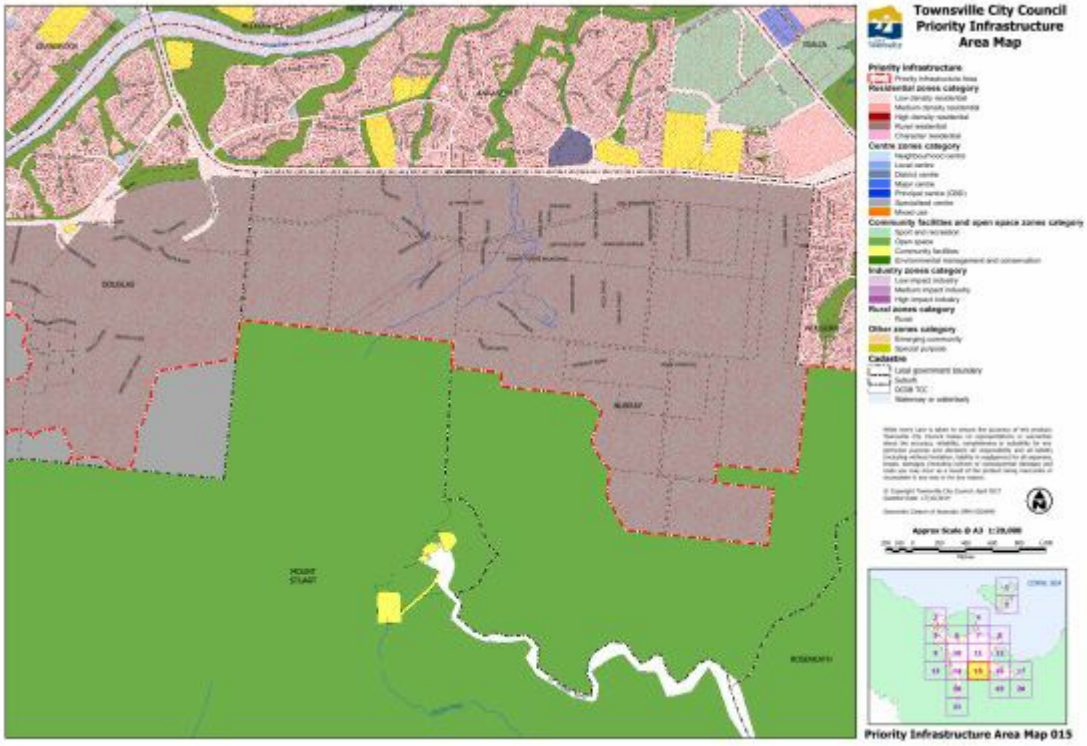

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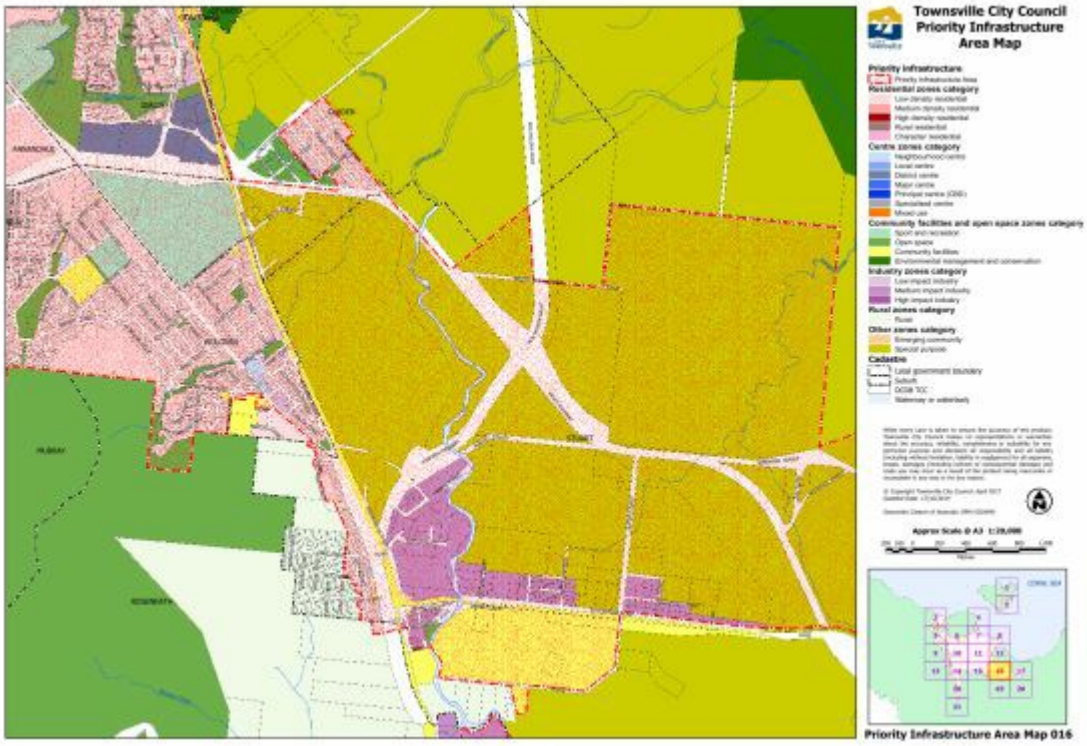

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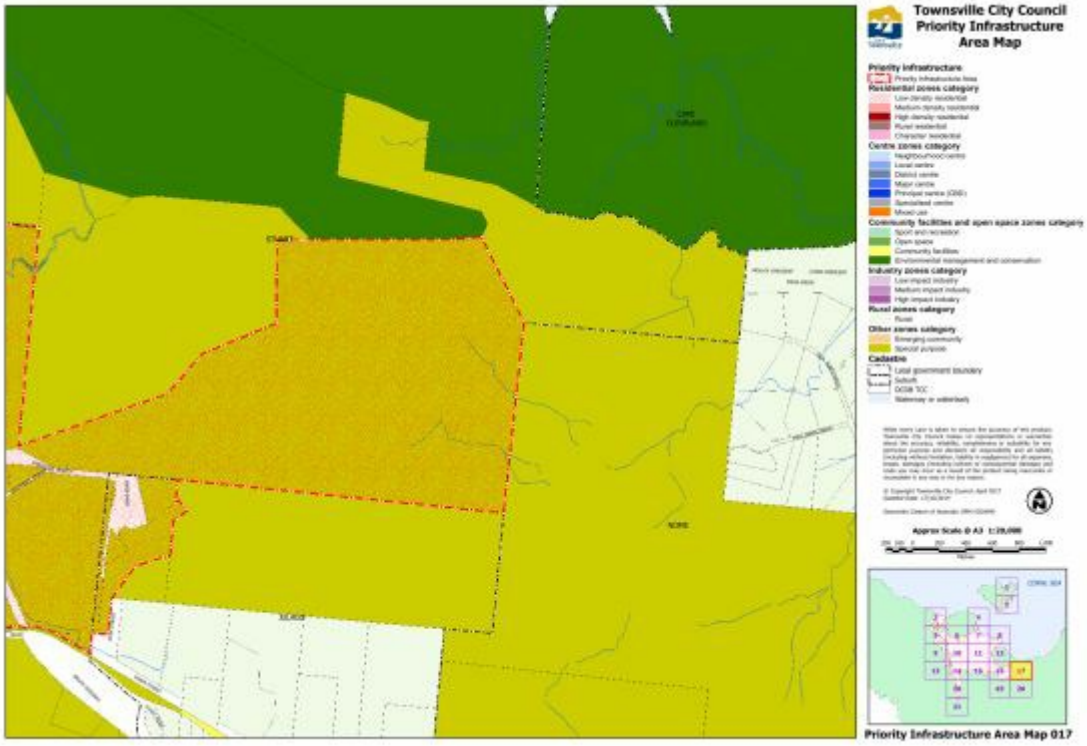

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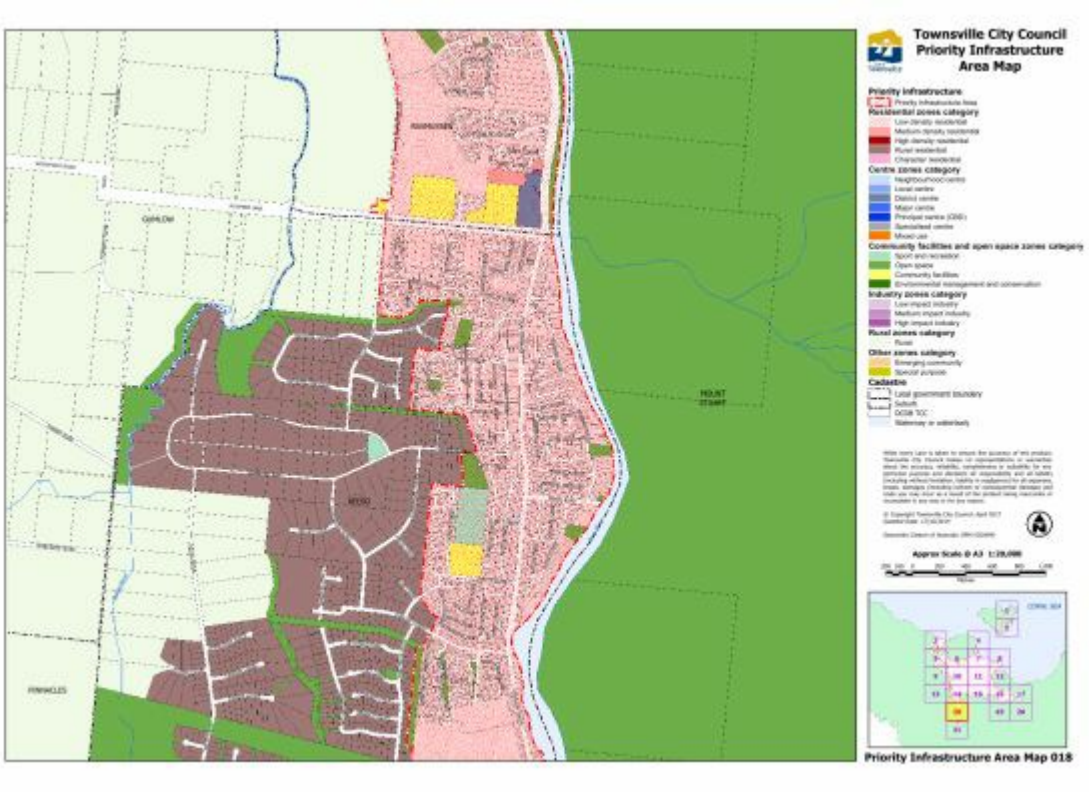

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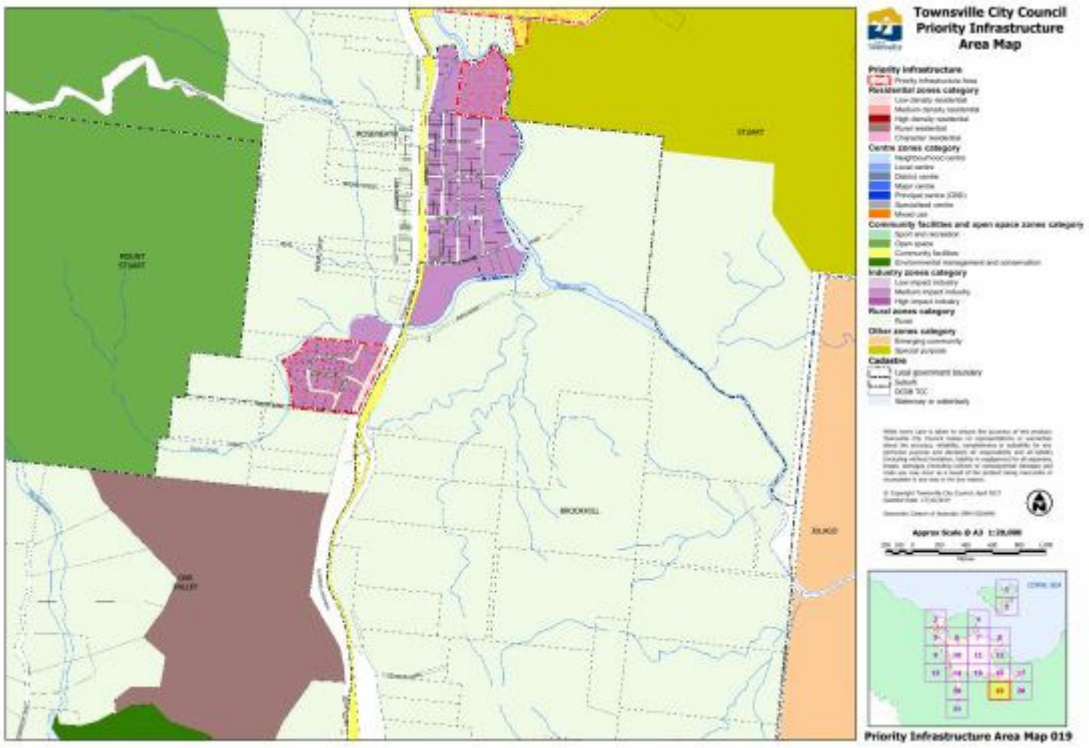

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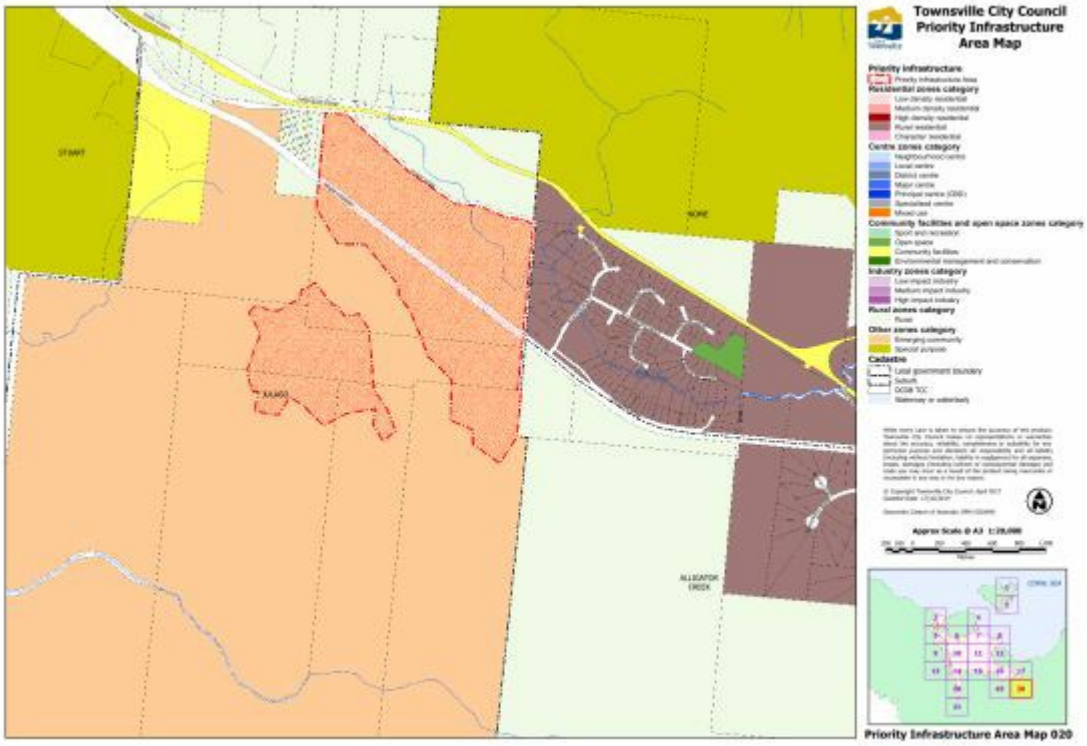

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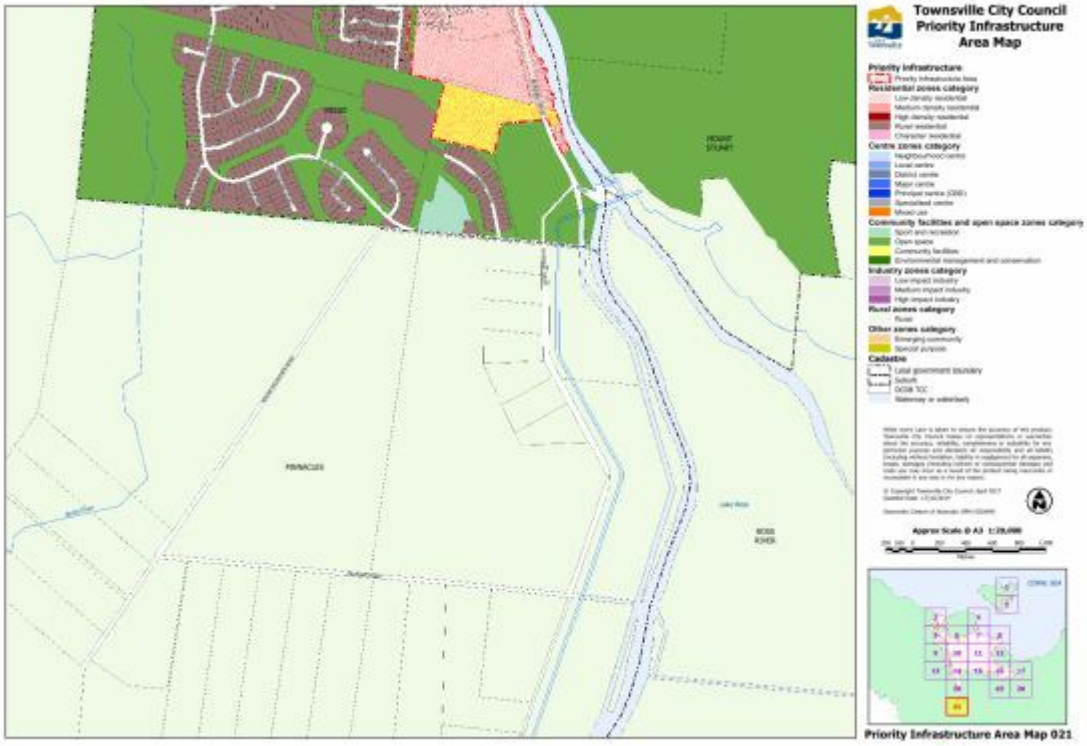

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SC3.3.5 - Plans for trunk water supply infrastructure

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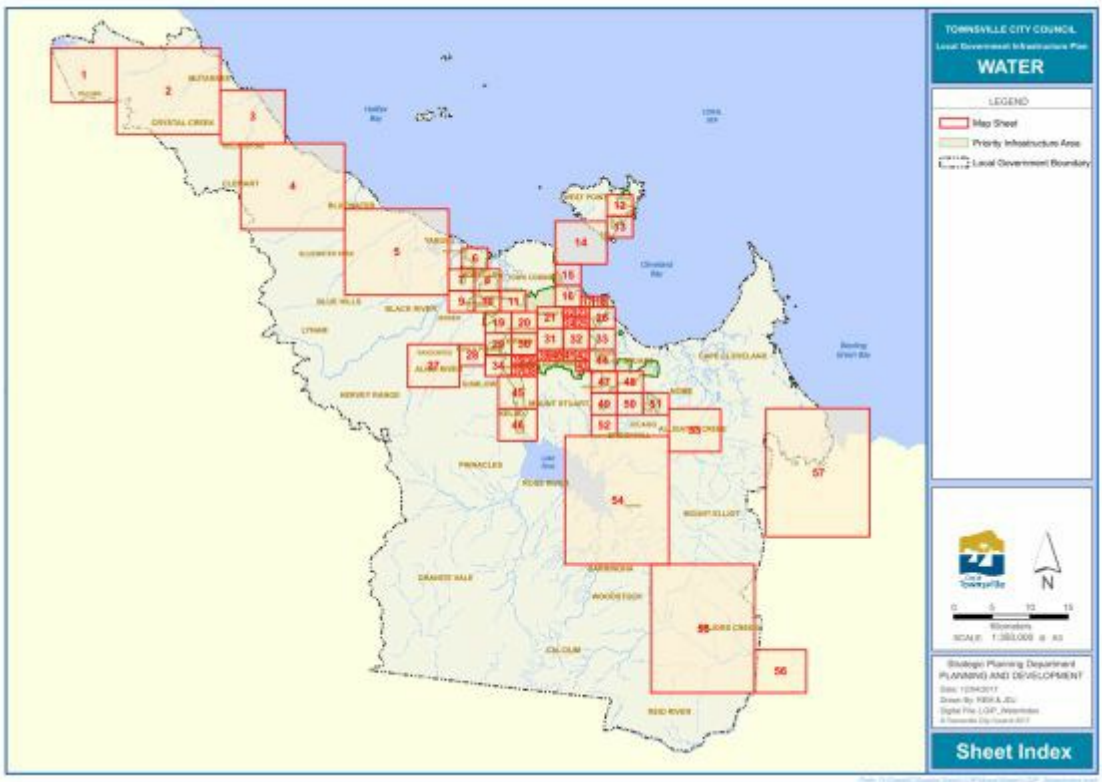
The maps are also loaded in a GIS environment. TownsvilleMaps is the current in-service GIS platform for this purpose, which can be publicly viewed at council, or privately accessed via subscription.



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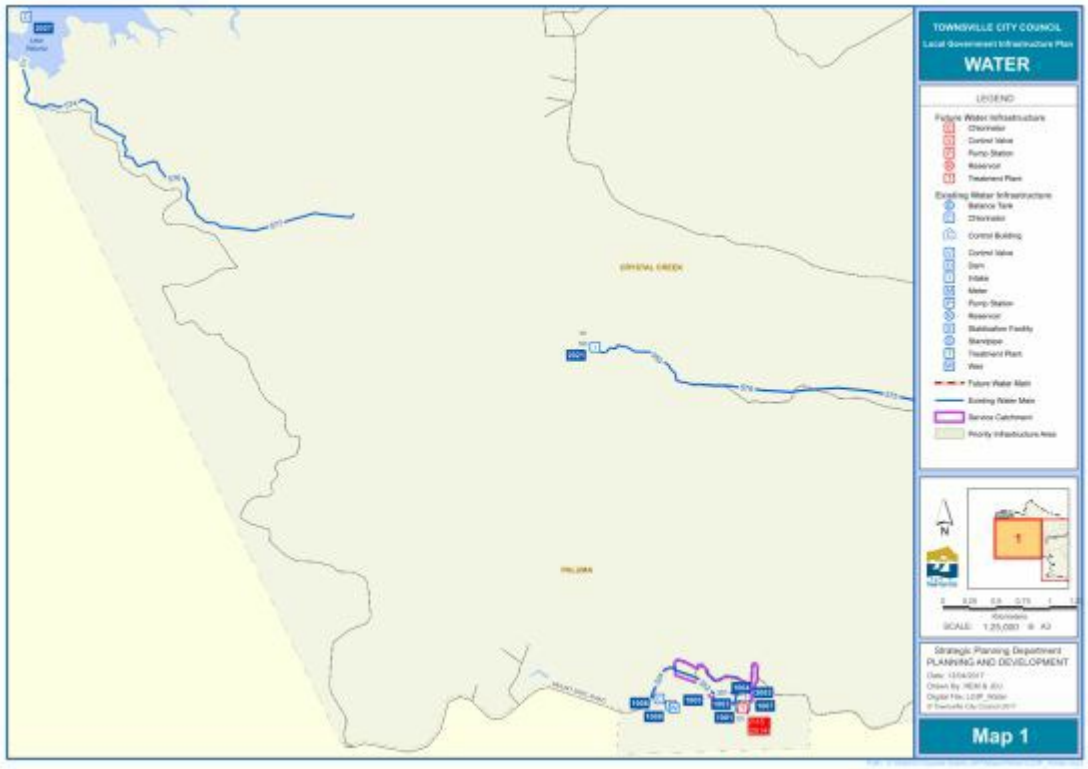

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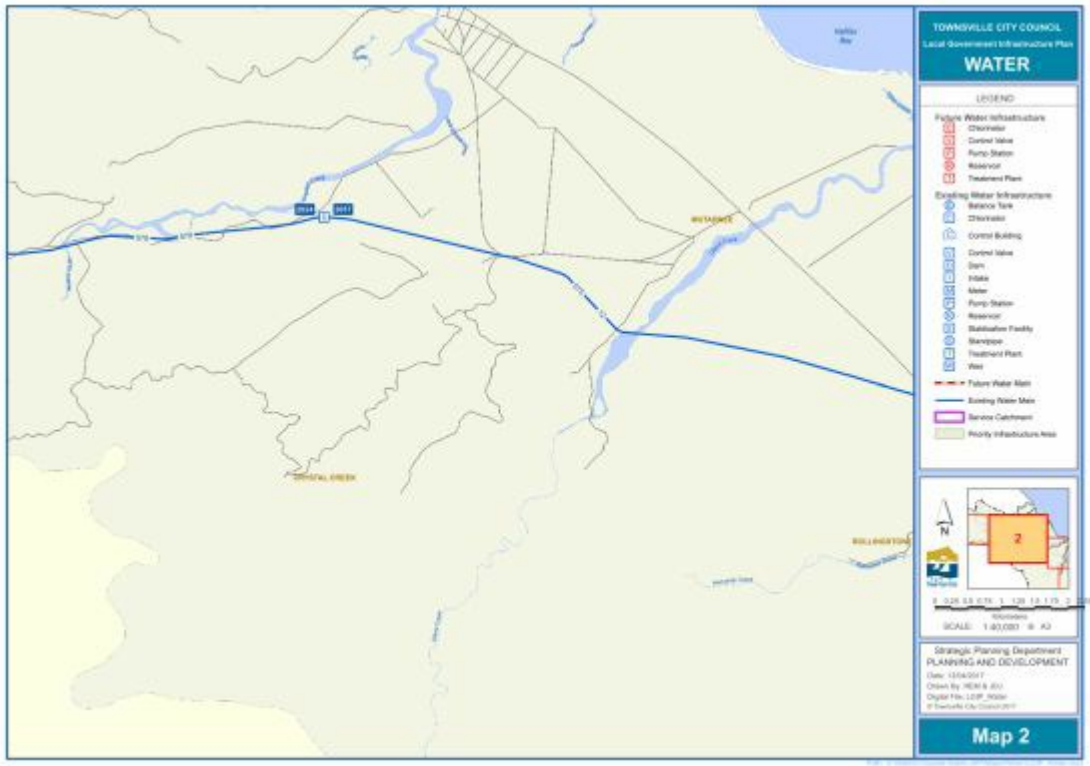

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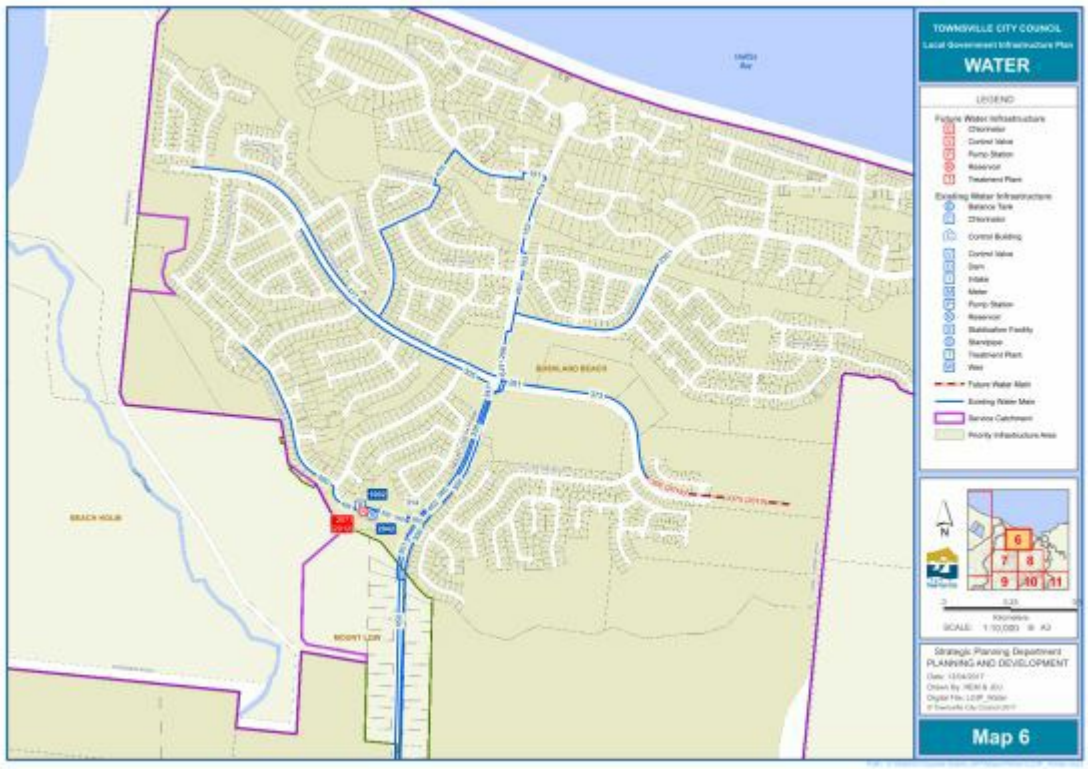

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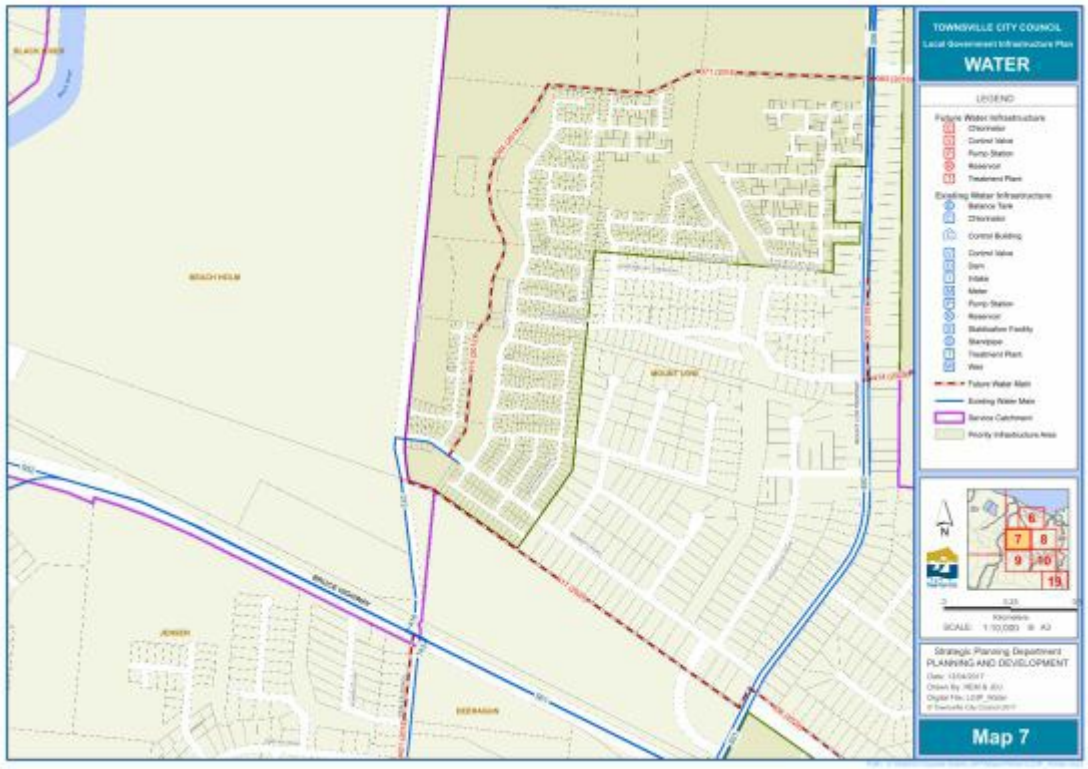

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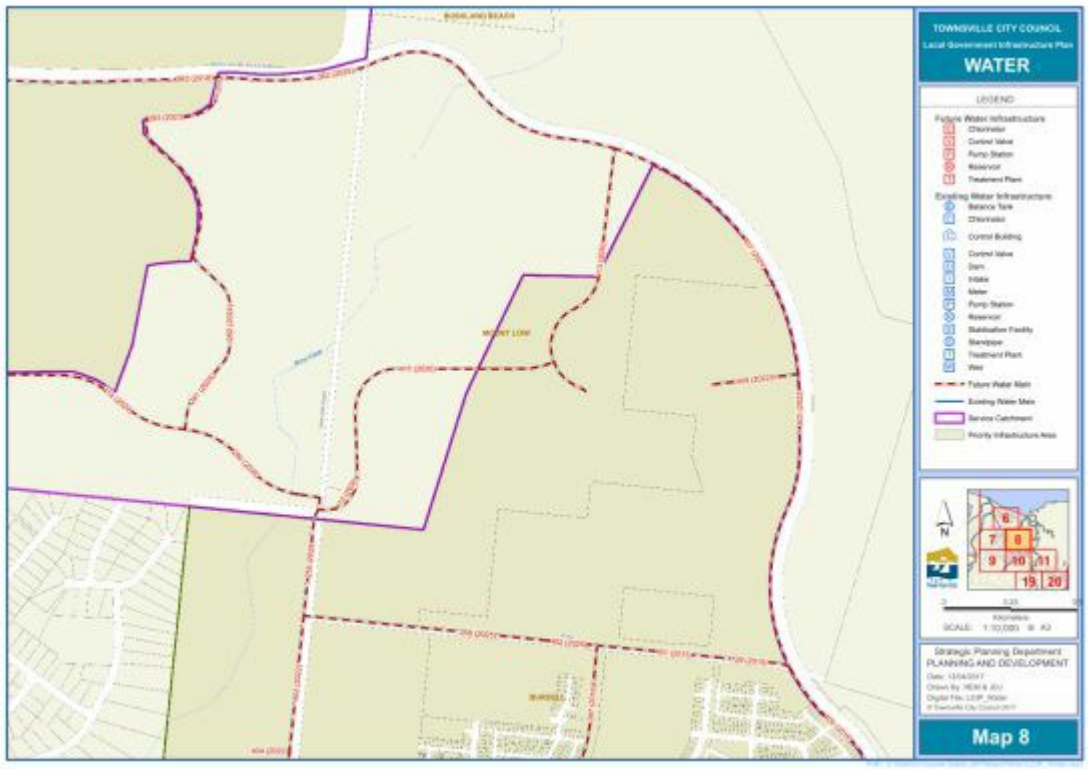

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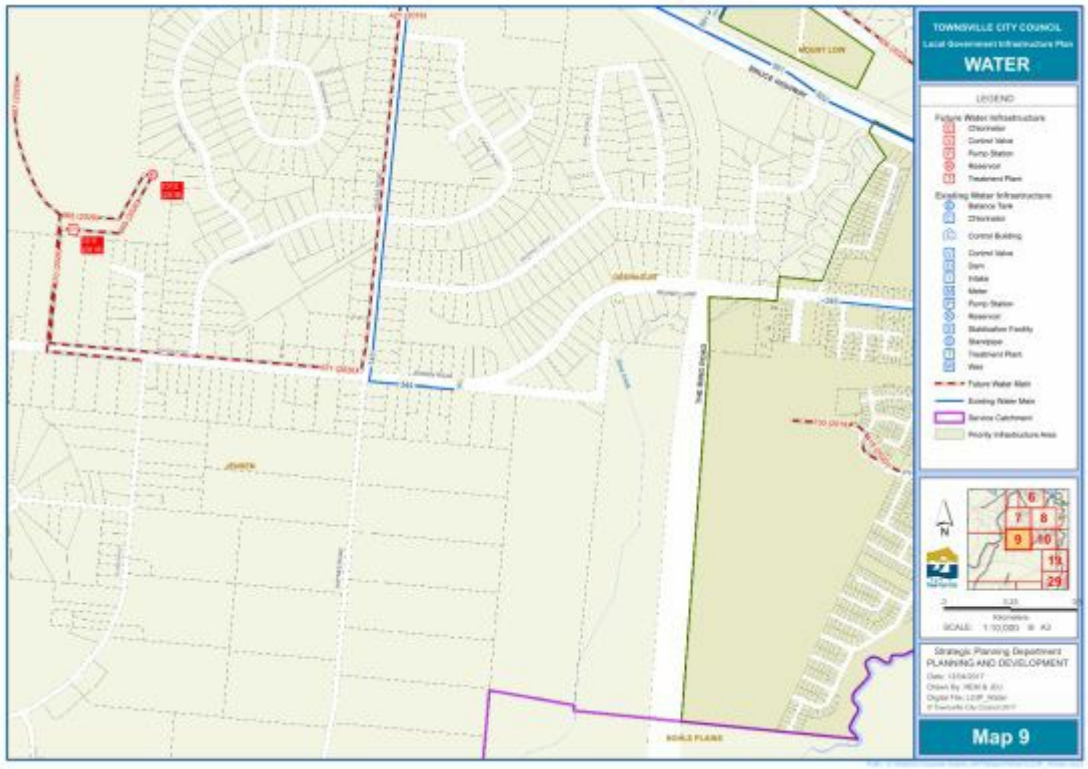

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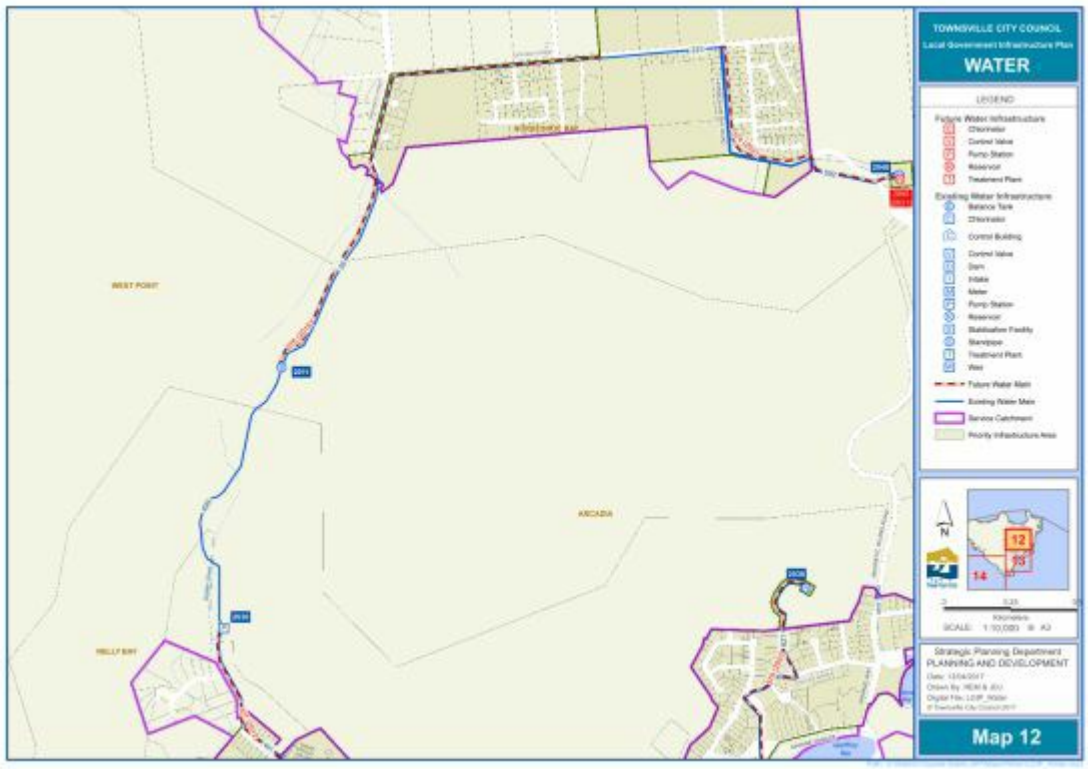

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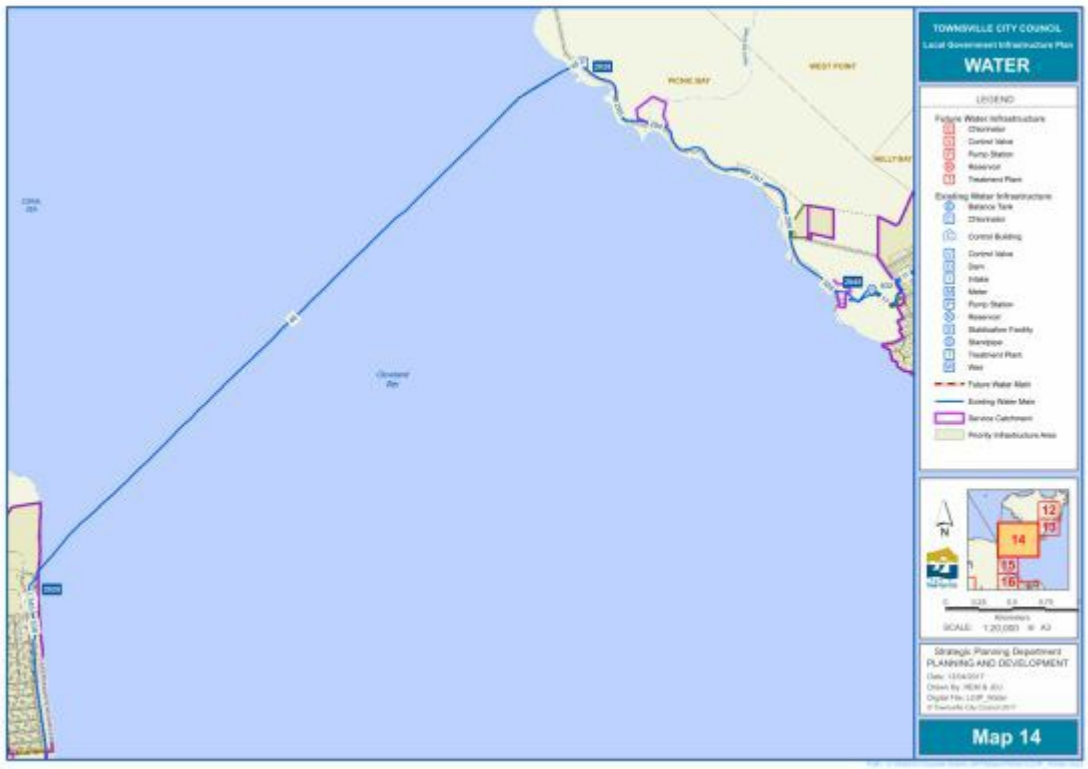

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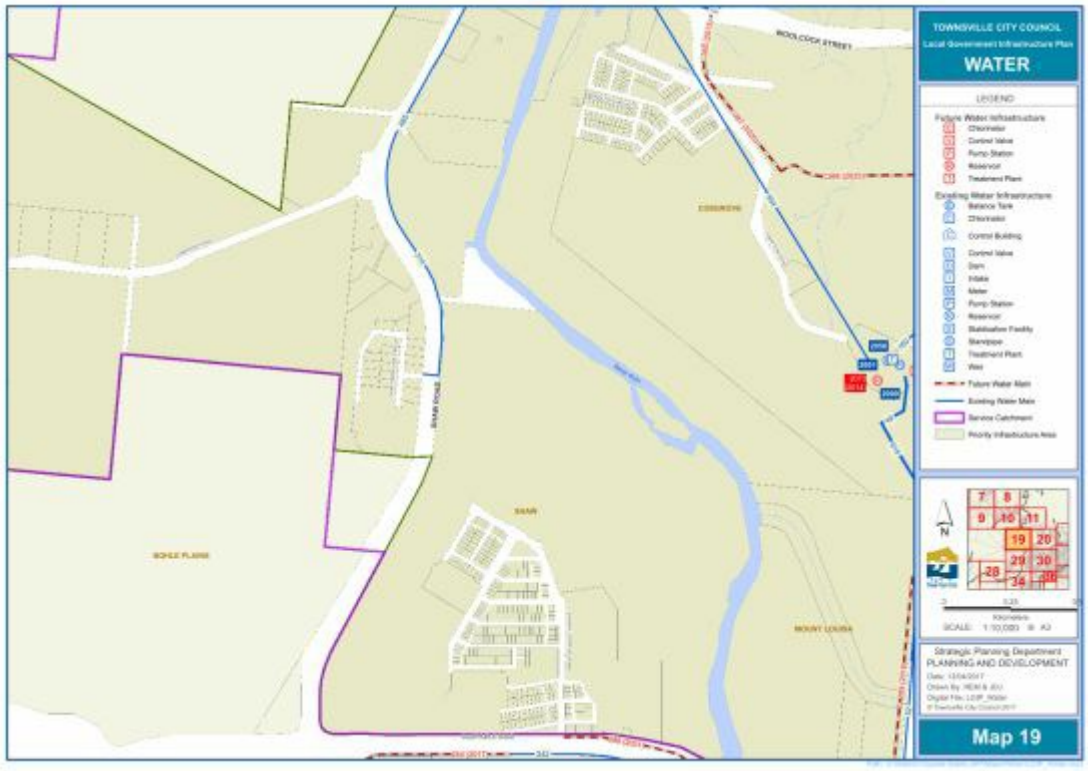

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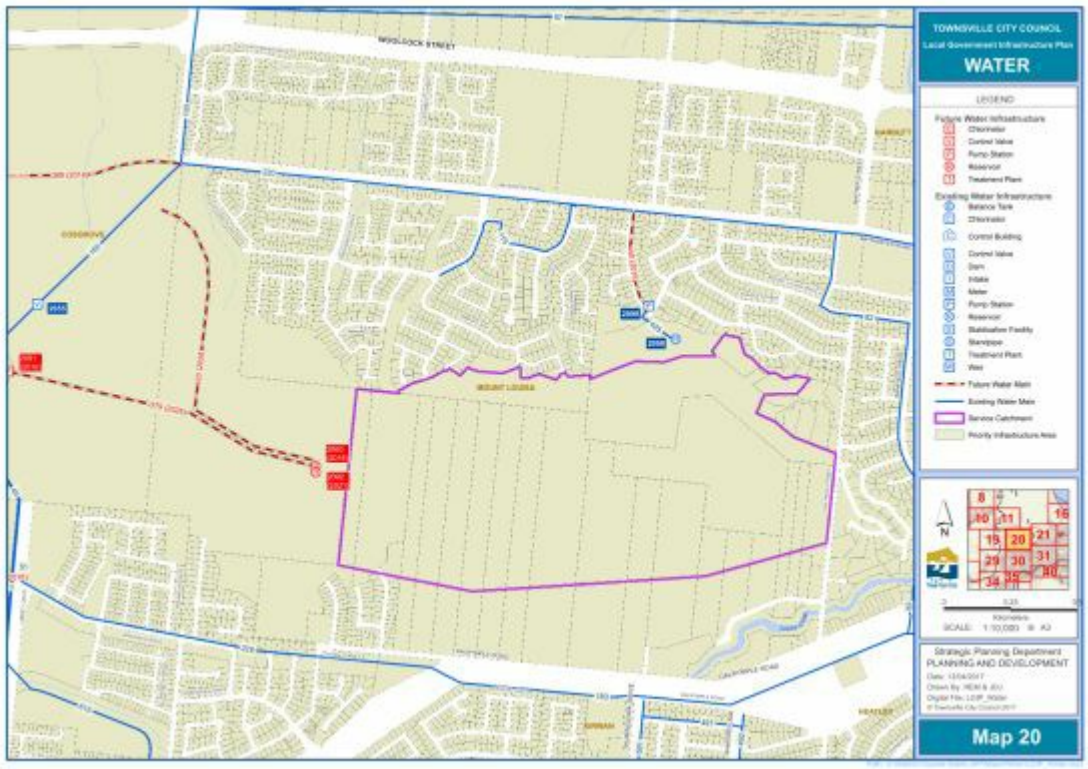

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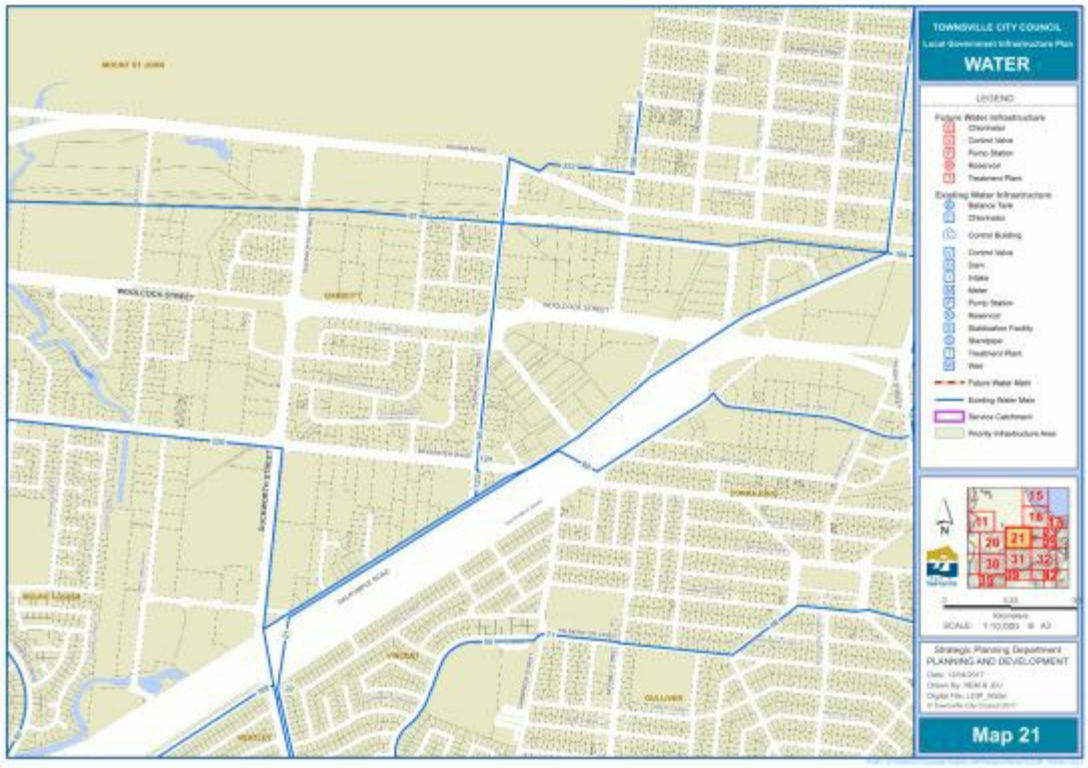

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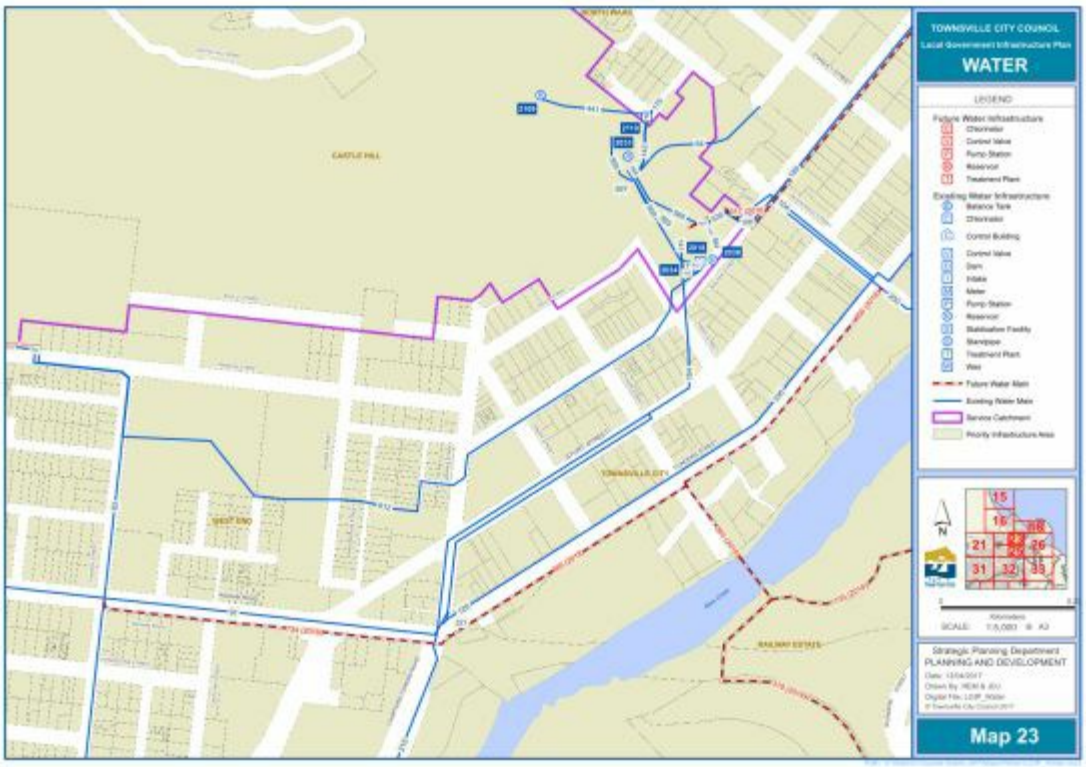

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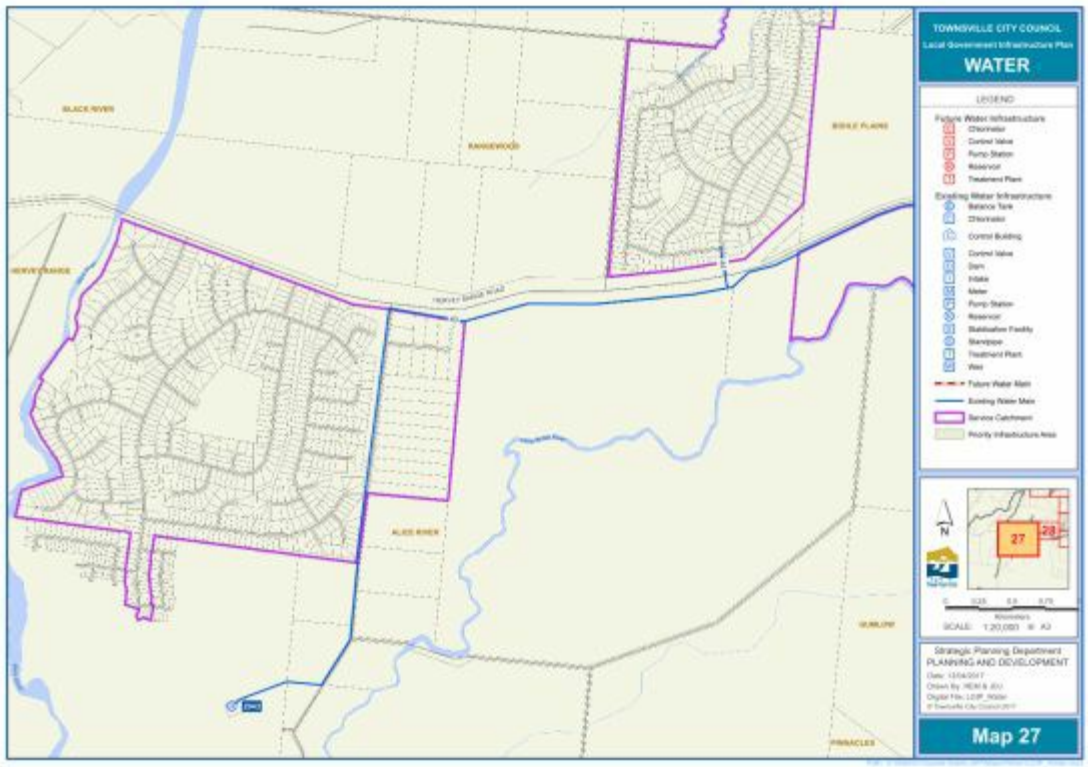

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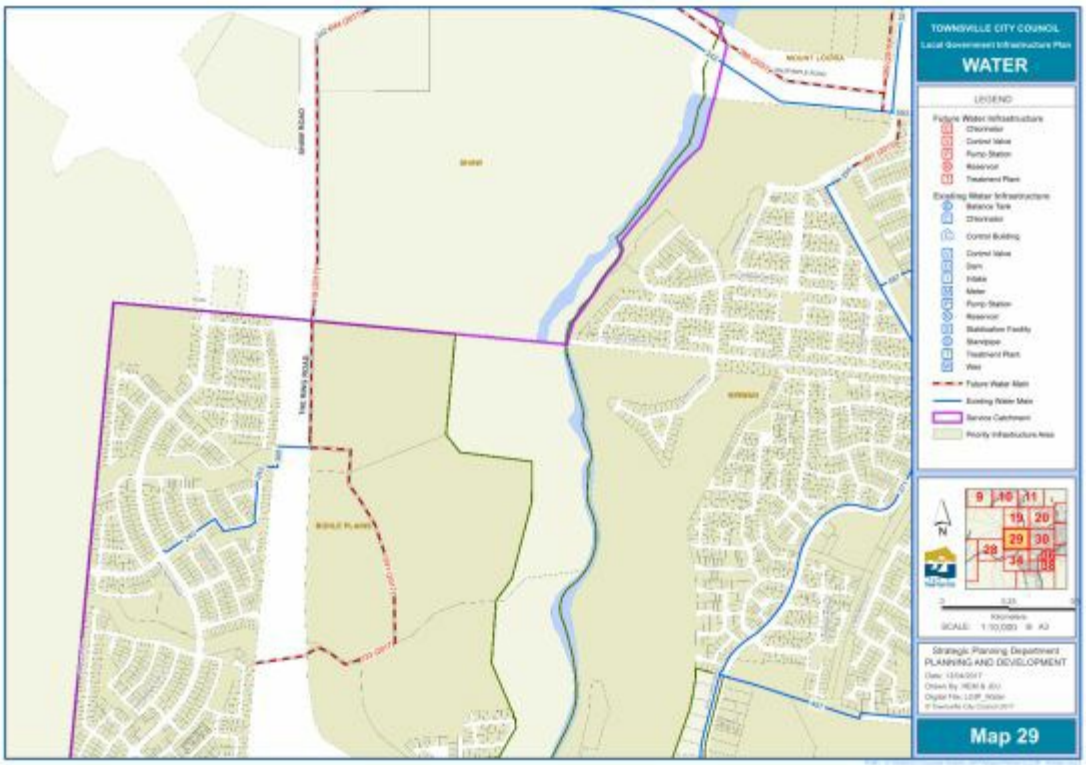

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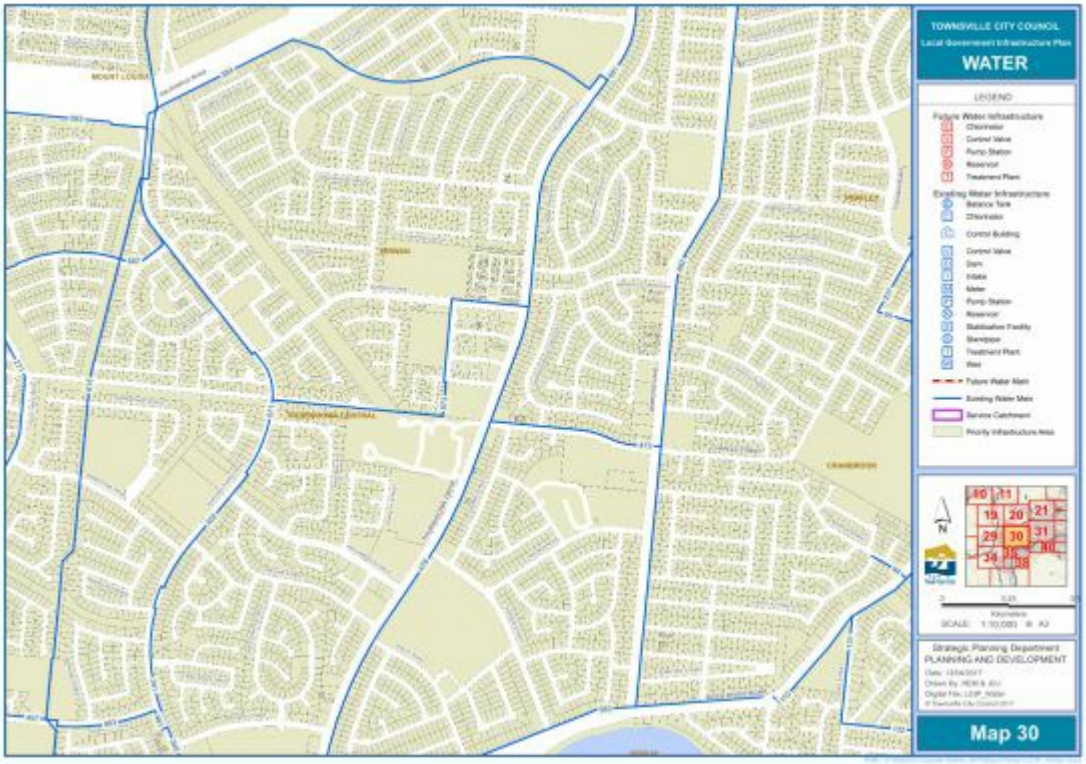

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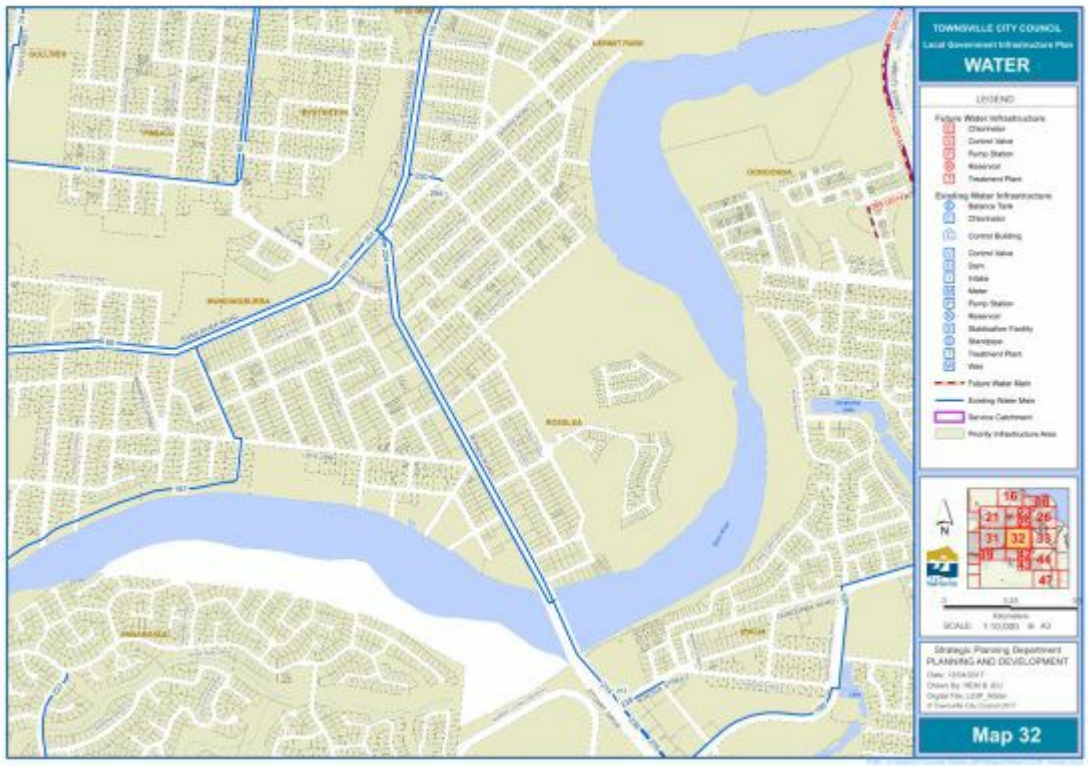

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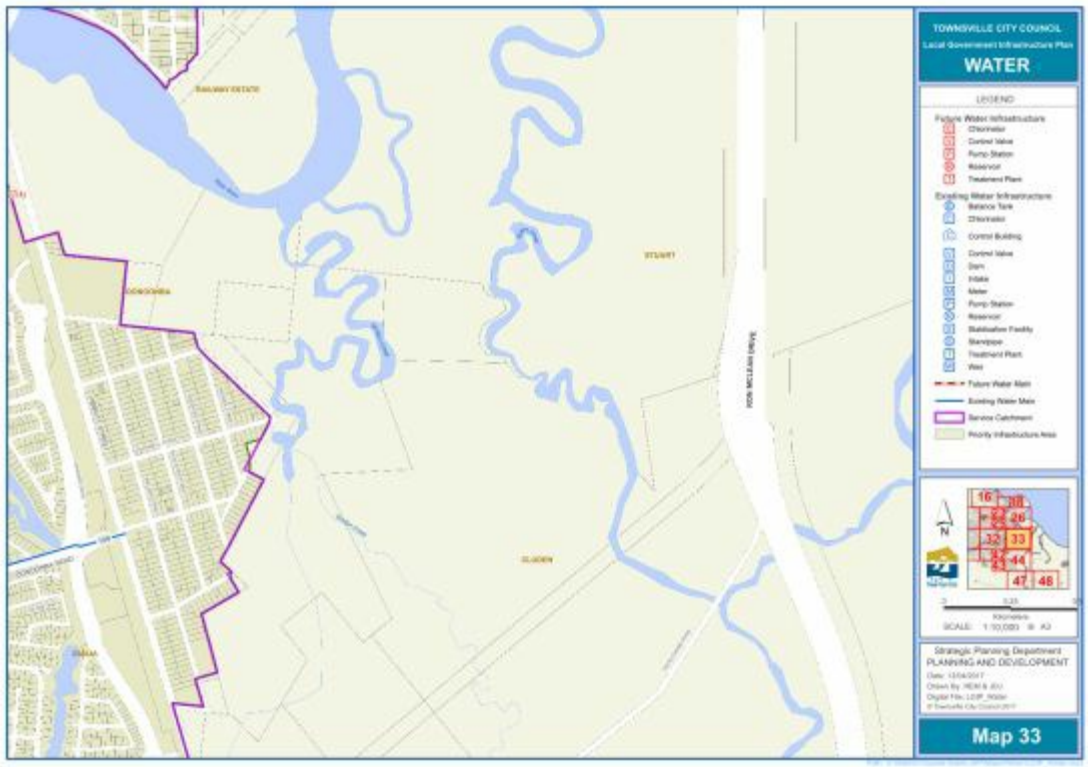

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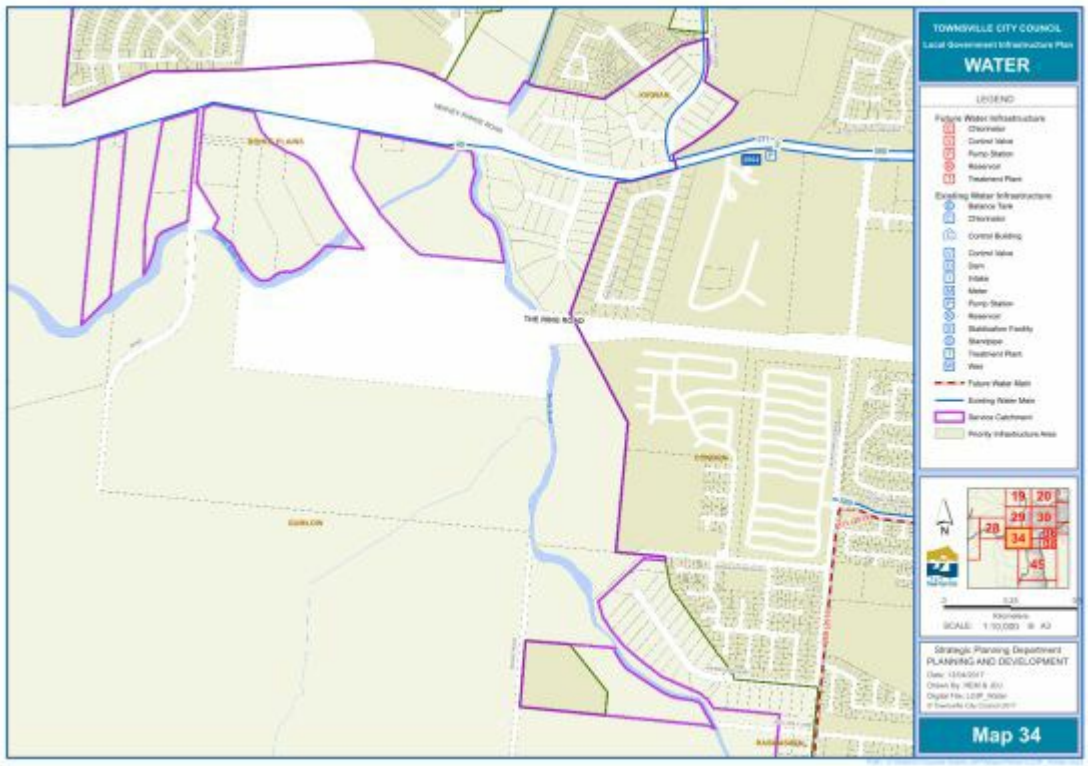

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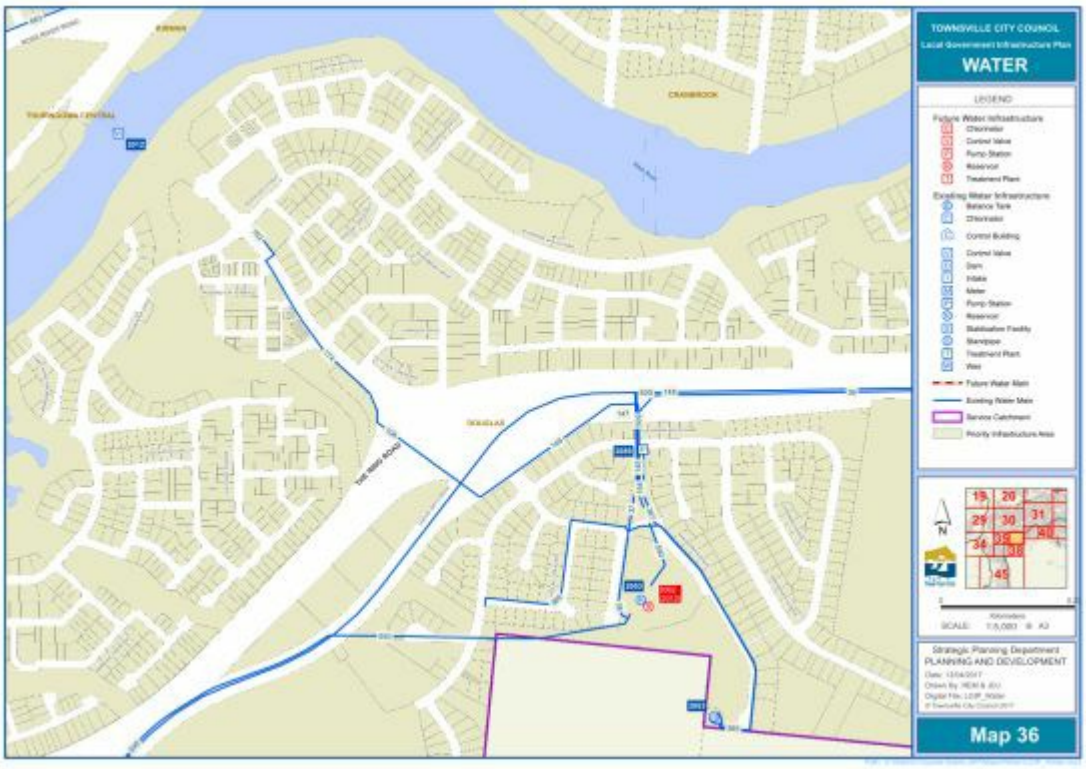

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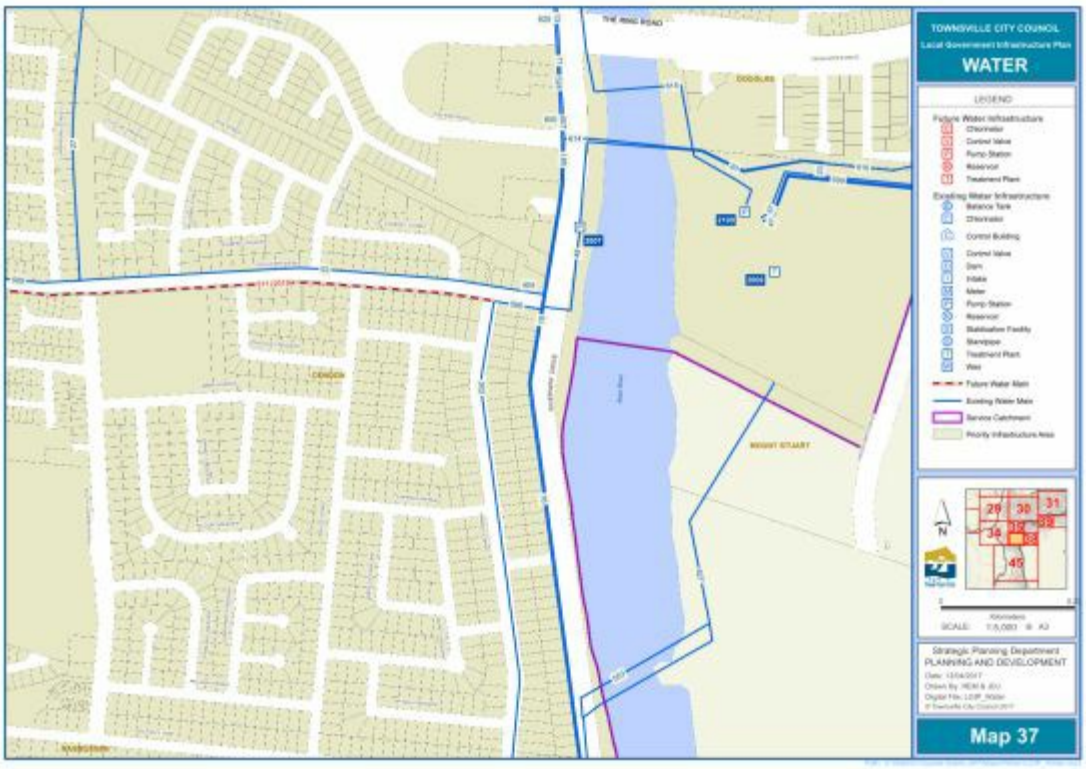

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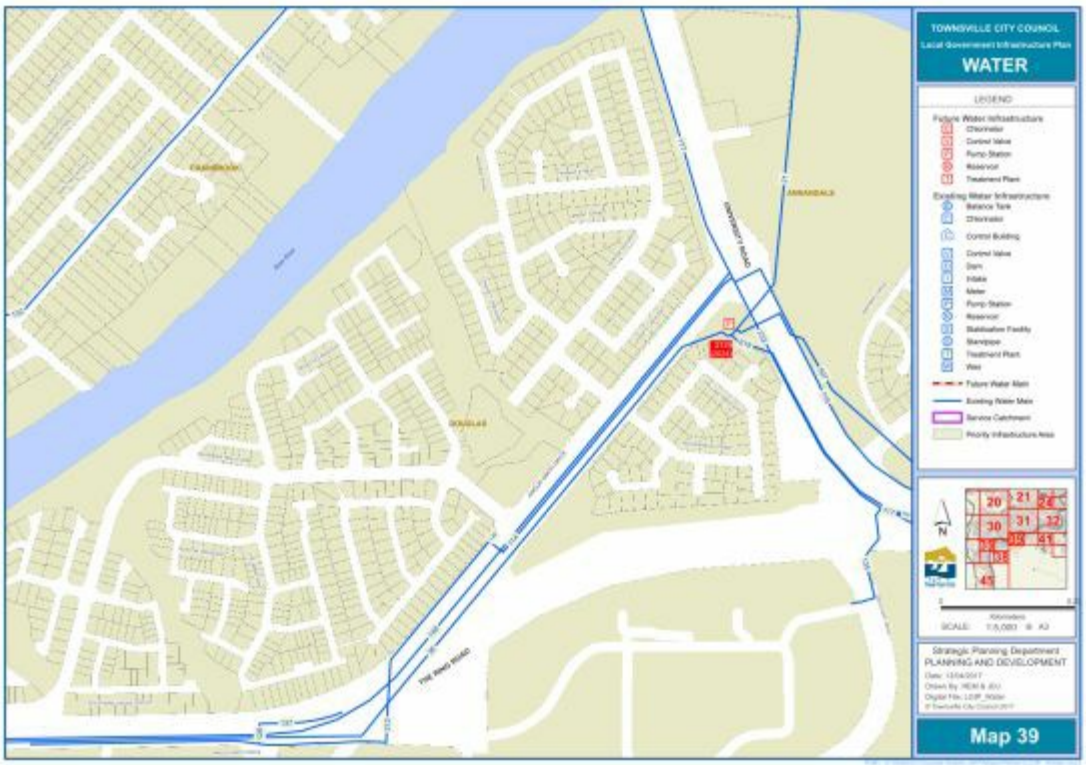

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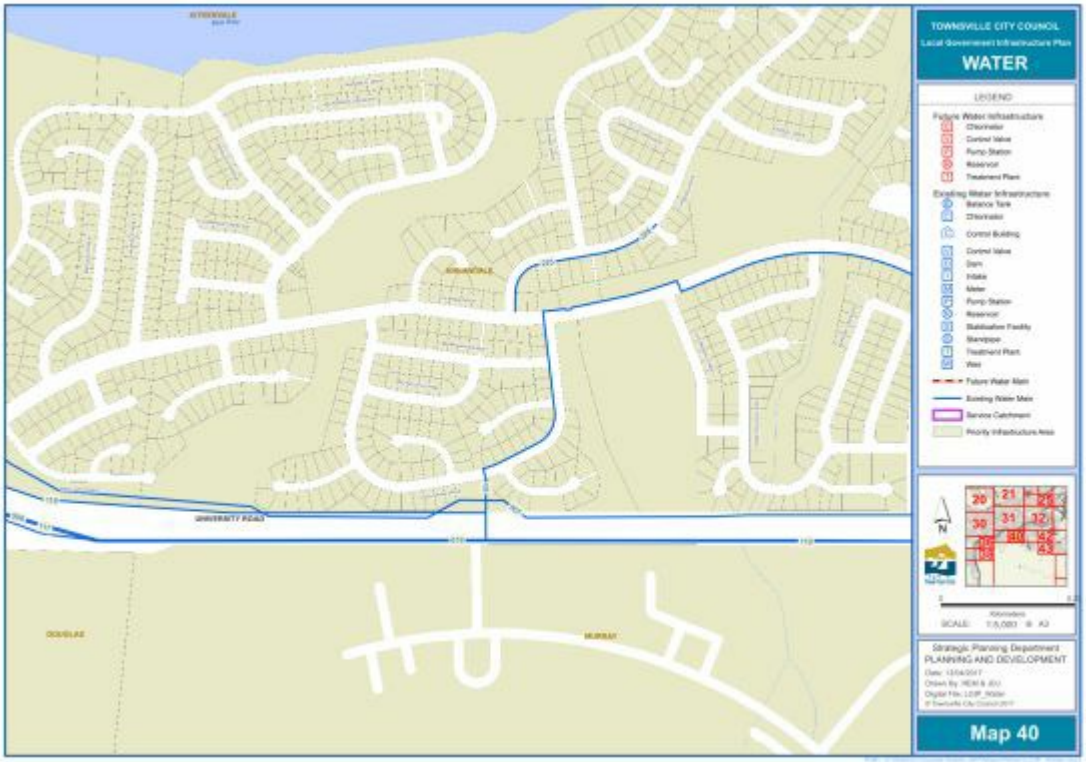

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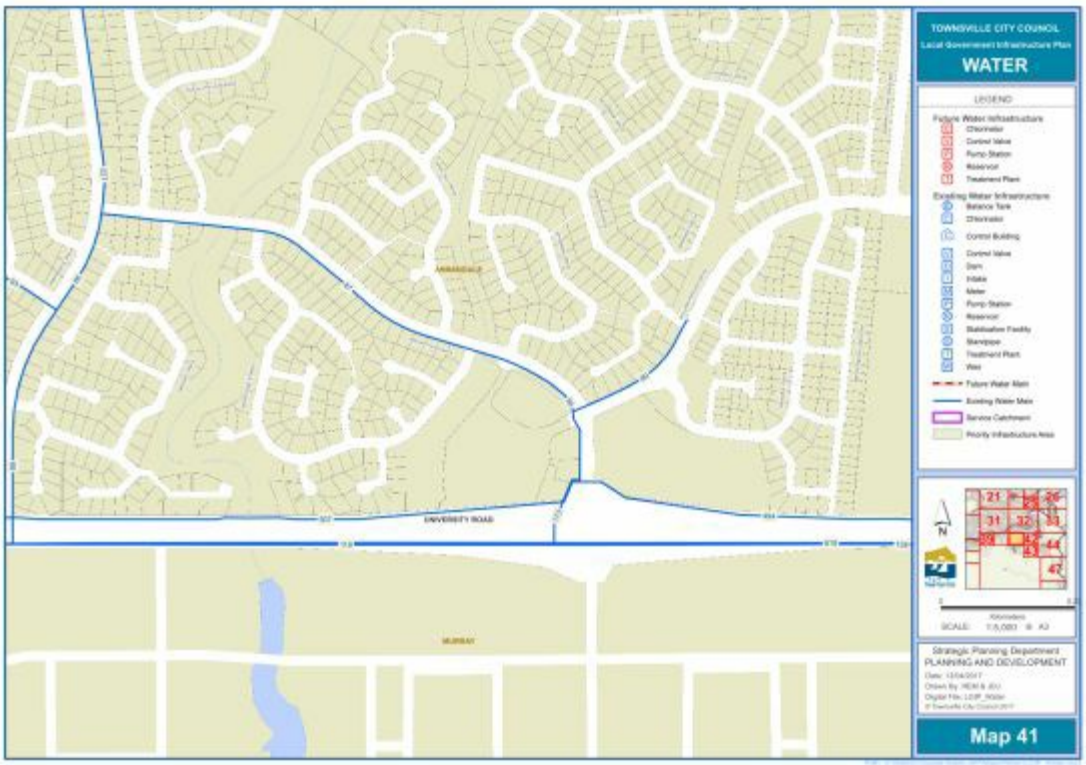

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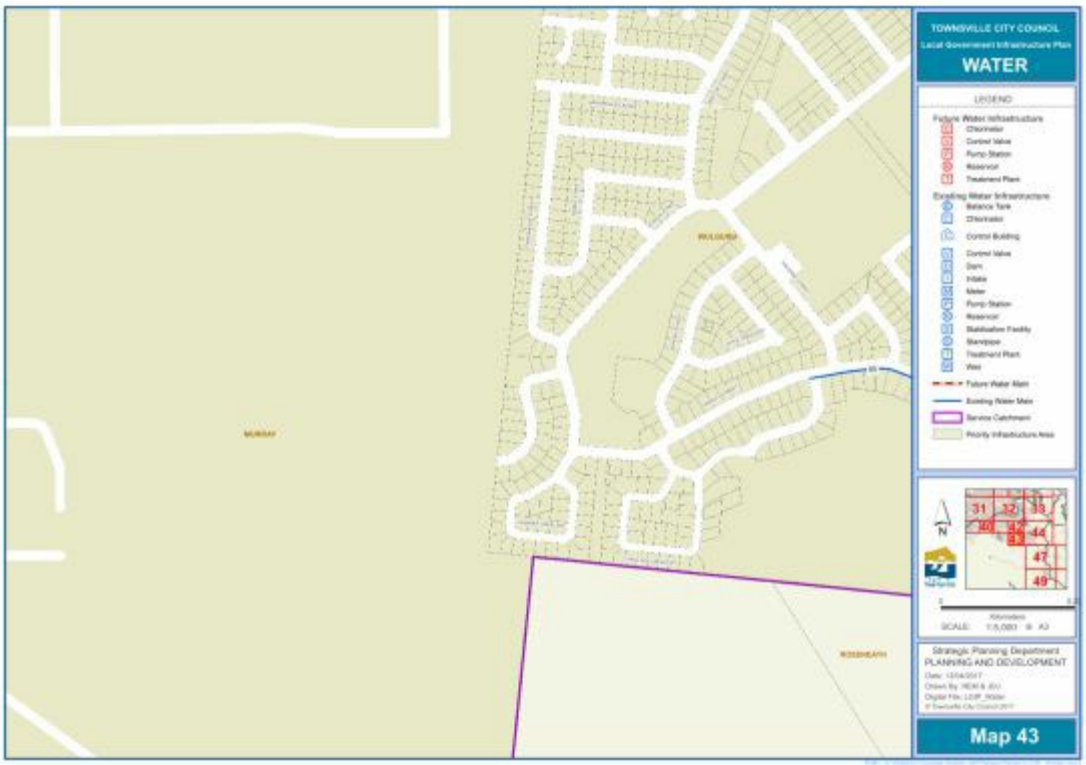

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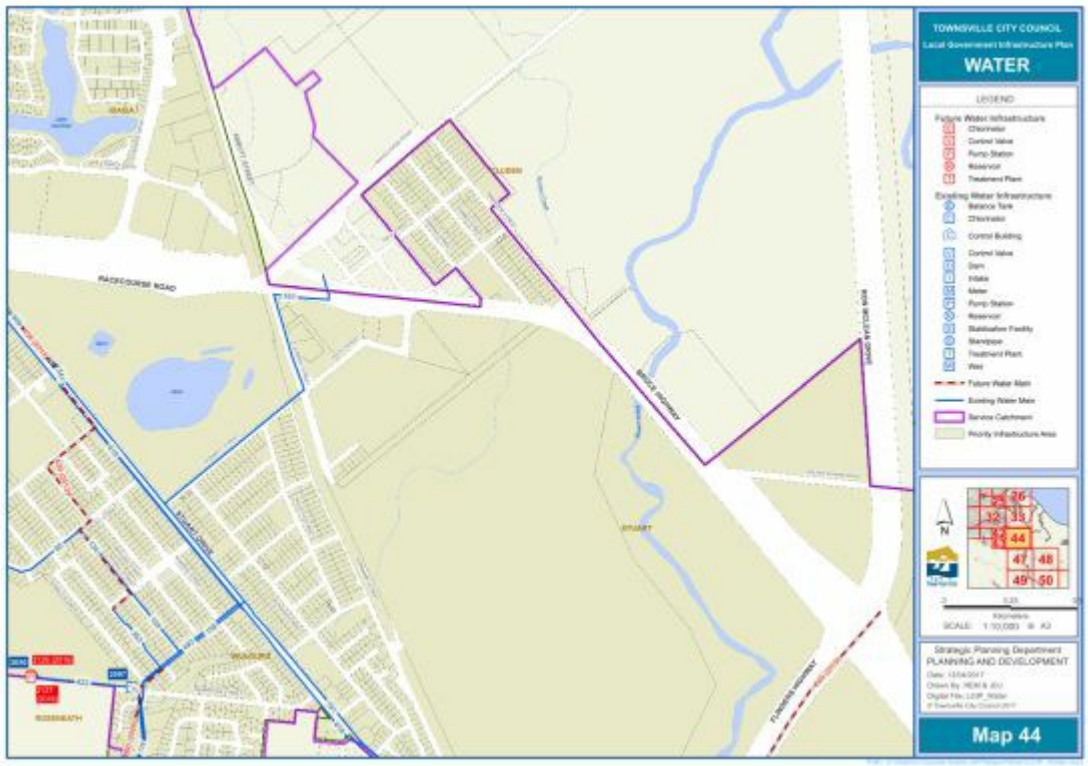

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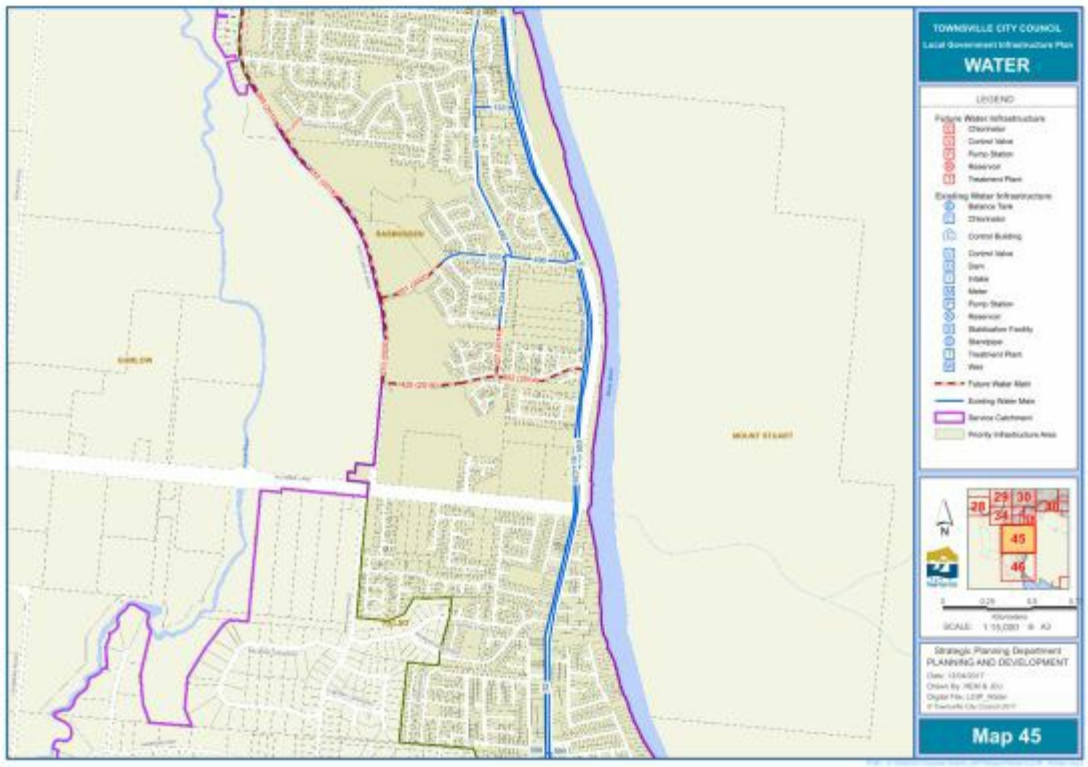

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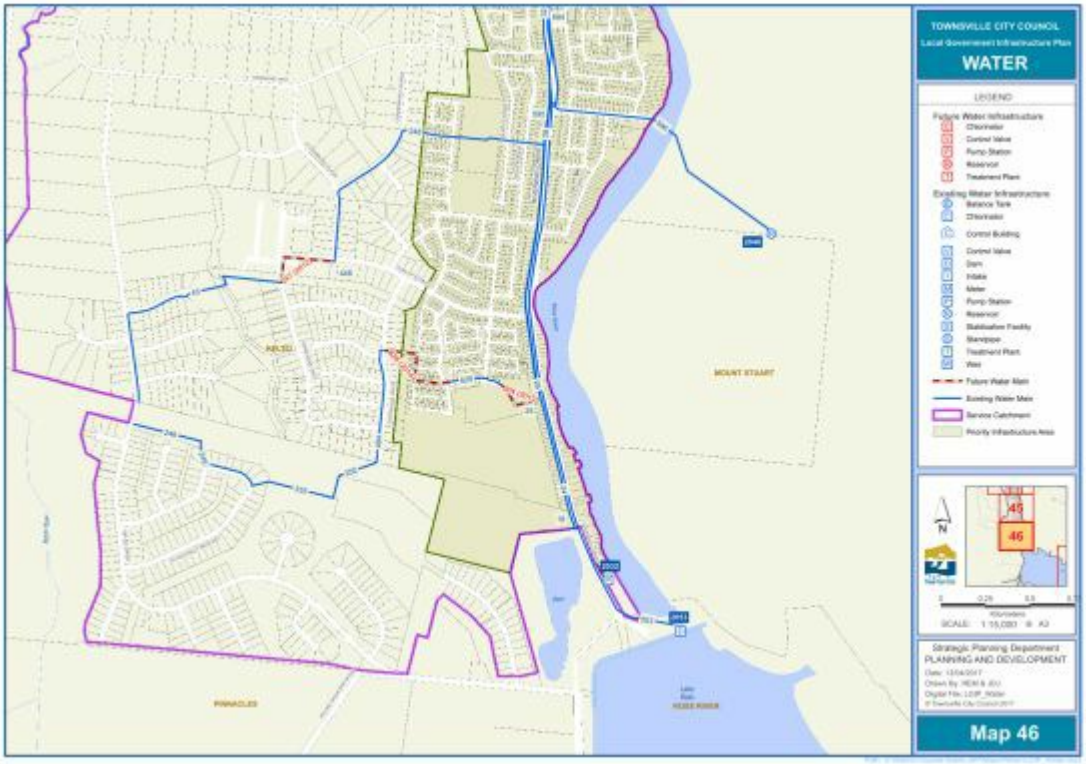

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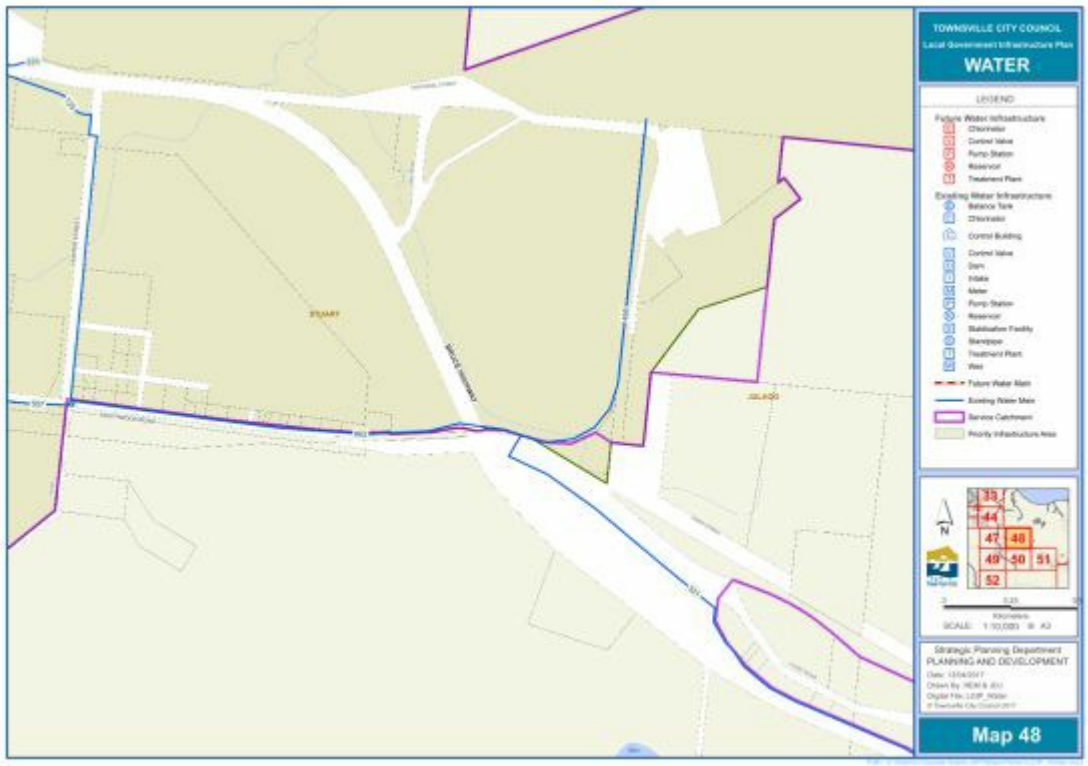

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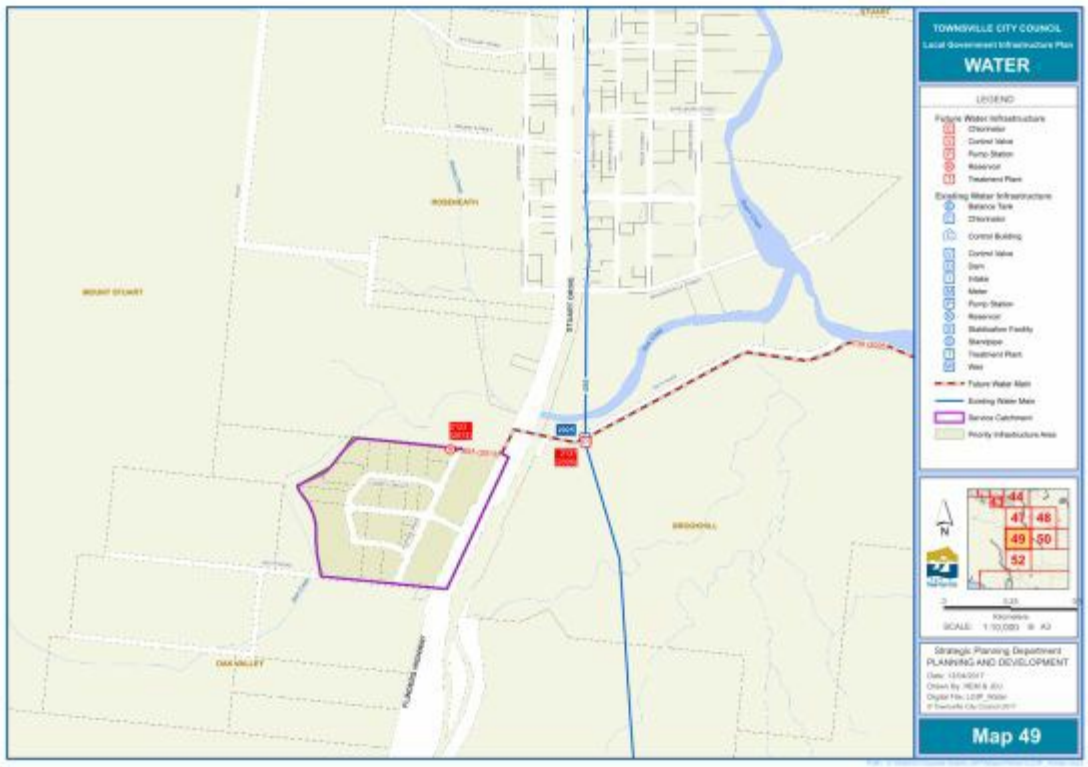

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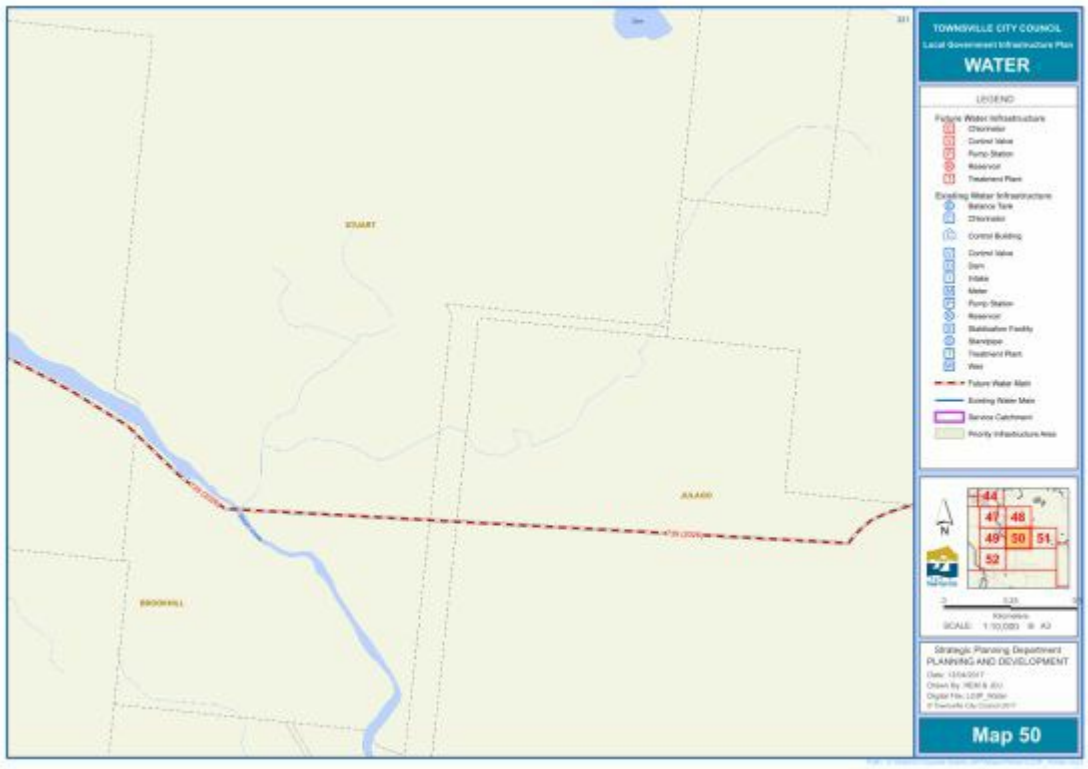

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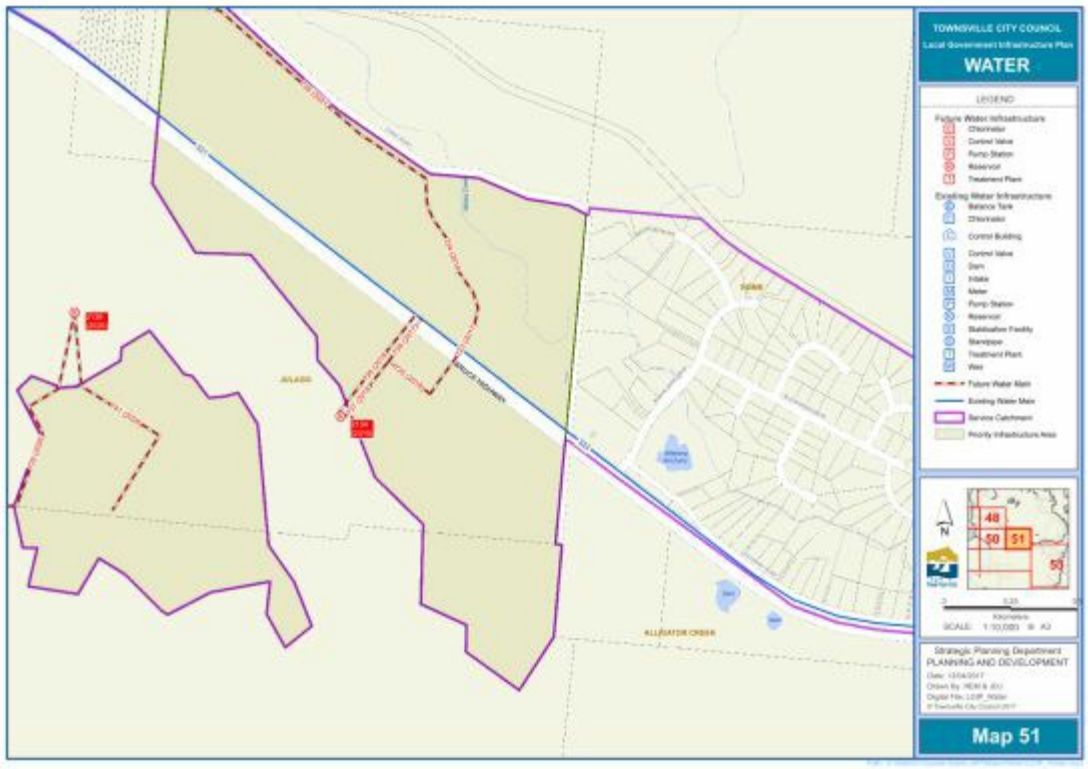

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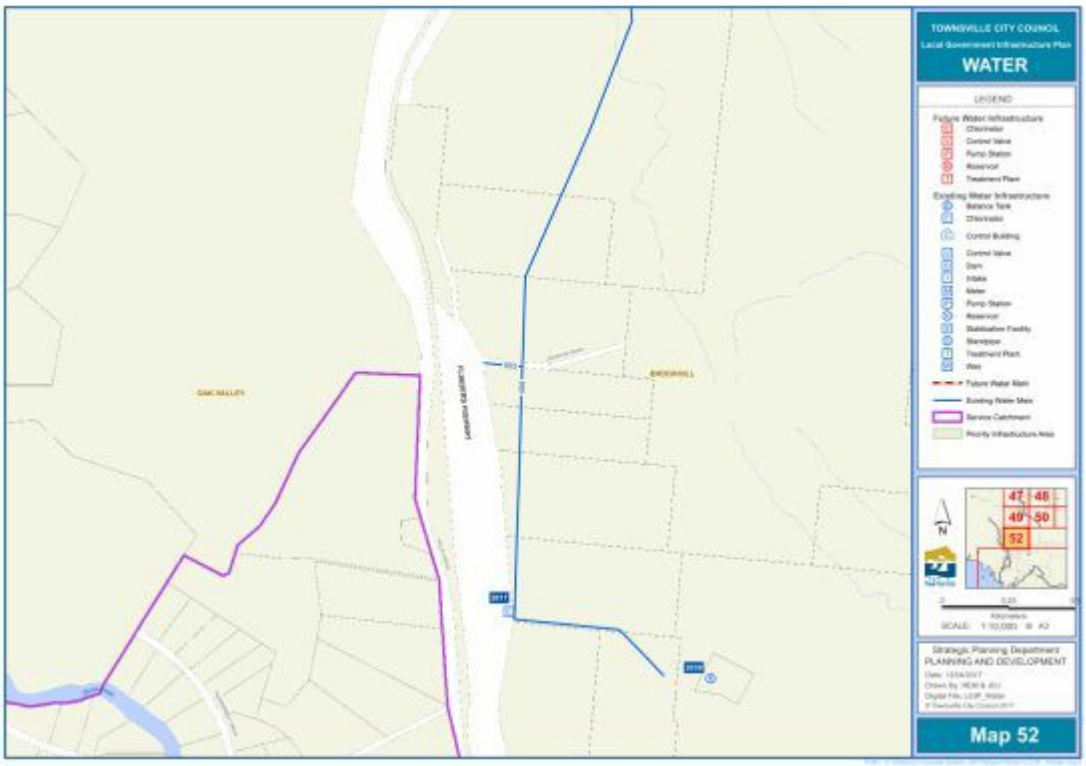

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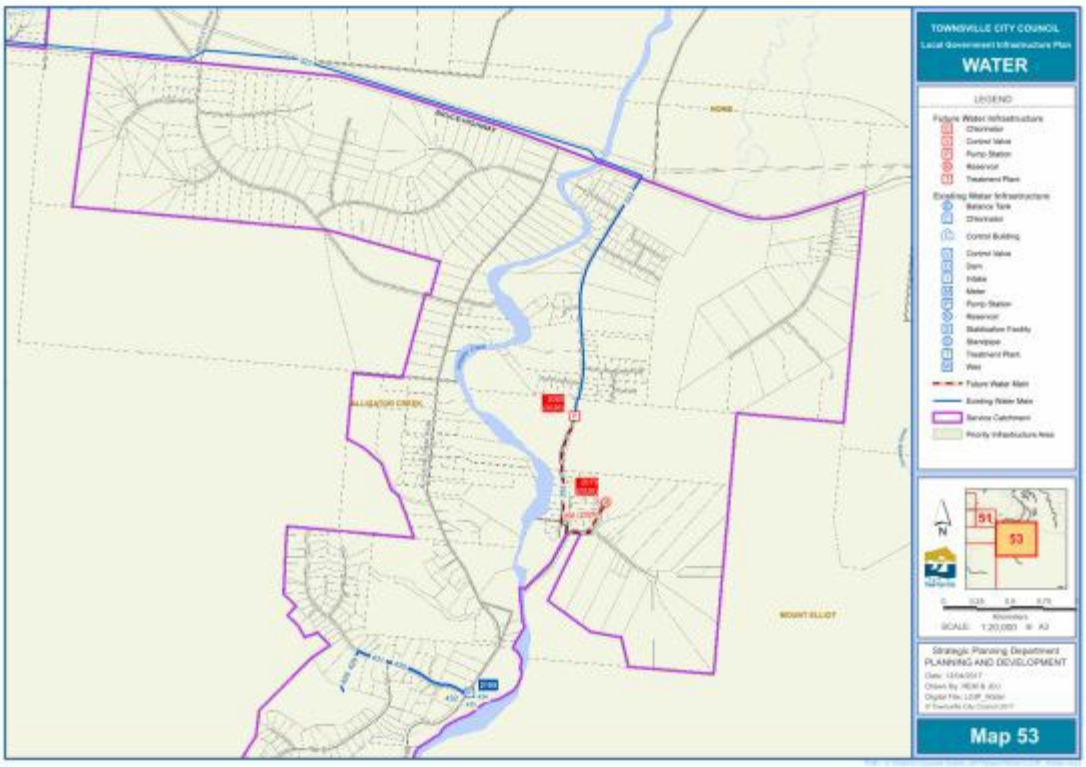

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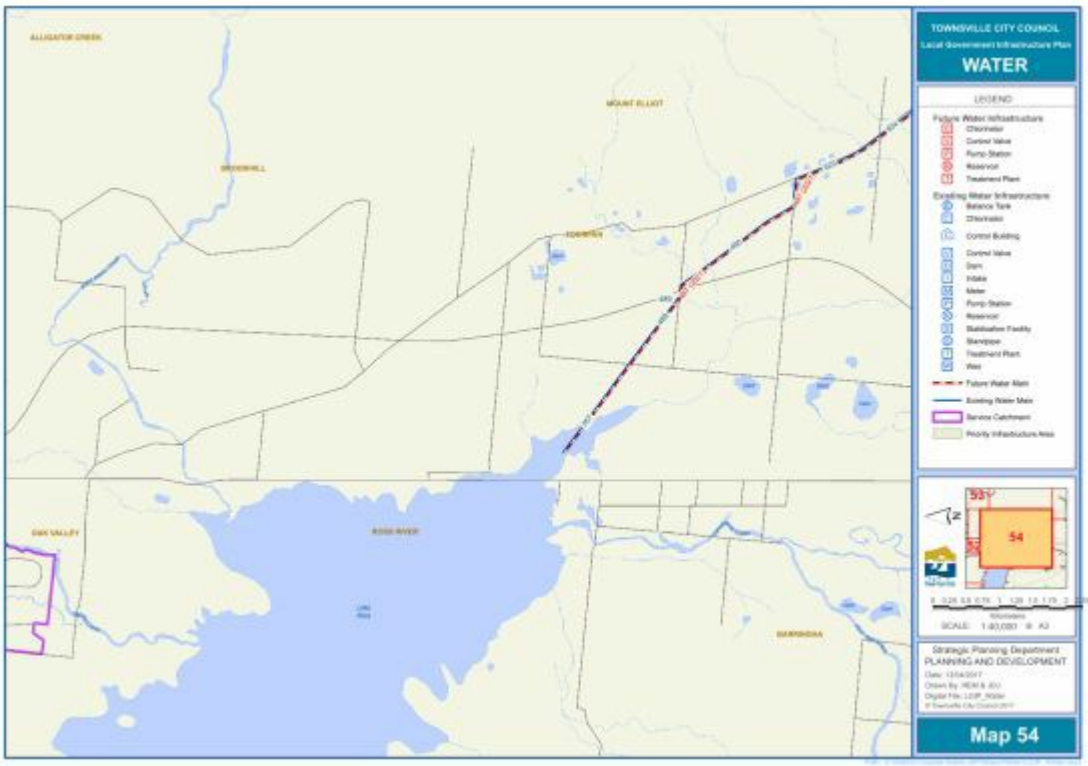

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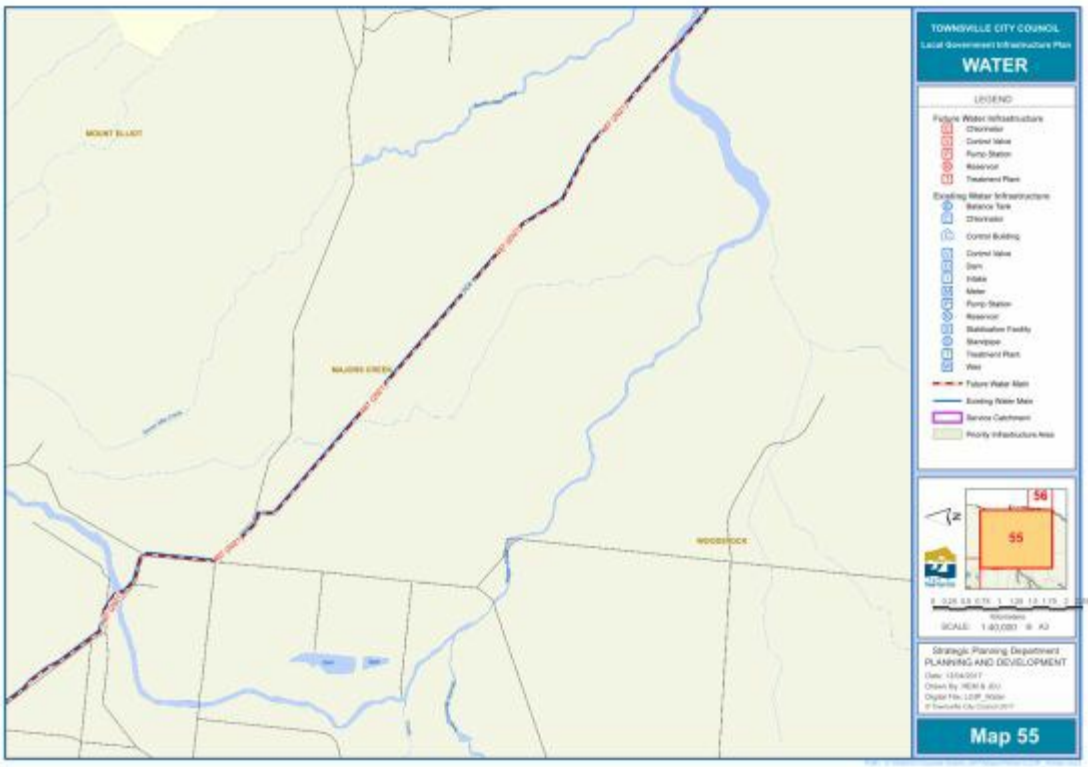

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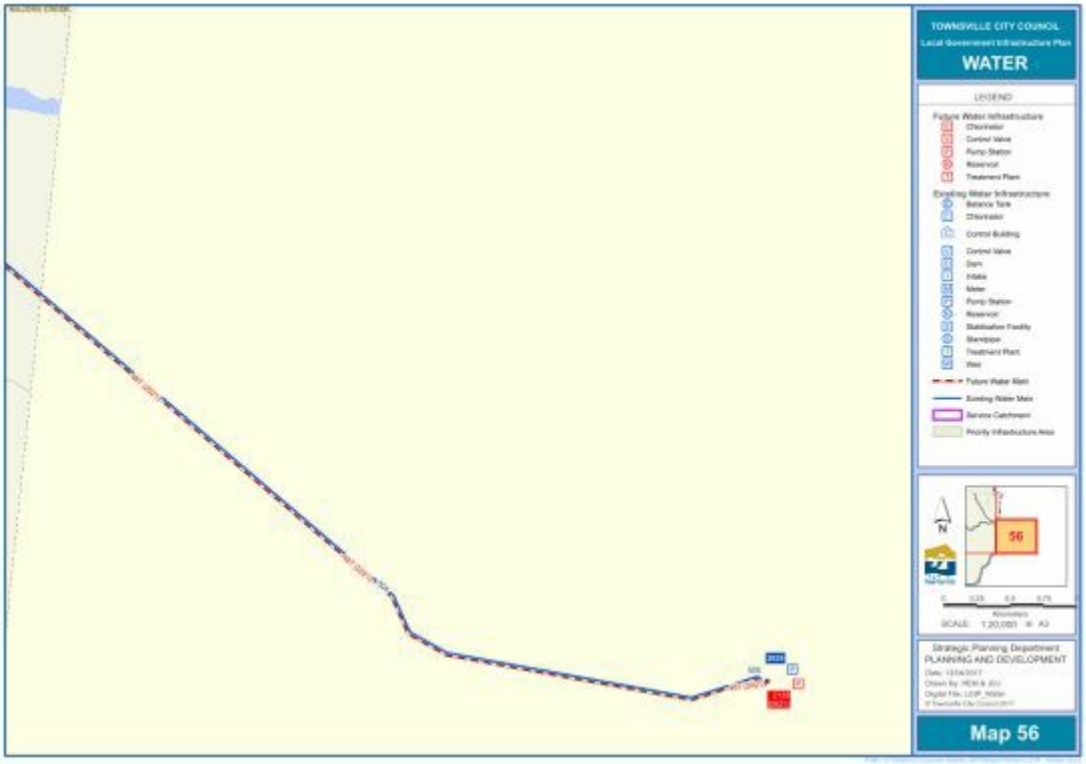

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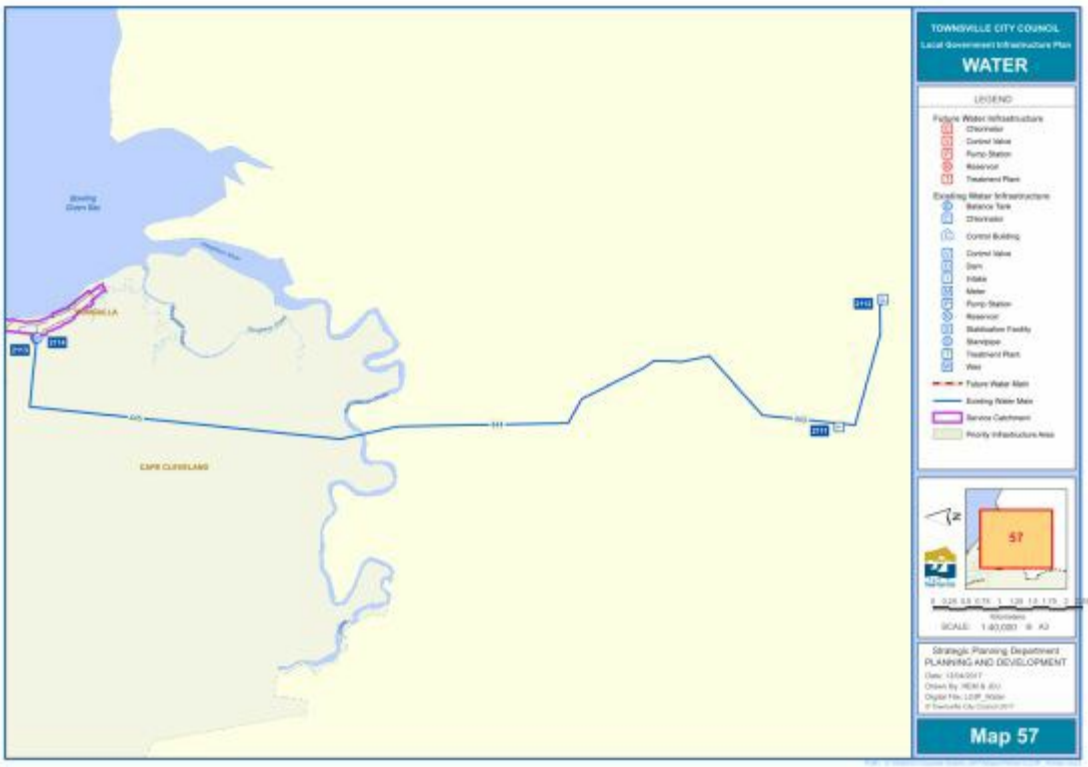

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Table SC3.3.5.1 - Water supply network schedule of future works

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
1	Treatment Plant	2115	Paluma Treatment Plant	-	-	2014	150,317
3	Reservoir	1012	Reservoir - Rollingstone No. 2 - upgrade	-	-	2024	3,892,911
3	Water Main	267		200	720	2031	287,547
3	Water Main	267		200	1,531	2031	436,850
3	Water Main	268		200	1,962	2031	783,954
3	Water Main	268		200	453	2031	129,340
3	Water Main	276		300	2,152	2024	1,218,474
3	Water Main	276		300	1,249	2024	565,726
3	Water Main	276		300	209	2024	94,485
3	Water Main	276		300	181	2024	97,651
3	Water Main	276		300	197	2024	106,242
3	Water Main	276		300	41	2024	18,703
3	Water Main	276		300	204	2024	115,590
3	Water Main	276		300	73	2024	46,780
5	Pump Station	2070	Pump Station - Kulburn	-	-	2014	3,286,933
5	Water Main	282		200	267	2013	63,428
5	Water Main	282		200	2,802	2013	932,976
5	Water Main	283		375	110	2013	87,455
5	Water Main	283		375	80	2013	63,399
5	Water Main	283		375	4,142	2013	2,791,753
5	Water Main	283		375	90	2013	60,769
5	Water Main	283		375	10	2013	8,536
5	Water Main	283		375	86	2013	70,296
5	Water Main	283		375	8	2013	5,188
6	Reservoir	2071	Reservoir - Mount Low (duplicate)	-	-	2012	4,513,520
6	Water Main	298		225	121	2016	44,829
6	Water Main	300		250	253	2012	102,657
6	Water Main	375		250	303	2018	131,902
7	Water Main	284		300	545	2014	268,568
7	Water Main	307		250	398	2012	161,583
7	Water Main	371		300	41	2016	16,106
7	Water Main	371		300	1,198	2016	589,916
7	Water Main	414		300	162	2031	95,643
7	Water Main	415		300	970	2012	477,488
7	Water Main	417		600	133	2029	221,419
7	Water Main	417		600	1,401	2029	2,655,583
7	Water Main	421		375	13	2018	12,510
7	Water Main	421		375	23	2018	16,308
7	Water Main	421		375	430	2018	377,338
8	Water Main	255		500	366	2026	531,997
8	Water Main	255		500	83	2026	104,483
8	Water Main	256		250	912	2026	425,393
8	Water Main	290		500	80	2029	104,264
8	Water Main	290		500	10	2029	12,477
8	Water Main	290		500	495	2029	648,153
8	Water Main	291		375	335	2029	270,925
8	Water Main	292		300	53	2023	24,048
8	Water Main	292		300	361	2023	204,338
8	Water Main	293		300	875	2021	463,371

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
8	Water Main	299		300	95	2021	50,223
8	Water Main	303		600	1,139	2026	1,815,095
8	Water Main	363		375	952	2014	776,560
8	Water Main	397		300	614	2018	324,782
8	Water Main	401		375	722	2015	588,581
8	Water Main	401		375	5	2015	3,261
8	Water Main	402		300	192	2016	94,396
8	Water Main	403		500	516	2021	702,149
8	Water Main	414		300	739	2031	349,559
9	Pump Station	1011	Pump Station	-	-	2018	68,012
9	Reservoir	1010	Reservoir	-	-	2018	921,142
9	Water Main	419		300	218	2014	107,350
9	Water Main	667		300	174	2021	105,868
9	Water Main	667		300	293	2021	178,298
9	Water Main	667		300	10	2021	7,055
9	Water Main	667		300	42	2021	25,415
9	Water Main	667		300	51	2021	26,874
9	Water Main	667		300	13	2021	7,682
9	Water Main	668		300	21	2021	14,577
9	Water Main	668		300	18	2021	12,680
9	Water Main	668		300	23	2021	16,128
9	Water Main	668		300	4	2021	2,783
9	Water Main	668		300	28	2021	17,065
9	Water Main	668		300	3	2021	1,556
9	Water Main	668		300	96	2021	67,962
9	Water Main	668		300	26	2021	15,776
9	Water Main	668		300	0	2021	129
9	Water Main	668		300	20	2021	12,101
9	Water Main	668		300	971	2021	513,864
9	Water Main	668		300	20	2021	10,767
9	Water Main	668		300	90	2021	54,984
9	Water Main	669		250	11	2021	5,835
9	Water Main	669		250	69	2021	41,280
9	Water Main	669		250	22	2021	13,010
9	Water Main	669		250	9	2021	5,535
9	Water Main	669		250	53	2021	31,638
9	Water Main	669		250	11	2021	5,835
9	Water Main	669		250	15	2021	7,867
9	Water Main	669		250	2	2021	1,141
9	Water Main	669		250	74	2021	37,406
9	Water Main	669		250	10	2021	5,098
9	Water Main	669		250	138	2021	60,356
9	Water Main	669		250	7	2021	2,885
9	Water Main	669		250	5	2021	2,473
9	Water Main	670		250	478	2021	208,411
9	Water Main	671		300	2,532	2018	1,340,529
9	Water Main	730		300	292	2018	154,574
10	Control Valve	1725	Control Valve	-	-	2024	288,108
10	Control Valve	1726	Control Valve	-	-	2024	288,108
10	Reservoir	2093	Reservoir	-	-	2023	10,492,961
10	Water Main	259		200	346	2016	115,053
10	Water Main	272		300	53	2016	26,103

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
10	Water Main	272		300	488	2016	240,396
10	Water Main	272		300	16	2016	7,874
10	Water Main	278		300	332	2021	175,888
10	Water Main	278		300	5	2021	2,796
10	Water Main	348		250	269	2012	109,267
10	Water Main	390		200	571	2019	204,347
10	Water Main	392		600	20	2023	40,940
10	Water Main	392		600	44	2023	98,407
10	Water Main	392		600	30	2023	56,039
10	Water Main	392		600	570	2023	1,036,117
10	Water Main	392		600	12	2023	28,138
10	Water Main	392		600	36	2023	81,636
10	Water Main	392		600	20	2023	32,024
10	Water Main	392		600	80	2023	163,760
10	Water Main	392		600	131	2023	242,837
10	Water Main	392		600	7	2023	12,479
10	Water Main	392		600	30	2023	56,039
10	Water Main	392		600	13	2023	27,265
10	Water Main	392		600	40	2023	81,880
10	Water Main	392		600	36	2023	57,325
10	Water Main	392		600	70	2023	142,975
10	Water Main	393		900	11	2023	41,461
10	Water Main	393		900	10	2023	35,152
10	Water Main	393		900	30	2023	105,455
10	Water Main	393		900	30	2023	105,455
10	Water Main	393		900	101	2023	369,672
10	Water Main	393		900	4	2023	11,328
10	Water Main	393		900	5	2023	15,826
10	Water Main	393		900	689	2023	2,146,361
10	Water Main	393		900	7	2023	25,835
10	Water Main	393		900	22	2023	77,566
10	Water Main	393		900	8	2023	29,249
10	Water Main	393		900	45	2023	172,266
10	Water Main	393		900	50	2023	163,404
10	Water Main	393		900	10	2023	32,681
10	Water Main	393		900	34	2023	109,528
10	Water Main	393		900	24	2023	84,049
10	Water Main	393		900	101	2023	326,809
10	Water Main	393		900	17	2023	53,876
10	Water Main	393		900	66	2023	185,185
10	Water Main	393		900	11	2023	38,783
10	Water Main	393		900	80	2023	281,214
10	Water Main	394		300	110	2014	54,155
10	Water Main	395		250	654	2016	265,312
10	Water Main	396		750	834	2024	2,128,798
10	Water Main	398		250	364	2016	147,653
10	Water Main	400		600	1,102	2016	1,527,389
10	Water Main	404		500	459	2016	580,389
10	Water Main	405		825	1,087	2029	3,182,424
10	Water Main	406		600	2,032	2029	3,852,110
10	Water Main	447		300	946	2012	465,924
10	Water Main	637		250	323	2012	131,079

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
10	Water Main	639		250	315	2016	127,595
10	Water Main	640		600	670	2024	1,216,724
12	Pump Station	2030	Pump Station - upgrade	-	-	2016	315,948
12	Reservoir	2090	2.25 ML Reservoir	-	-	2031	1,803,805
12	Water Main	327		200	119	2012	56,302
12	Water Main	327		200	84	2012	34,386
12	Water Main	327		200	190	2012	89,699
12	Water Main	327		200	30	2012	14,349
12	Water Main	327		200	11	2012	4,705
12	Water Main	327		200	5	2012	2,461
12	Water Main	374		200	10	2031	6,718
12	Water Main	374		200	10	2031	5,784
12	Water Main	374		200	202	2031	114,349
12	Water Main	374		200	41	2031	27,009
12	Water Main	374		200	10	2031	6,337
12	Water Main	374		200	468	2031	231,249
12	Water Main	374		200	55	2031	36,300
12	Water Main	374		200	2	2031	956
12	Water Main	374		200	10	2031	5,833
12	Water Main	374		200	95	2031	62,784
12	Water Main	374		200	10	2031	5,086
12	Water Main	374		200	26	2031	14,998
12	Water Main	374		200	10	2031	5,833
12	Water Main	374		200	60	2031	34,108
12	Water Main	374		200	31	2031	17,296
12	Water Main	374		200	19	2031	10,711
12	Water Main	374		200	10	2031	5,086
12	Water Main	376		200	79	2016	37,062
12	Water Main	376		200	159	2016	87,701
12	Water Main	376		200	24	2016	13,534
12	Water Main	376		200	59	2016	32,802
12	Water Main	376		200	11	2016	6,006
12	Water Main	376		200	192	2016	90,756
12	Water Main	376		200	13	2016	5,970
12	Water Main	376		200	61	2016	28,862
12	Water Main	376		200	60	2016	28,428
12	Water Main	376		200	3	2016	1,641
12	Water Main	376		200	8	2016	3,790
12	Water Main	376		200	119	2016	56,327
12	Water Main	376		200	1,204	2016	495,216
12	Water Main	378		200	77	2023	42,037
12	Water Main	378		200	119	2023	75,649
12	Water Main	378		200	10	2023	5,476
12	Water Main	378		200	40	2023	21,920
12	Water Main	378		200	50	2023	27,140
12	Water Main	378		200	2	2023	889
12	Water Main	378		200	1,180	2023	558,166
12	Water Main	378		200	10	2023	5,476
12	Water Main	378		200	20	2023	12,827
13	Water Main	326		375	1,790	2012	1,810,179
13	Water Main	326		375	5	2012	5,412
13	Water Main	327		375	6	2012	6,457

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
13	Water Main	327		375	812	2012	821,333
13	Water Main	327		375	1	2012	1,441
13	Water Main	327		375	164	2012	185,377
13	Water Main	377		200	824	2023	390,115
13	Water Main	380		375	5	2012	5,888
13	Water Main	380		375	12	2012	13,593
13	Water Main	380		375	72	2012	73,017
13	Water Main	380		375	60	2012	67,656
13	Water Main	380		375	1	2012	646
13	Water Main	380		375	11	2012	12,946
13	Water Main	380		375	14	2012	16,227
13	Water Main	380		375	12	2012	13,807
13	Water Main	380		375	11	2012	14,041
13	Water Main	380		375	1	2012	1,365
13	Water Main	380		375	252	2012	310,444
13	Water Main	380		375	8	2012	10,475
16	Water Main	658		300	1,459	2018	772,351
16	Water Main	659		200	130	2018	46,398
17	Water Main	317		500	31	2016	61,160
17	Water Main	381		500	1	2018	2,690
17	Water Main	381		500	107	2018	230,643
17	Water Main	381		500	177	2018	379,042
17	Water Main	381		500	178	2018	383,532
17	Water Main	381		500	9	2018	20,449
17	Water Main	381		500	20	2018	42,554
17	Water Main	381		500	56	2018	101,362
18	Water Main	315		300	562	2019	418,783
18	Water Main	316		450	350	2018	520,758
18	Water Main	316		450	13	2018	14,920
18	Water Main	381		500	53	2018	72,298
18	Water Main	381		500	64	2018	128,584
18	Water Main	381		500	21	2018	41,629
19	Reservoir	2073	Reservoir - Mount Louisa (No. 3)	-	-	2014	6,770,280
19	Water Main	278		300	570	2021	403,106
19	Water Main	281		250	256	2021	111,646
19	Water Main	281		250	110	2021	67,195
19	Water Main	288		300	607	2031	286,980
19	Water Main	289		500	1,084	2016	1,371,963
19	Water Main	385		300	3	2013	2,092
19	Water Main	385		300	284	2013	139,723
19	Water Main	387		250	332	2018	144,717
19	Water Main	387		250	85	2018	43,278
19	Water Main	388		300	604	2018	319,736
20	Pump Station	2091	Pump Station	-	-	2016	169,257
20	Reservoir	2060	Reservoir - Greenview	-	-	2016	2,136,375
20	Reservoir	2092	Reservoir - Greenview	-	-	2021	382,506
20	Reservoir	2098	Reservoir - upgrade	-	-	2016	385,814
20	Water Main	379		250	8	2016	4,230
20	Water Main	379		250	5	2016	2,860
20	Water Main	379		250	32	2016	15,191
20	Water Main	379		250	142	2016	78,915

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
20	Water Main	379		250	9	2016	4,045
20	Water Main	379		250	52	2016	28,887
20	Water Main	379		250	38	2016	21,098
20	Water Main	379		250	8	2016	4,326
20	Water Main	379		250	21	2016	11,478
20	Water Main	379		250	2	2016	1,107
20	Water Main	379		250	409	2016	227,965
20	Water Main	379		250	12	2016	6,802
20	Water Main	379		250	10	2016	5,714
20	Water Main	379		250	119	2016	56,066
20	Water Main	379		250	5	2016	2,450
20	Water Main	379		250	2	2016	969
20	Water Main	379		250	14	2016	6,616
20	Water Main	379		250	3	2016	1,580
20	Water Main	379		250	10	2016	4,847
20	Water Main	379		250	3	2016	1,355
20	Water Main	379		250	8	2016	3,961
20	Water Main	379		250	7	2016	2,651
20	Water Main	379		250	12	2016	5,540
20	Water Main	379		250	26	2016	12,294
20	Water Main	379		250	11	2016	5,105
20	Water Main	379		250	12	2016	5,609
20	Water Main	379		250	11	2016	5,105
20	Water Main	379		250	7	2016	3,091
20	Water Main	379		250	1	2016	435
20	Water Main	379		250	110	2016	52,191
20	Water Main	379		250	22	2016	10,275
20	Water Main	379		250	77	2016	43,145
20	Water Main	389		375	274	2018	239,817
20	Water Main	389		375	20	2018	22,435
20	Water Main	389		375	17	2018	16,790
20	Water Main	389		375	50	2018	50,266
20	Water Main	389		375	210	2018	210,629
20	Water Main	420		250	111	2018	66,783
20	Water Main	420		250	557	2018	333,991
20	Water Main	420		250	238	2018	142,427
20	Water Main	420		250	6	2018	3,718
20	Water Main	420		250	43	2018	25,799
20	Water Main	420		250	12	2018	5,894
20	Water Main	420		250	30	2018	18,094
20	Water Main	420		250	131	2018	78,269
20	Water Main	420		250	13	2018	6,585
20	Water Main	420		250	7	2018	4,409
20	Water Main	420		250	50	2018	21,939
20	Water Main	420		250	20	2018	10,223
20	Water Main	420		250	30	2018	15,347
20	Water Main	420		250	90	2018	45,889
20	Water Main	440		200	28	2016	11,197
20	Water Main	440		200	51	2016	19,985
20	Water Main	440		200	26	2016	10,223
20	Water Main	440		200	275	2016	91,424
22	Water Main	320		450	441	2028	548,061

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
23	Reservoir	2076	Reservoir - West End (duplicate)	-	-	2018	6,065,042
23	Water Main	317		500	1	2016	2,108
23	Water Main	317		500	1	2016	2,399
23	Water Main	317		500	77	2016	144,649
23	Water Main	317		500	44	2016	83,173
23	Water Main	317		500	11	2016	21,105
23	Water Main	317		500	145	2016	270,744
23	Water Main	317		500	7	2016	13,399
23	Water Main	317		500	11	2016	22,628
23	Water Main	317		500	12	2016	24,311
23	Water Main	317		500	85	2016	170,474
23	Water Main	317		500	12	2016	24,337
23	Water Main	318		500	536	2018	729,060
23	Water Main	383		600	65	2018	109,795
23	Water Main	383		600	176	2018	391,653
23	Water Main	383		600	32	2018	71,492
23	Water Main	663		500	82	2018	127,524
23	Water Main	663		500	38	2018	59,923
23	Water Main	663		500	52	2018	89,205
23	Water Main	664		750	101	2018	294,918
23	Water Main	664		750	21	2018	60,464
23	Water Main	664		750	20	2018	70,871
23	Water Main	664		750	135	2018	486,407
23	Water Main	664		750	456	2018	1,337,533
23	Water Main	664		750	218	2018	596,974
23	Water Main	664		750	359	2018	1,101,807
23	Water Main	664		750	20	2018	68,748
23	Water Main	664		750	60	2018	206,137
23	Water Main	664		750	10	2018	29,492
23	Water Main	664		750	39	2018	105,973
23	Water Main	664		750	56	2018	192,435
23	Water Main	664		750	20	2018	72,696
23	Water Main	665		600	504	2018	1,118,915
23	Water Main	666		300	523	2018	389,643
25	Water Main	318		500	14	2018	22,989
25	Water Main	319		450	67	2018	92,662
26	Water Main	317		500	469	2016	786,945
26	Water Main	319		450	732	2018	814,701
26	Water Main	386		375	565	2014	460,772
26	Water Main	641		300	543	2028	320,941
26	Water Main	641		300	22	2028	17,629
26	Water Main	642		300	694	2019	367,321
29	Water Main	241		300	970	2024	549,308
29	Water Main	244		375	741	2023	574,416
29	Water Main	288		300	18	2031	8,303
29	Water Main	288		300	641	2031	378,667
29	Water Main	288		300	35	2031	16,602
29	Water Main	418		375	1,499	2024	1,162,009
29	Water Main	481		375	295	2013	240,709
29	Water Main	733		200	573	2024	156,728
32	Water Main	369		250	301	2014	122,205

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
32	Water Main	370		250	496	2014	201,186
32	Water Main	386		375	102	2014	83,405
32	Water Main	386		375	193	2014	157,126
36	Reservoir	2062	Reservoir - Douglas 1B	-	-	2012	9,027,040
37	Pump Station	2100	Pump Station Douglas Water Treatment Plant - upgrade	-	-	2013	5,050,653
37	Treatment Plant	2006	Treatment Plant - upgrade	-	-	2018	8,977,268
37	Water Main	311		500	1,426	2024	2,075,253
39	Pump Station	2129	Booster Pump	-	-	2024	2,881,077
44	Pump Station	2127	Pump Station	-	-	2016	205,262
44	Reservoir	2126	Reservoir	-	-	2016	350,740
44	Water Main	438		500	1,029	2013	1,626,335
44	Water Main	439		450	934	2013	966,862
44	Water Main	439		450	2	2013	2,255
44	Water Main	439		450	17	2013	21,500
44	Water Main	649		450	61	2029	94,346
44	Water Main	649		450	948	2029	1,177,904
44	Water Main	660		500	159	2026	230,802
44	Water Main	660		500	52	2026	86,509
44	Water Main	660		500	15	2026	25,088
44	Water Main	660		500	119	2026	198,533
44	Water Main	660		500	37	2026	61,232
45	Water Main	251		300	406	2023	229,678
45	Water Main	252		450	1,090	2024	1,298,111
45	Water Main	253		200	132	2024	50,547
45	Water Main	269		500	1,483	2024	2,157,991
45	Water Main	270		375	446	2023	418,772
45	Water Main	426		300	475	2021	251,448
45	Water Main	427		375	277	2014	225,931
45	Water Main	652		300	710	2014	349,627
45	Water Main	652		300	19	2014	12,500
46	Water Main	247		250	406	2012	164,671
46	Water Main	304		300	275	2013	135,260
46	Water Main	628		300	527	2014	259,282
47	Reservoir	2121	Reservoir	-	-	2024	5,762,154
47	Water Main	647		450	15	2024	23,238
47	Water Main	647		450	5	2024	8,166
47	Water Main	647		450	8	2024	11,276
47	Water Main	647		450	50	2024	60,332
47	Water Main	647		450	16	2024	18,785
47	Water Main	647		450	39	2024	59,486
47	Water Main	647		450	9	2024	14,414
47	Water Main	647		450	28	2024	28,427
47	Water Main	648		500	16	2024	29,383
47	Water Main	648		500	3	2024	4,733
47	Water Main	648		500	31	2024	51,311
47	Water Main	648		500	604	2024	878,634
47	Water Main	648		500	28	2024	34,715
47	Water Main	648		500	29	2024	46,678
47	Water Main	648		500	8	2024	12,426
47	Water Main	648		500	78	2024	115,215
47	Water Main	648		500	26	2024	47,433

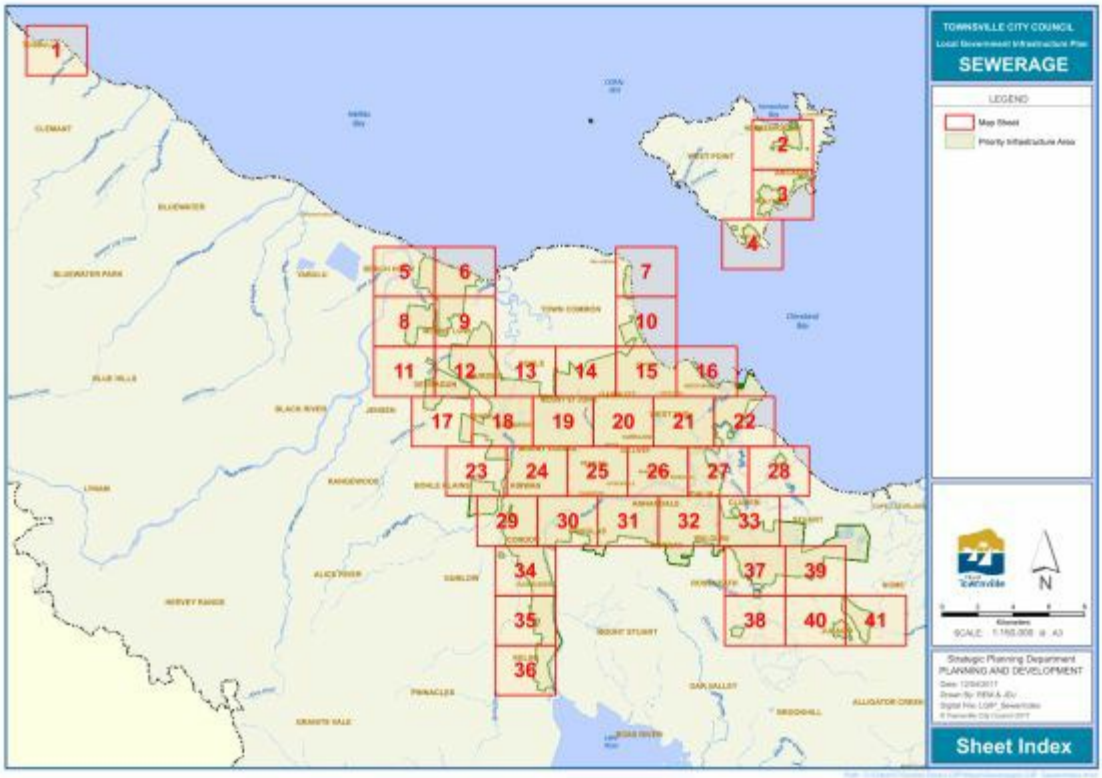
Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
47	Water Main	649		450	446	2029	553,733
47	Water Main	649		450	57	2029	98,882
47	Water Main	649		450	29	2029	35,777
47	Water Main	649		450	42	2029	60,518
47	Water Main	649		450	440	2029	683,287
47	Water Main	660		500	17	2026	31,160
47	Water Main	660		500	3	2026	4,775
47	Water Main	660		500	6	2026	9,098
47	Water Main	660		500	72	2026	106,504
47	Water Main	660		500	20	2026	37,302
47	Water Main	660		500	1	2026	2,070
47	Water Main	660		500	46	2026	74,241
47	Water Main	660		500	8	2026	12,484
47	Water Main	660		500	13	2026	16,011
49	Pump Station	2025	Booster Pump Station - upgrade	-	-	2031	132,605
49	Reservoir	2123	Reservoir	-	-	2013	601,268
49	Water Main	655		200	8	2013	3,820
49	Water Main	655		200	114	2013	44,818
49	Water Main	655		200	31	2013	13,950
49	Water Main	655		200	10	2013	4,650
49	Water Main	655		200	180	2013	60,070
49	Water Main	655		200	17	2013	6,257
49	Water Main	655		200	50	2013	14,998
49	Water Main	655		200	120	2013	35,727
49	Water Main	655		200	38	2013	9,071
50	Water Main	739	Rocky Springs	375	5,840	2026	6,272,314
51	Reservoir	2134	Rocky Springs	-	-	2019	3,312,463
51	Reservoir	2139	Rocky Springs	-	-	2026	4,787,130
51	Water Main	723	Rocky Springs	375	316	2017	317,258
51	Water Main	724	Rocky Springs	200	592	2018	250,415
51	Water Main	725	Rocky Springs	375	197	2018	198,145
51	Water Main	726	Rocky Springs	150	1,148	2021	404,060
51	Water Main	736	Rocky Springs	450	479	2018	614,288
51	Water Main	737	Rocky Springs	500	277	2018	433,247
51	Water Main	738	Rocky Springs	450	201	2017	257,770
51	Water Main	741	Rocky Springs	500	950	2026	1,589,531
53	Pump Station	2080	Ailligator Creek Pump Station	-	-	2026	177,038
53	Reservoir	2079	Alligator Creek Reservoir	-	-	2026	3,337,658
53	Water Main	356		150	1	2026	247
53	Water Main	356		150	213	2026	44,289
53	Water Main	356		150	49	2026	22,756
53	Water Main	356		150	44	2026	20,647
53	Water Main	356		150	132	2026	49,748
53	Water Main	356		150	26	2026	9,676
53	Water Main	356		150	10	2026	3,215
53	Water Main	356		150	22	2026	8,118
53	Water Main	356		150	66	2026	25,042
53	Water Main	356		150	21	2026	7,781
53	Water Main	356		150	30	2026	11,325
53	Water Main	356		150	23	2026	8,787

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
53	Water Main	356		150	10	2026	3,833
53	Water Main	356		150	727	2026	227,966
54	Water Main	487	Haughton - RRD pipeline	1,260	64	2021	274,222
55	Water Main	487	Haughton - RRD pipeline	1,260	32	2021	114,535
55	Water Main	487	Haughton - RRD pipeline	1,260	2,661	2021	9,503,794
55	Water Main	487	Haughton - RRD pipeline	1,260	1,385	2021	5,796,769
55	Water Main	487	Haughton - RRD pipeline	1,260	5,691	2021	20,328,296
55	Water Main	487	Haughton - RRD pipeline	1,260	142	2021	508,698
55	Water Main	487	Haughton - RRD pipeline	1,260	4,709	2021	16,820,736
55	Water Main	487	Haughton - RRD pipeline	1,260	36	2021	127,930
55	Water Main	487	Haughton - RRD pipeline	1,260	423	2021	1,771,313
55	Water Main	487	Haughton - RRD pipeline	1,260	13,945	2021	49,811,077
56	Pump Station	2128	Pump Station	-	-	2021	5,278,634
56	Water Main	487	Haughton - RRD pipeline	1,260	6,575	2021	23,484,405

SC3.3.6 - Plans for trunk sewerage infrastructure

Editor's note— This document is intended to function in an electronic environment whereupon hyperlinks to detailed PDF maps allow for closer examination of mapping information. The following images are true copies of such maps, but at a coarser scale.

The maps are also loaded in a GIS environment. TownsvilleMaps is the current in-service GIS platform for this purpose, which can be publicly viewed at council, or privately accessed via subscription.



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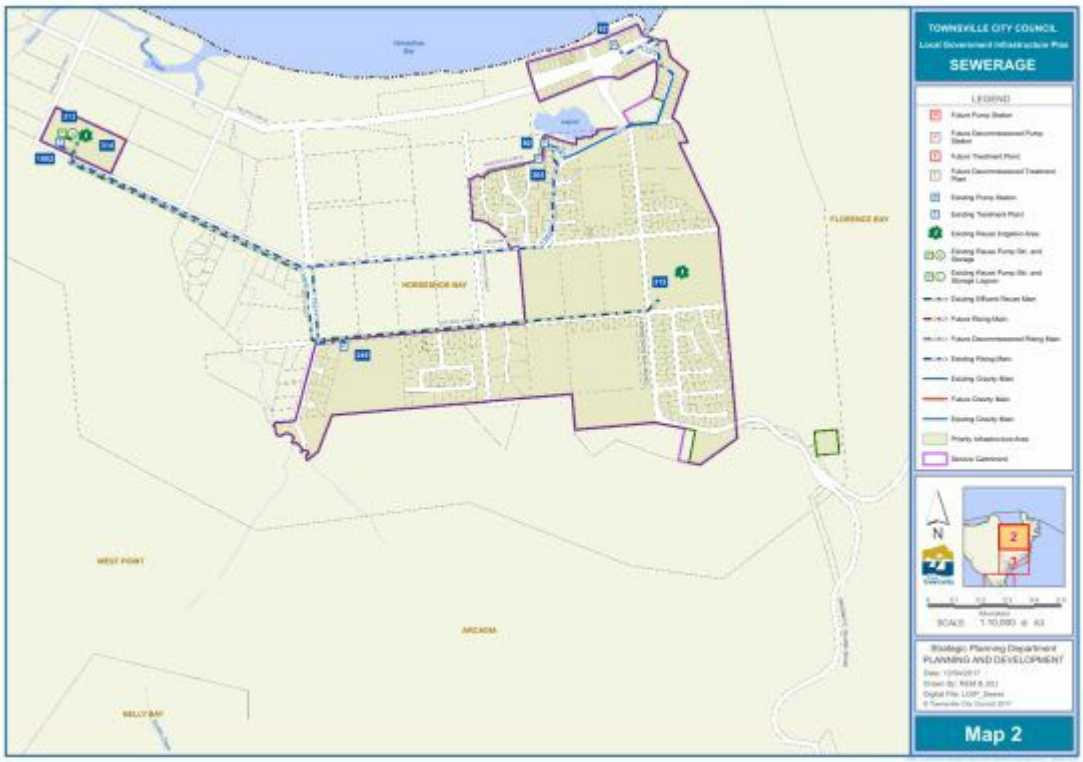

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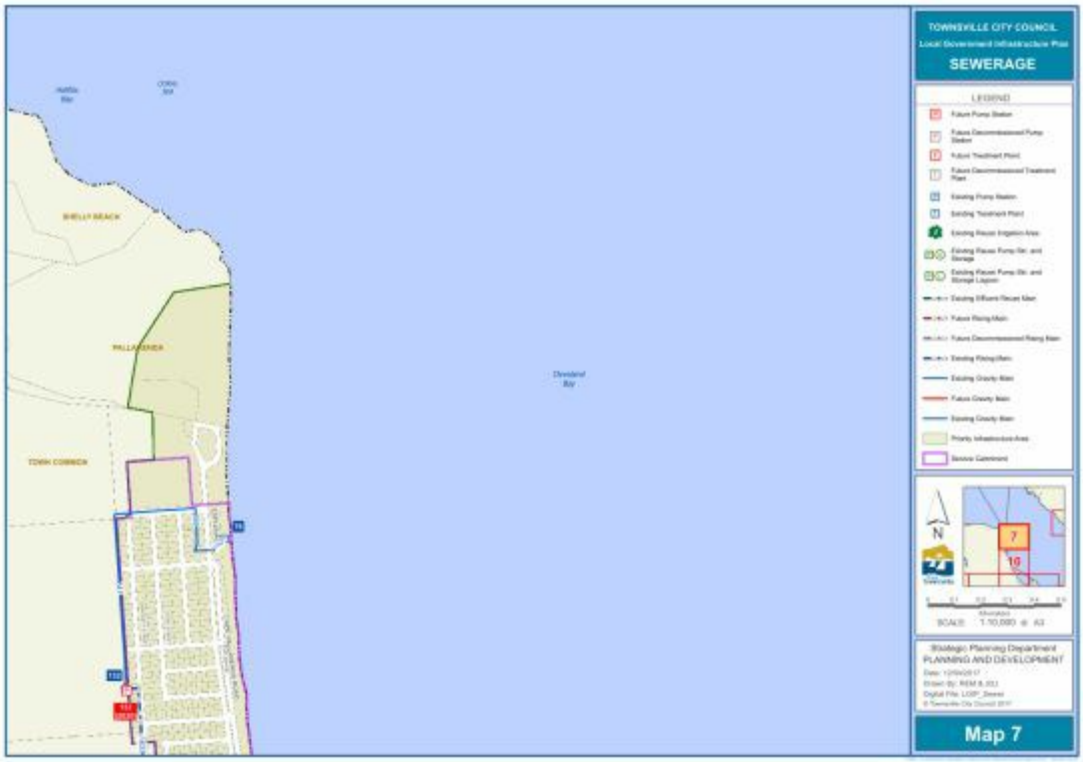

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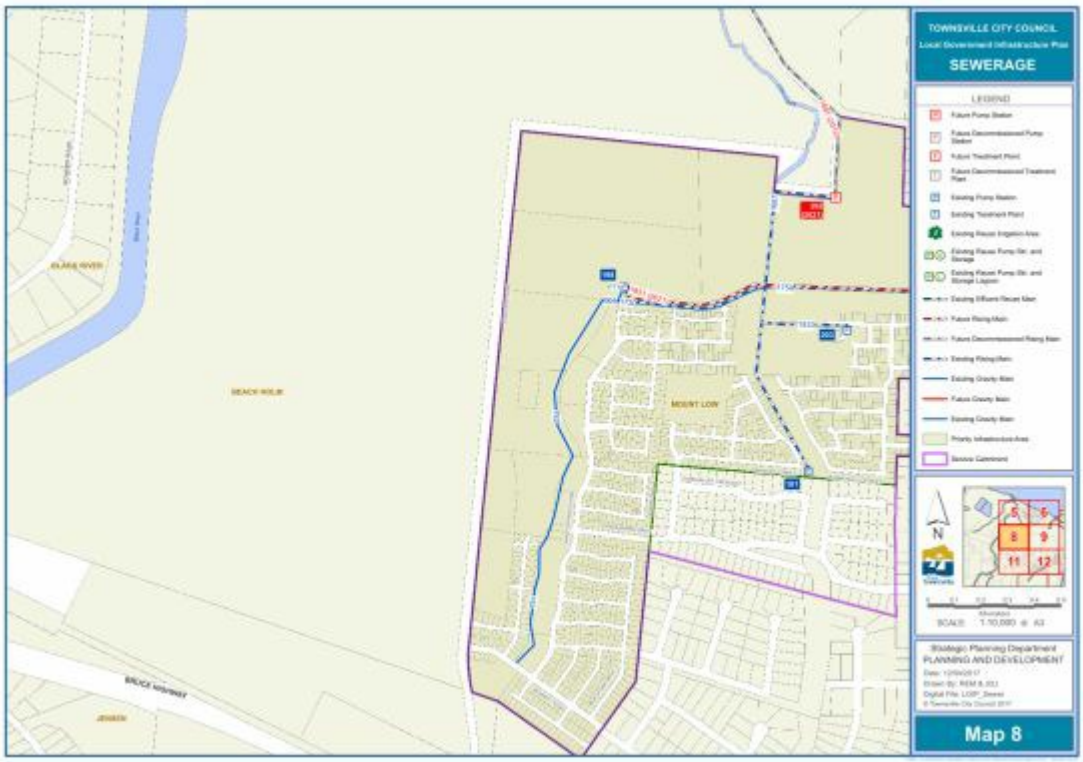

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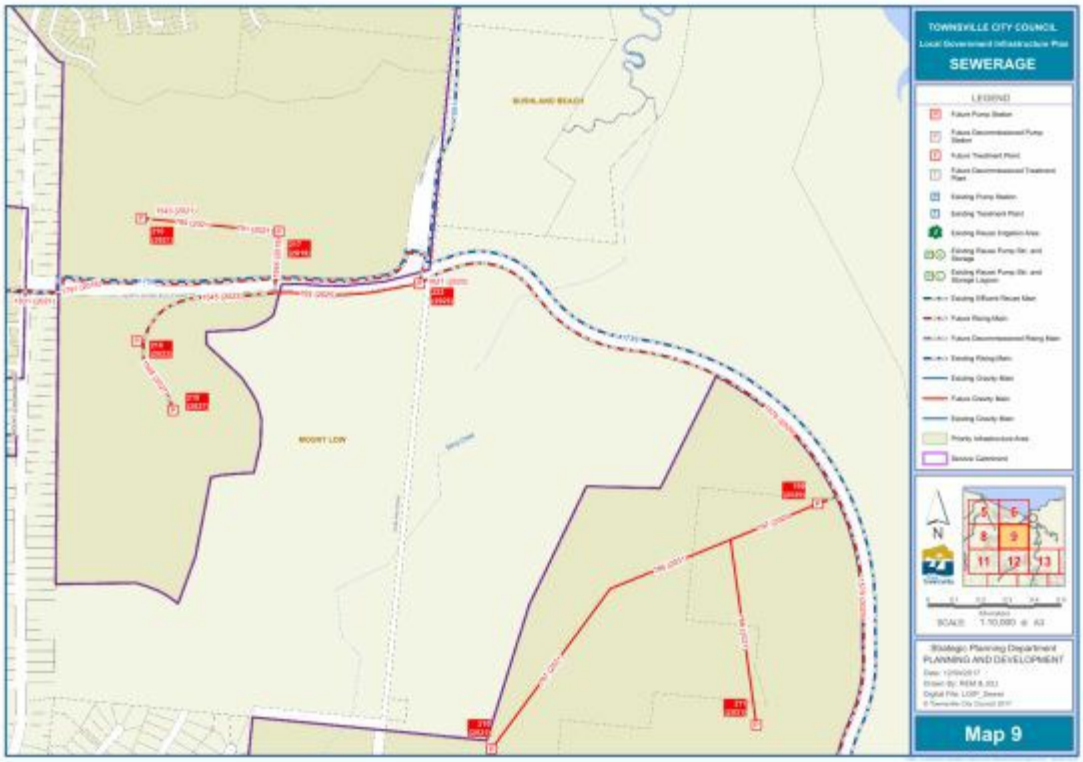

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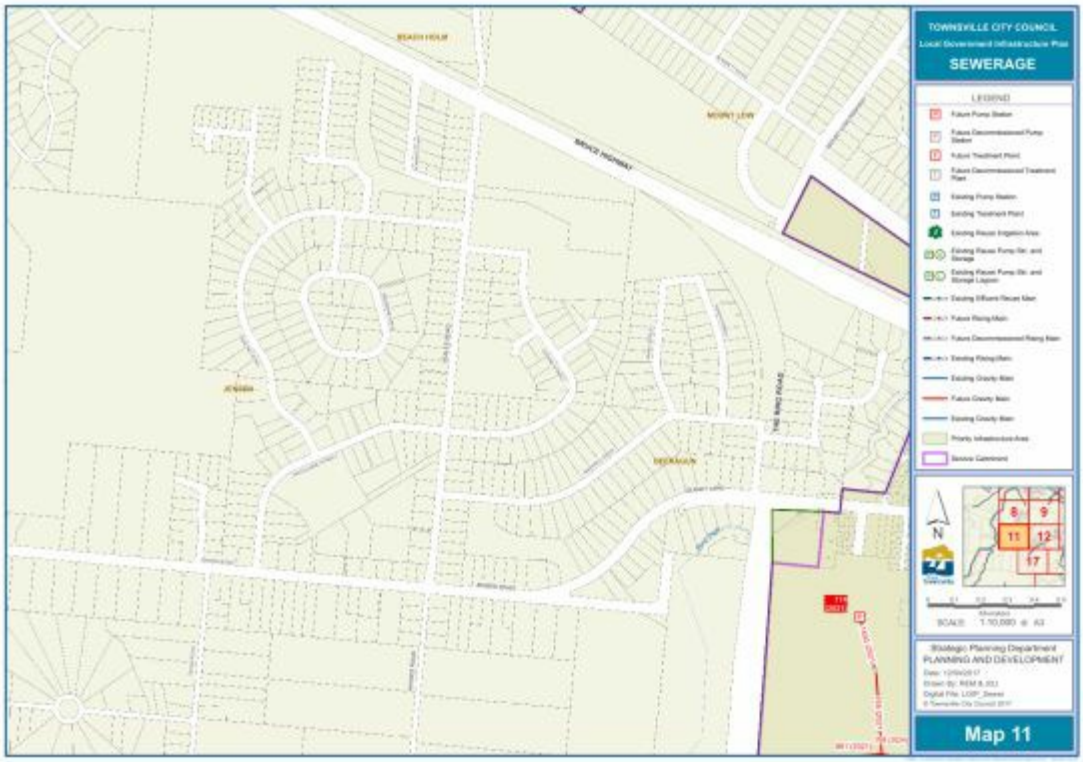

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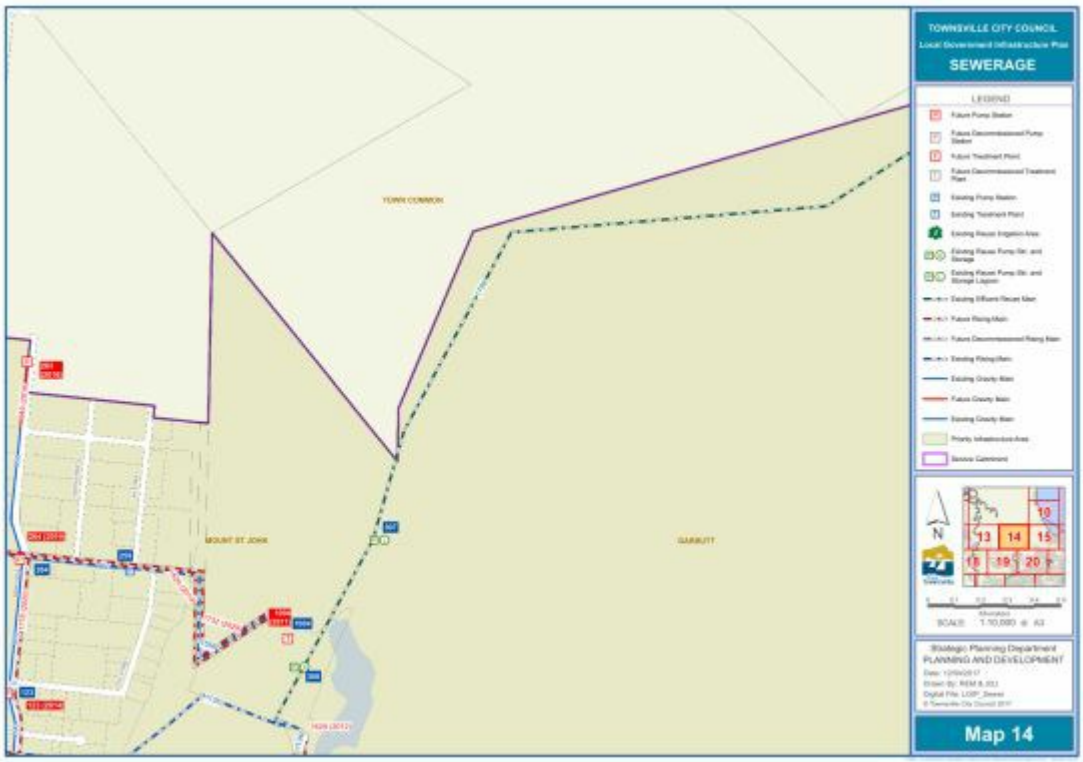

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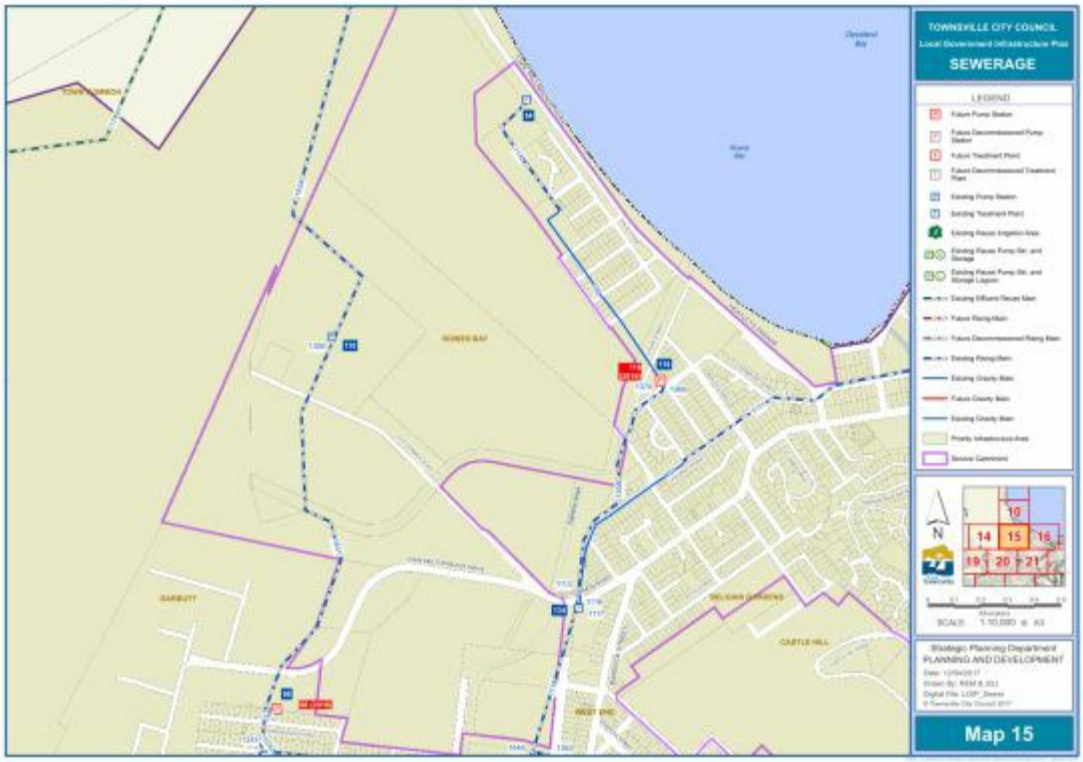

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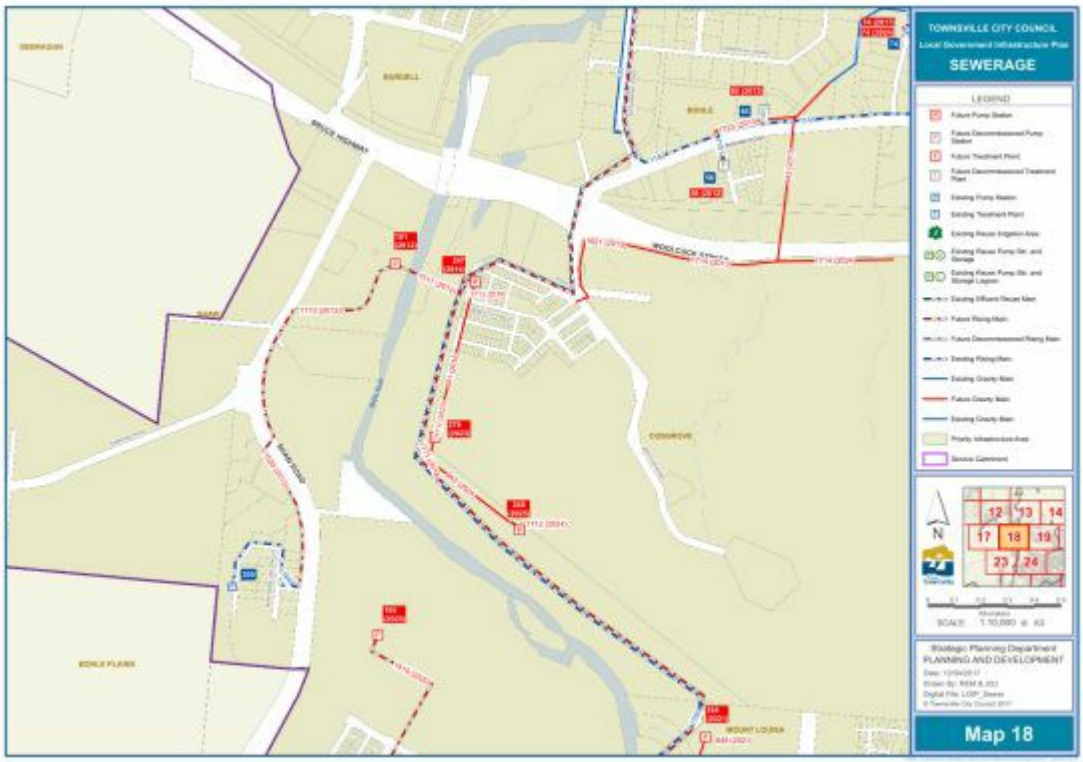

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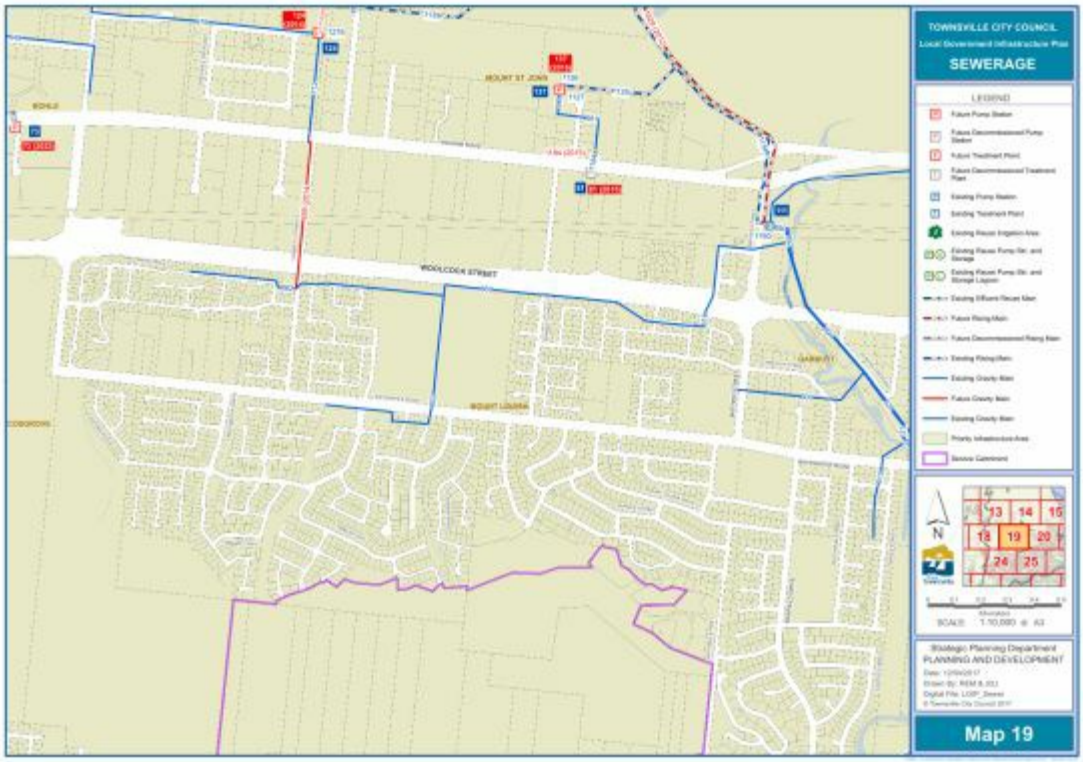

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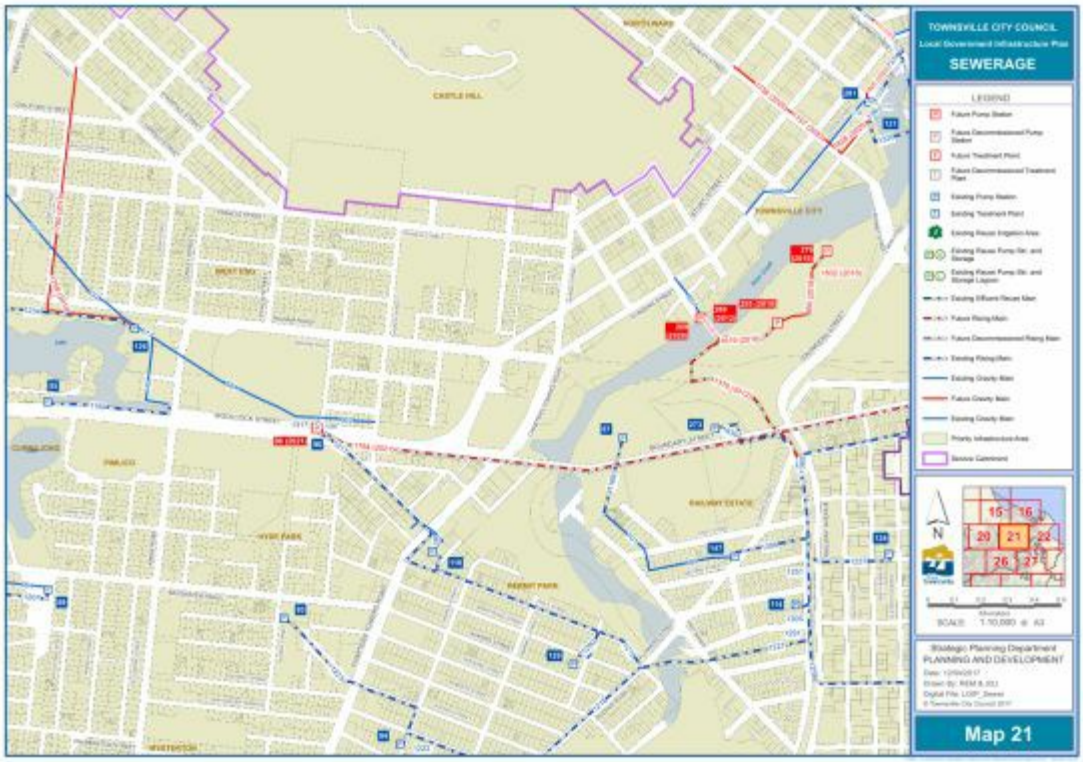

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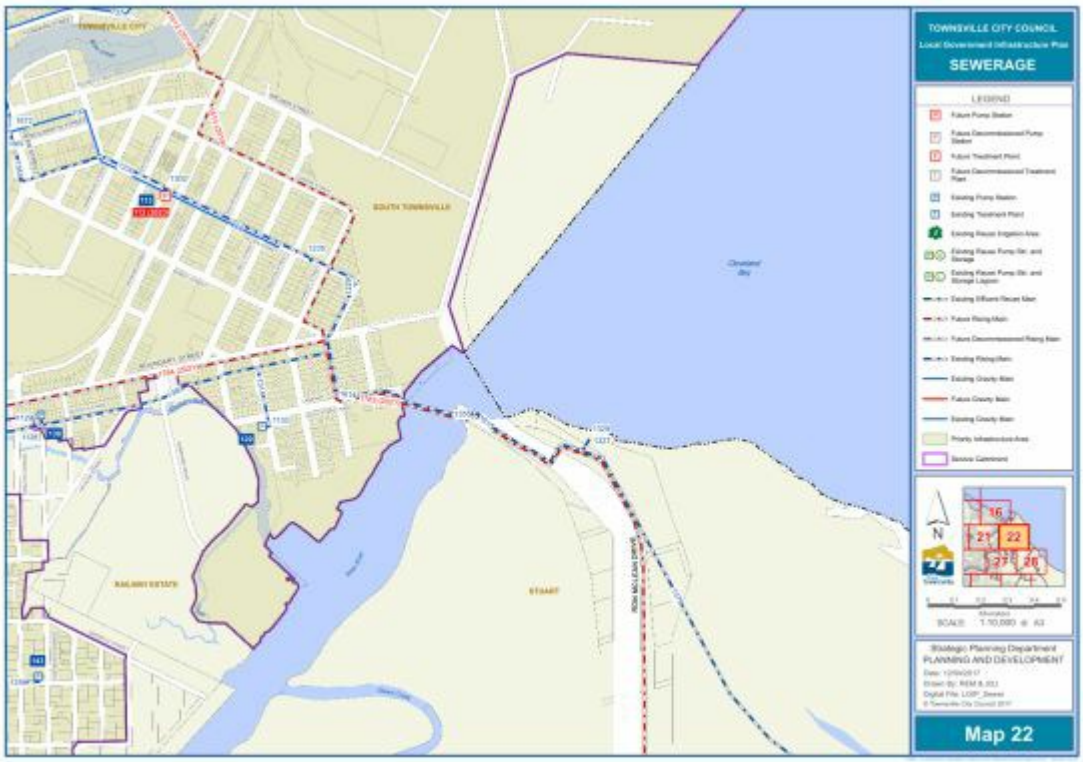

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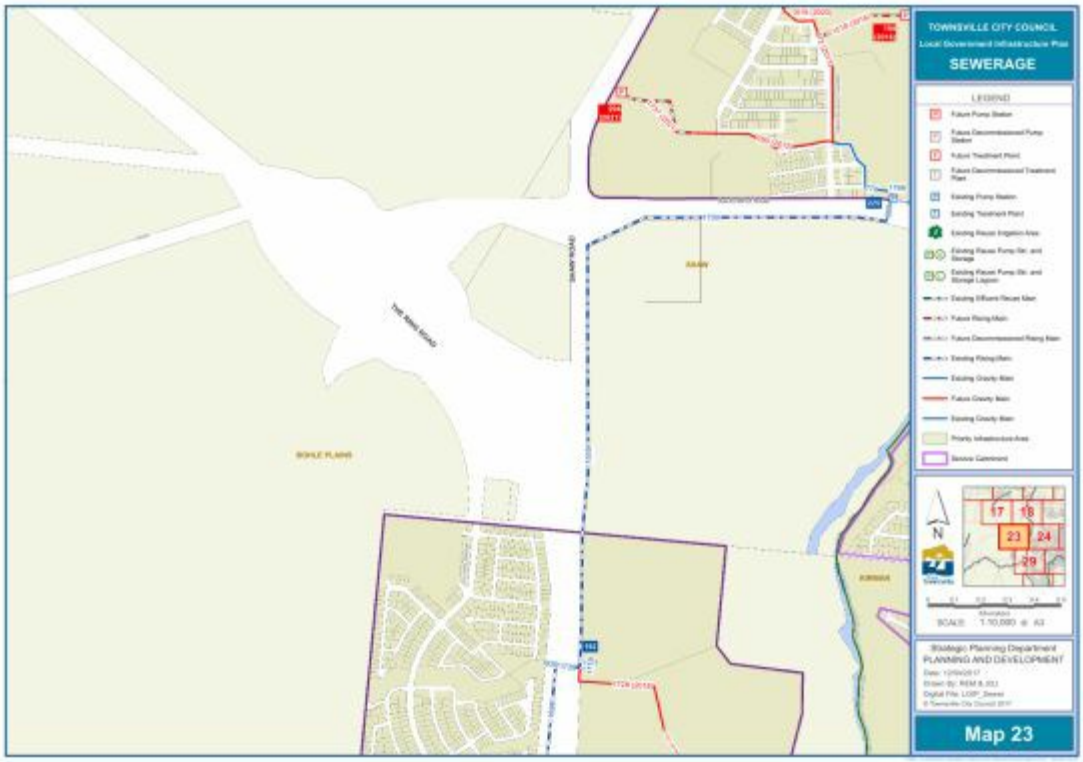

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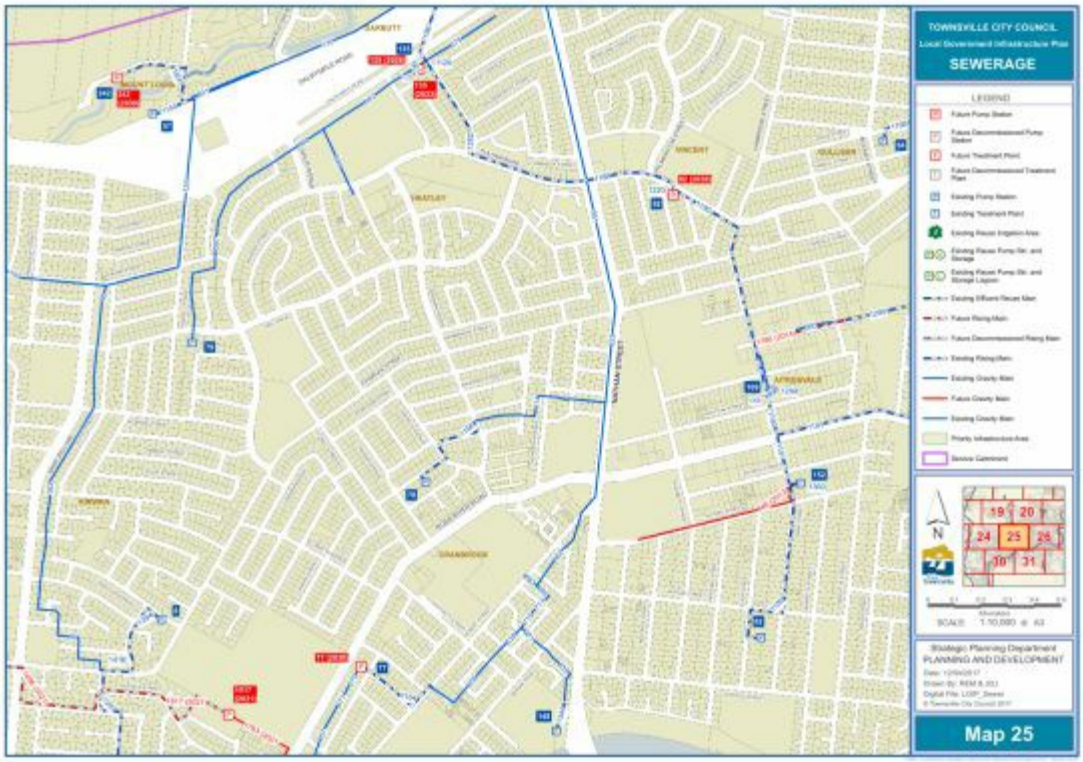

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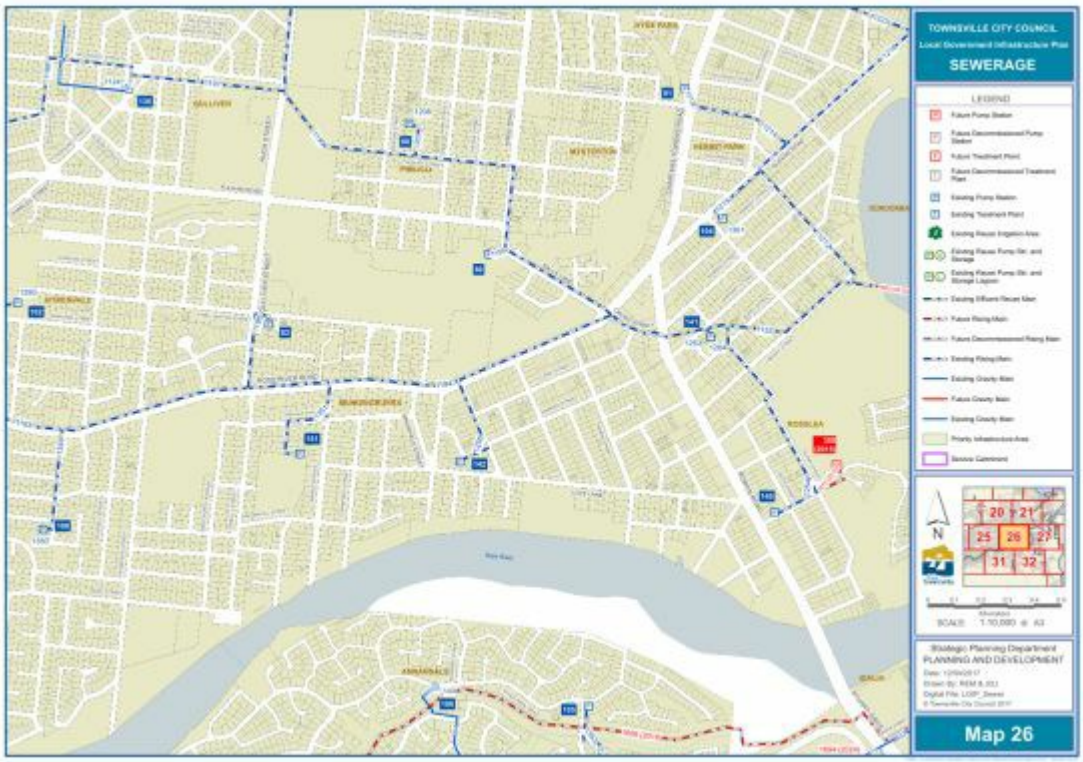

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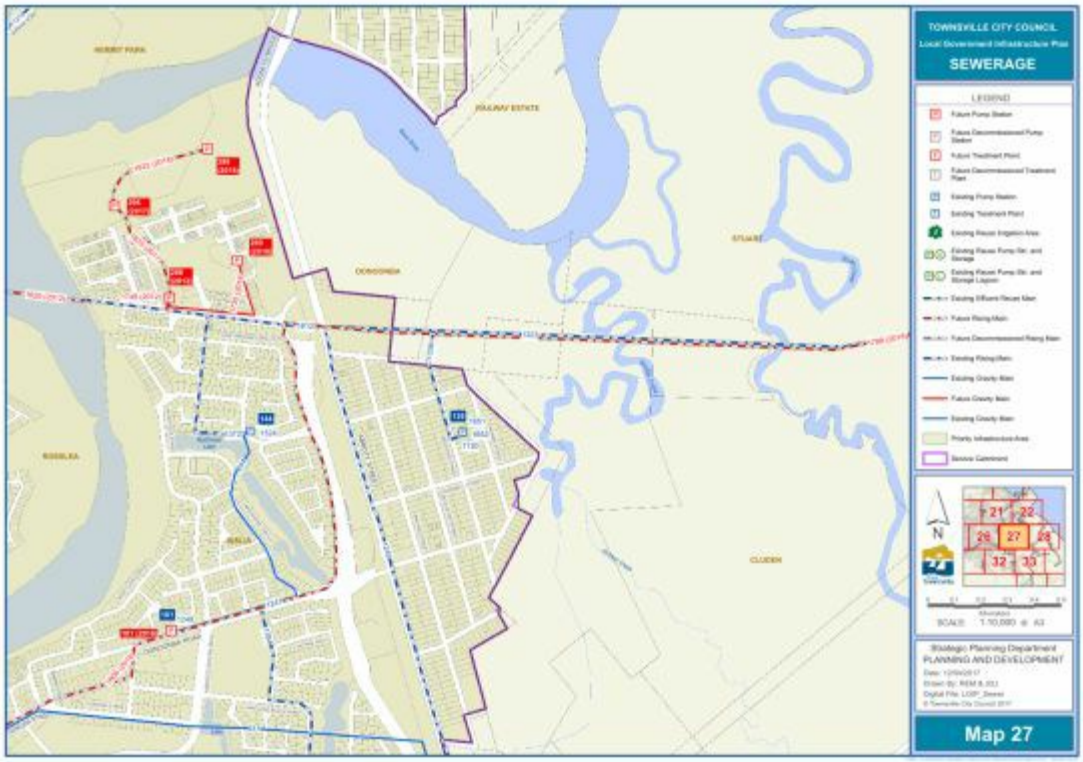

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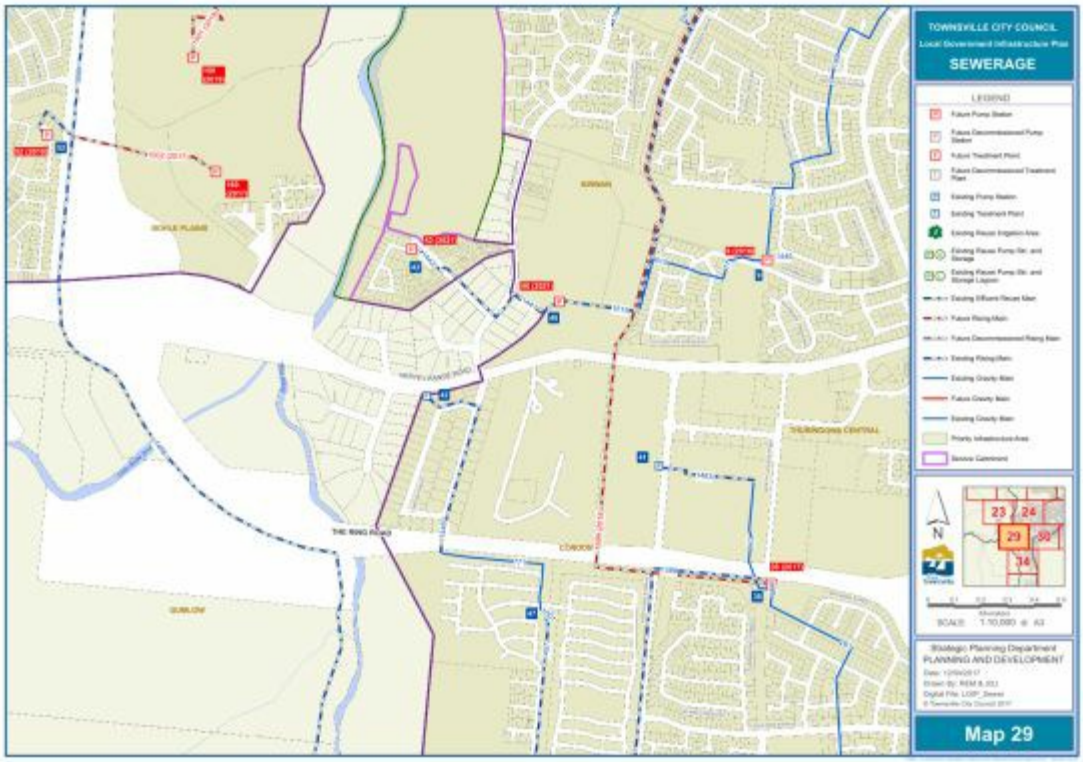

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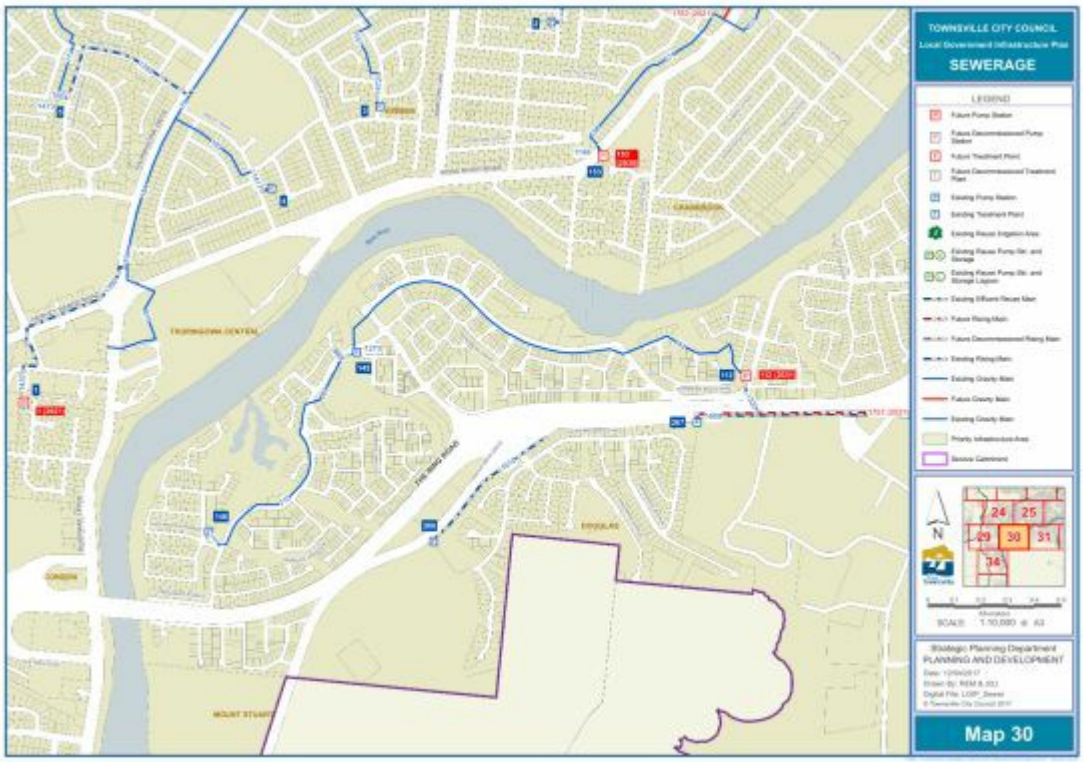

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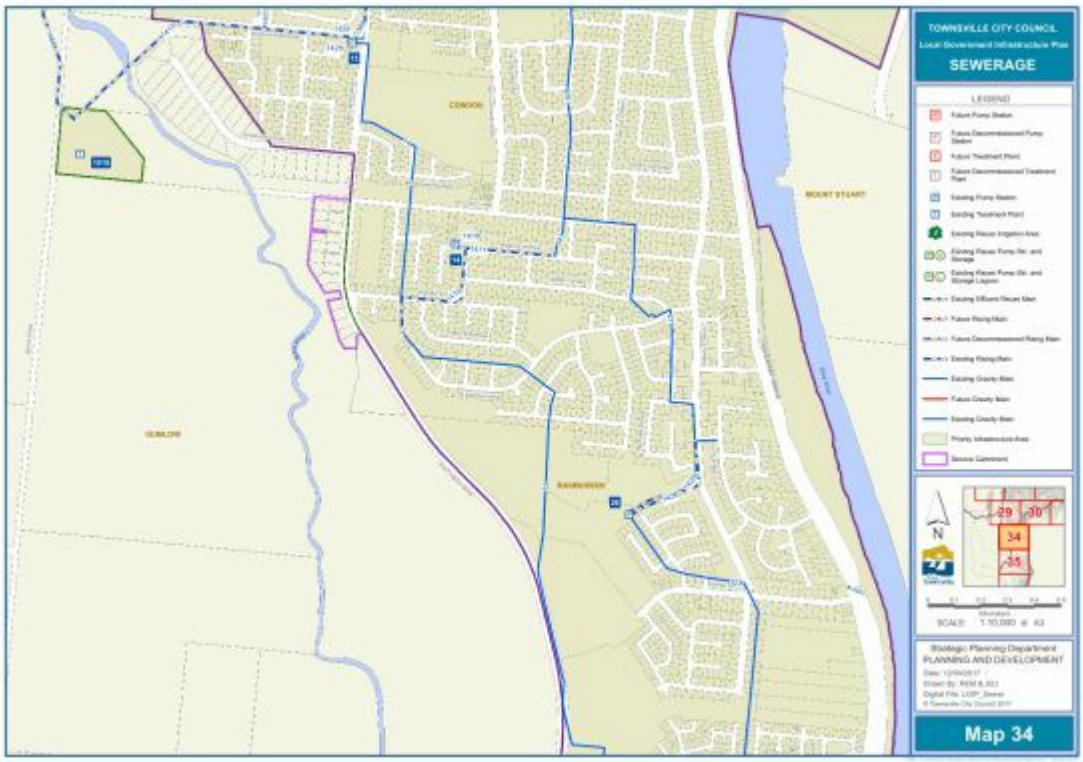

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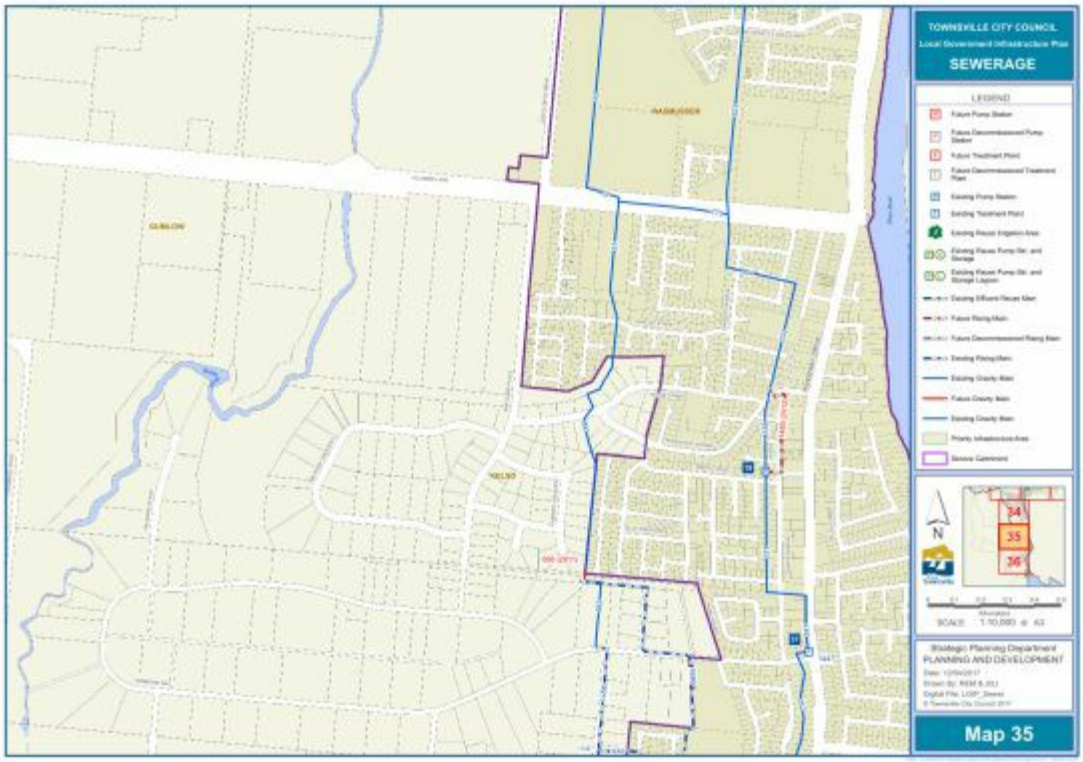

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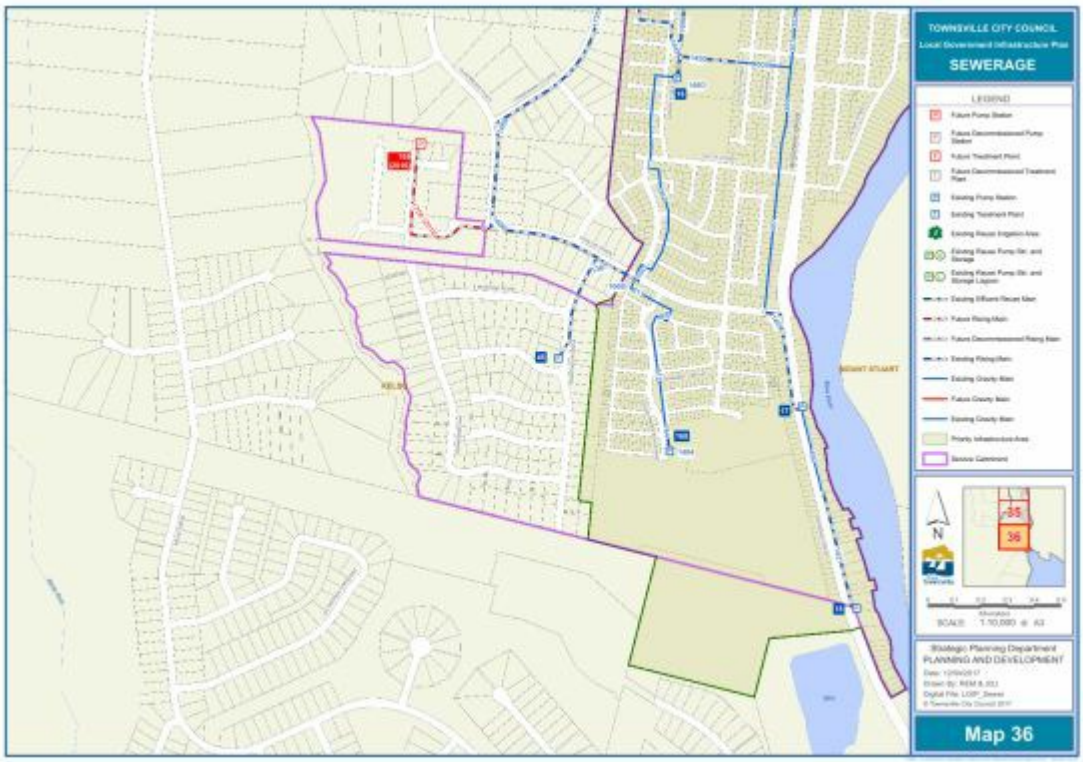

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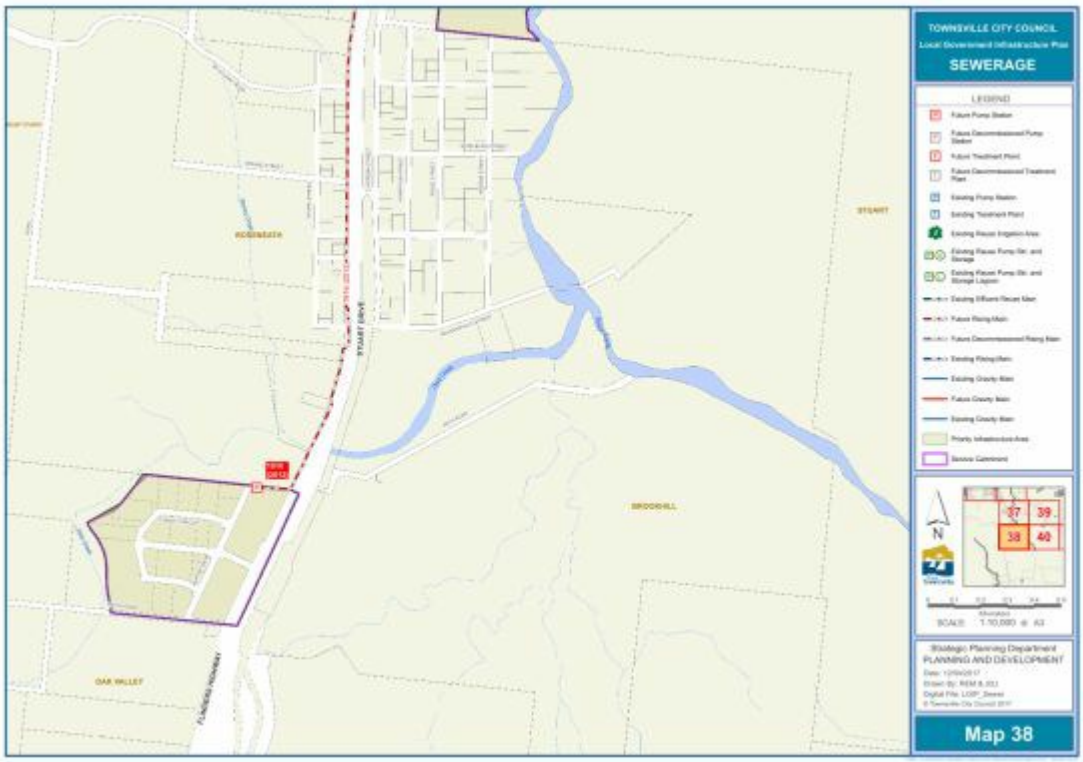

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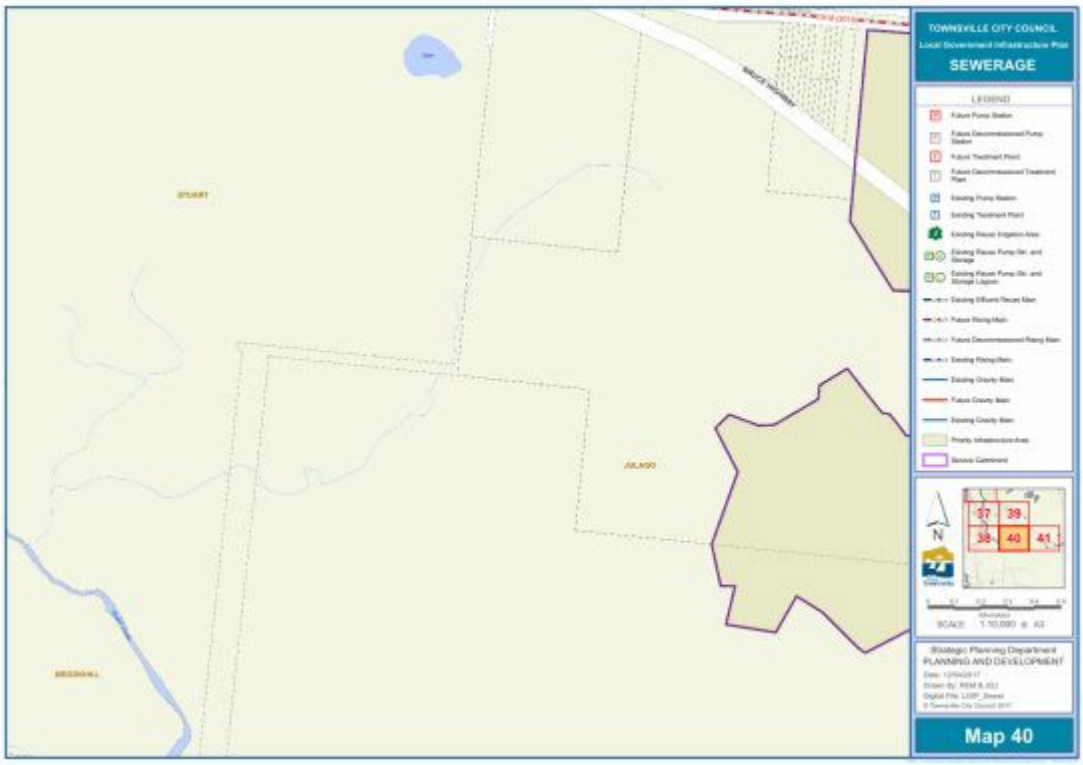

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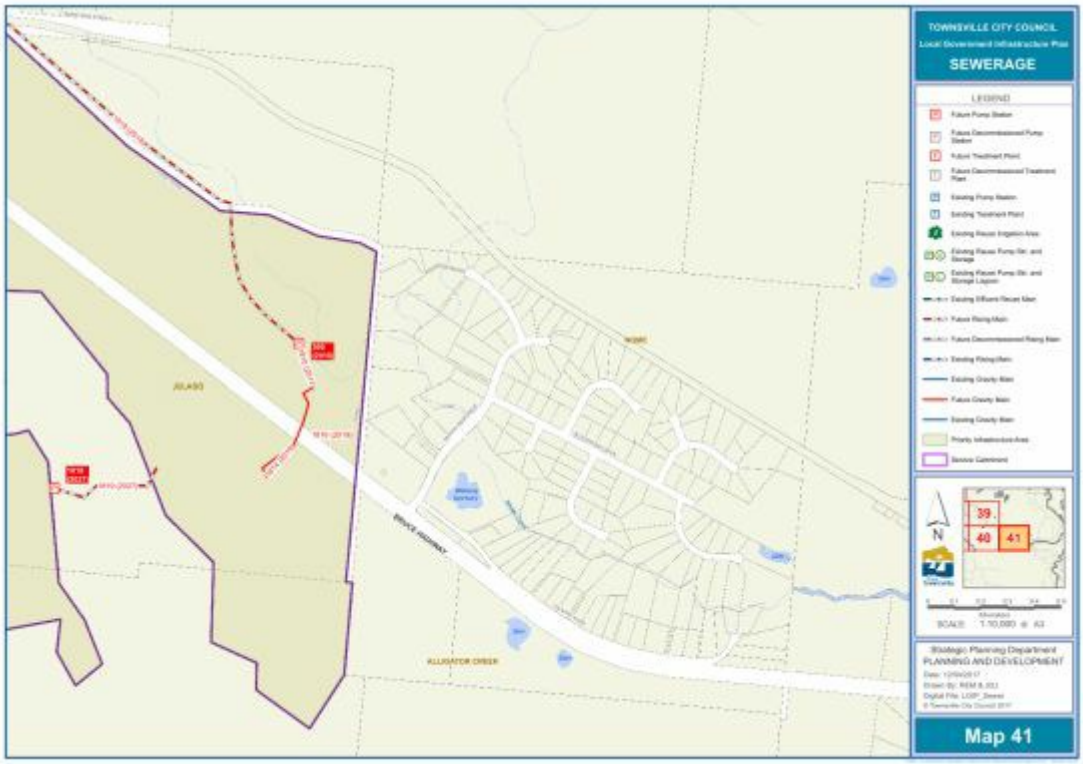

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Table SC3.3.6.1 - Sewerage network schedule of future works

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
3	Rising Main	1798		150	68	2013	21,544
5	Pump Station	241	P/S WB14	Type 2	1	2013	37,579
5	Rising Main	1673	Decommissioned	300	(980)	2012	-
5	Rising Main	1675	Decommissioned	200	(999)	2012	-
5	Treatment Plant	1009	Mount Low - decommission	0	1	2012	-
6	Gravity Main	833		225	196	2015	116,295
6	Pump Station	10	P/S WB3	Type 2	1	2018	40,398
6	Pump Station	11	P/S WB4	Type 2	1	2018	40,398
6	Pump Station	25	P/S WB2	Type 2	1	2014	37,579
6	Pump Station	29	P/S WB1	Type 2	1	2016	41,755
6	Pump Station	44	P/S WB7	Type 3	1	2016	639,891
6	Pump Station	49	P/S WB13	Type 2	1	2013	37,579
6	Pump Station	164	P/S WB8	Type 2	1	2018	40,398
6	Pump Station	165	P/S WB10	Type 2	1	2018	539,395
6	Rising Main	1481		100	425	2018	64,625
7	Pump Station	132	P/S P1A - upgrade	Type 2	1	2020	87,075
8	Pump Station	198	P/S ML21	Type 3	1	2023	4,321,615
8	Pump Station	202	P/S ML15	Type 1	1	2021	539,395
8	Rising Main	1687	Decommissioned	150	(1,750)	2012	-
9	Gravity Main	786		375	487	2031	461,554
9	Gravity Main	787		300	63	2031	47,297
9	Gravity Main	787		300	37	2031	32,810
9	Gravity Main	787		300	649	2031	487,234
9	Gravity Main	788		300	702	2031	527,024
9	Gravity Main	790		225	321	2021	204,747
9	Gravity Main	791		300	160	2021	127,104
9	Gravity Main	792		375	546	2025	495,910
9	Gravity Main	797		500	353	2029	612,595
9	Pump Station	199	P/S ML8	Type 4	1	2029	1,081,057
9	Pump Station	210	P/S ML5	Type 2	1	2031	602,115
9	Pump Station	211	P/S ML6	Type 2	1	2031	602,115
9	Pump Station	216	P/S ML16	Type 2	1	2021	539,395
9	Pump Station	217	P/S ML14	Type 2	1	2019	968,447
9	Pump Station	218	P/S ML12	Type 2	1	2023	577,027
9	Pump Station	219	P/S ML11	Type 2	1	2027	602,115
9	Pump Station	222	P/S ML13	Type 4	1	2025	1,036,013
9	Rising Main	1543		100	35	2021	5,272
9	Rising Main	1544		150	231	2019	63,368
9	Rising Main	1545		150	596	2023	174,741
9	Rising Main	1546		100	288	2027	48,885
9	Rising Main	1578		450	1,911	2029	1,959,458
9	Rising Main	1791		375	1,625	2016	1,237,046
9	Rising Main	1821		375	85	2025	60,994
9	Rising Main	1831		375	1,220	2021	818,353
10	Pump Station	133	P/S P2A	Type 2	1	2020	50,525
11	Gravity Main	765		225	298	2021	190,076
11	Pump Station	174	P/S WD8	Type 2	1	2021	539,395
11	Rising Main	1490		150	225	2021	61,579
12	Gravity Main	967		300	314	2013	232,038
12	Pump Station	27	P/S WD5	Type 2	1	2018	39,276
12	Pump Station	183	P/S BU09	Type 2	1	2019	539,395

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
12	Pump Station	187	P/S S1P3A	Type 2	1	2019	539,395
12	Pump Station	193	P/S BU07	Type 3	1	2031	662,648
12	Pump Station	201	P/S BU08	Type 2	1	2018	539,395
12	Pump Station	212	P/S BU3	Type 3	1	2015	3,757,926
12	Pump Station	213	P/S BU4	Type 2	1	2013	501,762
12	Pump Station	215	P/S BU6	Type 2	1	2016	501,762
12	Rising Main	1504		300	58	2018	39,327
12	Rising Main	1504		300	58	2018	39,327
12	Rising Main	1504		300	578	2018	292,468
12	Rising Main	1504		300	48	2018	32,653
12	Rising Main	1504		300	144	2018	72,966
12	Rising Main	1504		300	144	2018	72,966
12	Rising Main	1508		450	910	2015	909,548
12	Rising Main	1509		100	695	2018	105,643
12	Rising Main	1530		100	301	2019	45,782
12	Rising Main	1531		375	561	2018	459,092
12	Rising Main	1532		100	1,334	2018	202,832
12	Rising Main	1548		150	477	2016	121,610
12	Rising Main	1549		150	484	2014	123,395
12	Rising Main	1579		600	2,665	2029	4,234,035
12	Treatment Plant	1006	Deeragun - decommission	0	1	2012	-
13	Gravity Main	1720		225	1,140	2020	727,138
13	Pump Station	291	P/S LH21A	Type 2	1	2023	699,200
13	Rising Main	1526	New DN750 from Everett St to MSJ WWTP	750	2,402	2019	5,568,316
13	Rising Main	1527	Bohle R to Everett St	750	1,341	2029	3,098,378
13	Rising Main	1732	New DN750 from Everett St to MSJ WWTP	750	2,359	2029	6,104,521
13	Rising Main	1733	New SRM between Bohle R and Everett St	750	1,413	2029	3,264,734
13	Rising Main	1734		750	182	2029	852,350
13	Rising Main	1777		100	360	2023	58,560
13	Rising Main	1826	New SRM from P/S BU3 to NSB crossing	600	560	2029	889,778
13	Treatment Plant	1001	Bohle - decommission	0	1	2012	-
14	Gravity Main	949		225	246	2016	145,962
14	Pump Station	123	P/S LA21A	Type 2	1	2014	68,000
14	Pump Station	263	P/S LE21A	Type 2	1	2016	662,000
14	Pump Station	264	P/S LB21A	Type 2	1	2019	73,100
14	Rising Main	1778		300	996	2020	504,470
15	Pump Station	98	P/S 11B	Type 2	1	2016	-
15	Pump Station	116	P/S 8B	Type 3	1	2016	37,579
16	Gravity Main	1820		450	140	2017	197,130
16	Pump Station	85	P/S 7A	Type 3	1	2017	3,927,555
16	Pump Station	117	P/S A1A	Type 2	1	2019	127,461
16	Pump Station	253	P/S 1B	Type 2	1	2024	577,027
16	Rising Main	1611		200	493	2019	253,718
16	Rising Main	1781		300	2,195	2017	1,111,382
16	Rising Main	1782		375	350	2019	396,727
16	Rising Main	1782		375	686	2019	561,379
17	Gravity Main	767		300	478	2024	406,214
17	Gravity Main	768		375	337	2024	349,643

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
17	Gravity Main	881		450	161	2021	226,699
18	Gravity Main	851		300	460	2016	339,928
18	Gravity Main	942		225	474	2024	323,430
18	Gravity Main	943		375	60	2013	63,897
18	Gravity Main	943		375	663	2013	598,151
18	Gravity Main	1714		300	433	2024	367,972
18	Gravity Main	1715		300	280	2013	206,913
18	Gravity Main	1723		150	440	2013	147,600
18	Gravity Main	1821	Extn of 1715	225	647	2013	383,891
18	Pump Station	56	P/S LA18A - decommission	Type 2	1	2012	-
18	Pump Station	65	P/S LC18A - decommission	Type 2	1	2013	-
18	Pump Station	74	P/S LE18A - environmental overflow	Type 2	1	2017	77,400
18	Pump Station	74	P/S LE18A - backup generator	Type 2	1	2024	93,149
18	Pump Station	191	P/S S1P1C	Type 2	1	2012	501,762
18	Pump Station	195	P/S BP08	Type 2	1	2020	539,395
18	Pump Station	244	P/S LR3	Type 2	1	2021	539,395
18	Pump Station	247	P/S L17	Type 2	1	2014	501,762
18	Pump Station	278	P/S LA17	Type 2	1	2023	1,459,342
18	Rising Main	1517		250	59	2012	22,440
18	Rising Main	1517		250	39	2012	22,762
18	Rising Main	1517		250	154	2012	58,733
18	Rising Main	1519		150	636	2020	174,308
18	Rising Main	1529		100	563	2012	79,574
18	Rising Main	1529		100	286	2012	63,864
18	Rising Main	1710		200	469	2012	145,917
18	Rising Main	1710		200	284	2012	132,493
18	Rising Main	1711		150	153	2023	44,729
18	Rising Main	1712		100	48	2024	7,798
18	Rising Main	1713		150	102	2018	27,945
18	Rising Main	1771		600	6,880	2018	11,163,887
18	Rising Main	1771		600	60	2018	120,358
19	Gravity Main	939		300	218	2014	161,096
19	Gravity Main	939		300	279	2014	206,174
19	Gravity Main	939		300	60	2014	53,624
19	Pump Station	73	P/S LD18A - backup generator	Type 2	1	2024	93,150
19	Pump Station	81	P/S LA16A - decommission	Type 2	1	2015	-
19	Pump Station	124	P/S L21A	Type 3	1	2014	730,708
19	Pump Station	137	P/S L16A - backup generator	Type 2	1	2021	87,075
19	Rising Main	1184		100	93	2015	13,155
19	Rising Main	1629		600	1,098	2012	1,657,883
20	Pump Station	59	P/S A11B	Type 2	1	2027	64,800
20	Pump Station	86	P/S 11C	Type 3	1	2028	300,634
21	Gravity Main	856		300	289	2018	229,581
21	Gravity Main	1757		375	199	2020	263,631
21	Gravity Main	1758		300	262	2020	293,267
21	Gravity Main	1759		300	194	2019	154,113
21	Gravity Main	1759		300	377	2019	299,488
21	Gravity Main	1760		225	378	2019	241,104
21	Gravity Main	1760		225	303	2019	193,266
21	Gravity Main	1825		375	230	2020	304,700
21	Gravity Main	1825		500	230	2020	509,791

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
21	Gravity Main	1826		500	244	2020	540,822
21	Gravity Main	1830		300	135	2020	173,570
21	Pump Station	96	P/S 6 - upgrade	Type 3	1	2021	2,019,885
21	Pump Station	96	P/S 6	Type 3	1	2026	7,322,737
21	Pump Station	255	P/S 24	Type 3	1	2018	968,447
21	Pump Station	269	P/S 23	Type 3	1	2012	450,000
21	Pump Station	269	P/S 23	Type 3	1	2028	72,900
21	Pump Station	270	P/S A24	Type 2	1	2018	539,395
21	Rising Main	1376		375	664	2012	505,340
21	Rising Main	1376		375	74	2012	74,182
21	Rising Main	1618		250	56	2012	21,355
21	Rising Main	1618		250	55	2012	30,846
21	Rising Main	1619		200	300	2018	100,221
21	Rising Main	1784		375	3,495	2021	3,782,758
21	Rising Main	1832		150	90	2018	24,666
22	Pump Station	113	P/S 2A - upgrade	Type 4	1	2023	72,027
22	Rising Main	1612		250	141	2019	87,697
22	Rising Main	1612		250	123	2019	50,373
22	Rising Main	1612		250	140	2019	84,690
22	Rising Main	1612		250	46	2019	28,599
22	Rising Main	1613		500	1,471	2019	1,923,306
22	Rising Main	1613		500	61	2019	100,035
22	Rising Main	1783		600	436	2021	707,477
23	Gravity Main	780		300	540	2012	399,046
23	Gravity Main	872		300	599	2013	442,646
23	Gravity Main	1728		300	508	2018	403,554
23	Pump Station	192	P/S BP02	Type 3	1	2028	43,842
23	Pump Station	194	P/S BP07	Type 2	1	2016	501,762
23	Pump Station	225	P/S BP03	Type 3	1	2013	160,756
23	Pump Station	294	P/S BP21	Type 2	1	2021	539,395
23	Rising Main	1518		150	341	2016	86,937
23	Rising Main	1737		150	367	2021	100,465
24	Gravity Main	847		300	146	2021	115,982
24	Gravity Main	848		225	674	2021	429,905
24	Pump Station	6	P/S K13B	Type 3	1	2016	17,537
24	Pump Station	7	P/S K15A	Type 2	1	2012	20,877
24	Pump Station	30	P/S K13D	Type 3	1	2013	13,779
24	Pump Station	33	P/S K16C - upgrade	Type 4	1	2016	417,547
24	Pump Station	33	P/S K16C - upgrade	Type 4	1	2021	89,773
24	Pump Station	243	P/S LD6	Type 3	1	2012	900,881
24	Pump Station	245	P/S LR2	Type 2	1	2021	539,395
24	Rising Main	1496		300	1,021	2021	516,957
24	Rising Main	1601		225	217	2012	75,242
24	Rising Main	1602		150	224	2021	61,392
24	Rising Main	1765		200	1,067	2012	331,959
24	Rising Main	1787		200	62	2024	33,244
24	Rising Main	1787		200	1,825	2024	653,129
25	Gravity Main	846		225	667	2013	395,758
25	Gravity Main	1763		300	328	2021	260,562
25	Gravity Main	1764		225	205	2021	130,757
25	Pump Station	57	P/S L6A - decommission	Type 2	1	2013	-
25	Pump Station	77	P/S L1A - environmental overflow	Type 3	1	2030	151,199

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
25	Pump Station	92	P/S 9M - backup generator	Type 3	1	2030	113,999
25	Pump Station	135	P/S 9N - backup generator	Type 3	1	2026	109,250
25	Pump Station	152	P/S 9K	Type 2	1	2013	208,774
25	Pump Station	152	P/S 9K	Type 2	1	2014	82,466
25	Pump Station	242	P/S L6C - upgrade	Type 2	1	2030	56,400
25	Pump Station	1017	P/S L1C	Type 2	1	2021	2,209,113
25	Rising Main	1786		150	349	2014	89,017
25	Rising Main	1817		200	590	2021	197,410
26	Pump Station	309		Type 2	1	2015	627,213
26	Rising Main	1606		600	6,438	2016	9,718,352
26	Rising Main	1606		600	1,327	2016	2,472,905
26	Rising Main	1813		100	166	2015	23,426
27	Gravity Main	1735		300	570	2016	421,215
27	Pump Station	101	P/S SA6A	Type 2	1	2016	113,782
27	Pump Station	288	P/S S15	Type 2	1	2012	501,762
27	Pump Station	289	P/S SB15	Type 3	1	2016	900,881
27	Pump Station	296	P/S SA15	Type 2	1	2017	539,395
27	Pump Station	298	P/S SC15	Type 2	1	2018	539,395
27	Rising Main	1620		900	437	2012	2,128,391
27	Rising Main	1620		900	5	2012	24,884
27	Rising Main	1749		300	48	2012	22,739
27	Rising Main	1788		750	21	2018	59,122
27	Rising Main	1788		750	353	2018	818,161
27	Rising Main	1788		750	3,684	2018	7,625,875
27	Rising Main	1788		750	64	2018	161,203
27	Rising Main	1832		100	458	2018	41,954
27	Rising Main	1833		100	461	2017	42,228
28	Rising Main	1783		600	250	2021	722,365
28	Rising Main	1783		600	540	2021	973,841
28	Rising Main	1783		600	3,714	2021	5,286,432
28	Rising Main	1794	Rocky Springs connection	375	807	2018	660,148
28	Rising Main	1794	Rocky Springs connection	375	1,313	2018	1,074,212
28	Rising Main	1794	Rocky Springs connection	375	46	2018	62,705
28	Rising Main	1794	Rocky Springs connection	375	976	2018	798,674
28	Rising Main	1794	Rocky Springs connection	375	121	2018	164,918
28	Rising Main	1794	Rocky Springs connection	375	1,441	2018	1,179,465
28	Rising Main	1794	Rocky Springs connection	375	157	2018	213,584
28	Rising Main	1794	Rocky Springs connection	375	566	2018	462,860
28	Treatment Plant	1005	Cleveland Bay	0	1	2018	26,931,805
29	Pump Station	9	P/S K13A	Type 2	1	2016	31,942
29	Pump Station	38	P/S C6B - upgrade	Type 3	1	2017	3,164,487
29	Pump Station	40	P/S K13E	Type 2	1	2021	35,909
29	Pump Station	43	P/S W13G	Type 2	1	2021	35,909
29	Pump Station	52	P/S BP01 - backup generator	Type 2	1	2018	37,625
29	Pump Station	159	P/S BP11	Type 2	1	2017	539,395
29	Pump Station	160	P/S BP12	Type 2	1	2019	539,395
29	Rising Main	1501		100	412	2019	62,697
29	Rising Main	1502		160	564	2017	162,086
29	Rising Main	1699		450	4,528	2018	4,865,926
29	Rising Main	1699		450	120	2018	162,288
30	Pump Station	1	P/S K12	Type 3	1	2021	40,398
30	Pump Station	4	P/S K17C	Type 2	1	2016	858,060

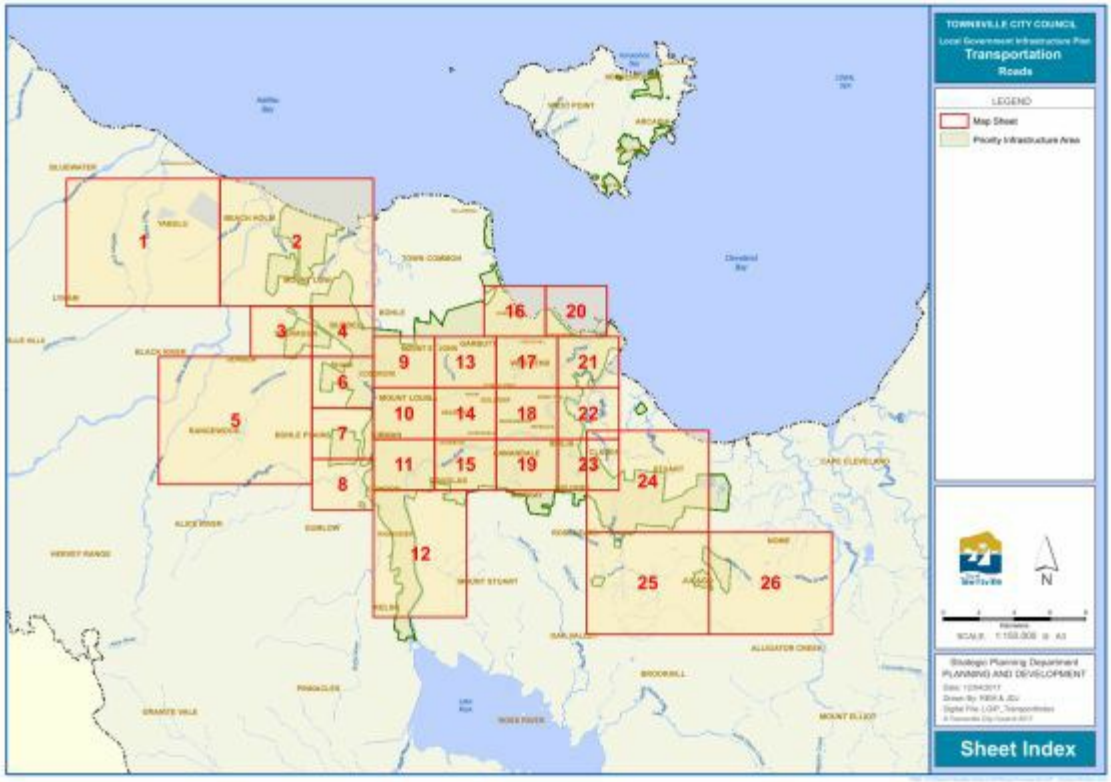
Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
30	Pump Station	112	P/S S1A	Type 3	1	2031	315,666
30	Pump Station	153	P/S L1B	Type 2	1	2030	24,000
30	Rising Main	1757		375	697	2031	636,681
30	Rising Main	1757		375	468	2031	565,793
31	Pump Station	103	P/S S3A	Type 2	1	2016	167,019
31	Pump Station	154	P/S S2A	Type 2	1	2016	97,080
31	Pump Station	268	P/S S21	Type 4	1	2014	1,724,830
31	Pump Station	279	P/S S22	Type 3	1	2021	968,447
31	Rising Main	1608		450	62	2021	83,591
31	Rising Main	1608		450	1,121	2021	1,204,910
32	Gravity Main	1007		225	204	2014	121,041
32	Pump Station	274	P/S S50	Type 2	1	2024	577,027
32	Rising Main	1694		150	1,854	2024	543,535
32	Rising Main	1694		150	60	2024	28,125
33	Gravity Main	845		450	106	2013	145,341
33	Gravity Main	845		450	555	2013	659,830
33	Gravity Main	845		450	222	2013	331,244
33	Gravity Main	1729		450	13	2014	15,455
33	Gravity Main	1729		450	375	2014	491,187
33	Gravity Main	1729		450	1,910	2014	2,501,779
33	Gravity Main	1729		450	5	2014	6,856
33	Pump Station	1012	P/S CL10	Type 2	1	2018	539,395
33	Rising Main	1814		150	929	2019	406,790
33	Rising Main	1814		150	397	2019	108,768
34	Pump Station	15	P/S C36A	Type 4	1	2014	104,387
35	Rising Main	1489		250	428	2012	163,067
36	Pump Station	16	P/S 33	Type 2	1	2018	67,330
36	Pump Station	169	P/S C34A	Type 2	1	2016	501,762
36	Rising Main	1756		100	659	2016	93,216
37	Gravity Main	1729		450	74	2014	110,415
37	Pump Station	100	P/S SA18A	Type 2	1	2021	157,102
37	Pump Station	290	P/S SA18B	Type 2	1	2019	539,395
37	Rising Main	1755		200	697	2019	163,140
37	Rising Main	1755		200	714	2019	238,790
37	Rising Main	1793		200	2,415	2019	808,017
37	Rising Main	1793		200	69	2019	34,573
37	Rising Main	1815		250	300	2019	174,414
37	Rising Main	1815		250	19	2019	11,840
37	Rising Main	1815		250	112	2019	64,955
38	Pump Station	1016		Type 2	1	2013	501,762
38	Rising Main	1816		100	193	2013	27,281
38	Rising Main	1816		100	114	2013	25,381
38	Rising Main	1816		100	117	2013	16,487
38	Rising Main	1816		100	918	2013	153,201
38	Rising Main	1816		100	2,039	2013	173,709
39	Rising Main	1818		300	56	2018	45,553
39	Rising Main	1818		300	50	2018	40,677
39	Rising Main	1818		300	623	2018	315,412
39	Rising Main	1818		300	59	2018	47,404
39	Rising Main	1818		300	888	2018	449,765
39	Rising Main	1818		300	1,187	2018	601,059
39	Rising Main	1818		300	3,269	2018	1,655,002

Map	Type	LGIP ID	Description	Diameter (mm)	Length (m)	Year	Cost ($'16)
39	Rising Main	1818		300	1,694	2018	857,893
41	Gravity Main	1814	Rocky Springs	300	187	2021	108,580
41	Gravity Main	1815	Rocky Springs	300	346	2017	200,893
41	Gravity Main	1816	Rocky Springs	300	79	2017	59,253
41	Pump Station	300	Rocky Springs (P/S R4 aka P1)	Type 4	9	2018	1,854,193
41	Pump Station	1018	Rocky Springs	Type 1	9	2025	577,027
41	Rising Main	1819		200	451	2025	112,790

SC3.3.7 - Plans for trunk roads infrastructure

Editor's note—This document is intended to function in an electronic environment whereupon hyperlinks to detailed PDF maps allow for closer examination of mapping information. The following images are true copies of such maps, but at a coarser scale.

The maps are also loaded in a GIS environment. TownsvilleMaps is the current in-service GIS platform for this purpose, which can be publicly viewed at council, or privately accessed via subscription.



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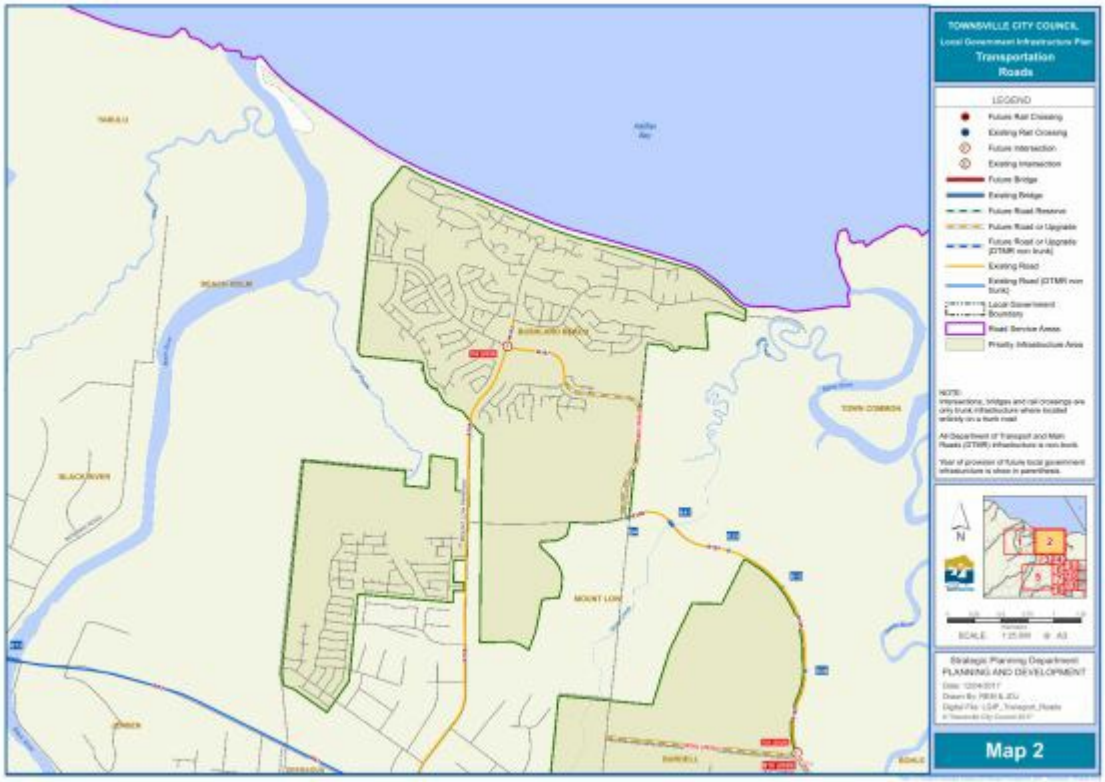

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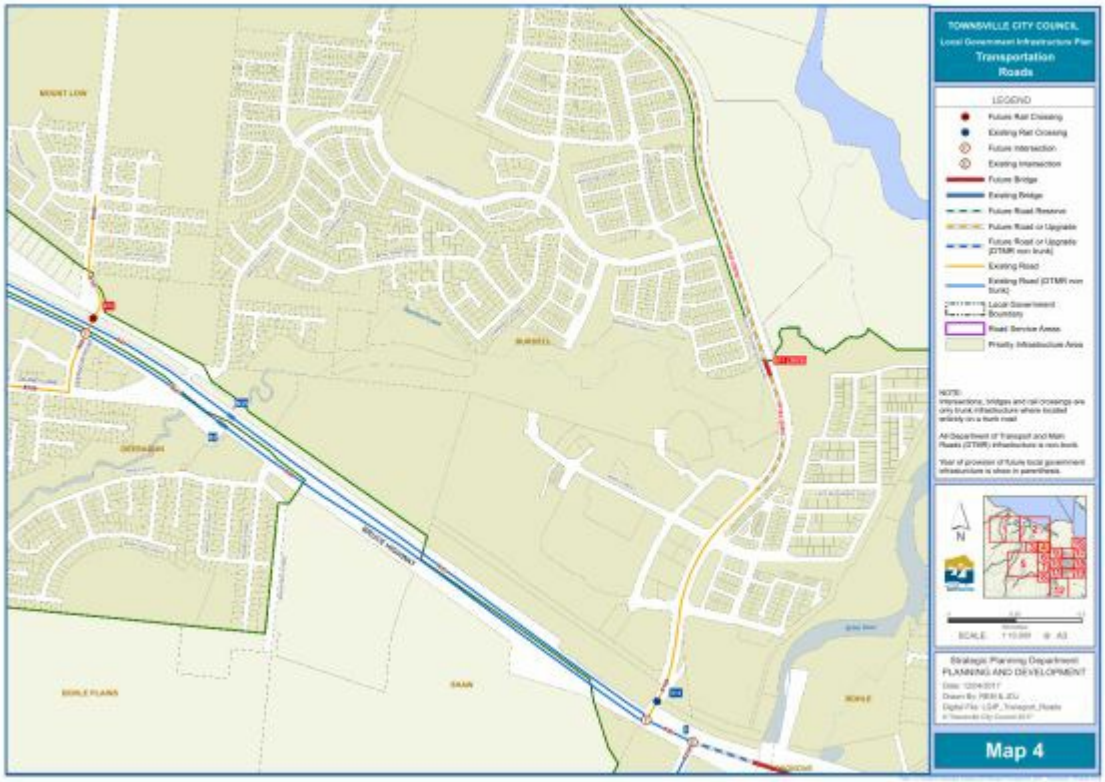

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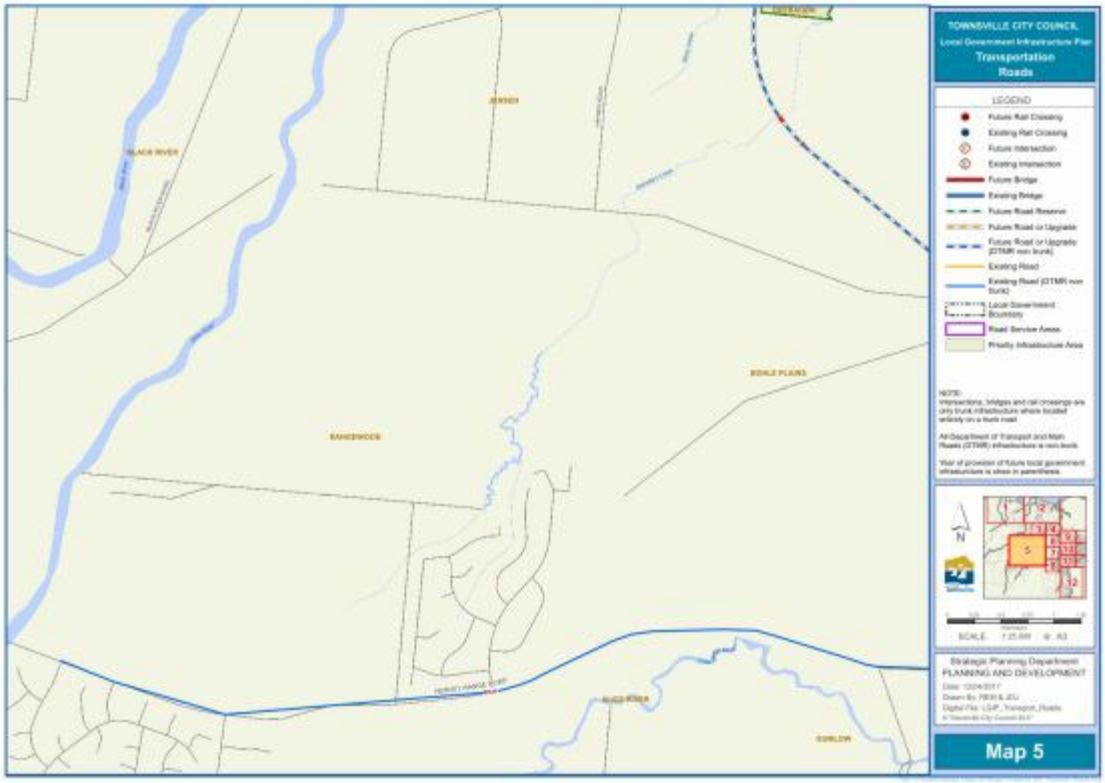

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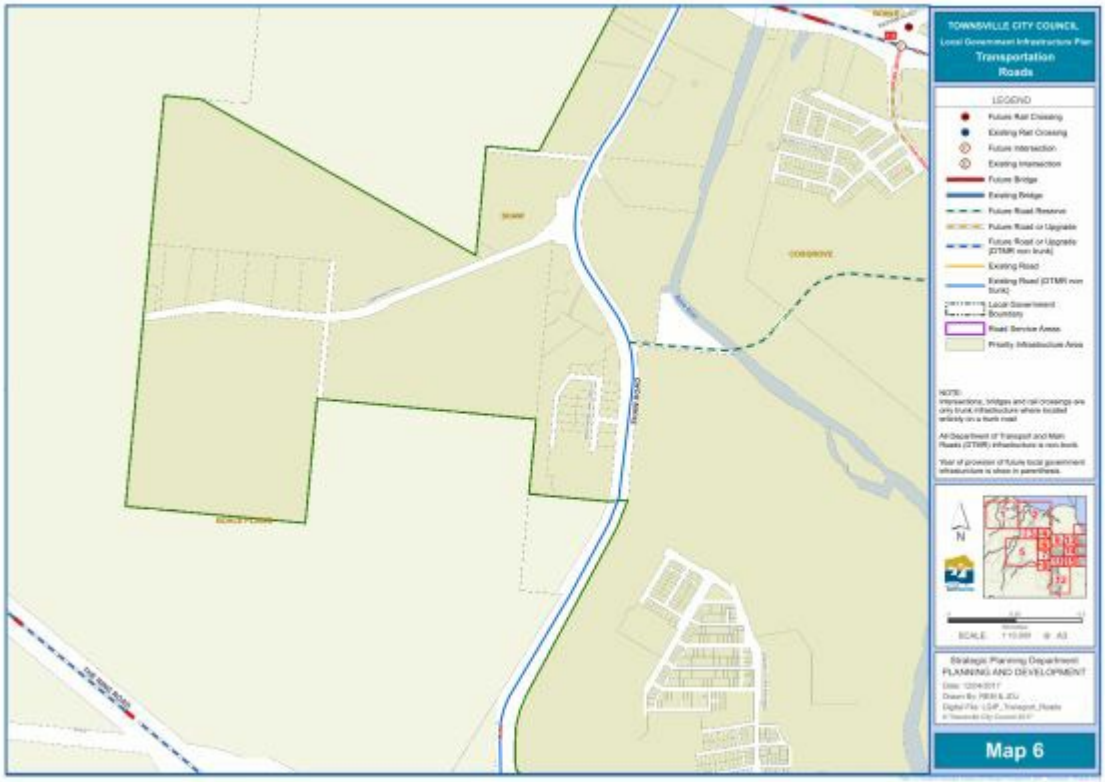

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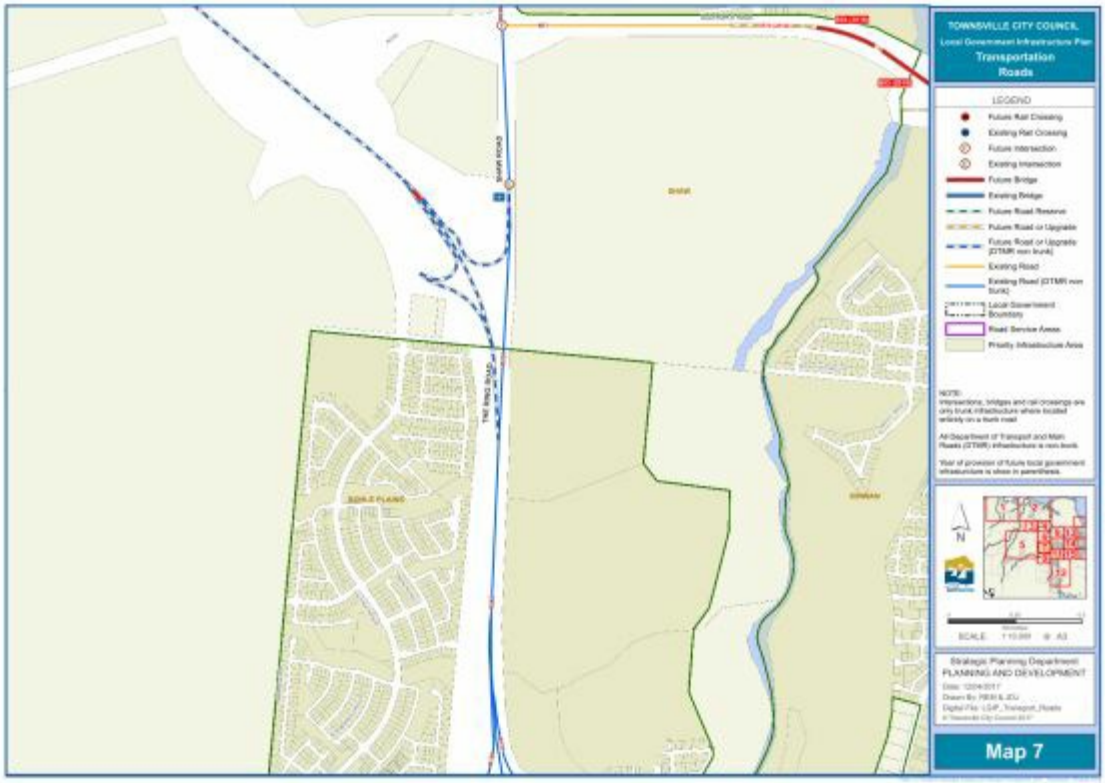

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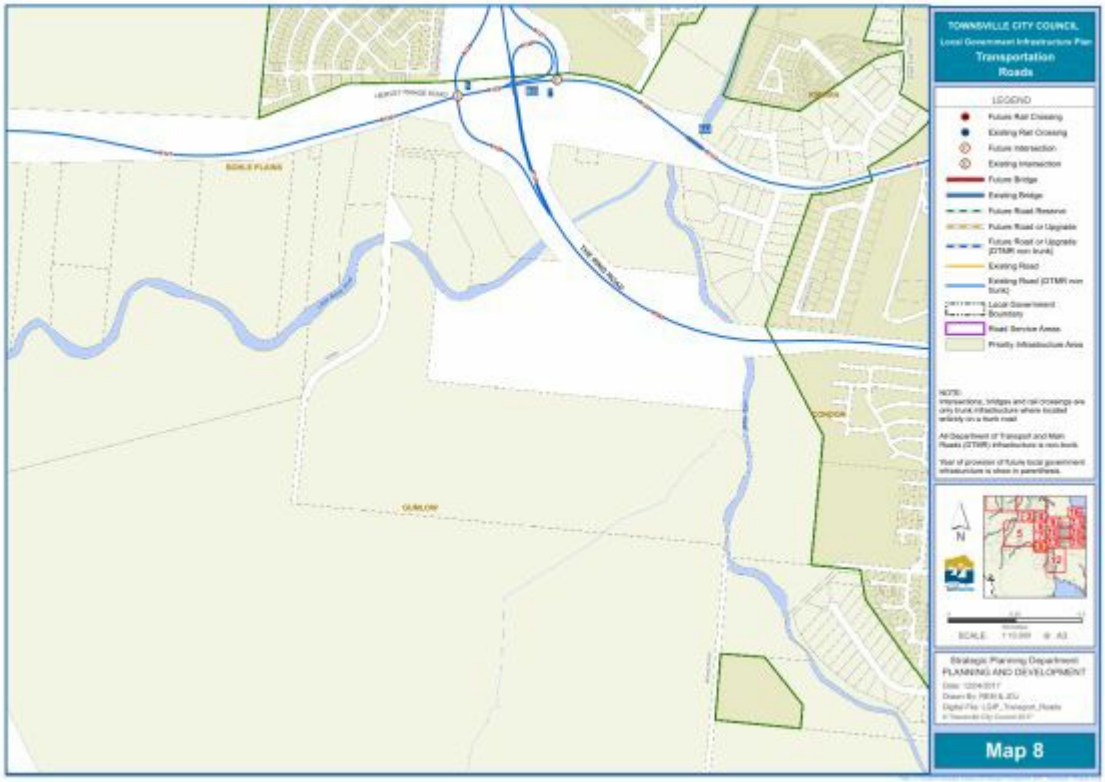

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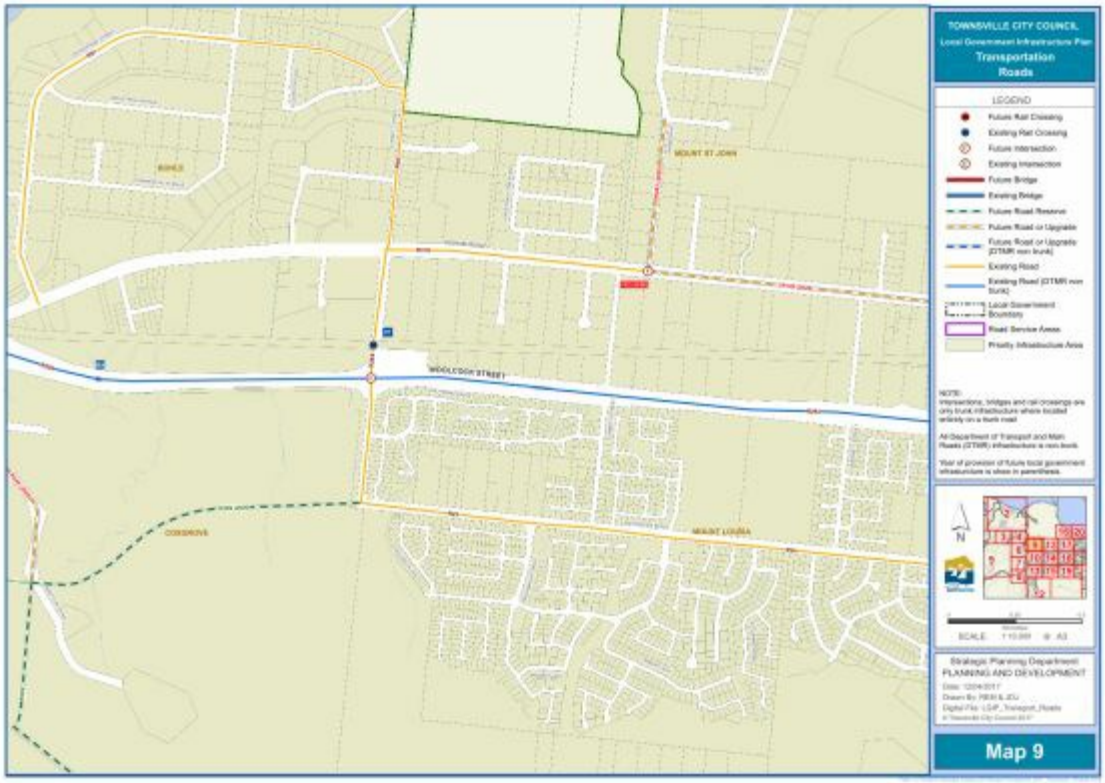

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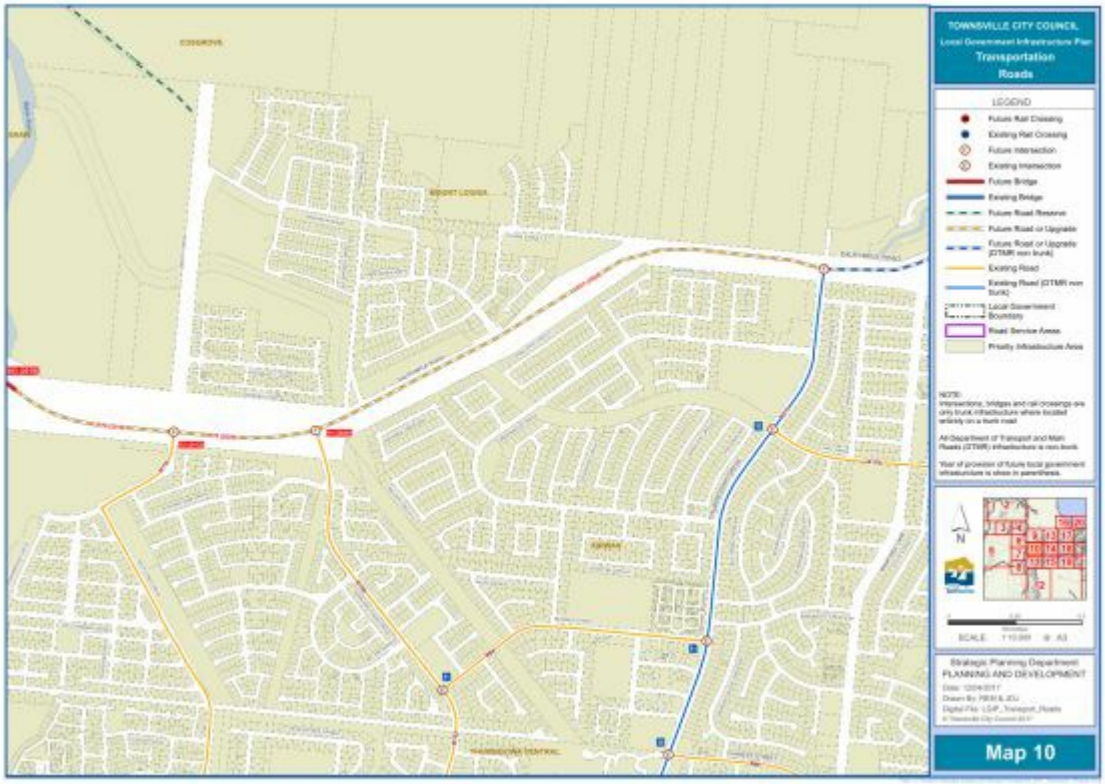

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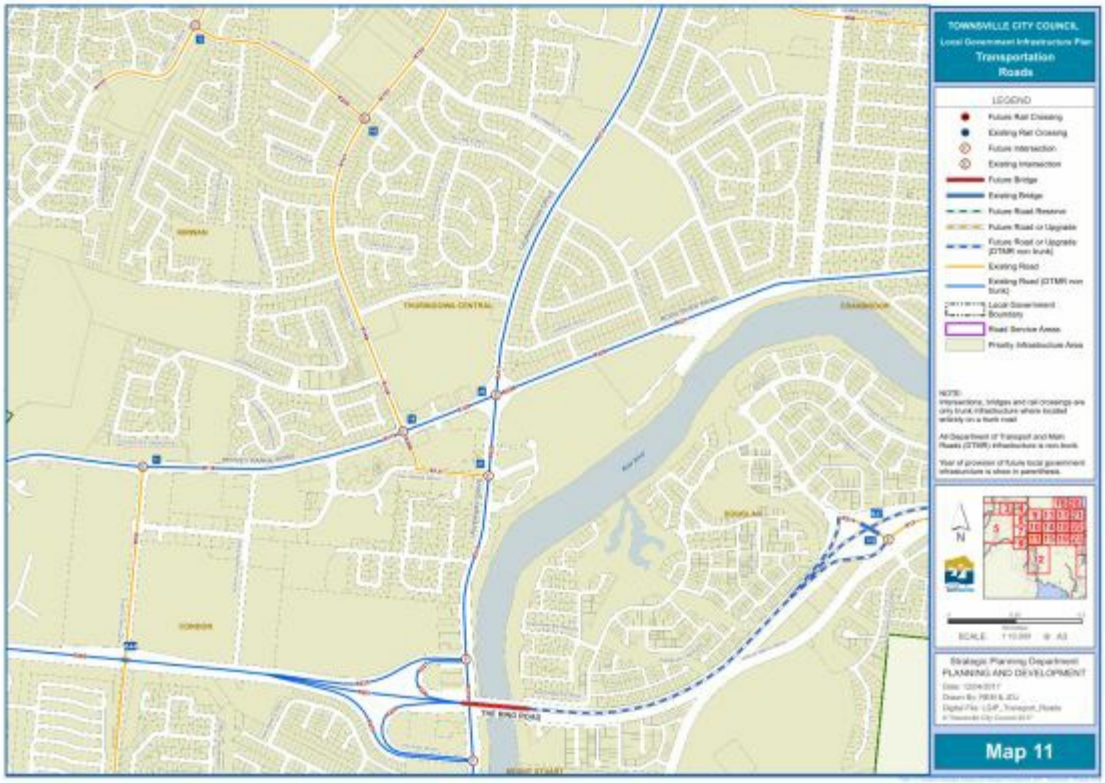

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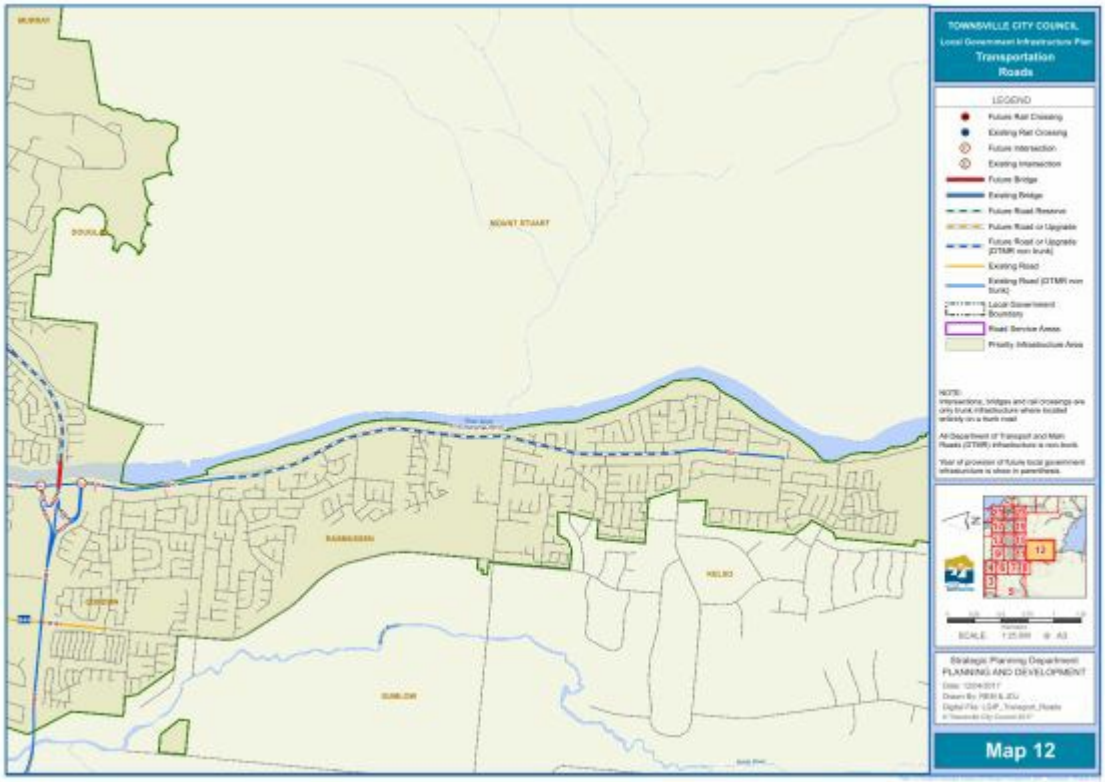

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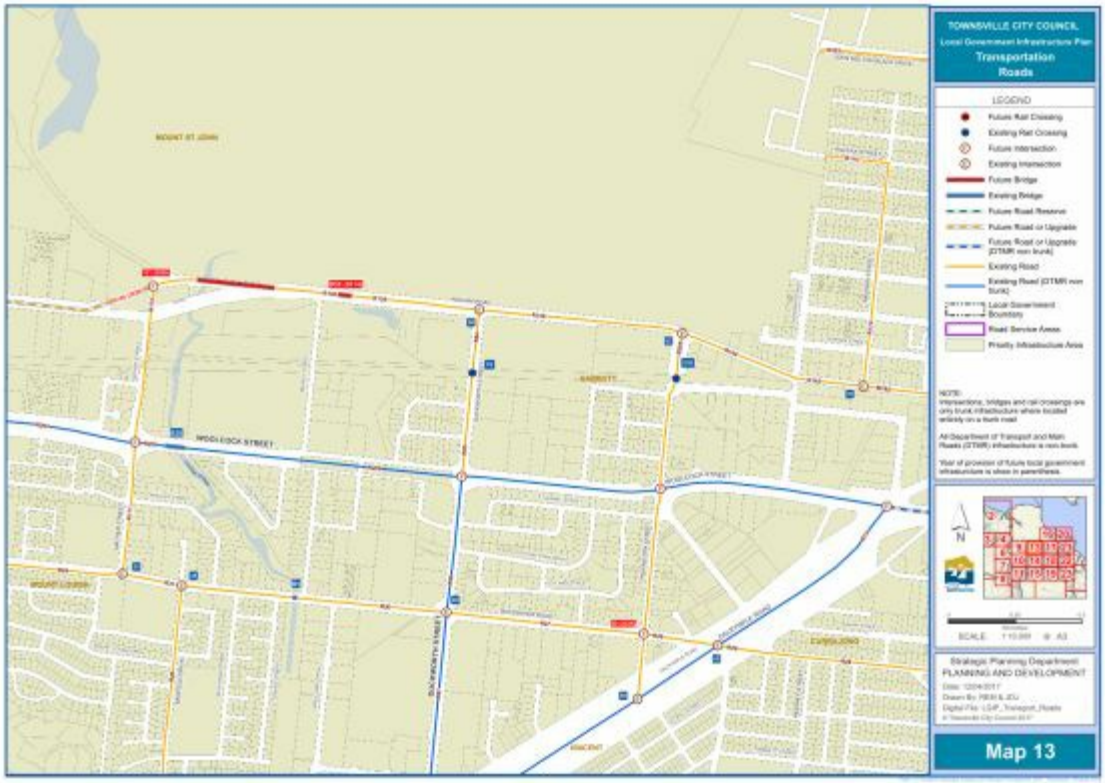

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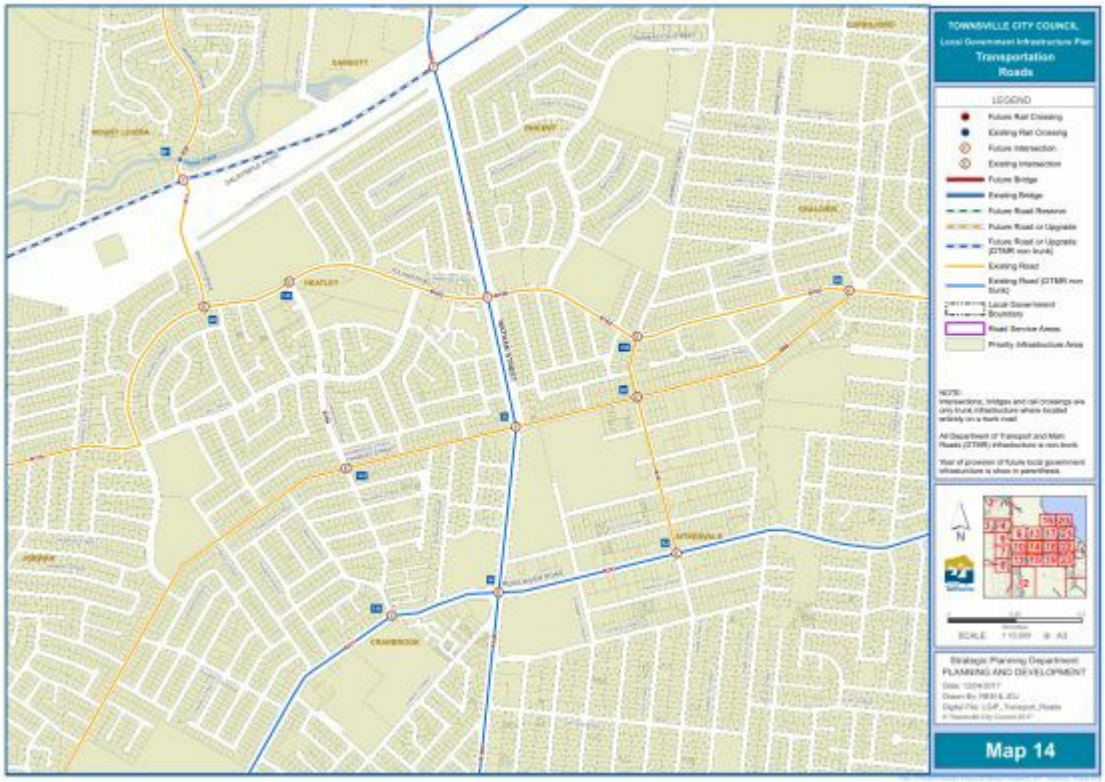

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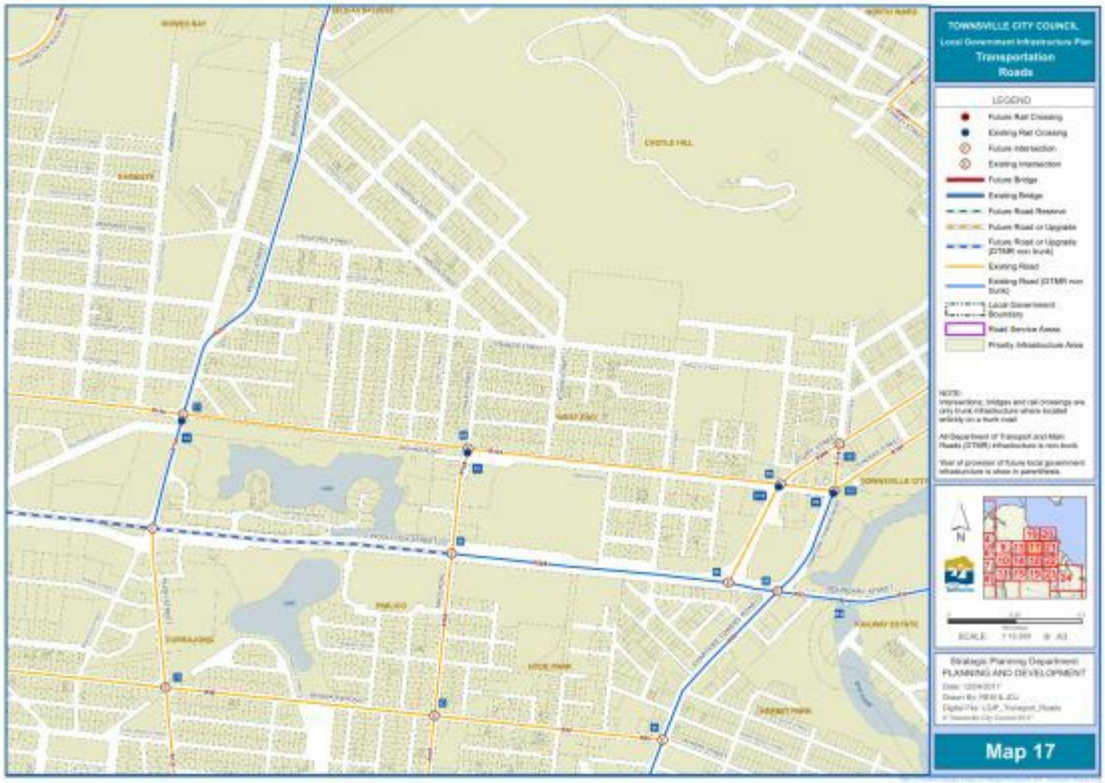

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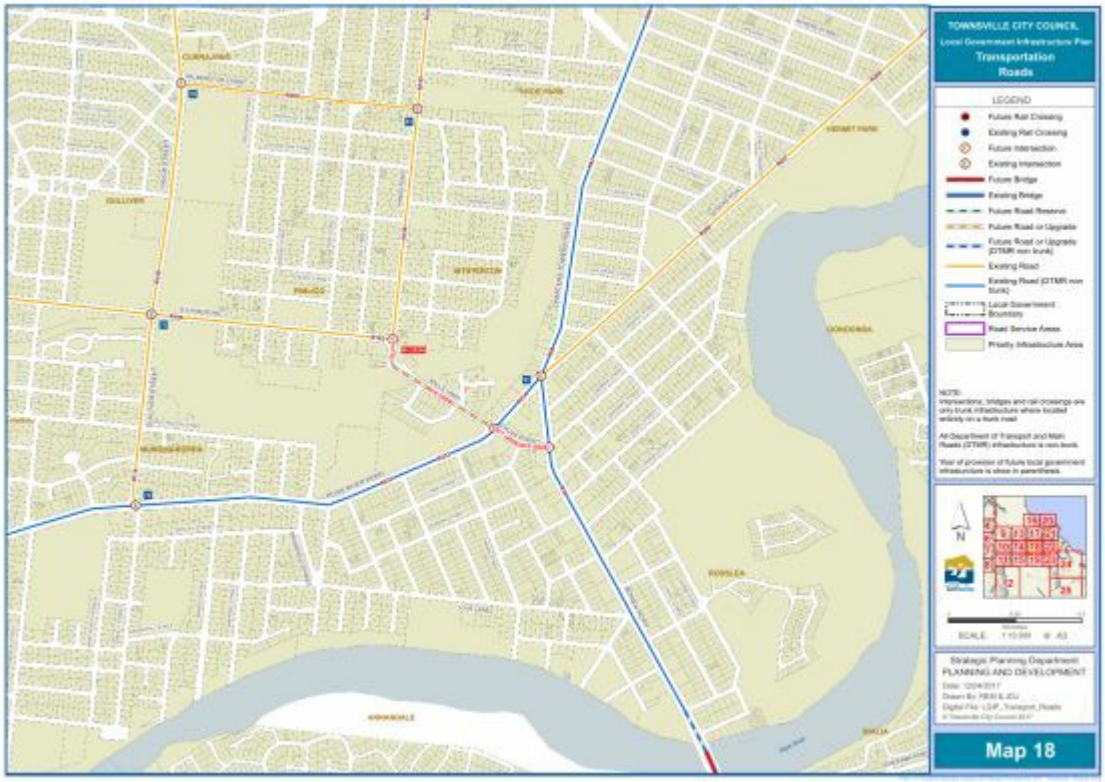

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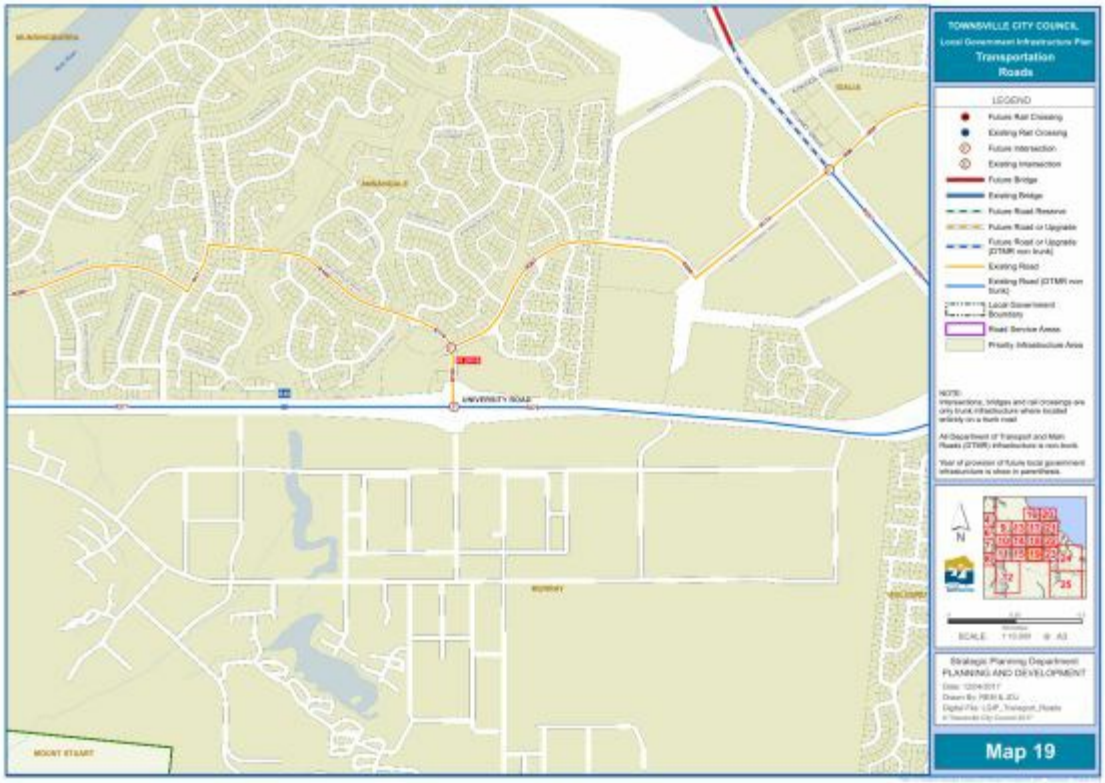

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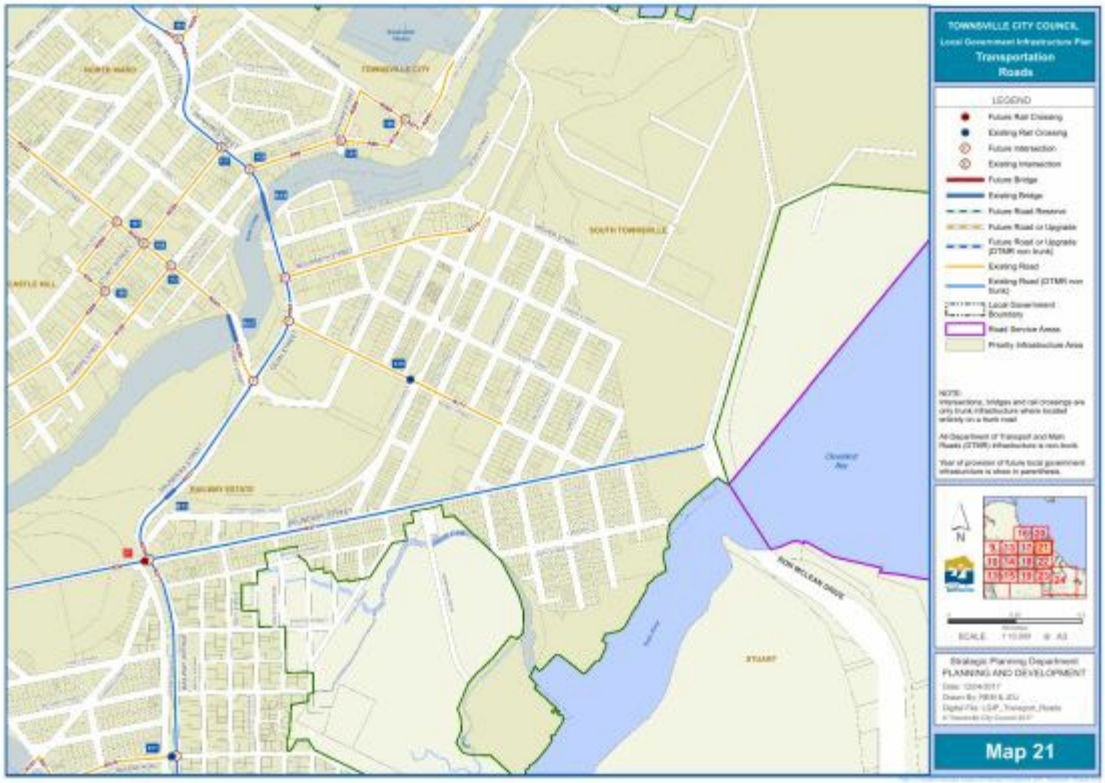

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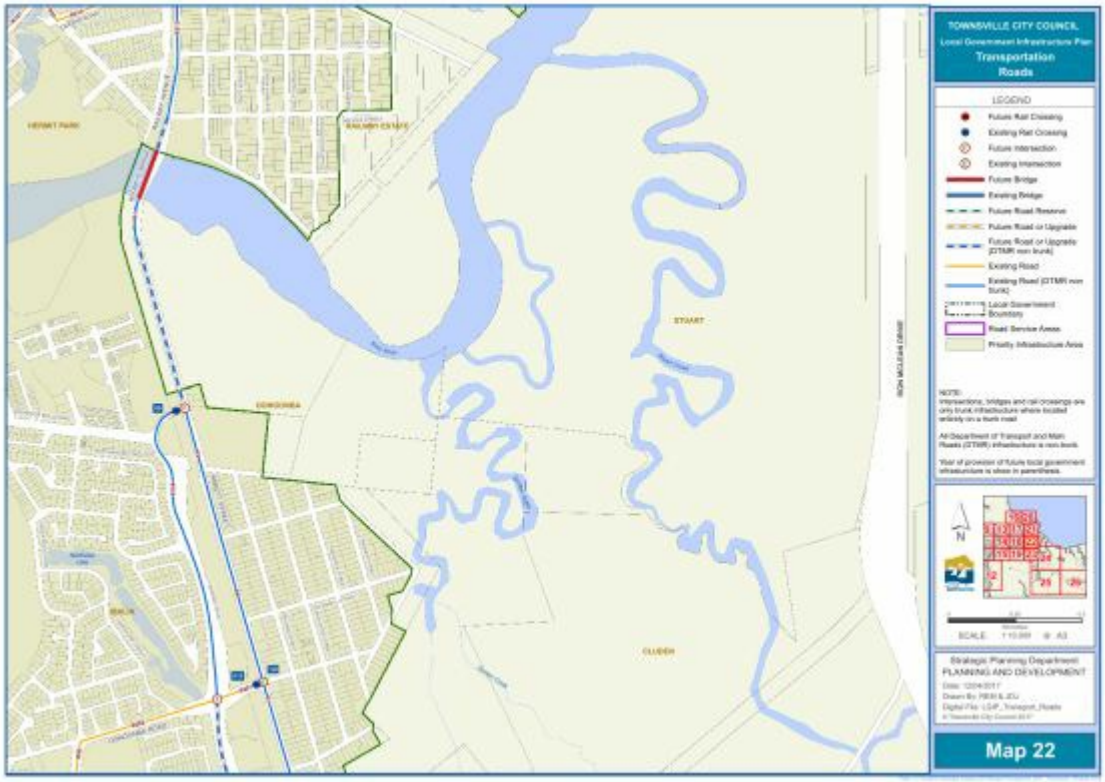

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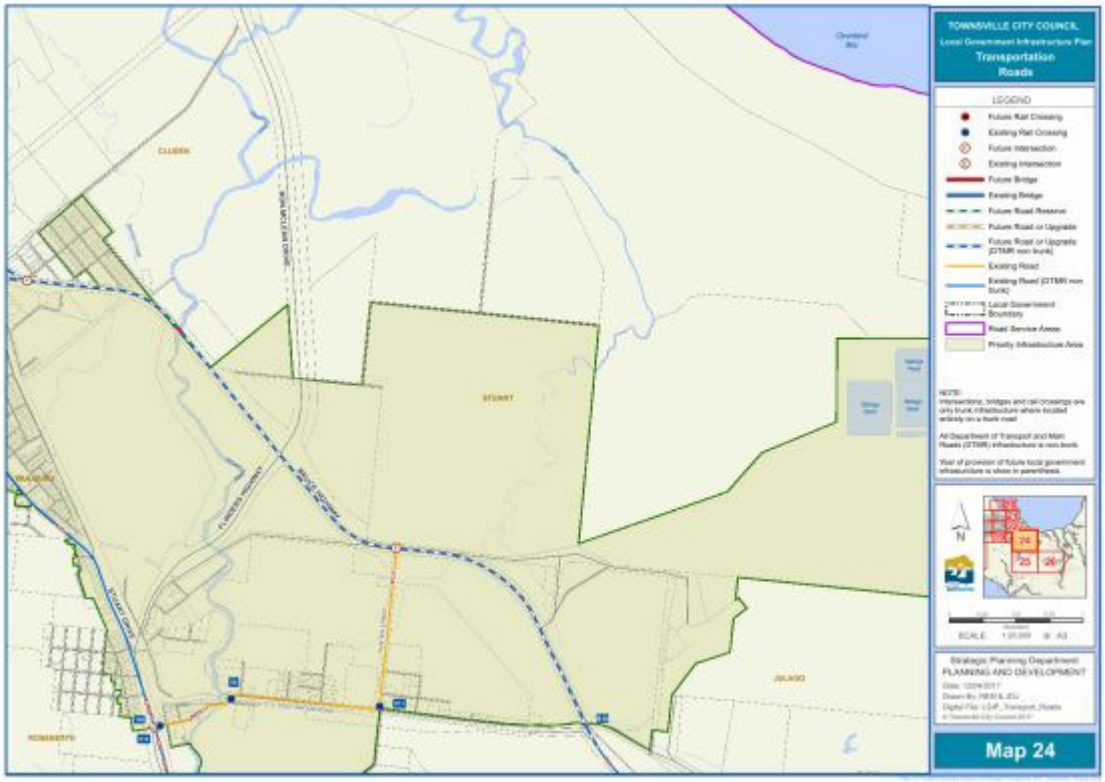

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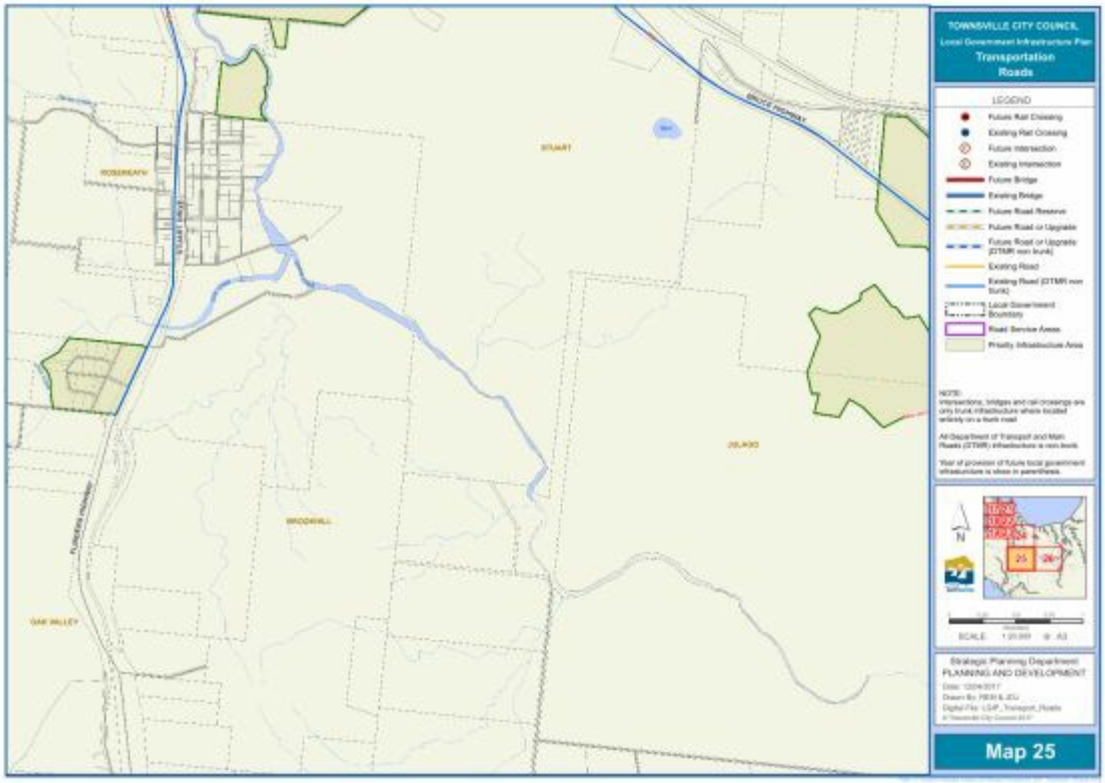

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Table SC3.3.7.1 - Roads network schedule of future works

Map	Type	LGIP ID	Profile	Location	Length (m)	Year	Cost ($'16)
2	Bridge	B16.1	Culvert with 2 lanes	NORTHSHORE BOULEVARD CULVERT	(13)	2026	(43,314)
2	Bridge	B16.1	Culvert with 4 lanes	NORTHSHORE BOULEVARD CULVERT	13	2026	567,925
2	Intersection	I135	3 way Signalised intersection with 5, 5, 3, lanes	Garland Link Road North Shore Boulevard		2026	(386,898)
2	Intersection	I135	3 way Signalised intersection with 5, 5, 3, lanes	Garland Link Road North Shore Boulevard		2026	1,624,548
2	Intersection	I154	4 way -1 lane Roundabout	Mount Low Parkway Lionel Turner Drive		2026	(787,977)
2	Intersection	I154	4 way Signalised intersection with 5, 3, 3, 4 lanes	Mount Low Parkway Lionel Turner Drive		2026	1,796,319
2	Road	R302	Subarterial with 2 lanes, table drains and no median	GARLAND LINK ROAD	1,803	2026	1,563,383
2	Road	R309	Subarterial with 2 lanes, table drains and no median	LIONEL TURNER DRIVE	1,854	2026	1,607,605
4	Bridge	B11.1	Bridge with short spans with 2 lanes	NORTHSHORE BOULEVARD SAUNDERS CREEK BRIDGE	(62)	2026	(629,751)
4	Bridge	B11.1	Bridge with short spans with 4 lanes	NORTHSHORE BOULEVARD SAUNDERS CREEK BRIDGE	62	2026	9,685,466
4	Rail Xing	X12	Rail Crossing with 2 lanes	GARLAND ROAD	(8)	2018	(253,322)
4	Rail Xing	X12	Rail Crossings with 6 lanes	GARLAND ROAD	8	2018	2,074,826
4	Road	R194	Arterial with 2 lanes, table drains and no median	NORTH SHORE BOULEVARD	(462)	2026	(921,113)
4	Road	R194	Arterial on ramp with 1 lanes, table drains	NORTH SHORE BOULEVARD	462	2026	2,820,235
4	Road	R32	Arterial with 2 lanes, table drains and no median	NORTH SHORE BOULEVARD	(1,652)	2026	(3,293,678)
4	Road	R32	Arterial with 4 lanes, table drains and median	NORTH SHORE BOULEVARD	1,652	2026	17,446,573
6	Rail Xing	X14	Rail Crossing with 2 lanes	INGHAM ROAD	(8)	2026	(253,322)
6	Rail Xing	X14	Rail Crossings with 6 lanes	INGHAM ROAD	8	2026	2,219,582
6	Reserve Only	R317	40 Road Reserve only	BAYSWATER ROAD	1,321	2026	1,599,527
6	Road	R298	Subarterial with 2 lanes, table drains and no median	ABATTOIR ROAD	973	2014	6,156,777
7	Bridge	B53	Bridge with long spans with 2 lanes	DALRYMPLE ROAD OVER BOHLE RIVER	250	2018	20,735,373
7	Bridge	B54	Bridge with short spans with 2 lanes	DALRYMPLE ROAD OVER BOHLE RIVER BYWASH	230	2018	16,234,733
9	Intersection	I152	3 way Uncontrolled intersection with 3, 3, 3 lanes	Ingham Road Webb Drive		2026	(658,425)

Map	Type	LGIP ID	Profile	Location	Length (m)	Year	Cost ($'16)
9	Intersection	I152	3 way Signalised intersection with 5, 5, 5, lanes	Ingham Road Webb Drive		2026	1,770,813
9	Reserve Only	R299	40 Road Reserve only	BAYSWATER ROAD	1,317	2026	1,594,683
9	Road	R146	Subarterial with 2 lanes, kerbs and median	INGHAM ROAD	(1,620)	2026	(3,588,972)
9	Road	R146	Subarterial with 4 lanes, table drains and median	INGHAM ROAD	1,620	2026	16,264,115
9	Road	R283	Major Collector with 4 lanes, kerbs and no median	WEBB DRIVE	(578)	2026	(1,177,685)
9	Road	R283	Major Collector with 4 lanes, kerbs and no median	WEBB DRIVE	578	2026	3,869,536
10	Intersection	I12	4 way Signalised intersection with 4, 6, 4, 6 lanes	Dalrymple Road Golf Links Drive Liberty Drive		2012	(2,081,394)
10	Intersection	I12	4 way Signalised intersection with 6, 6, 4, 5 lanes	Dalrymple Road Golf Links Drive Liberty Drive		2012	2,361,226
10	Intersection	I14	3 way Signalised intersection with 5, 4, 5 lanes	Kern Brother Drive Dalrymple Road		2026	(1,595,059)
10	Intersection	I14	3 way Signalised intersection with 5, 5, 5, lanes	Kern Brother Drive Dalrymple Road		2026	2,044,268
10	Reserve Only	R308	40 Road Reserve only	LIBERTY DRIVE	1,418	2026	1,716,979
10	Road	R72	Arterial with 2 lanes, table drains and no median	DALRYMPLE ROAD	(2,082)	2026	(4,150,991)
10	Road	R72	Arterial one way with 6 lanes, table drains and median	DALRYMPLE ROAD	2,082	2026	24,827,362
10	Road	R78	Arterial with 2 lanes, table drains and no median	DALRYMPLE ROAD	(535)	2026	(1,066,657)
10	Road	R78	Arterial with 4 lanes, table drains and no median	DALRYMPLE ROAD	535	2026	4,669,344
10	Road	R79	Arterial with 2 lanes, table drains and no median	DALRYMPLE ROAD	(980)	2018	(1,894,099)
10	Road	R79	Arterial with 2 lanes, table drains and no median	DALRYMPLE ROAD	980	2018	5,817,589
13	Bridge	B47	Bridge with short spans with 2 lanes	BLAKEYS CROSSING	290	2014	18,969,051
13	Bridge	B58	Bridge with short spans with 2 lanes	BLAKEYS CROSSING	50	2014	3,476,940
13	Intersection	I151	4 way Signalised intersection with 3, 3, 3, 3 lanes	Ingham Road Mather Street		2026	(1,428,416)
13	Intersection	I151	4 way Signalised intersection with 3, 5, 4, 5 lanes	Ingham Road Mather Street		2026	2,093,888
13	Intersection	I60	4 way -1 lane Roundabout	Bayswater Road Pilkington Street		2026	(875,530)

Map	Type	LGIP ID	Profile	Location	Length (m)	Year	Cost ($'16)
13	Intersection	I60	4 way Roundabout intersection with 2, 3, 2, 2 lanes	Bayswater Road Pilkington Street		2026	1,324,772
18	Intersection	I80	3 way 1 lane Roundabout	Kings Road Balls Lane Fulham Road		2026	(900,341)
18	Intersection	I80	3 way Roundabout intersection with 4, 4, 4, lanes	Kings Road Balls Lane Fulham Road		2026	2,576,261
18	Road	R159	Subarterial with 2 lanes, kerbs and median	KINGS ROAD	(92)	2026	(203,818)
18	Road	R159	Subarterial with 4 lanes, kerbs and median	KINGS ROAD	92	2026	857,983
18	Road	R19	Subarterial with 2 lanes, kerbs and no median	BALLS LANE	(453)	2026	(781,462)
18	Road	R19	Arterial off ramp with 1 lanes, kerbs	BALLS LANE	453	2026	2,365,688
18	Road	R70	Subarterial with 2 lanes, kerbs and no median	CROSS STREET	(115)	2026	(198,384)
18	Road	R70	Subarterial with 2 lanes, table drains and no median	CROSS STREET	115	2026	735,526
18	Road	R71	Subarterial with 2 lanes, kerbs and no median	CROSS STREET	(112)	2026	(193,209)
18	Road	R71	Arterial one way with 6 lanes, table drains and no median	CROSS STREET	112	2026	1,144,841
19	Intersection	I85	4 way -1 lane Roundabout	MacArthur Drive William Angliss Drive		2016	(1,553,867)
19	Intersection	I85	4 way Signalised intersection with 3, 3, 5, 4 lanes	MacArthur Drive William Angliss Drive		2016	2,023,452
25	Road	R343	Major Collector with 2 lanes, kerbs and median	Rocky Springs	388	2027	449,740
26	Bridge	B81	Culvert with 2 lanes	Rocky Springs	5	2027	27,557
26	Bridge	B82	Culvert with 4 lanes	Rocky Springs	-	2017	6,514
26	Road	R344	Major Collector with 2 lanes, kerbs and median	Rocky Springs	445	2027	516,292
26	Road	R345	Major Collector with 2 lanes, kerbs and median	Rocky Springs	410	2019	178,278
26	Road	R346	Major Collector with 2 lanes, kerbs and median	Rocky Springs	241	2019	104,837
26	Road	R347	Subarterial with 4 lanes, kerbs and median	Rocky Springs	264	2017	154,620

SC3.3.8 - Plans for trunk footpaths and cycleways infrastructure

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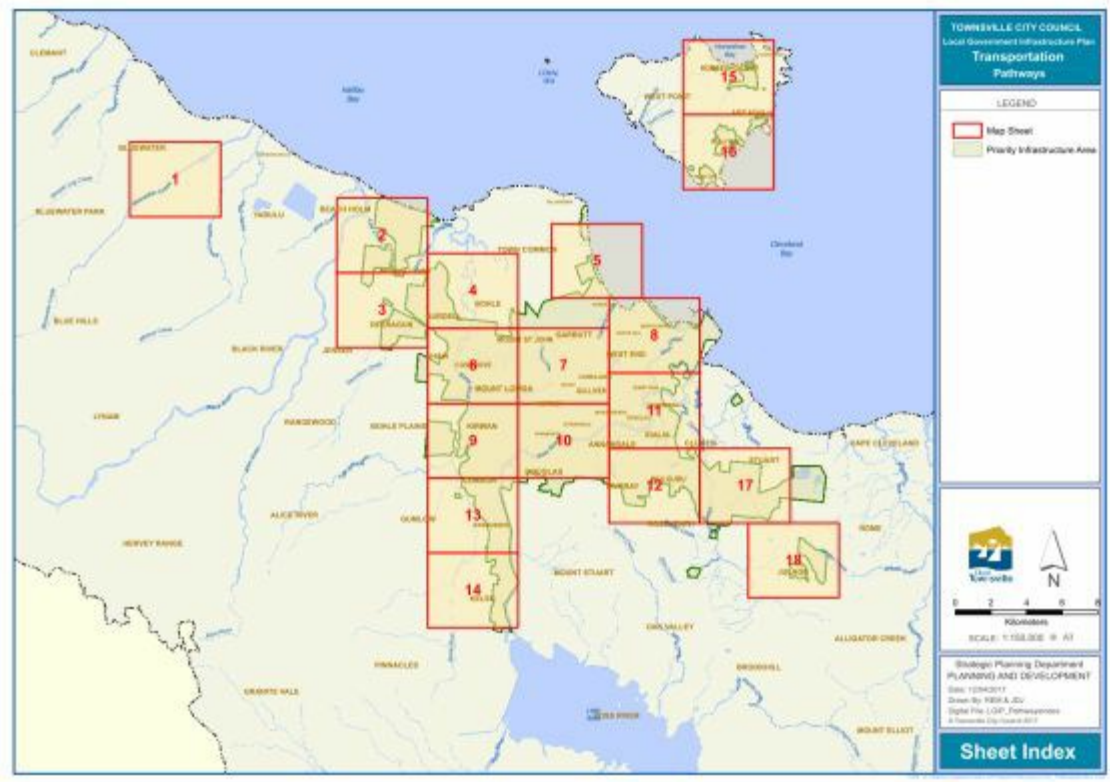

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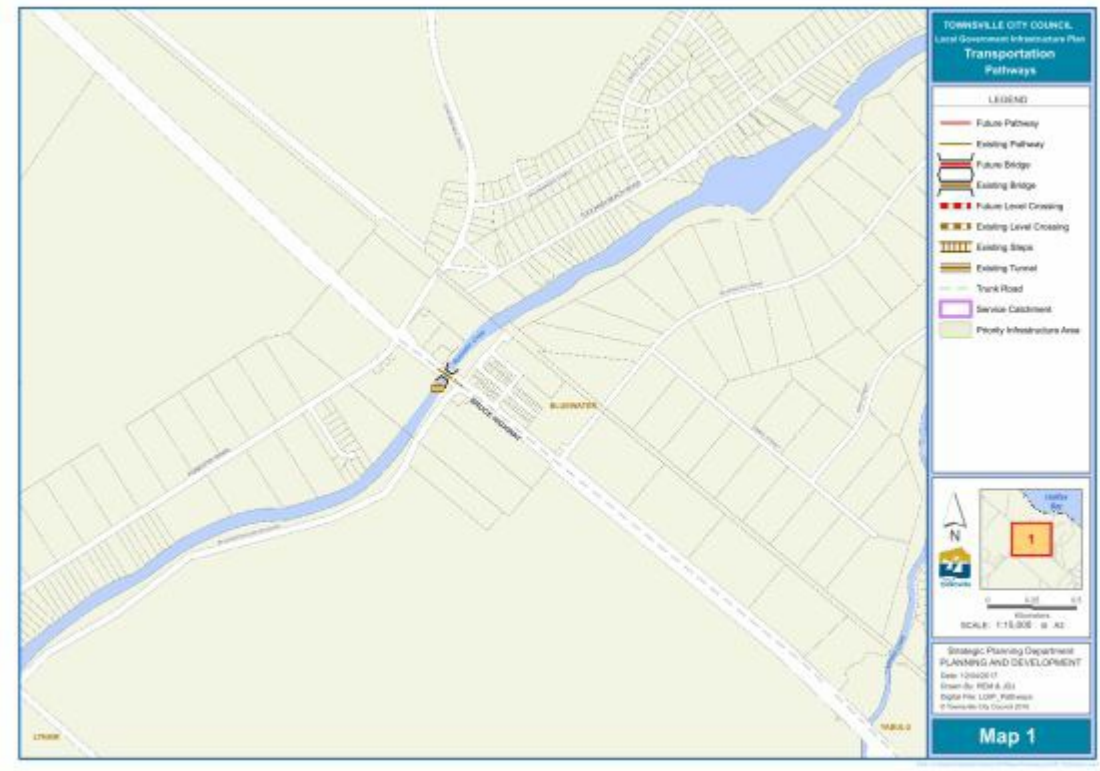

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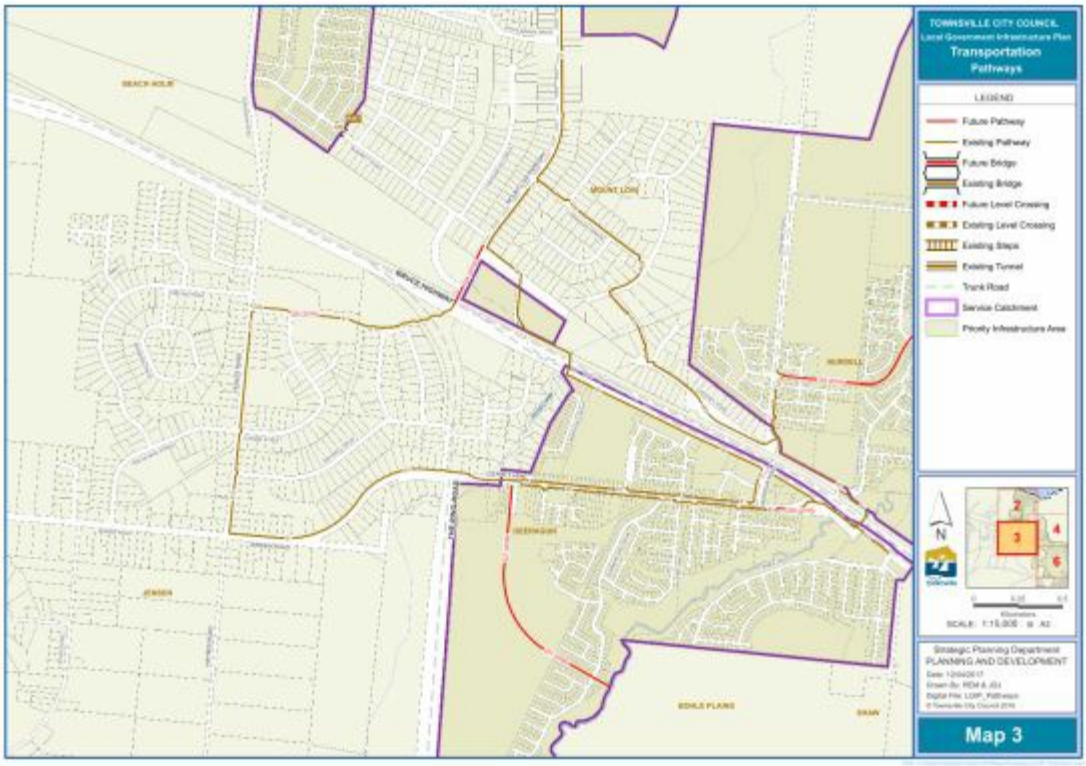

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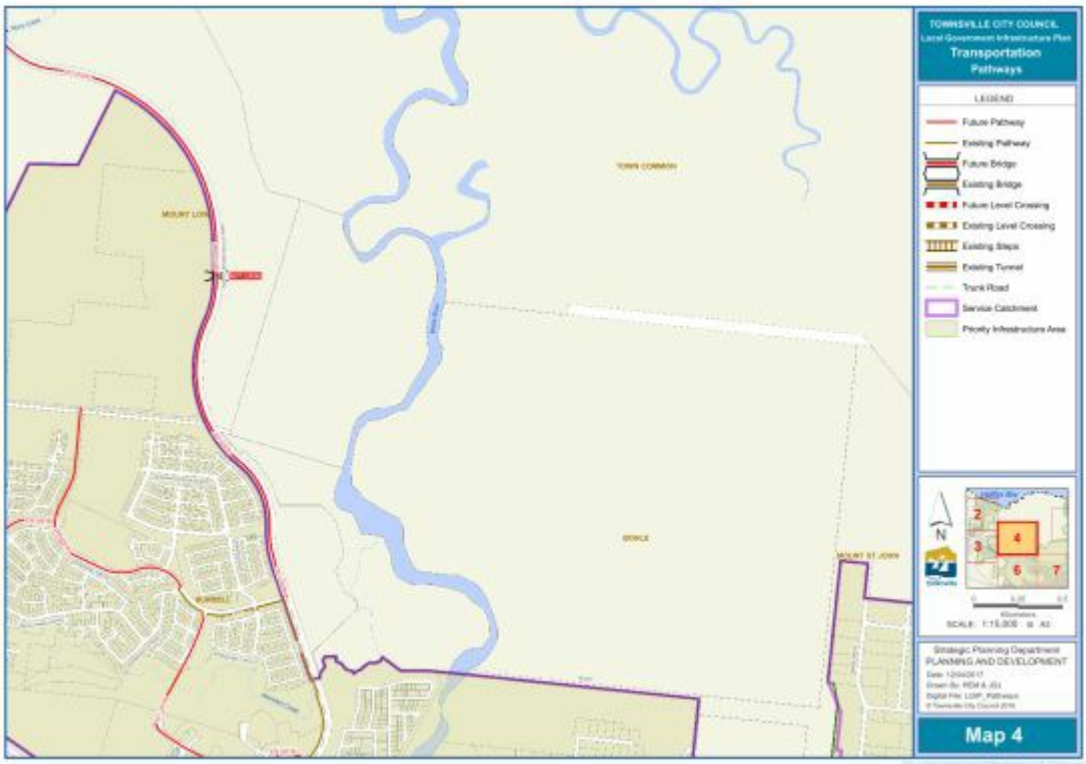

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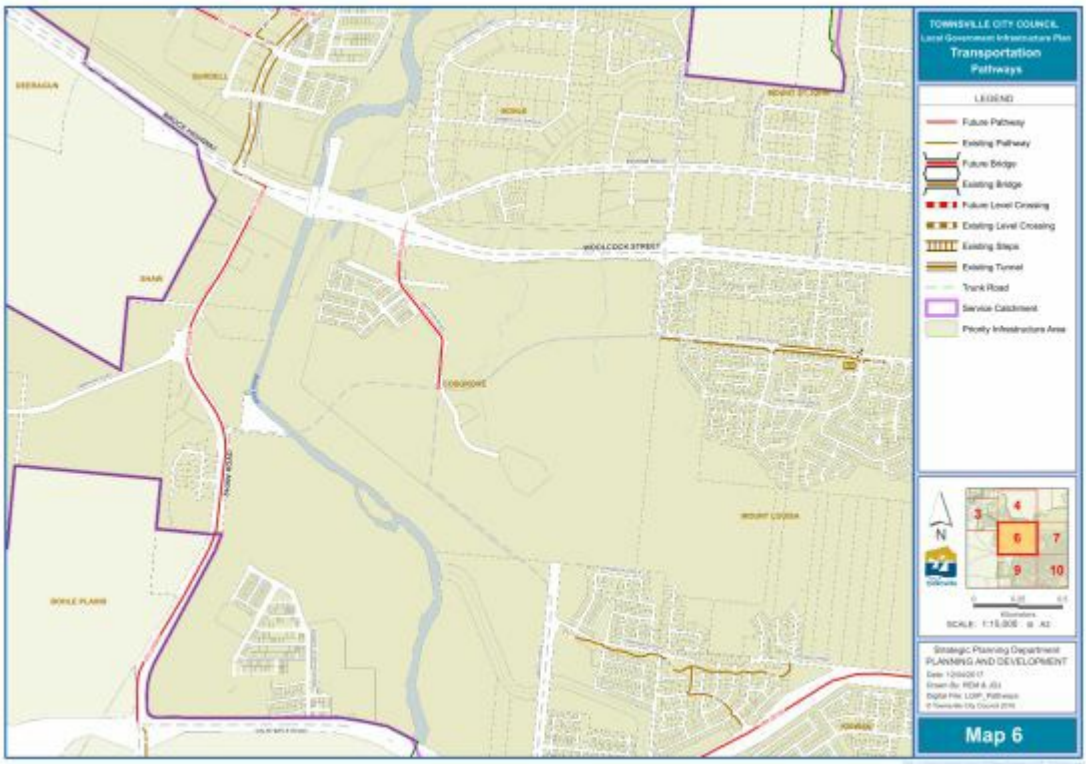

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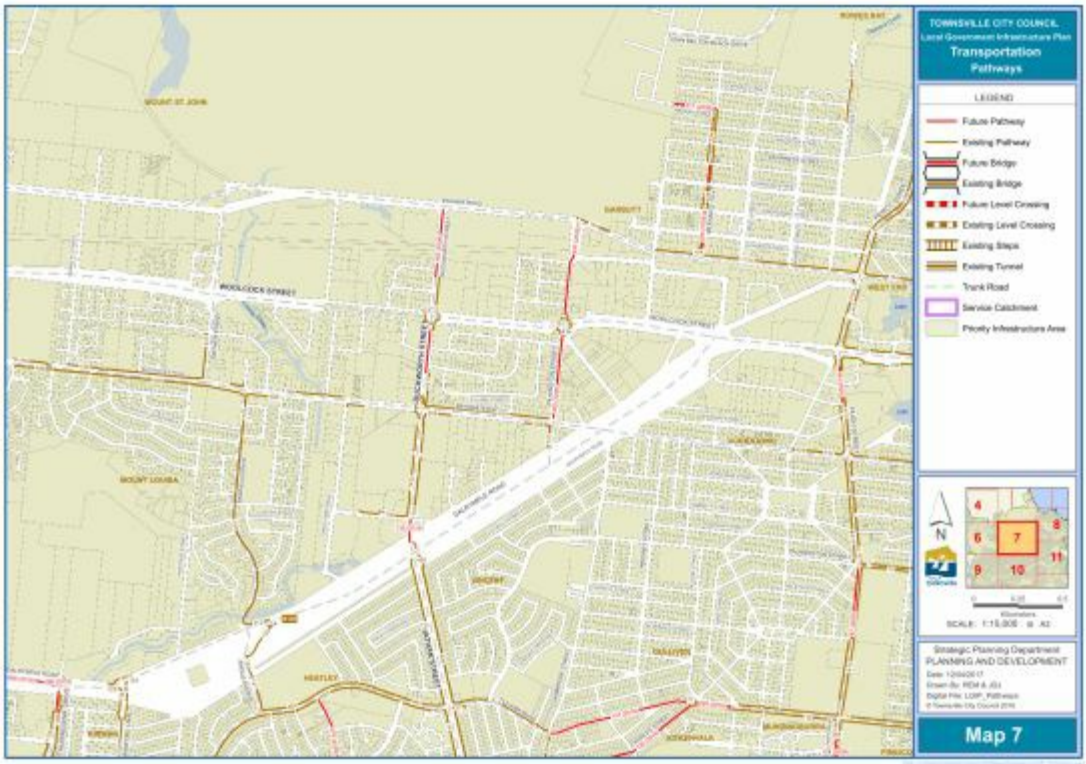

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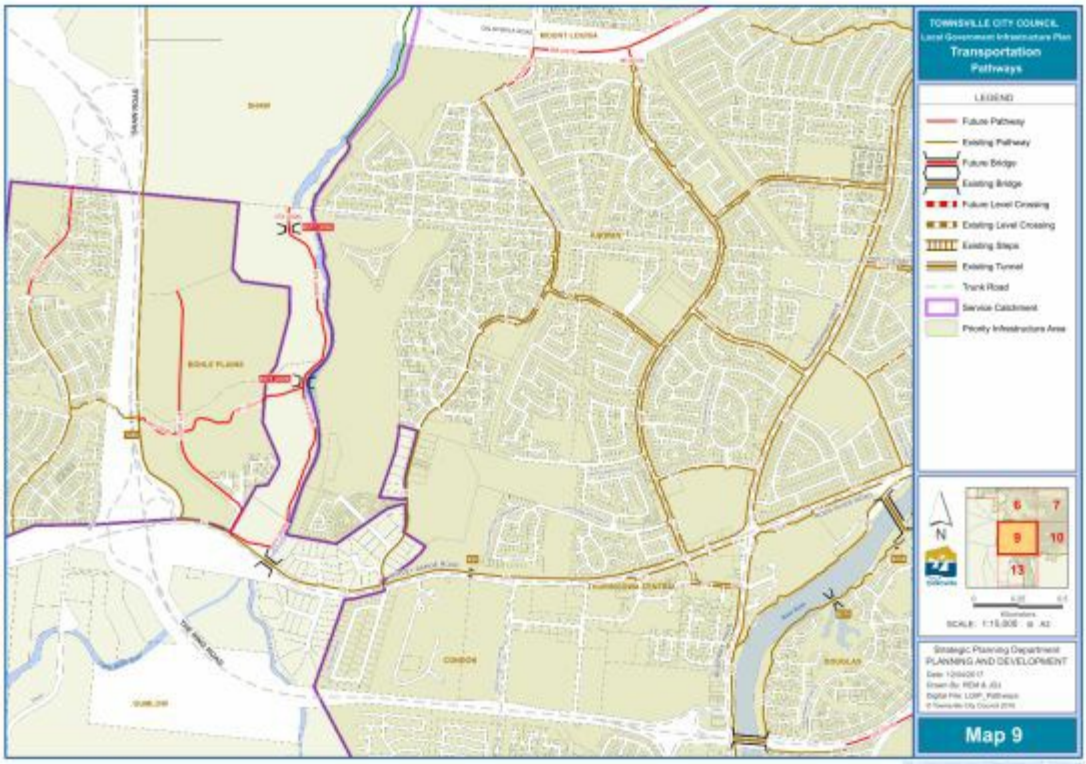

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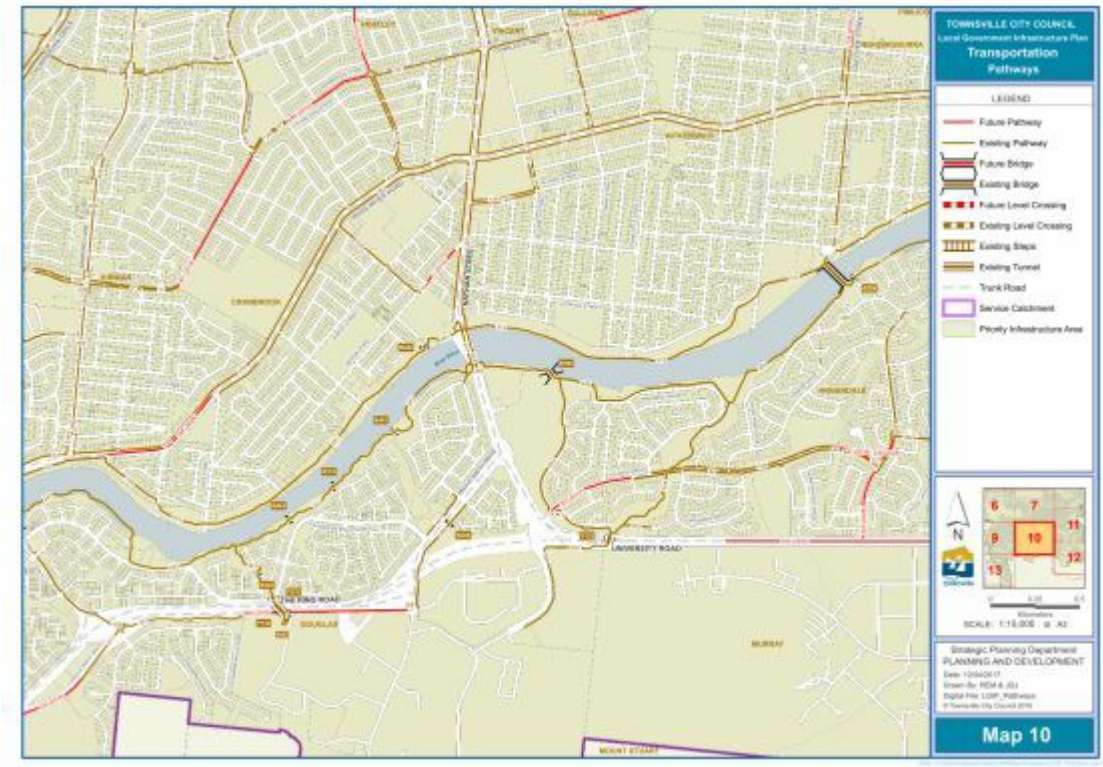

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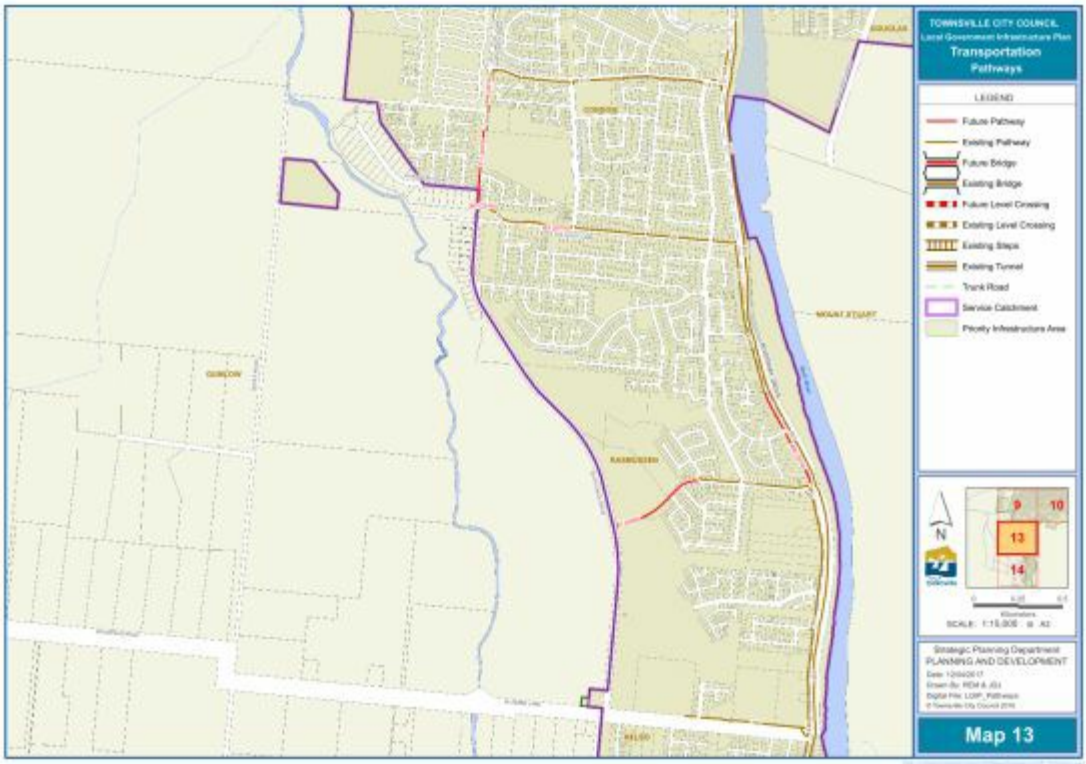

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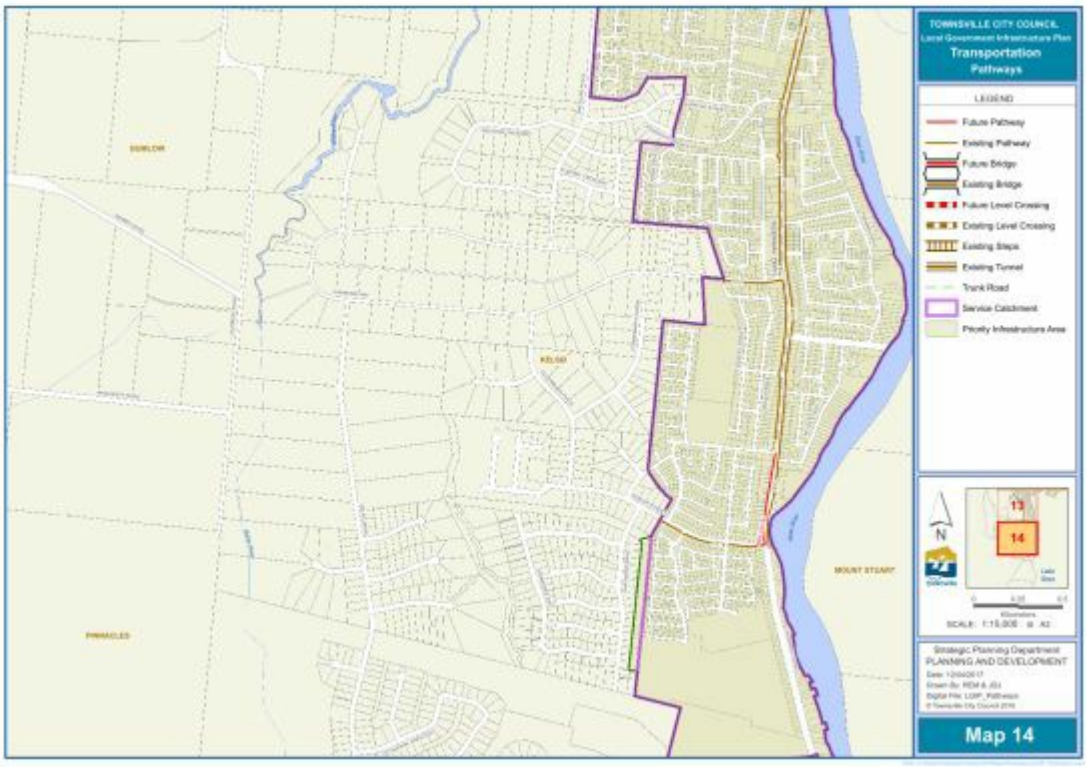

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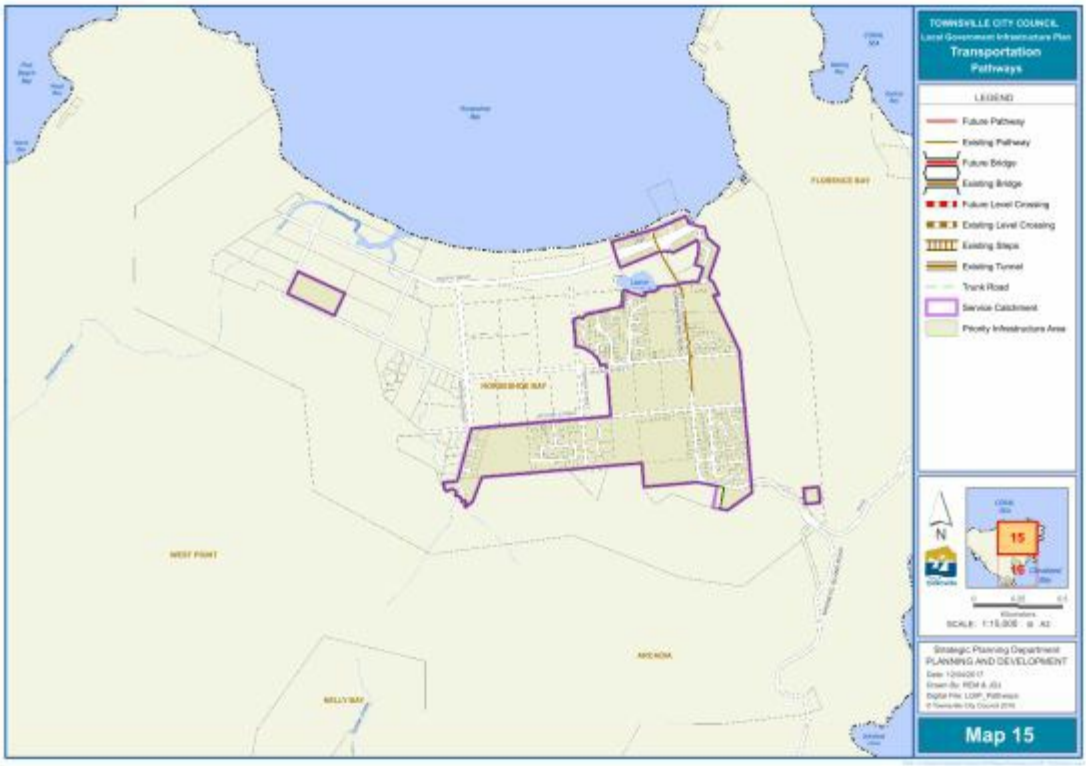

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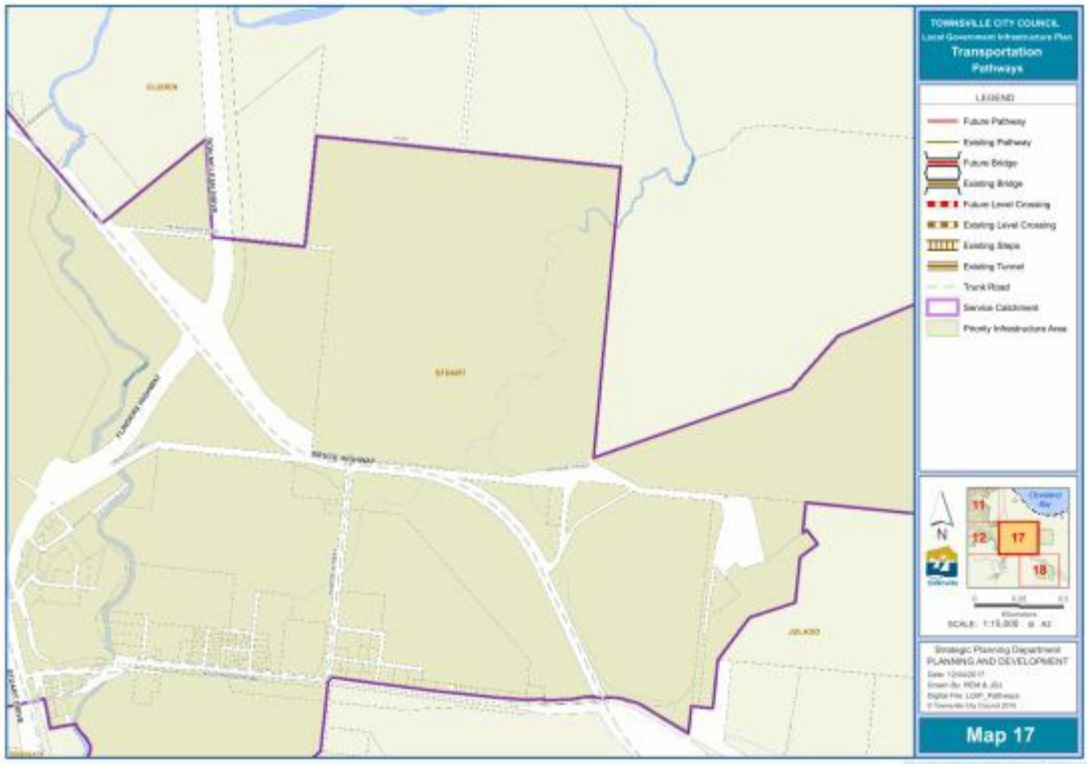

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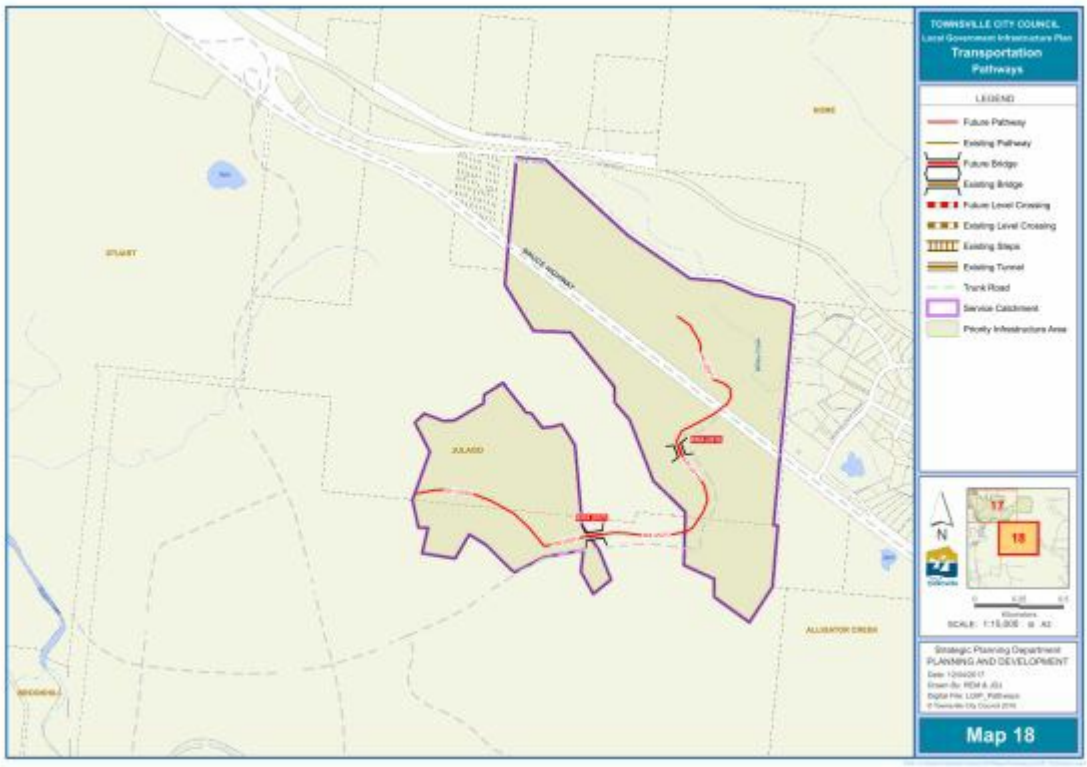

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Table SC3.3.8.1 - Footpaths and cycleways network schedule of future works

Map	Type	LGIP ID	Location	Length (m)	Year	Cost ($'16)
2	Bridge	370	North Shore Boulevard	68	2026	189,522
3	Path	224	Moun Low Parkway	368	2018	112,413
3	Path	225	Joanne Street	101	2018	30,852
3	Path	227	Brendale Drive	1,431	2026	467,624
3	Path	228	Geaney Lane	136	2018	41,544
3	Path	230	Weatherby Drive	1,170	2018	357,399
4	Bridge	371	North Shore Boulevard	30	2026	83,613
4	Path	223	North Shore Boulevard	5,876	2026	1,920,168
4	Path	229	Waterway Drive	1,570	2018	479,587
4	Path	231	Yalbira Drive	1,308	2018	399,554
4	Path	232	Erskine Place	186	2018	56,817
6	Path	233	Shaw Road	3,291	2026	1,075,438
6	Path	259	Abattoir Road	974	2014	276,770
6	Path	266	Dalrymple Road	2,592	2018	791,777
7	Path	86	Hugh Street	206	2026	67,317
7	Path	87	Hugh Street	401	2026	131,039
7	Path	135	Duckworth Street	134	2018	40,933
7	Path	137	Fulham Road	787	2018	240,405
7	Path	138	Charles Street	892	2018	272,479
7	Path	155	Duckworth Street	631	2026	206,199
7	Path	277	Halifax Street	238	2026	77,774
7	Path	294	Meenan Street	363	2026	118,622
7	Path	295	Fulham Road	200	2018	61,094
7	Path	296	Thuringowa Drive	126	2018	38,489
7	Path	435	Pilkington Street	982	2026	320,899
7	Path	489	Hugh Street	632	2013	179,588
7	Path	491	Douglas Street	569	2013	161,686
8	Bridge	492	Old Common Road	36	2013	87,248
8	Bridge	494	Heatleys Parade	40	2013	96,942
8	Levelxing	509	Reid Park	25	2026	25,319
8	Path	141	Kissing Point	590	2013	167,653
8	Path	315	Kissing Point	66	2013	18,754
8	Path	319	Woolcock Street	1,001	2018	305,775
8	Path	320	Sturt Street	354	2026	115,681
8	Path	323	Mcilwraith Street	373	2018	113,940
8	Path	328	Reid Park	847	2021	258,733
8	Path	329	Rocky Springs - post LGIP	74	2020	22,605
8	Path	330	Ross Creek	269	2031	91,726
8	Path	347	Ross Creek	414	2031	141,170
8	Path	350	Ross Creek	358	2021	109,358
8	Path	359	Archer Street	134	2018	40,933
8	Path	362	Reid Park	619	2026	202,278
8	Path	363	Reid Park	145	2021	44,293
8	Path	421	Warburton Street	217	2018	66,287
8	Path	474	Oxley Street	126	2018	38,489
8	Path	477	Oxley Street	19	2018	5,804
8	Path	479	Boundary Street	925	2018	282,559
8	Path	482	Ross Creek	513	2026	167,639
8	Path	493	Lynam Street (Balance)	455	2031	155,150
8	Path	513	Lynam Street (Heatley Pde to Evans St)	640	2013	181,861
8	Path	570	Dean Street	400	2026	130,713

Map	Type	LGIP ID	Location	Length (m)	Year	Cost ($'16)
9	Bridge	575	0	41	2026	114,271
9	Bridge	577	0	33	2026	91,974
9	Path	2	Kalynda Parade	694	2018	211,996
9	Path	96	Kern Brothers Drive	98	2018	29,936
9	Path	235	Angus Smith Drive	805	2018	245,903
9	Path	265	Golf Links Drive	278	2018	84,921
9	Path	505	Dalrymple Road (Green View To Greenwood)	212	2026	69,278
9	Path	507	Kalynda Parade To The Ring Road	692	2014	196,637
9	Path	571	0	1,527	2021	466,452
9	Path	574	0	1,243	2026	406,189
9	Path	576	0	942	2026	307,828
9	Path	578	0	105	2026	34,312
9	Path	580	0	272	2026	88,885
9	Path	581	0	809	2026	264,366
10	Path	1	Bergin Road	234	2016	66,493
10	Path	128	Gulliver Street	324	2026	105,877
10	Path	279	Lindeman Avenue	699	2026	228,420
10	Path	280	Charles Street	522	2018	159,455
10	Path	281	Charles Street	846	2018	258,427
10	Path	284	Bonnett Road	999	2026	326,455
10	Path	300	Angus Smith Drive	931	2018	284,392
10	Path	303	Yolanda Drive	491	2012	139,521
10	Path	336	Ross River Road	723	2026	236,263
10	Path	339	Annandale Drive	118	2026	38,560
10	Path	340	Yolanda Drive	202	2018	61,705
10	Path	342	University Road	1,794	2026	586,246
10	Path	343	Annandale Drive	390	2026	127,445
10	Path	500	Casuariina Drive	320	2018	97,750
10	Path	501	Cassia Court	166	2018	50,708
11	Levelxing	369	Abbott Street Deviation	18	2018	17,041
11	Path	50	Queens Road	1,310	2018	400,165
11	Path	322	Fairfield Waters Drive	642	2026	209,794
11	Path	352	Abbott Street	752	2018	229,713
11	Path	353	Lakeside Drive	1,802	2018	550,456
11	Path	368	Riveredge Boulevard	1,001	2018	305,775
12	Path	355	Racecourse Road	1,222	2018	373,284
12	Path	356	Stuart Drive	58	2018	17,717
13	Path	3	Santal Drive	535	2026	174,828
13	Path	163	Gollogoly Lane	90	2018	27,492
13	Path	211	North Beck Drive	423	2018	129,214
13	Path	246	North Beck Drive	178	2018	54,374
13	Path	387	Gollogoly Lane	50	2018	15,273
13	Path	480	Riverway Drive	549	2018	167,703
14	Path	481	Riverway Drive	571	2018	174,423
15	Path	498	Horseshoe Bay Road	527	2026	172,214
16	Bridgeh	290	Magnetic Island Road	562	2026	5,699,257
16	Path	255	Nelly Bay Road	948	2026	309,789
16	Path	256	Birt Street	736	2026	240,511
16	Path	291	Marine Parade	236	2026	77,120
16	Path	292	Nelly Bay Road	72	2026	23,528
16	Path	293	Sooning Street	169	2026	55,226
18	Bridge	559	Rocky Springs	95	2027	276,043

Map	Type	LGIP ID	Location	Length (m)	Year	Cost ($'16)
18	Bridge	564	Rocky Springs	69	2019	179,207
18	Path	521	Rocky Springs	840	2030	286,431
18	Path	538	Rocky Springs	381	2027	129,763
18	Path	539	Rocky Springs	827	2019	252,623
18	Path	540	Rocky Springs	680	2021	207,747
18	Path	582	Rocky Springs	353	2027	120,369

SC3.3.9 - Plans for trunk parks and land for community facilities

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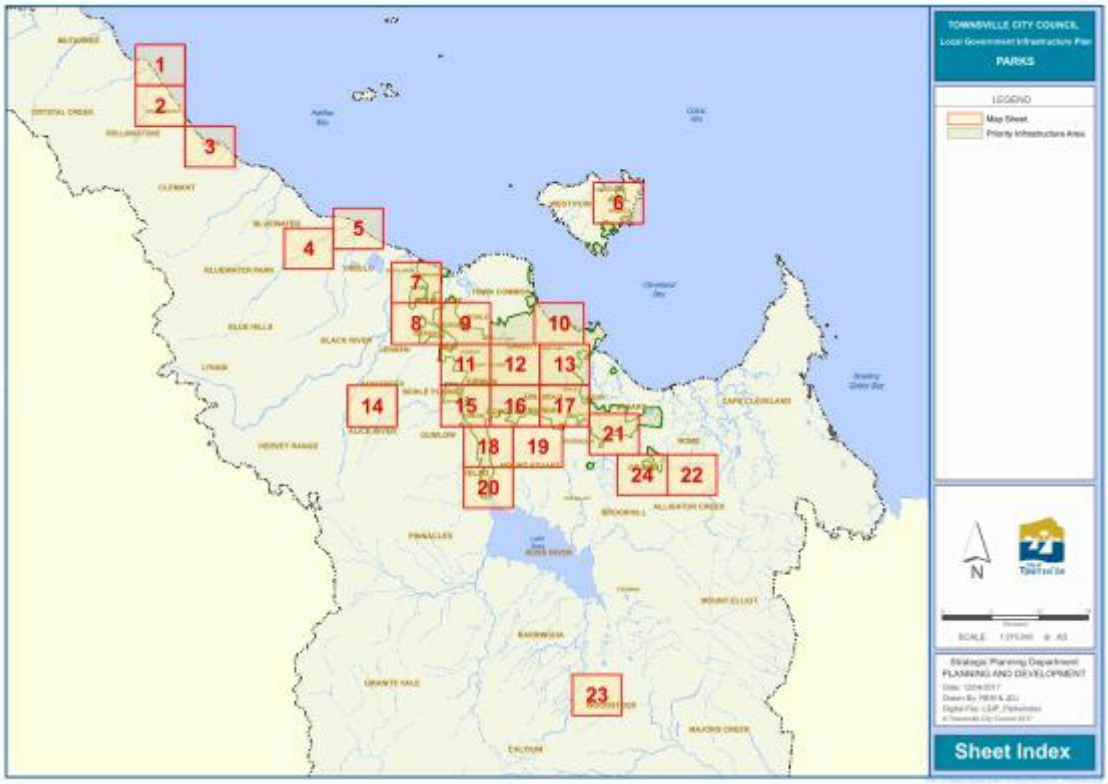

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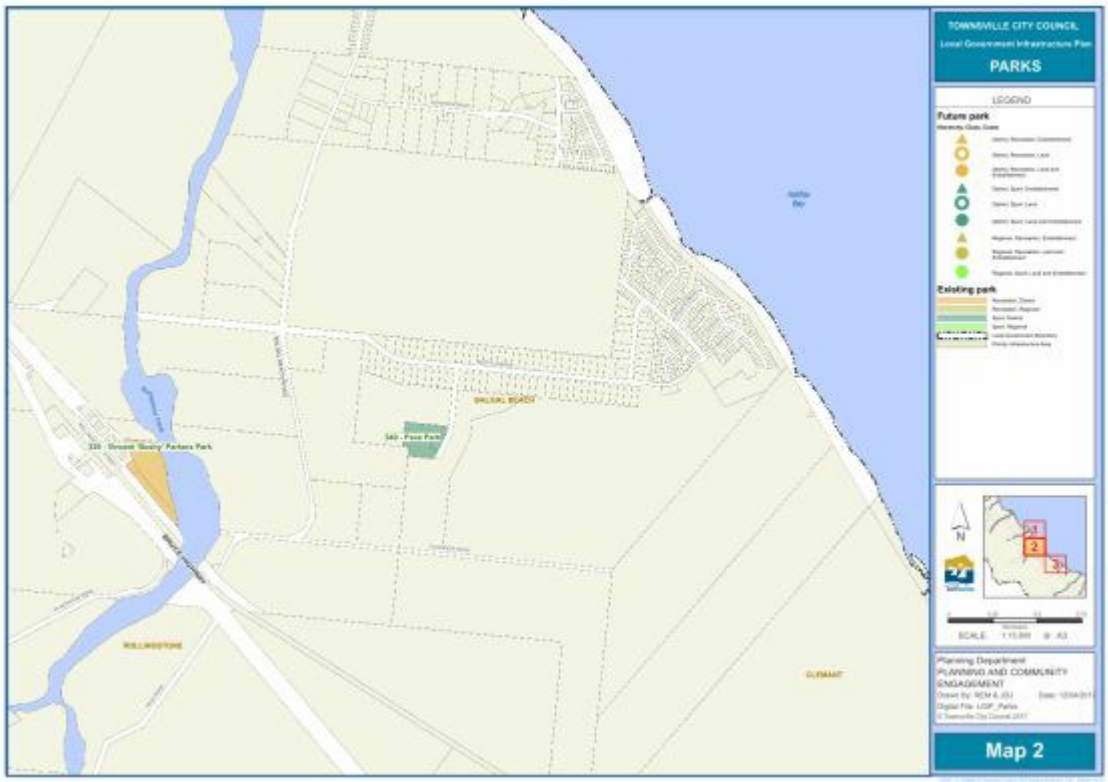

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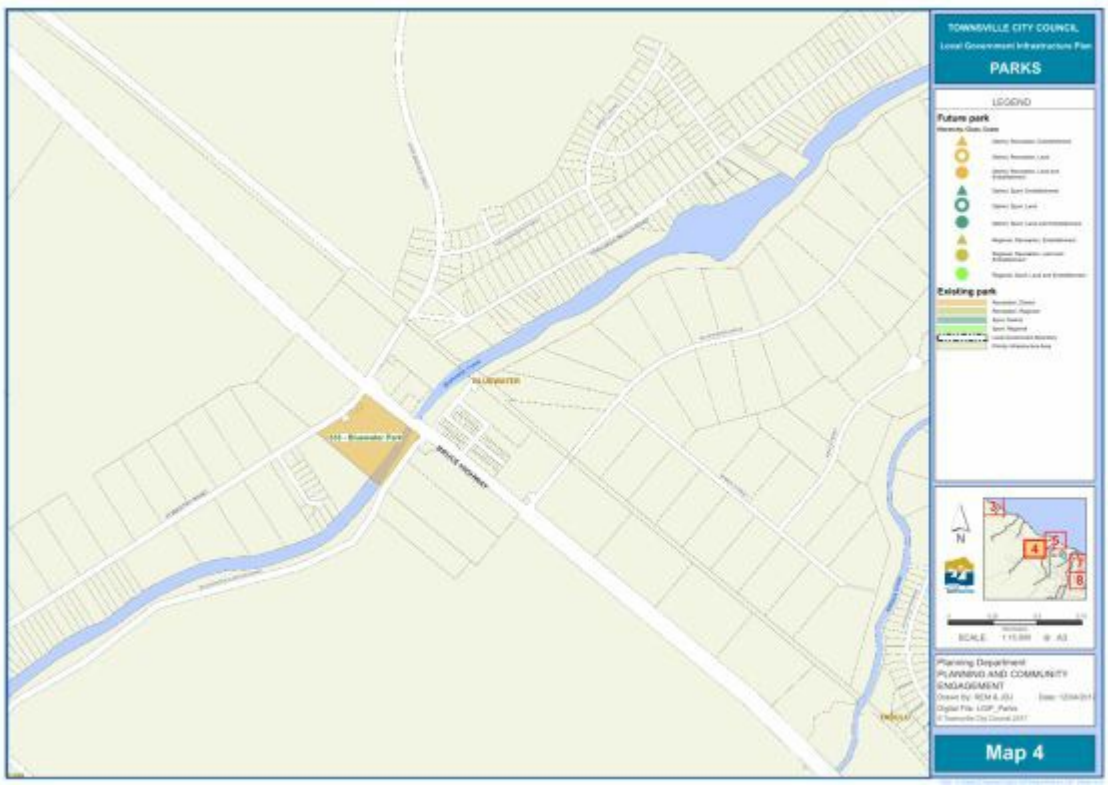

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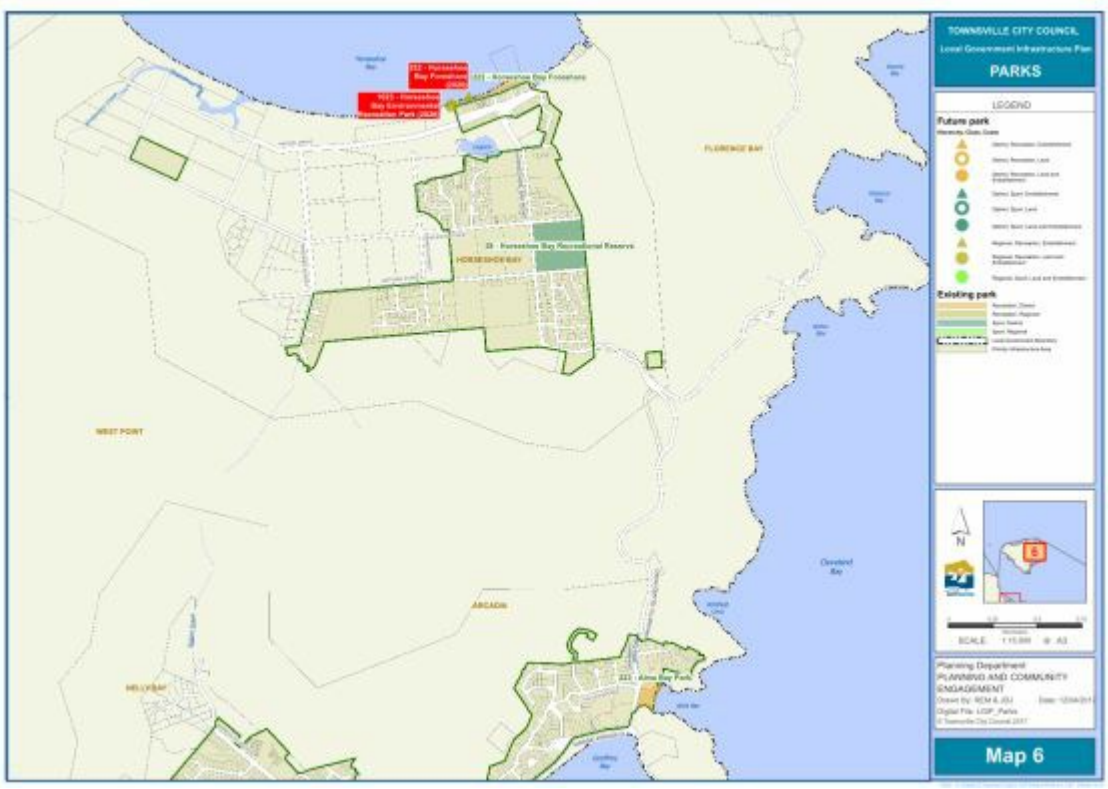

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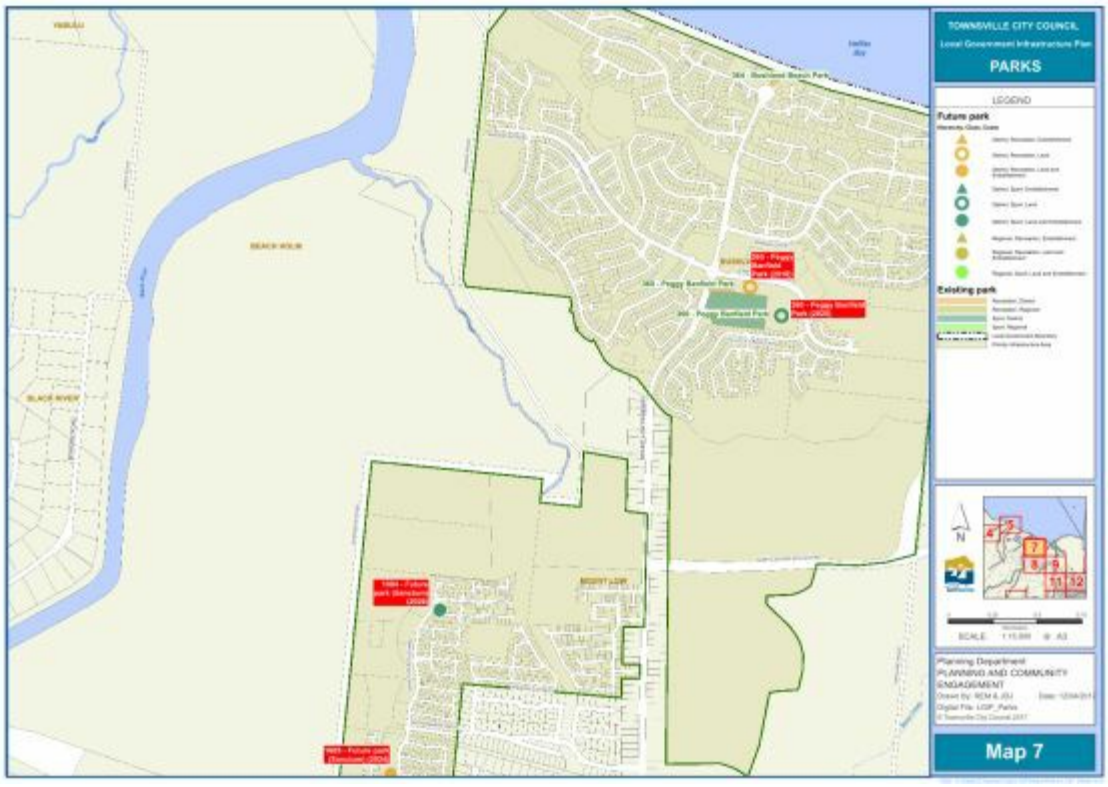

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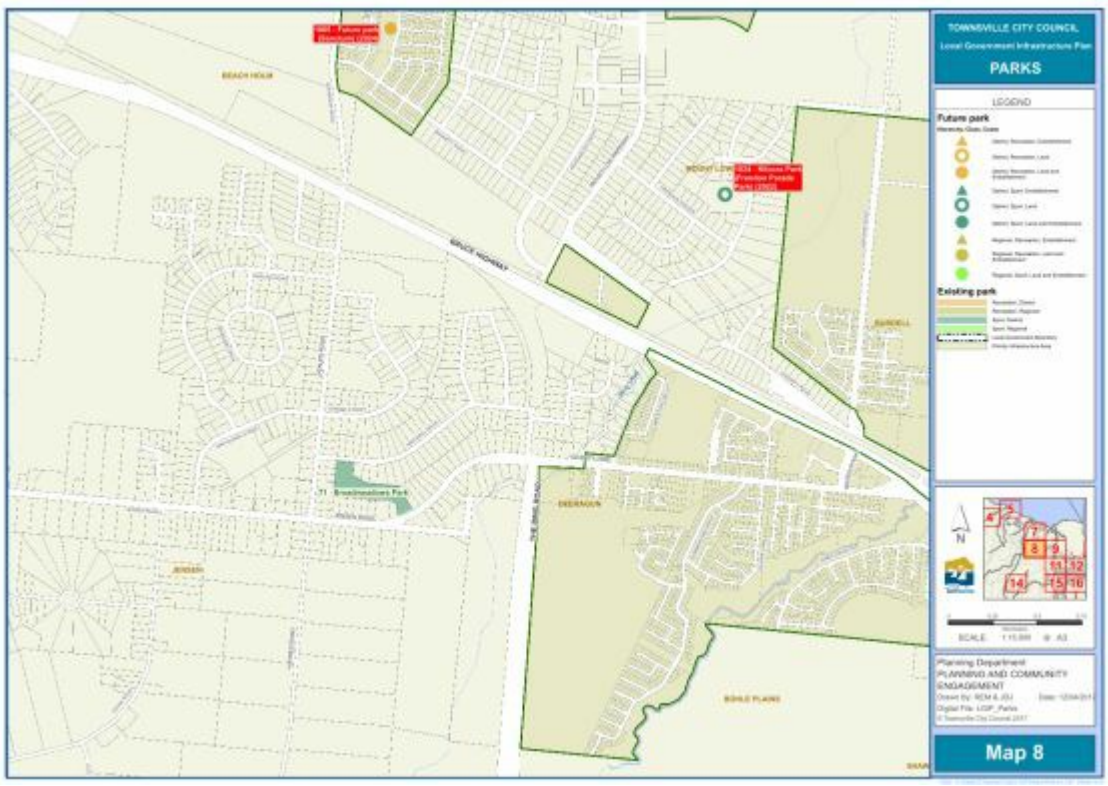

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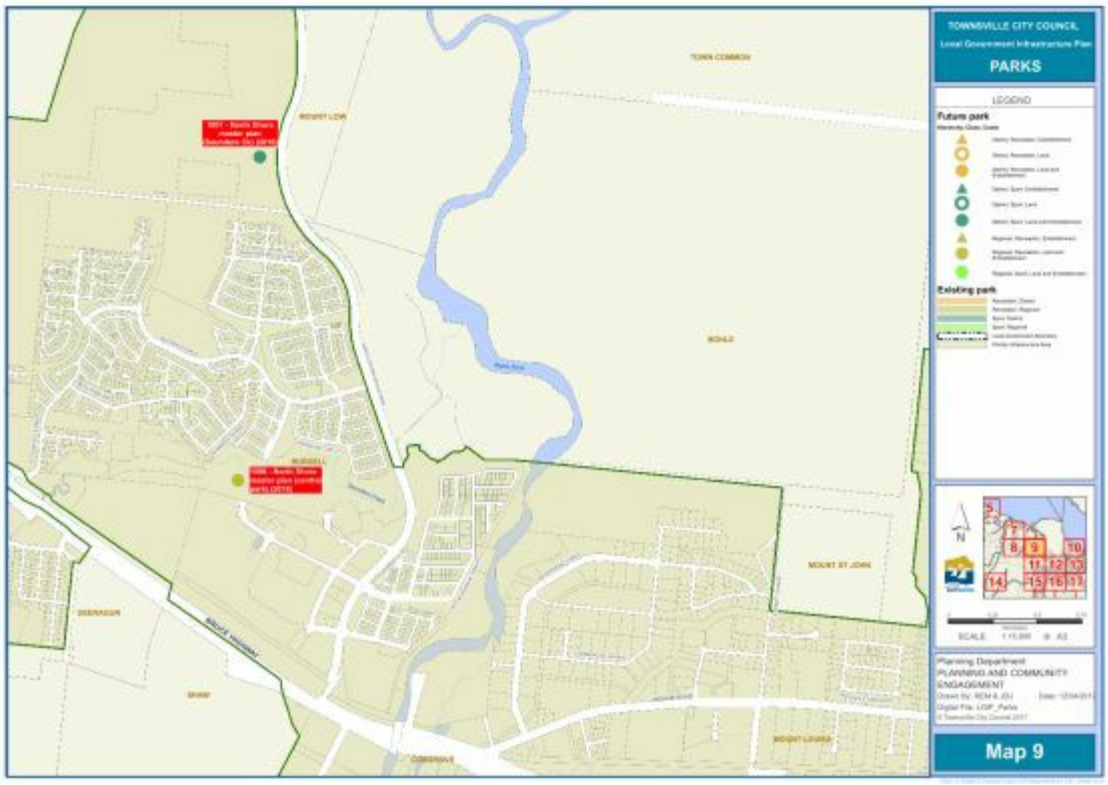

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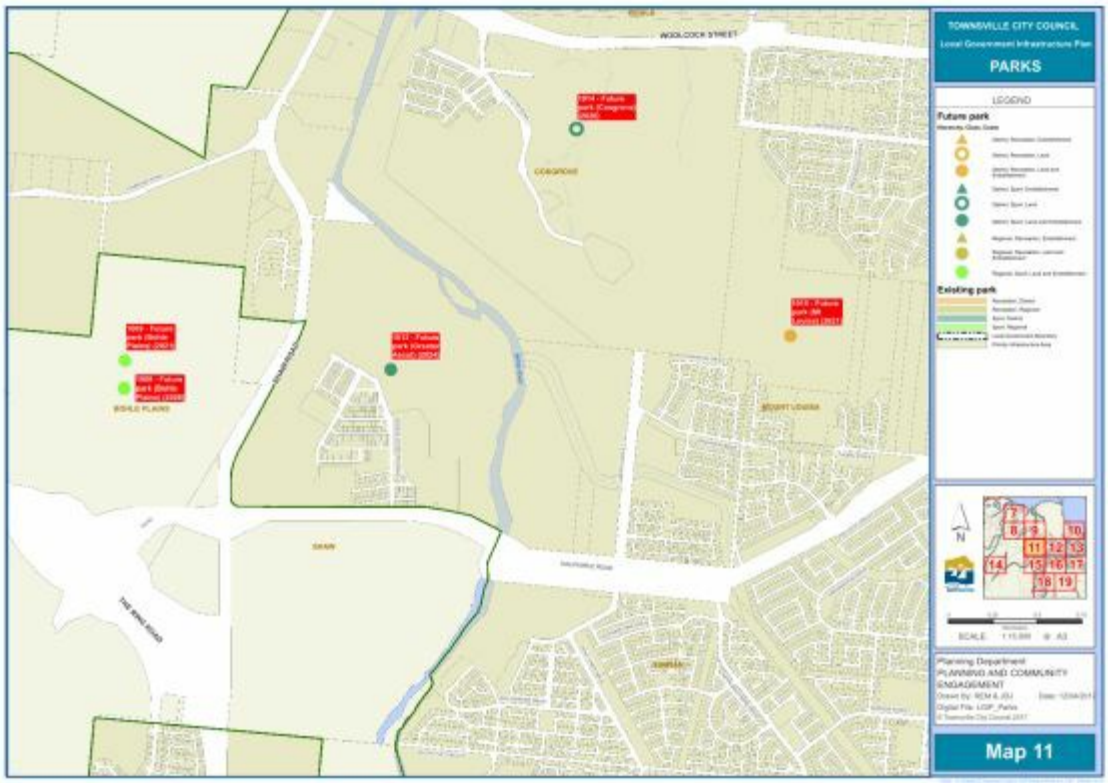

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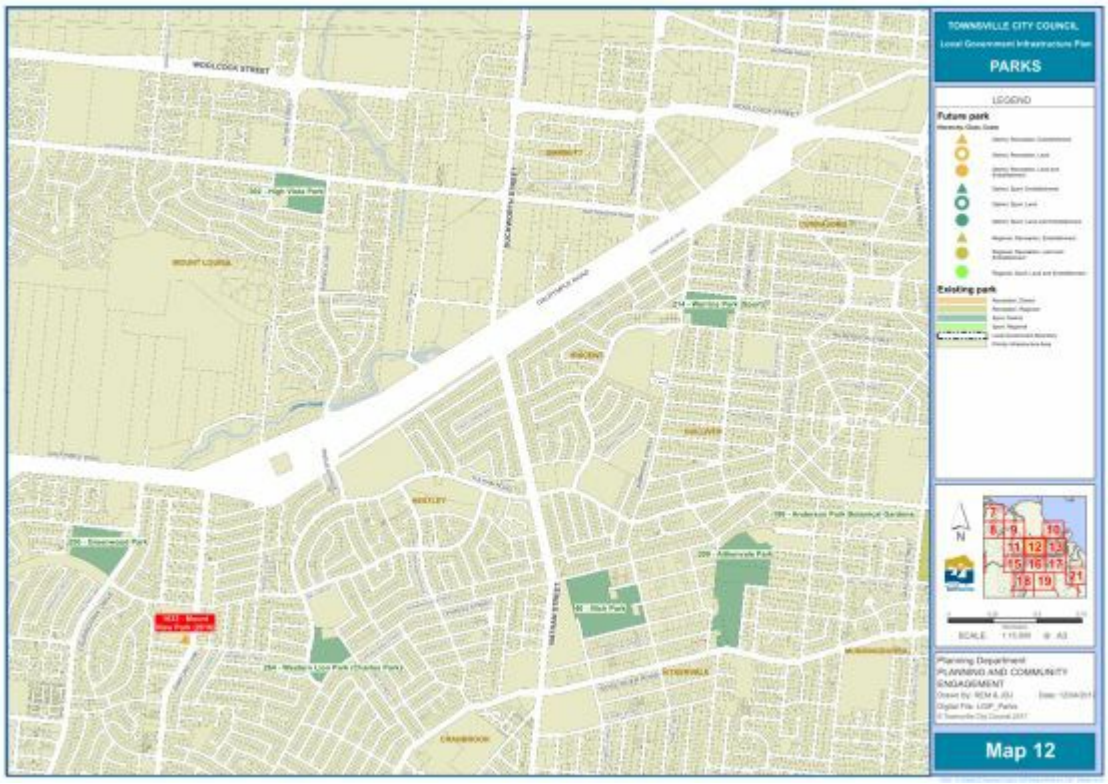

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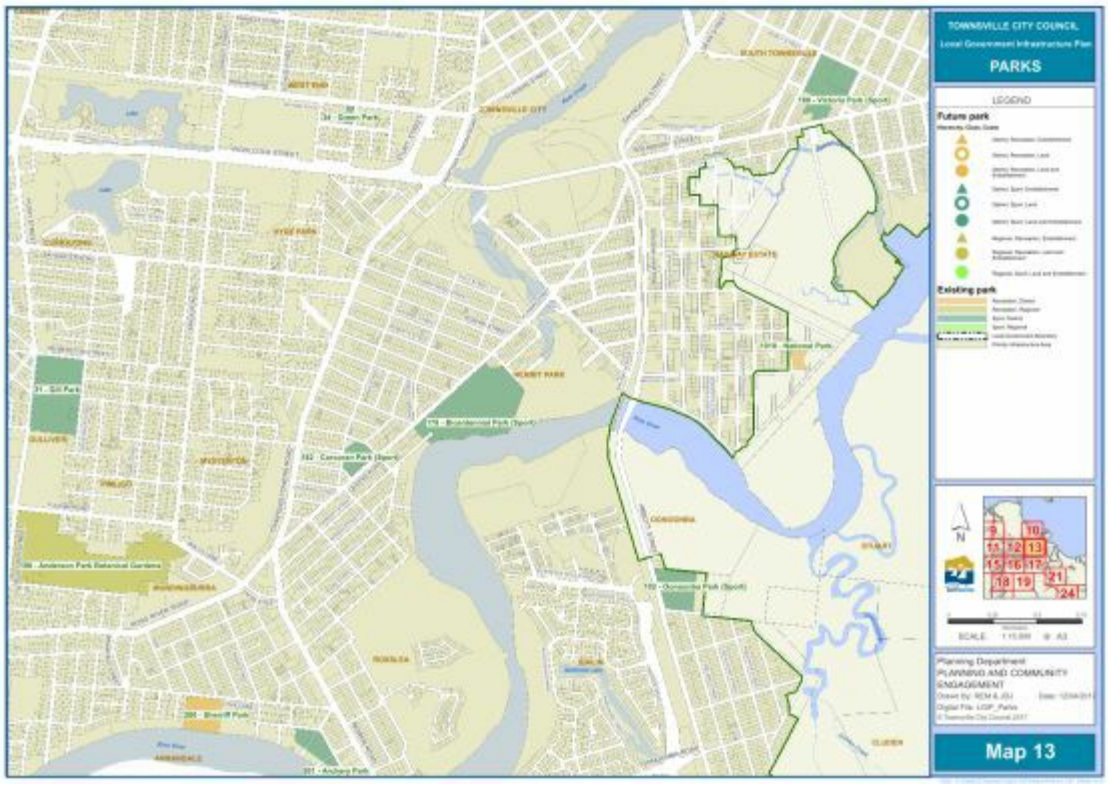

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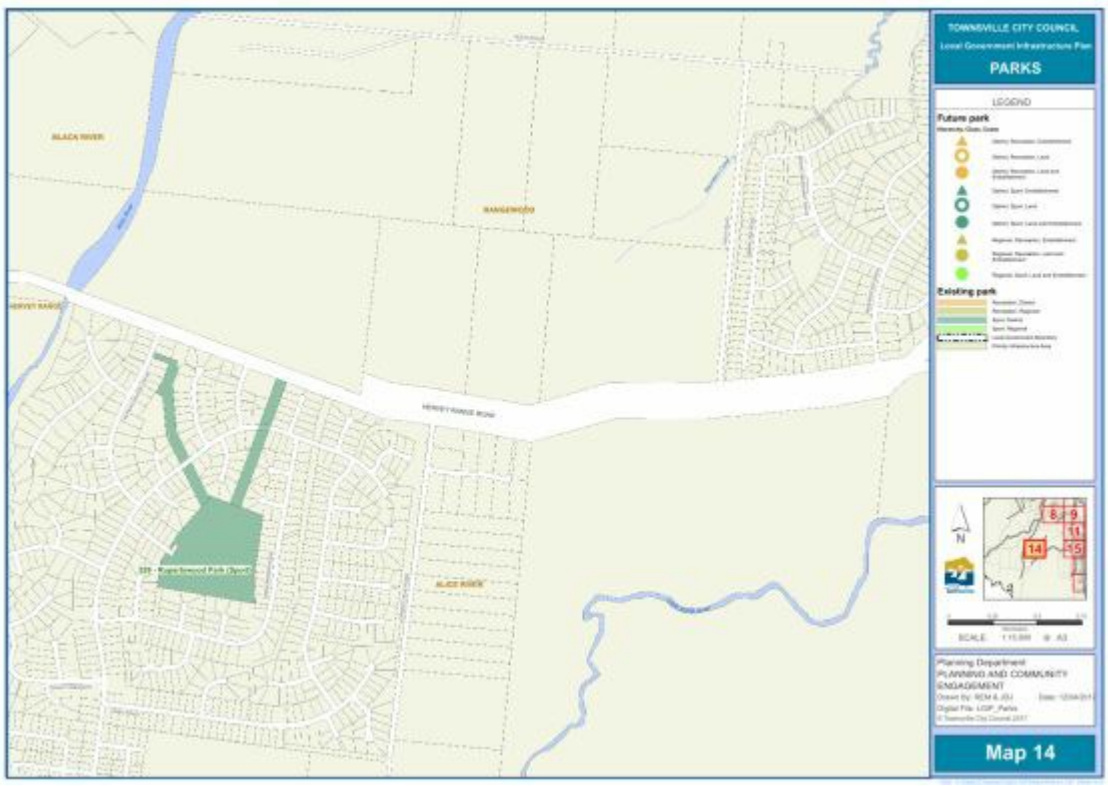

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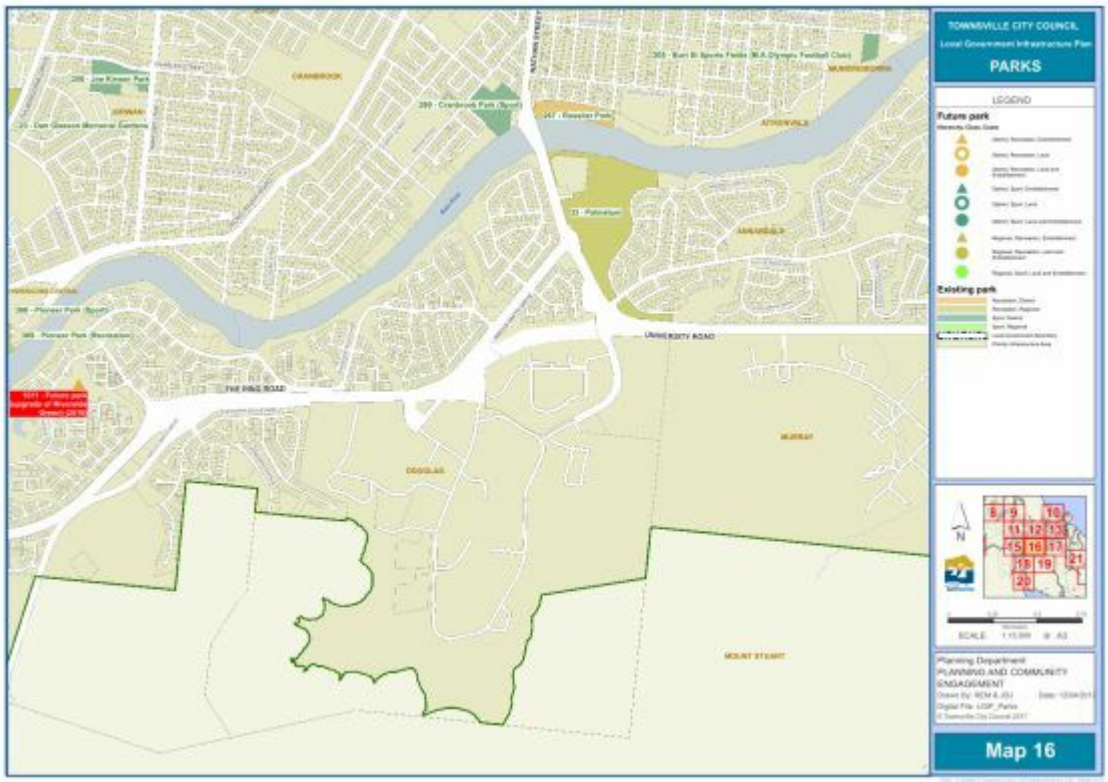

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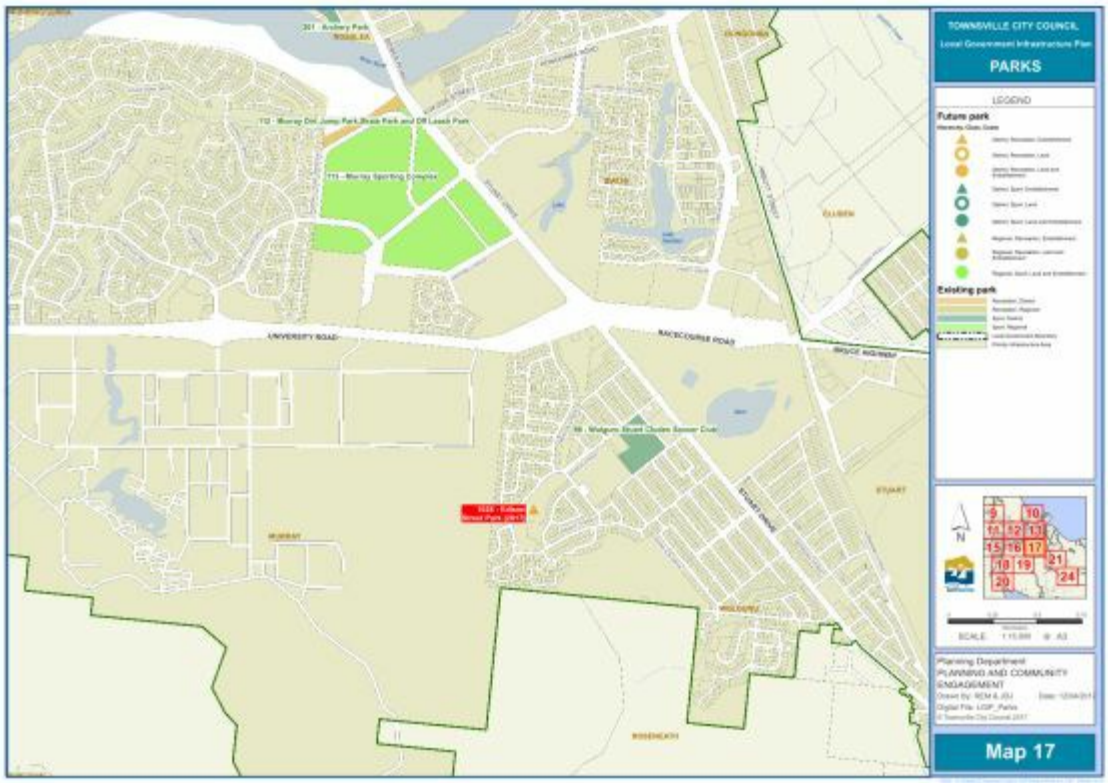

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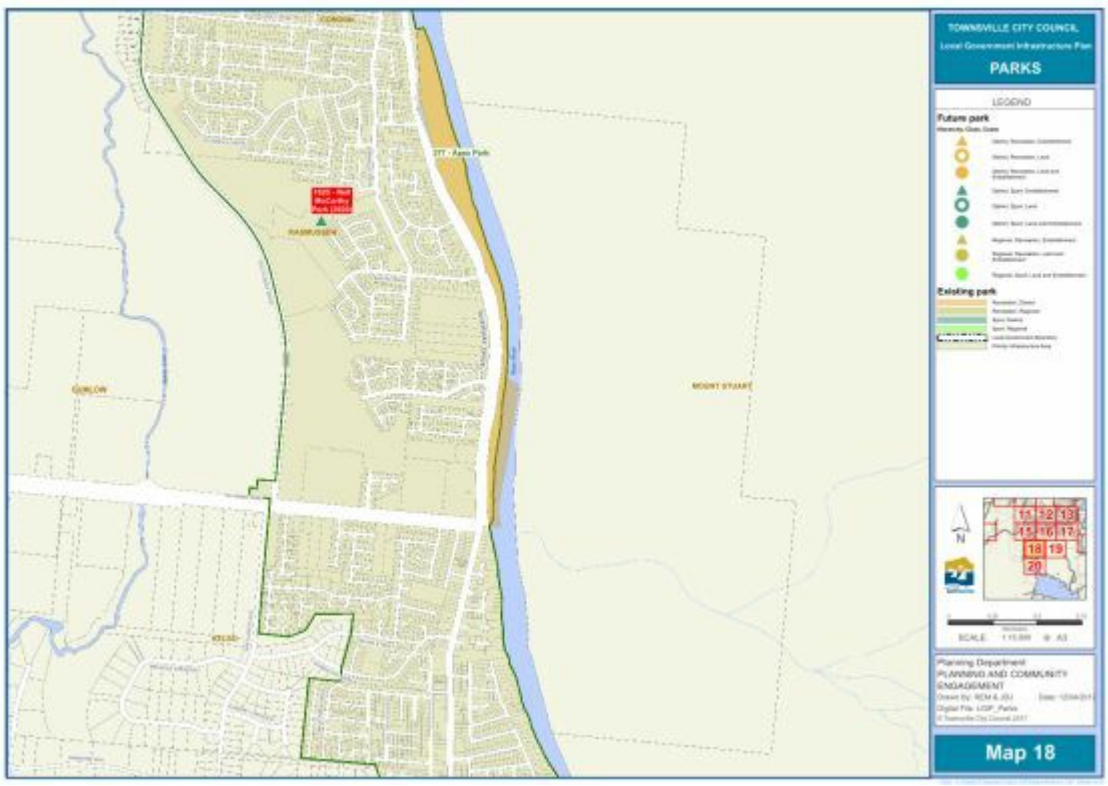

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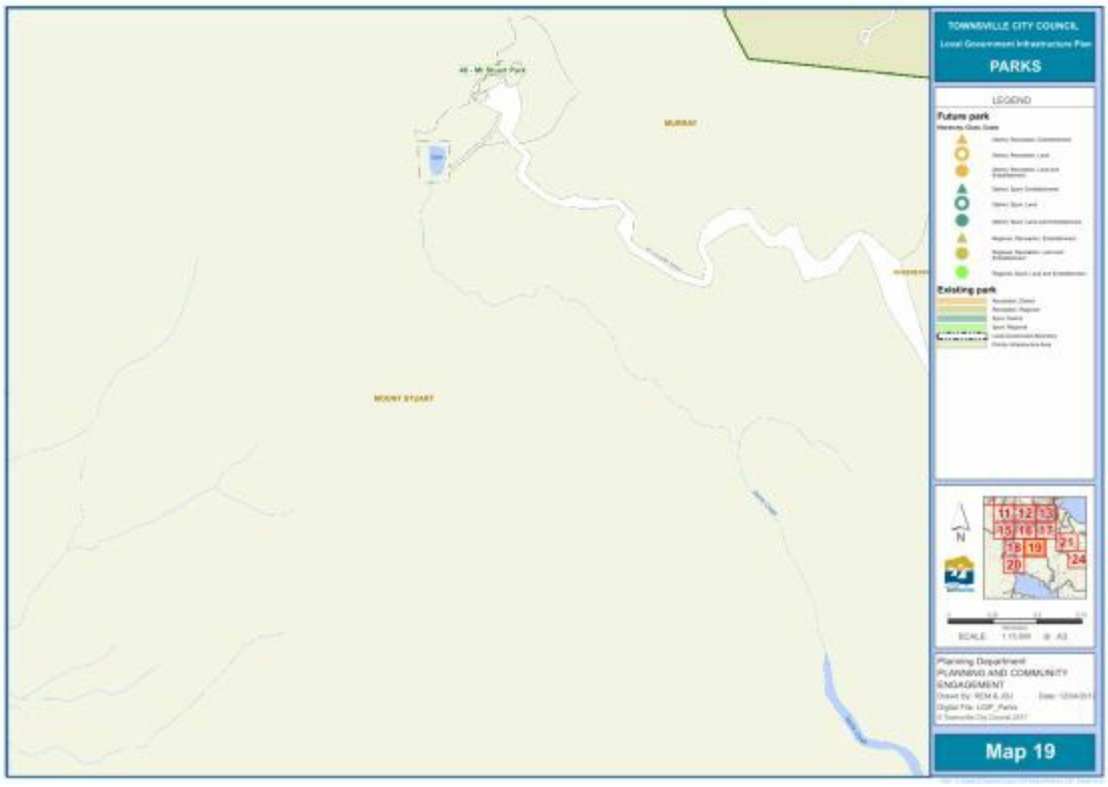

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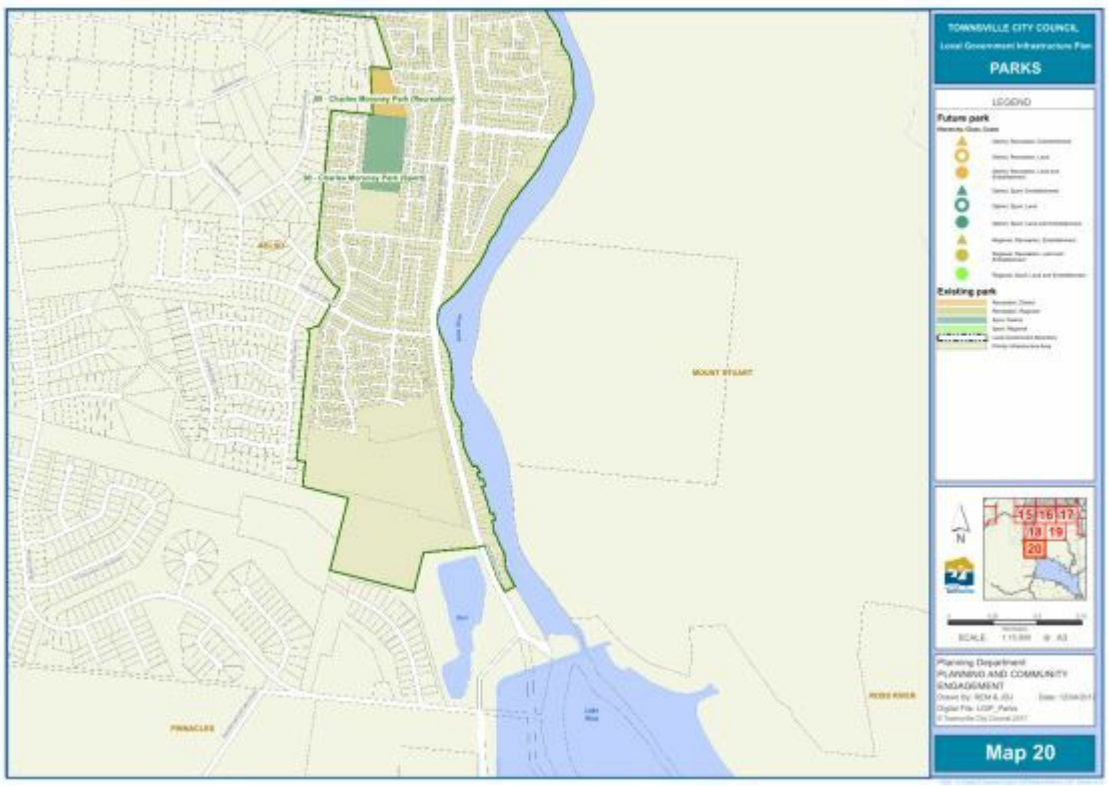

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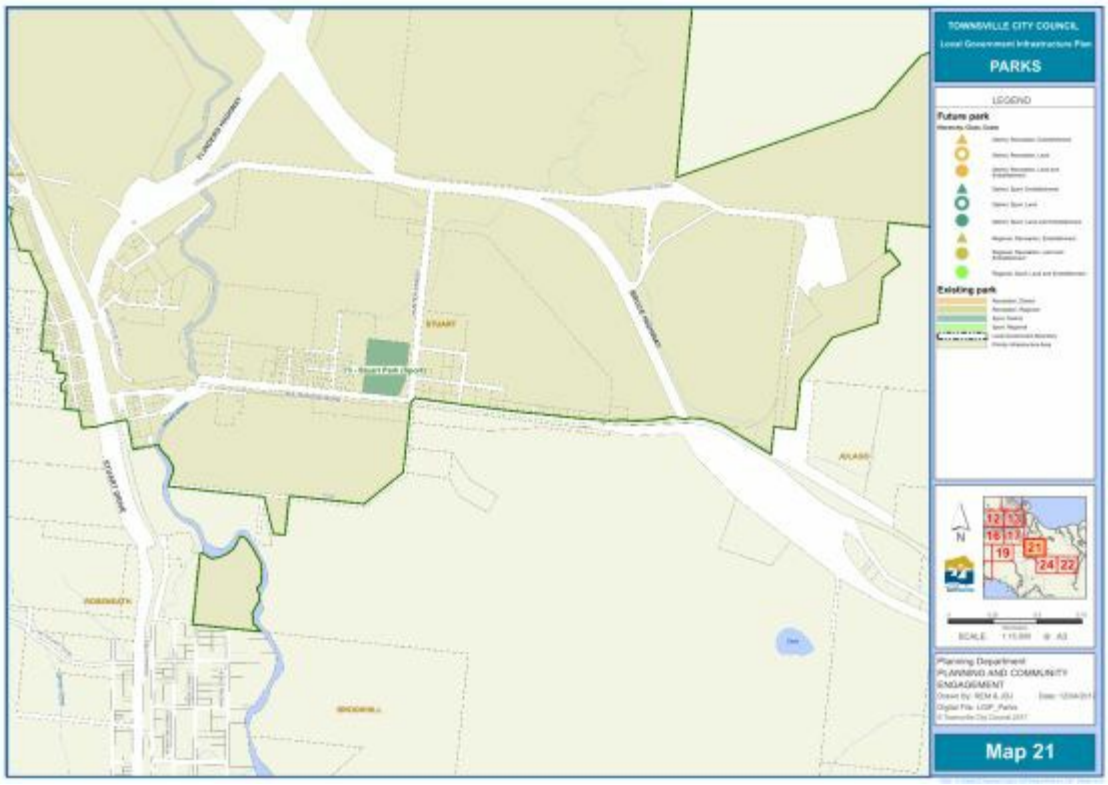

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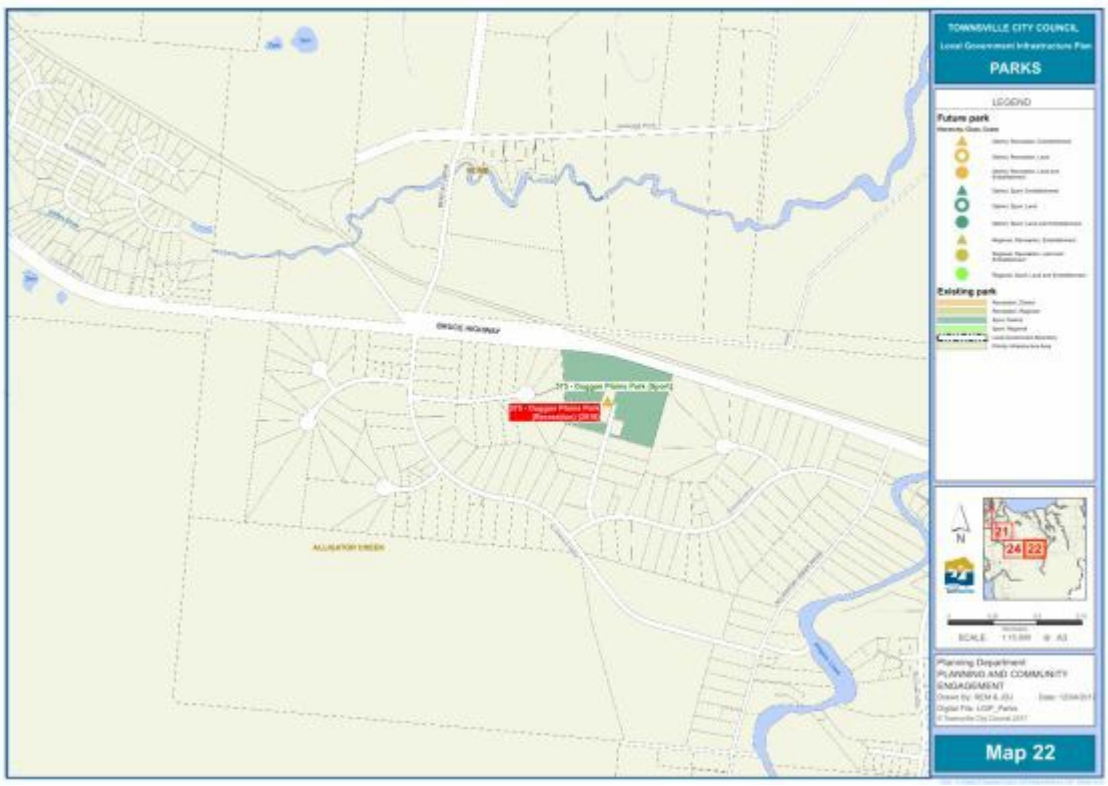

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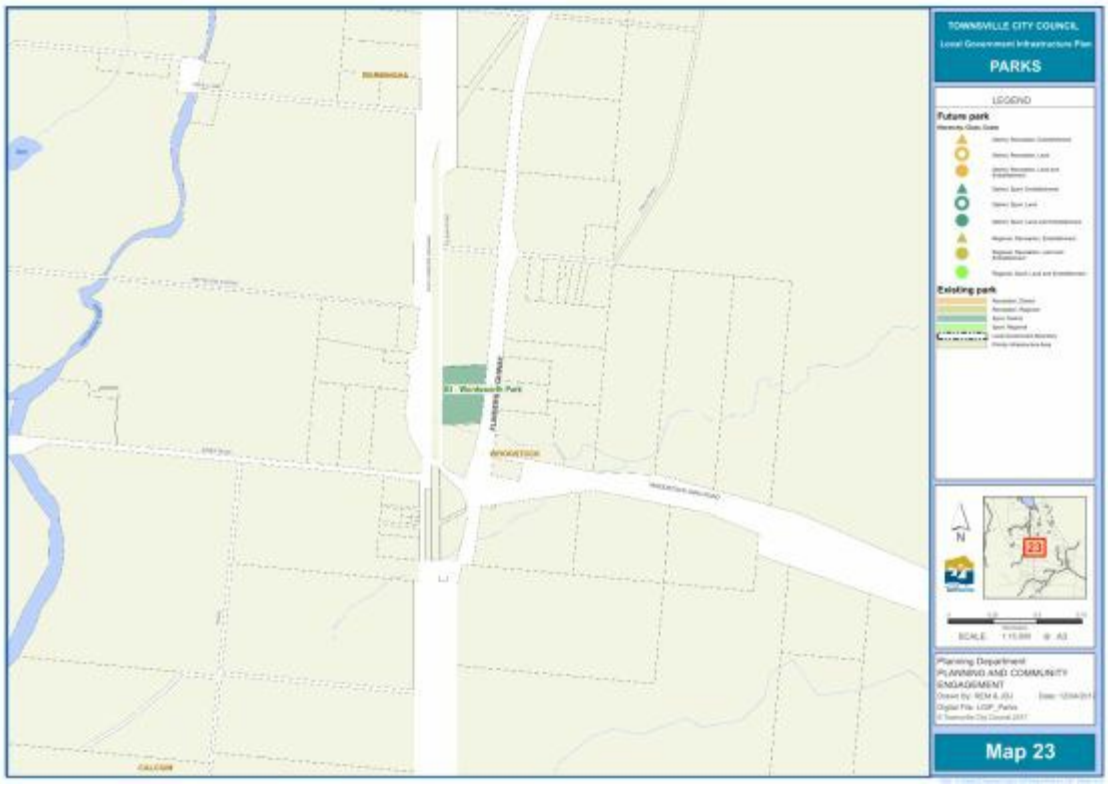

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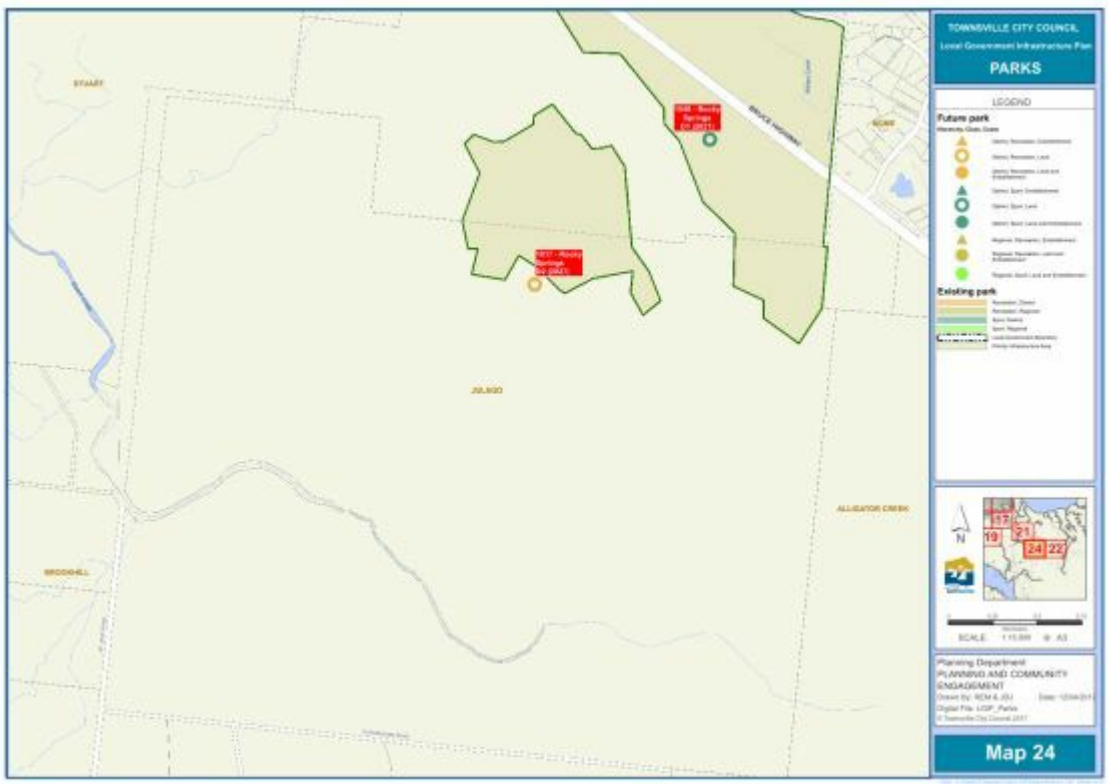

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Table SC3.3.9.1 - Parks and land for community facilities network schedule of future works

Map	Park type	LGIP ID	Area (Ha)	Name	Suburb	Year	Cost ($'16)
6	District recreation	222	(1.4)	Horseshoe Bay Foreshore	HORSESHOE BAY	2026	(1,523,746)
6	Regional recreation	222	1.4	Horseshoe Bay Foreshore	HORSESHOE BAY	2026	3,647,151
6	Regional recreation	1023	2.5	Horseshoe Bay Environmental Recreation Park	HORSESHOE BAY	2026	6,512,770
7	District recreation	360	2.0	Peggy Banfield Park	BUSHLAND BEACH	2016	1,859,512
7	District sport	360	4.0	Peggy Banfield Park	BUSHLAND BEACH	2020	4,534,832
7	District sport	1004	6.0	Future park (Sanctum)	MOUNT LOW	2026	7,276,823
8	District recreation	1005	4.0	Future park (Sanctum)	MOUNT LOW	2024	4,276,878
8	District sport	1024	3.6	Kilcora Park (Frendon Parade Park)	MOUNT LOW	2022	4,420,670
9	District sport	1007	12.0	North Shore master plan (Saunders Ck)	MOUNT LOW	2016	12,655,344
9	Regional recreation	1006	13.0	North Shore master plan (central park)	MOUNT LOW	2018	26,278,862
10	District recreation	1012	2.5	Future park (North of Harold Phillips)	GARBUTT	2018	2,498,719
10	Regional recreation	1050	1.7	Central Park	TOWNSVILLE CITY	2022	3,793,177
11	District recreation	1015	4.0	Future park (Mount Louisa)	MOUNT LOUISA	2021	3,997,951
11	District recreation	1034	-	Future park (Kirwan) - to be deleted	KIRWAN	2018	-
11	District sport	1013	6.0	Future park (Greater Ascot)	BOHLE PLAINS	2024	7,276,823
11	District sport	1014	6.0	Future park (Cosgrove)	BOHLE	2026	1,816,268
11	Regional sport	1009	18.0	Future park (Bohle Plains)	BOHLE PLAINS	2021	17,086,011
11	Regional sport	1009	18.0	Future park (Bohle Plains)	BOHLE PLAINS	2026	18,278,058
12	District recreation	1020	-	Heatley Park - to be deleted	HEATLEY	2026	-
12	District recreation	1021	-	Cambridge Park - to be deleted	VINCENT	2018	-
12	District recreation	1033	3.6	Mount View Park	KIRWAN	2016	3,319,229
15	District recreation	1027	-	Willow Gardens Park - to be deleted	KIRWAN	2018	-
15	District recreation	1047	4.0	New park land (Harris Crossing)	BOHLE PLAINS	2016	1,052,909
16	District recreation	1011	2.3	Future park (upgrade of Riverside Green)	DOUGLAS	2016	2,138,439
17	District recreation	1028	6.1	Edison Street Park	WULGURU	2017	6,056,895
18	District sport	1025	6.0	Neil McCarthy Park	RASMUSSEN	2020	6,802,248
22	District recreation	375	1.3	Duggan Plains Park (Recreation)	ALLIGATOR CREEK	2018	1,255,977
24	District recreation	1017	4.0	New park land (Rocky Springs - D2)	JULAGO	2027	976,334
24	District sport	1040	6.0	New park land (Rocky Springs - D1)	JULAGO	2021	1,311,948

Schedule 4 Notations required under the Planning Act 2016

SC4.1 Notation of decisions affecting the planning scheme under section 89 of the Act

Table SC4.1.1—Notation of decisions under section 89 of the Act

Date of decision	Location (real property description)	Decision type	File/Map reference
17/12/2014	122 Webb Road, MAJORS CREEK QLD 4816 (Lot 4 SP267460)	Superseded Planning Scheme Request - Lot Creation One (1) into Three (3)	SPS14/0001
16/01/2015	Bruce Highway, DEERAGUN QLD 4814 (Lot 2 EP2209)	Superseded Planning Scheme Request - Community Facilities (Water Reservoir)	SPS14/0002
6/02/2015	599 Ross River Road, KIRWAN QLD 4817 (Lot 23 RP716944)	Superseded Planning Scheme Request - Medical Centre	SPS14/0003
20/02/2015	609-673 Sturt Street, TOWNSVILLE CITY QLD 4810 (Lot 501 on SP195746)	Superseded Planning Scheme Request - Sales or Hire Yard	SPS15/0001
27/04/2015	2-4 Marinez Avenue, WEST END QLD 4810 (Lot 1 RP893499)	Superseded Planning Scheme Request - Extension of Morleys Funerals	SPS15/0002
31/08/2015	52-54 The Strand, NORTH WARD QLD 4810 (Lot 3 & 4 on RP712269 and Lots 255, 256 & 264 - 266 T1181)	Superseded Planning Scheme Request - Multiple Dwelling	SPS15/0005
23/07/2015	2 Conway Street, MOUNT LOW QLD 4818 (Lot 63 SP226254)	Superseded Planning Scheme Request - Lot Creation One (1) into Two (2)	SPS15/0006
22/10/2015	28 Darling Road, JENSEN QLD 4818 (Lot 2 RP800747)	Superseded Planning Scheme Request - Lot Creation One (1) into 10	SPS15/0010
29/05/2015	51-101 Everett Street, TOWNSVILLE QLD 4818 (Lot 7 RP889756 & Lot 6 RP889760)	Negotiated Development Application Decision - Approved	MI11/0010
24/06/2015	44 Hugh Street, GARBUTT QLD 4814 (Lot 420 EP1533)	Negotiated Development Application Decision - Approved	MI11/0054
23/03/2015	47 and 55 Texas Road, JENSEN QLD 4818 (Lot 3 RP748165 & Lot 82 RP846352)	Negotiated Development Application Decision - Approved	MI13/0045

20/03/2015	Nexus Drive, BURDELL QLD 4818 (Lot 2500 SP248845)	Development Application Decision - Approved	MI14/0008
27/01/2015	84 Marina Drive, BUSHLAND BEACH QLD 4818 (Lot 505 SP247145)	Development Application Decision - Approved	MI14/0032
20/10/2015	Place Park, 52B Mystic Avenue, Balgal Beach QLD 4816 (Lot 2 SP160493)	Superseded Planning Scheme Request - Rollingstone Rural Fire Brigade	SPS15/0009
11/11/2015	11 Sunderland Street, Garbutt QLD 4814 (Lot 147 T118291)	Superseded Planning Scheme Request - Lot Creation - One (1) into Two (2) Lots	SPS15/0012
4/12/2015	15 Slayton Road, Jensen QLD 4818 (Lot 57 RP725245)	Superseded Planning Scheme Request - Dual Occupancy	SPS15/0015
11/11/2015	36 McKillop Street, Belgian Gardens QLD 4810 (Lot 12 RP701679)	Superseded Planning Scheme Request - Lot Creation One (1) into Two (2)	SPS15/0016
11/12/2015	11 Armidale Avenue Balgal Beach QLD4816 (Lot 15 RP743003)	Superseded Planning Scheme Request - Lot Creation - One (1) into Two (2)	SPS15/0017
18/12/2015	697 Ross River Road, Kirwan QLD 4817 (Lot 12 T118519, Lot 13 T118519 and Lot 11 T118519)	Superseded Planning Scheme Request - Mixed Commercial Development	SPS15/0018
17/12/2015	235 Purono Parkway, Yabulu QLD 4818 (Lot 30 RP859135)	Superseded Planning Scheme Request - Lot Creation - One (1) into Two (2)	SPS15/0019
4/12/2015	130 Woodfield Road, Gumlow QLD 4815 (Lot 25 RP912553)	Superseded Planning Scheme Request - Reconfiguring a Lot	SPS15/0020
4/12/2015	76 One Mile Drive, Gumlow QLD 4815 (Lot 5 SP171604, Lot 30 SP132600 and Lot 6 SP171604	Superseded Planning Scheme Request - Reconfiguring a Lot	SPS15/0021
21/12/2015	40057 Bruce Highway, Deeragun QLD 4818 (Lot 1 RP747112)	Superseded Planning Scheme Request - Showroom	SPS15/0023
18/12/2015	101 Thuringowa Drive, Kirwan 4817 (Lot 22 T118595)	Superseded Planning Scheme Request - Health Care Services	SPS15/0024

22/12/2015	369 Shaw Road, Shaw QLD 4818 (Lot 16 SP232874	Superseded Planning Scheme Request - Warehouse and Service Station (Preliminary Approval component withdrawn)	SPS15/0025
21/12/2015	325 Shaw Road, Shaw QLD 4818 (Lot 19 SP107219	Superseded Planning Scheme Request - Service Station	SPS15/0026
7/12/2015	14 Mackley Street, Garbutt QLD 4814 (Lots 40 - 44 RP703609, Lots 67 - 69 RP703609, Lots 70 & 71 RP703609 and Lot 2 RP891356)	Superseded Planning Scheme Request - Sales or Hire Yard	SPS15/0027
13/01/2016	106 Balgal Beach Road, Balgal Beach QLD 4816 (Lot 12 SP177431)	Superseded Planning Scheme Request - Lot Creation - One (1) into Two (2) Lots	SPS15/0028
06/08/2015	40 Texas Road, Jensen QLD 4818 (Lot 32 RP 74244, Lot 2 RP 854023, Lot 57 RP 725245, Lot 24 RP 724568 and Lot 25 RP 725244)	Preliminary Approval Under Section 242 of the Sustainable Planning Act 2009 to Facilitate Use Rights in accordance with a Plan of Development	MI14/0041
07/09/2015	127 Allambie Lane, Rasmussen QLD 4815 (Lot 61 SP 120855)	Preliminary Approval for Development in accordance with a Plan of Development for Residential Land Use	MI14/0011
02/02/2016	158 Hugh Street, Currajong QLD 4812 (Lot 17 RP 703502 and Part Lot 1 SP 286571)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009	MI15/0036
16/12/2016	829 Bradon Road, Beach Holm QLD 4818 (Lot 267 EP 1719 and Lot 256 SP 196179)	Preliminary Approval for Development in Accordance with a Plan of Development for Residential and Open Space Land Use	MI13/0020
01/02/2017	25 Fulham Road, Pimlico QLD 4812 (Lot 32 RP 703502, Lot 17 RP 703502 and Part Lot 1 SP 286571)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to facilitate the Plan of Development for the Mater Hospital	MI15/0036
11/04/2017	86 Thuringowa Drive, Thuringowa Central QLD 4817 (Lot 1 SP 280601)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to Override the Planning Scheme - Eastbrooke	MI16/0032

04/05/2017	19 Wentworth Avenue, Mundingburra QLD 4812 (Lot 16 and 17 RP 717981)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to Override the Planning Scheme for Use Rights in Accordance with the Community Facilities Zone	MI16/0035
01/08/2017	41 Afton Way, Mount Louisa QLD 4814 (Lot 1 SP 247130)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to Override the Planning Scheme combined with RC16/0043	MI16/0013
20/12/2017	45 Flinders Street, Townsville City QLD 4810 (Lots 47 and 48 T1181, Lots 1 and 2 RP 702069, Lot 1 RP 702069, Lot 2 RP 717290, Lot 2 RP 731759, Lots 2 and 3 RP 745353)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to vary the effect of the Townsville City Plan in accordance with The Hive Master Plan and Preliminary Approval for Building Work for the Demolition of the Criterion Hotel (Local Heritage Place)	MI16/0033
23/01/2018	443 – 481 Ross River Road, Cranbrook QLD 4814 (Lot 2 CP 895233 and Lot 237 CP 895233)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to Override the Planning Scheme in accordance with the Bwgaman Development Scheme.	MI14/0033
11/07/2018	55 Lynham Road, Gumlow QLD 4815 (Lot 26 SP 248803) (formerly described as Lot 26 on Crown Plan E 124278)	Preliminary Approval under Section 242 of the Sustainable Planning Act 2009 to vary the effect of the local planning instrument to allow for development to occur in accordance with the Willowbend Plan of Development	MI10/0026 and AP12/0009 (Final Order)
21/10/2018	35 Toll Street, Mount St John QLD 4818 (Lot 63 SP 209545)	Preliminary Approval – Variation Request under Section 61 of the Planning Act 2016 to Override the Planning Scheme	MCU18/0062

Editor's note—This schedule should include:

- approvals that conflict with the planning scheme;
- a variation approval under the *Planning Act 2016* that varies the effect of any local planning instrument in effect for the premises;
- development approvals under section 242 of the *Sustainable Planning Act 2009* that vary the effect of the scheme;
- decisions agreeing to a superseded planning scheme request.

Editor's note—Development approvals under section 3.1.6 of the *Integrated Planning Act 1997* or section 242 of the *Sustainable Planning Act 2009* that vary the effect of the scheme, but were issued prior to adoption of the Townsville City Plan, are available for information online at www.eplanning.townsville.qld.gov.au.

SC4.2 Notation of resolution(s) under Chapter 4, Part 2, Division 2 of the Act

Table SC4.2.1—Notation of resolutions under Chapter 4, Part 2, Division 2 of the Act

Date of resolution	Date of effect	Details	Contact information
28 June 2011	1 July 2011	Adopted Infrastructure Charges Resolution (01 – 1 July 2011)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810
24 June 2014	1 July 2014	Adopted Infrastructure Charges Resolution (02 – 1 July 2014)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810.
23 June 2015	1 July 2015	Adopted Infrastructure Charges Resolution (03 - 1 July 2015)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810.
28 June 2016	1 July 2016	Adopted Infrastructure Charges Resolution (04 - 1 July 2016)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810.
27 June 2017	1 July 2017	Adopted Infrastructure Charges Resolution (05 - 1 July 2017)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810.
26 June 2018	1 July 2018	Adopted Infrastructure Charges Resolution (06 - 1 July 2018)	A copy of this resolution can be viewed online at www.townsville.qld.gov.au. For more information, contact council's Customer Service Centre on 134 810.

Editor's note—This schedule should provide information about the adopted infrastructure charges for the local government and where a copy of the adopted charges can be obtained, including a link to the local government website where a copy of the infrastructure charges resolution can

be viewed or downloaded.

SC4.3 Notation of registration for urban encroachment provisions under section 680ZE of the Act

Table SC4.3.1—Notation of decisions under section 680ZE of the Act

Date of decision	Location of premises (real property description)	Details of registration	Term of registration

Schedule 5 Land designated for community infrastructure

Table SC5.1—Land designated for community infrastructure

Date of designation or repeal	Real property description	Street address	Type of community infrastructure
7 May 1999	Lot 56 EP1573 Lot 57 EP2061	Dwyer Street, Townsville QLD 4810	(e) correctional facilities (Townsville Correctional Centre)
Designation matters Not applicable			
9 July 1999	Lot 513 EP1443	27 Old Common Road, Belgian Gardens QLD 4810	(e) correctional facilities (Cleveland Youth Detention Centre)
Designation matters Not applicable			
10 December 1999	Lots 40 SP116222 Lots 42 SP116222 Lot 1 RP723277 Lot 2 RP723277 Lot 3 RP723277 Lot 4 RP723277 Lot 5 RP723277 Lot 2 RP727842 Lot 1 RP31591	Angus Smith Drive, Townsville City QLD 4810	(f) educational facilities (James Cook University, Douglas Campus)
Designation matters Not applicable			
10 December 1999	Lot 3 RP725384	235 Fulham Road, Vincent QLD 4814	(f) educational facilities (James Cook University, Vincent Campus)
Designation matters Not applicable			
24 December 1999	Lot 41 SP116222	University Drive, Douglas QLD 4814	(h) hospitals and associated institutions (Townsville Hospital)
Designation matters Not applicable			
24 March 2000	Part Lot 9 SP118914	Hunter Street, Stuart QLD 4811	(k) operation works under the *Electricity Act 1994* (Townsville South Substation to Sun Metals Refinery Transmission Line)
Designation matters Not applicable			

24 March 2000	Part Lot 3 SP103580 Part Lot 62 SP103587 Part Lot 65 SP103587 Part Lot 57 EP2061 Part Lot 42 CP905700		(k) operating works under the *Electricity Act 1994* (Townsville South Substation to AES Mt Stuart Power Station Transmission Line)
Designation matters Not applicable			
24 March 2000	Part Lot 1 RP726908		(k) operating works under the *Electricity Act 1994* (Townsville Power Station Switchyard and Transmission Line)
Designation matters Not applicable			
11 August 2000	Lot 1 RP 882869	Corner Veales Road and Bruce Highway, Deeragun QLD 4818	(s) any other facility not in (a) to (r) and intended to accommodate government functions (Deeragun Police Station)
Designation matters Not applicable			
27 October 2000	Lot 561 EP1848	138 Thuringowa Drive, Kirwan QLD 4817	(h) hospitals and associated institutions (Kirwan Hospital)
Designation matters Not applicable			
1 June 2001	Lot 716 T118501	31 Walker Street, Townsville City QLD 4810	(s) any other facility not in (a) to (r) and intended to accommodate government functions (Townsville Magistrates Court)
Designation matters Not applicable			
15 February 2002	Lot 423 EP1979	79 Fulham Road, Pimlico QLD 4812	(f) educational facilities (Barrier Reef Institute of TAFE)
Designation matters Not applicable			
3 May 2002	Lot 4 K1243 Lot 76 RP203473 Lot 77 RP203473	Corner Charters Towers Road and Goldring Street, Mundingburra QLD 4812	(r) storage and works depots and the like including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in paragraphs (a) to (q) (s) any other facility not in (a) to (r) and intended to accommodate government functions (Mundingburra Police Station)

Designation matters Not applicable			
27 June 2003	Lot 5 K103939 Lot 6 K103939 Lot 7 K103939 Lot 9 K103939 Lot 10 K103939 Lot 12 K103939 Lot 13 K103939 Lot 15 K103939 Lot 16 K103939 Lot 21 K103939 Lot 22 K103939 Lot 23 K103939 Lot 26 K103939 Lot 49 K103939 Lot 206 EP1967 Lot 20 USL51199 Lot 1 USL51604 Lot 1 RP711920 Lot 2 RP721599 Lot 2 RP724555 Lot 2 RP725280 Lot 1 RP730111 Lot 2 RP732944 Lot 1 RP734574 Lot 2 RP737885 Lot 2 RP737886 Lot 1 RP840346 Lot 2 RP840346 Lot 67 EP856 Lot 1 EP930		(m) railway lines, stations and associated facilities (o) transport infrastructure mentioned in Schedule 10 definition “development infrastructure” (Townsville Port Eastern Access Corridor. Being land for the future construction and operation of railway lines, stations and associated facilities and transport in the corridor)
Designation matters Not applicable			
23 April 2004	Lot 534 EP1582 Lot 537 EP1582	Paluma and Thuringowa Streets and 5 Hinchinbrook Drive, Kirwan QLD 4817	(s) any other facility not in (a) to (r) and intended to accommodate government functions (Kirwan Police Facilities)
Designation matters Not applicable			

8 April 2005	Lot 28 EP1249 Lot 466 EP1249	Warburton, Redpath & Burke Street, North Ward QLD 4810	(d) community and cultural facilities, including child care facilities, community centres, meeting halls, galleries and libraries (f) educational facilities (l) parks and recreational facilities (r) storage and works depots and the like including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in paragraphs (a) to (q) (s) any other facility not mentioned in paragraphs (a) to (r) and intended primarily to accommodate government functions (The land has been designated to accommodate the operations of regional sporting groups, the State agency and other entities associated with provisions of the region's sports and recreation including training, offices, administration facilities and athlete accommodation, associated sporting fields and sporting facilities and car parking)
Designation matters Not applicable			

20 January 2006	Lot 7 SP107219 Lot 6 SP107219 Lot 5 SP107219 Lot 2 SP112189 Lot 91 SP112722 Lot 12 E124328 Lot 272 K124640 Lot 3 SP128466 Lot 4 SP128466 Lot 7 SP150157 Lot 3 SP156430 Lot 56 EP1634 Lot 25 EP1890 Lot 18 EP240 Lot 1 PER6999 Lot 2 RP726908 Lot 1 RP726908 Lot 4 RP727808 Lot 3 RP727810 Lot 2 RP729458 Lot 1 RP731210 Lot 5 RP737005 Lot 6 RP737089 Lot 7 RP737090 Lot 4 RP743037 Lot 3 RP746699 Lot 1 RP882865 Lot 7 RP901162 Lot 6 RP901162 Lot 377 RP912547		(k) operating works under the *Electricity Act 1994* (Operating works under the *Electricity Act 1994*. Specifically, these operating works are the proposed Bohle River to Townsville Gas Turbine Power Station 132 kilovolt transmission line and Yabulu south electrical substation)
Designation matters Not applicable			
20 June 2008	Lot 1 SP199862	The Strand, Townsville City QLD 4810	(s) any other facility not in (a) to (r) and intended to accommodate government functions (Townsville City Council – The Strand police beat – police facilities including but not limited to offices, storage, amenities, interview rooms, air-conditioning plant and car parking)
Designation matters Not applicable			
19 December 2008	Lot 1 T118460 Lot 2 T118460 Lot 11 T118460 Lot 12 T118460 Lot 3 SP137809 Lot 513 EP1443 Lot 100 CP860214 Lot 1 CP86528 Lot 30 CP903570	Old Common Road, Rowes Bay QLD 4810	(f) correctional facilities (f) educational facilities (r) storage and works depots associated and the like including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in paragraphs (a) to (q) (Townsville City Council – 'Cleveland Youth Detention Centre')

Designation matters Not applicable			
17 April 2009	Haughton River (Easement CIDA AP12418) Lot 11 EP1679 (Easement D SP145193) Lot 11 EP1679 (Easement E SP145193) Unnamed Road (Easement CIDA SR17.500) Lot 17 EP2204 (Easement C SP144887) Unnamed Road (Easement CIDA SR18.500) Lot 10 EP101 (Easement A SP144888) Lot 14 SP101846 (Easement B SP145191) Lot 4 RP865808 (Easement A SP145190) Dingo Park Road (Easement CIDA SR21.500) Lot 134 EP2055 (Easement B SP144890) Unnamed Road (Easement CIDA SR22.500) Lot 135 EP2055 (Easement A SP144890) Unnamed Road (Easement CIDA SR23.500) Lot 49 E124241 (Easement A SP144891) Spring Creek (Easement CIDA AP12419) Lot 50 E124241 (Easement B SP144891) Lot 54 E124329 (Easement C SP144891)		(k) operating works under the *Electricity Act 1994* (Whitsunday Regional Council; Burdekin Shire Council; Townsville City Council – Queensland Electricity Transmission Corporation Limited, trading as Powerlink Queensland, proposes to build community infrastructure)

	Unnamed Road (Easement CIDA SR26.500) Lot 177 EP1118 (Easement A SP144892) Lot 51 EP124241 (Easement D SP144891) Lot 51 E124241 (Easement E SP144891) Lot 480 E12462 (Easement A SP145197) Lot 455 E1243 (Easement F SP144891) Flinders Highway (Easement CIDA AP12420) Lot 181 SP130029 (Easement CIDA SR30.501) Unnamed Road (CIDA AP12421) Lot 442 EP1319 (Easement A SP144893) Double Barrel Creek (Easement CIDA AP12422) Lot 417 E12421 (Easement E SP144894) Lot 64 E124248 (Easement C SP144894) Lot 64 E124248 (Easement D SP144894) Unnamed Road (Easement CIDA SR34.500) Unnamed Road (Easement CIDA SR34.501) Lot 104 E124279 (Easement B SP144894) Lot 65 E124264 (Easement A SP144894) Unnamed Road (Easement CIDA AP12423) Lot 41 E124381			

	(Easement D SP145764) Lot 41 E124381 (Easement E SP145764) Unnamed Road (Easement CIDA SR37.500) Unnamed Road (Easement CIDA SR37.501) Lot 43 RP911427 (Easement B SP145764) Lot 43 RP911427 (Easement C SP145764) Lot 4 USL44323 (Easement A SP145765) Lot 500 E12466 (Easement A SP145764) Unnamed Road (Easement CIDA SR40.500) Lot 1 EP32 (Easement A SP145762) Unnamed Road (Easement CIDA SR41.500) Lot 25 E124347 (Easement C SP145757) Lot 27 EP21 (Easement B SP145757) Lot 29 EP72 (Easement A SP145757) Lot 228 EP115 (Easement N SP145756) Ross River (Easement CIDA AP12424) Lot 2 EP102 (Easement M SP145756) Lot 4 EP1485 (Easement L SP143325) Central Creek (Easement CIDA AP12425) Lot 3 EP1372			

	(Easement B EP1432) Lot 3 EP1372 (Easement D EP2103) Lot 3 EP1372 (Easement C SP143325) Lot 3 EP1372 (Easement K SP143325) Unnamed Road (Easement CIDA SR48.500) Lot 40 EP1309 (Easement A EP1432) Lot 40 EP1309 (Easement B EP2034) Lot 1 RP742612 (Easement A RP725994) Lot 1 RP742612 (Easement C RP729414) Lot 1 RP724660 (Easement A RP725993) Lot 1 RP724660 (Lot B RP742344) Lot 4 RP891360 (Lot C RP725992) Lot 4 RP891360 (Easement D RP742345) Laudham Road (Easement CIDA SR52.500) Lot 1 SP195322 (Easement B RP742343) Lot 2 SP195322 (Easement A RP725991) Kelso Drive (Easement CIDA SR53.500) Lot 4 RP800998 (Easement B RP723119) Lot 2 RP800998 (Easement B RP723119) Lot 4 RP891340 (Easement B RP723119)			

	Lot 1 RP800998 (Easement B RP723119)		
Designation matters The type of community infrastructure for which the above land has been designated is operating works under the *Electricity Act 1994*. Specifically, these operating works are Powerlink Queensland's proposed Strathmore to Ross 275 kilovolt transmission line.			
22 May 2009	Lot 1 SP203854	763 Ingham Road, Mount St John QLD 4818	(f) educational facilities (Townsville City Council - The Trade and Technician Skills Institute, further described as 'a place of higher education and vocational education and training that provides a ranges of courses, utilising associated teaching, social and public support functions; including car parking, conference, cultural, sport and recreational facilities, and engages in commercial activities and alliances that are in support of its educational programs, and as: 'Trade and Technician Skills Institute')
Designation matters Not applicable			
5 June 2009	Part Lot 10 SP143318 Part Lot 105 EP1535 Part Lot 1 SP199852 Part Lot 4 SP199852		(k) operating works under the *Electricity Act 1994* (Townsville City Council – Powerlink Queensland's proposed Mt Stuart Gas Turbine 132 Kilovolt transmission line)
Designation matters Not applicable			
23 September 2009	Lot 18 EP240 (Easement AA SP211707) Lot 18 EP240 (Easement AB SP211707) Unnamed Road (Easement CIDA AP16490) Althaus Creek (Easement CIDA AP13070) Lot 1 RP728417 (Easement AC SP211708) Lot 19 RP746087 (Easement AD SP211709) Lot 19 RP746087 (Easement AE SP211709) Unnamed Road		(k) operating works under the *Electricity Act 1994* (Townsville City Council; Hinchinbrook Shire Council – Powerlink Queensland's proposed Yabulu south to Ingham 275/132 kilovolt double circuit transmission line)

	(Easement CIDA AP16491) Lot 20 RP746087 (Easement AF SP211709) Forestry Road (Easement CIDA AP16492) Lot 20 SP151988 (Easement AG SP211710) Lot 20 SP151988 (Easement AJ SP211710) Lot 18 SP151988 (Easement AH SP211711) Lot 19 SP151988 (Easement AK SP211712) Lot 583 E124155 (Easement AN SP211714) Lot 2 RP742572 (Easement AL SP211713) Lot 2 RP742572 (Easement AM SP211713) Setter Road (Easement CIDA AP16493) Leichardt Creek (Easement CIDA AP16494) Lot 34 FTY1751 (Easement AP SP211715) Bruce Highway (Easement CIDA AP16495) Lot 151 SP112727 (Easement AQ SP211716) Lot 59 NPW935 (Easement CIDA A AP16497) Lot 59 NPW935 (Easement AR SP211717) Lot 59 NPW935 (Easement AS SP211717) Lot 59 NPW935 (Easement AU SP211719) Lot NPW935			

	(Easement AV SP211719) Lot 59 NPW935 (Easement AX SP211719) Lot 59 NPW935 (Easement ASR SP211737) Toomulla Beach Road (Easement CIDA AP16498) Camp Oven Creek (Easement CIDA B AP16496) Lot 59 WG312 (Easement AT SP211718) Saltwater Creek (Easement CIDA B AP16497) Lot 14 USL42237 (Easement AW SP211720) Unnamed Road (Easement CIDA AP16499) Unnamed Road (CIDA AP16500) Lot 1 RP722093 (Easement AY SP211721) Lot 2 RP722093 (Easement AZ SP211722) Lot 1 RP716204 (Easement BA SP211723) Lot 1 RP 716204 (Easement BB SP211723) Lot 422 WG7 (Easement BC SP211724) Lot 2 RP901334 (Easement BD SP211725) Bruce Highway (Easement CIDA AP16507) Lot 182 SP112728 (Easement BE SP211726) Lot 183 SP112728 (Easement BF SP211726) Rollingstone Creek			

	(Easement CIDA AP16508) Lot 2 RP845503 (Lot BG SP211727) Lot 2 RP845503 (Easement BH SP211727) Lot 2 RP845503 (Easement BK SP211727) Bruce Highway (Easement CIDA AP16509) Lot 31 WG800989 (Easement BJ SP211728) Lot 1 RP718150 (Easement BL SP211729) Bruce Highway (Easement CIDA AP13040) Lot 2 RP743374 (Easement BN SP211731) Lot 194 SP112729 (Easement BM SP211730) Gottani Road (Easement CIDA AP13041) Lot 3 RP743374 (Easement BP SP211732) Lot 3 RP743374 (Easement BQA SP211739) Hencamp Creek (Easement CIDA AP13071) Lot 5 WG3 (Easement BQ SP211733) Lot 2 RP735801 (Easement BR SP211734) Unnamed Road (Easement CIDA AP13072) Lot 1 RP735801 (Easement BS SP211738) Lot 12 RP859197 (Easement BY SP211738) Reserved Road (Easement			

	CIDA AP13073) Lot 2 RP744760 (Easement BT SP211735) Lot 2 RP744760 (Easement BU SP211735) Unnamed Road (Easement CIDA AP16501) Unnamed Road (Easement CIDA SP16502) Lot 1 RP744760 (Easement BV SP211735) Lot 23 WG110 (Easement BW SP211736) Lot 23 WG110 (Easement BX SP211736) Lorna Creek (Easement CIDA AP16503) Esplanade (Easement CIDA AP16504) Crystal Creek (Easement CIDA AP16505)		
Designation matters The type of community infrastructure for which the above land has been designated is operating works under the *Electricity Act 1994*. Specifically, these operating works are Powerlink Queensland's proposed Yabulu South to Ingham 275/132 kilovolt double circuit transmission line.			
17 June 2011	Lot 2 SP202064		(11) operating works under the *Electricity Act 1994* (Townsville City Council – The 66kV/11kV Bohle Plains substation)
Designation matters Not applicable			

30 November 2012	Lot 1 SP232890	151 John Melton Black Drive, Garbutt QLD 4814	(4) community and cultural facilities, including facilities where a child care service under the *Child Care Act 2002* is conducted, community centres, meeting halls, galleries and libraries (6) educational facilities (9) hospitals and associated institutions (Salvation Army Recovery Services Facility for the purpose of providing support to community members who are seeking assistance to overcome their addictions to alcohol, drugs or gambling)
Designation matters Not applicable			
5 April 2013	Lot 41 SP116222 Lot 2 SP189854	450 University Drive, Douglas, QLD 4814	(9) hospitals and associated institutions (15) storage and works depots and the like including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part (Townsville Hospital)
Designation matters Not applicable			
20 June 2014	Lot 89 CWL 1621	53 Mount Spec Road Paluma QLD 4816	(4) community; cultural facilities, inc. where a service under the *Child Care Act 2002* is conducted... (6) educational facilities (15) storage and works depots, inc. admin facilities assoc. with provision or maint. of the CID in this part (Paluma Environmental Education Centre)
Designation matters Not applicable			

11 November 2016	Proposed Lot 951 SP263024	205 North Shore Boulevard, Burdell QLD 4818	(4) community and cultural facilities including facilities where an education and care service under the Education and Care Services National Law (Queensland) is operated or a child care service under the *Child Care Act 2002* is conducted, community centres, meeting halls, galleries and libraries; (6) educational facilities; (8) facilities for parks and recreation (11) sporting facilities; and (15) storage and works depots and similar facilities, including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part.
Designation matters Not applicable			
18 August 2017	Lot 543 on EP1747	64 Hudson Street, Kirwan	(4) community and cultural facilities, including facilities where an education and care service under the Education and Care Services National Law (Queensland) is operated or a child care service under the *Child Care Act 2002* is conducted, community centres, meeting halls, galleries and libraries; (6) educational facilities; (15) storage and works depots and similar facilities, including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part. Further to the above, the designation includes: sporting facilities and associated infrastructure, road, vehicle layby and car parking and including commercial activities that support its Educational program.
Designation matters Not applicable			
16 February 2018	Lot 2 on RP724653	Riverway Drive, Kelso	(7) emergency services facilities; (15) storage and works depots and similar facilities, including administrative facilities associated with the provision or maintenance of the community infrastructure mentioned in this part; (16) any other facility not mentioned in this part that is intended primarily to accommodate government functions.

Schedule 6 Planning scheme policies

SC6.1 Planning scheme policy index

The table below lists all the planning scheme policies applicable to the planning scheme area.

Table SC6.1.1 - Planning scheme policy index

Number	Planning scheme policy title
SC6.2	Character residential planning scheme policy
SC6.3	Cultural heritage planning scheme policy
SC6.4	Development manual planning scheme policy
SC6.5	Economic impact assessment planning scheme policy
SC6.6	Emerging community planning scheme policy
SC6.7	Flood hazard planning scheme policy
SC6.8	Mitigating bushfire hazards planning scheme policy
SC6.9	Natural assets planning scheme policy
SC6.10	Parking rates planning scheme policy

SC6.2 Character residential planning scheme policy

SC6.2.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Character residential PSP.

SC6.2.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) provide advice about achieving outcomes in the Character residential zone code; and

(2) identify and provide guidance about information that may be required to support a development application where assessable against the Character residential zone code.

SC6.2.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.2.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Character residential zone code.

SC6.2.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1.

SC6.2.2 Planning scheme policy details

The Character residential zone identifies and defines parts of the city with a unique mixture of architecture and overall streetscape. The Character residential zone code regulates development within identified character precincts. This code ensures that the features of these neighbourhoods that make a positive contribution to each precinct's overall character are retained and appropriately managed.

There are twelve precincts in the Character residential zone code, each with its unique features (such as Workers Cottages, Grand Queenslanders and 1960s Defence Housing). The precincts provide for specific development outcomes over and above the general zone code outcomes. Individual properties are included within a precinct. The character features are described fully in the code.

The purpose of the Character residential PSP is to provide applicants with guidance in meeting the requirements of the Character residential zone code. Appendix 1 of this policy identifies non-contributing properties in the Character residential zone. Properties and buildings identified in the Character residential zone and not listed in Appendix 1 of this policy are considered to be contributing properties and buildings. Appendix 2 of this policy identifies contributing non-residential properties.

SC6.2.2.1 Understanding your precinct and your character building

Each character residential precinct is defined in the Character residential zone code. Townsville has defined character residential precincts; these precincts are rich in diversity, unique in character, and capture Townsville's history and North Queensland lifestyle.

(1) Your precinct

The buildings in your street create the character of your precinct. Properties are defined as either contributing character buildings or non-contributing properties. Non-contributing properties must still comply with certain provisions of the Character residential zone code, however; they are not to be used for comparative assessment.

Your street will provide the majority of the information you need to better understand the types of buildings, design, developments and architectural aspects that will be relevant to any new works on your property.

SC6.2.2.2 Finding your way around the policy

The policy is divided into the following eight sections:

(1) Key contributing character elements (SC6.2.3)

(2) Non-residential contributing character buildings (SC6.2.4)

(3) Reconfiguring a lot (SC6.2.5)

(4) Information that may support a development proposal (SC6.2.6)

(5) Preparing an assessment report (SC6.2.6.2)

(6) Preparing a condition report (SC6.2.6.3)

(7) SC6.2 Appendix 1: Non-contributing properties in the Character residential zone

(8) SC6.2 Appendix 2: Contributing non-residential properties

SC6.2.3 Key contributing character elements

SC6.2.3.1 Roofs

This section of the policy provides design principles and examples that may be considered when addressing the requirements of the Character residential zone code. Applicants may refer to this section for guidance on Character residential zone code outcomes regarding roof forms and pitch, material type and colour and depth of roof overhang.

(1) Figure SC6.2.3.1 below demonstrates acceptable roof pitch in relation to neighbouring properties. This may provide guidance in addressing roof pitch related outcomes of the Character residential zone code requirements in particular, in relationship to PO18, PO21, PO28, PO33, PO40, PO45, PO51, PO56, PO63, PO69, PO74 and PO80.

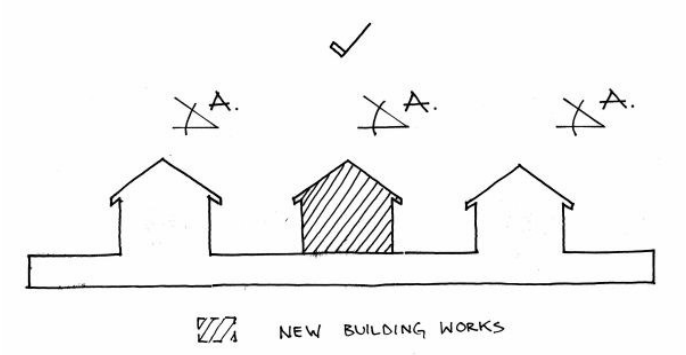


Figure SC6.2.3.1 Illustrates an example of acceptable roof pitch

(2) Figure SC6.2.3.2 below demonstrates an unacceptable roof pitch in relation to addressing roof pitch related outcomes of the Character residential zone code requirements in particular, in relation to PO18, PO21, PO28, PO33, PO40, PO45, PO51, PO56, PO63, PO69, PO74 and PO80.

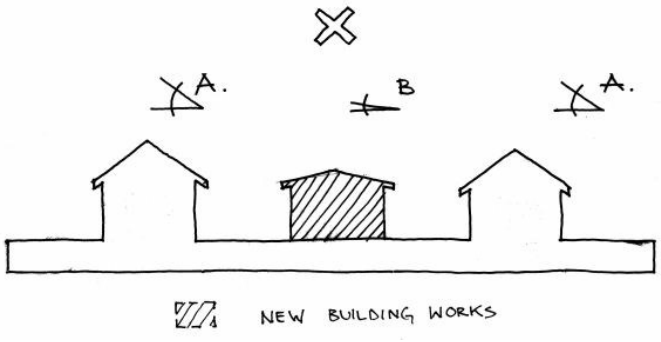


Figure SC6.2.3.2 Illustrates an example of unacceptable roof pitch

(3) Figure SC6.2.3.3a and Figure SC6.2.3.3b identifies some examples of compatible roof pitches found in various character residential precincts. These may be considered in addressing Character residential zone code requirements relating to roof pitch.

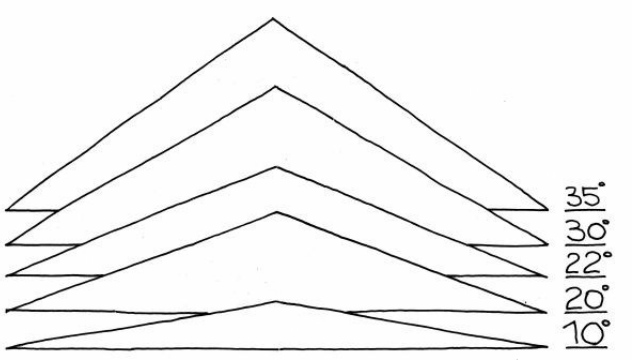
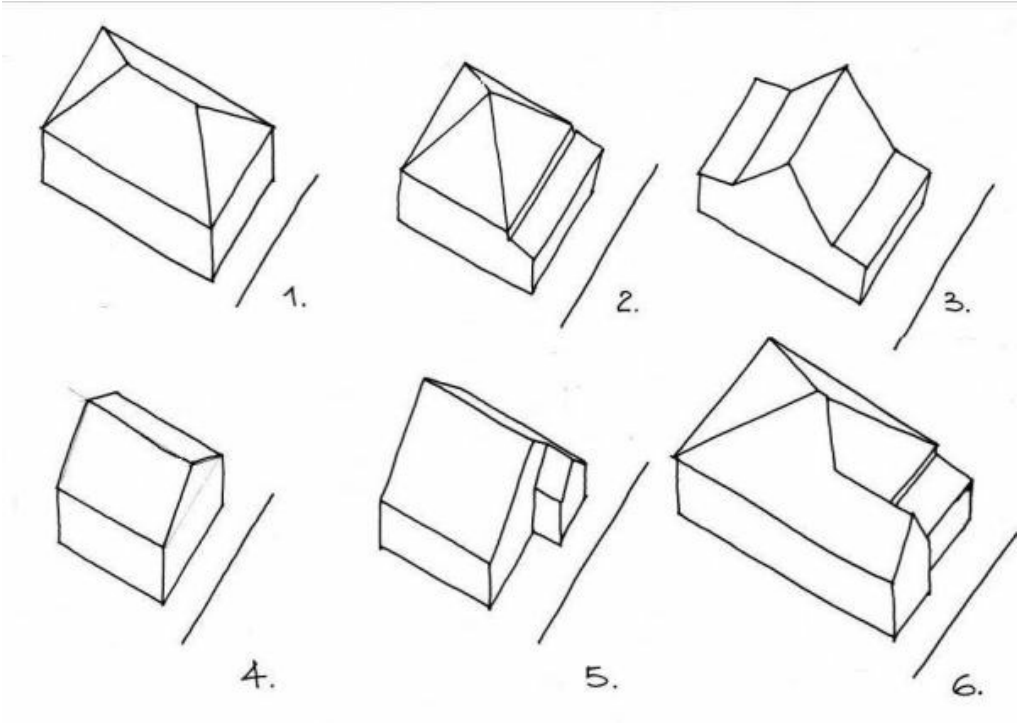


Figure SC6.2.3.3a Illustrates an example of common roof pitches in character residential precincts



Note—the resulting roof may be expressed as a combination of any number of roof forms:

(1) hip roof;

(2) pyramid roof with skillion/lean-to verandah;

(3) side gable roof with skillion/lean-to verandahs;

(4) front gable roof;

(5) double gable roof (sometimes expressed as triple gable roof); and

(6) combination of gable and hip roofs, with skillion/lean-to verandah.

Figure SC6.2.3.3b Illustrates an example of common roof forms in character residential precincts

(4) Figure SC6.2.3.4 provides guidance on the identification of roof eave depth. This figure may assist in the determination of eave depth in particular, in relation to PO19, PO22, PO57, PO64, PO75 and PO81 of the Character residential zone code.

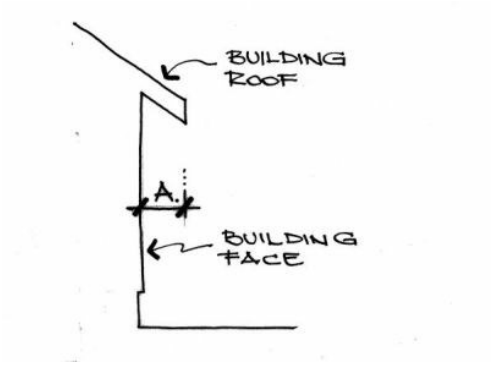


Figure SC6.2.3.4 Illustration of the roof eave depth which is shown by measurement "A"

SC6.2.3.2 Verandahs and front facades

A front verandah or an articulated front façade is commonly observed as a fundamental element of character within some precincts. This section of the policy provides examples of variation in verandah design, including scale (width, depth) enclosure, setback and height above ground level (see Figure SC6.2.3.5 for illustration of terms).

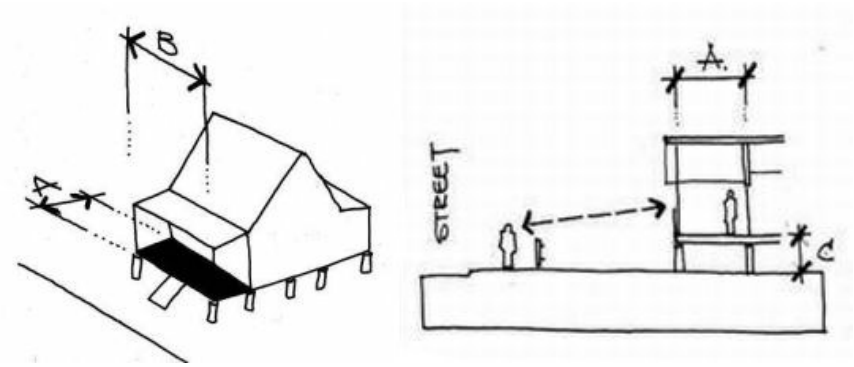


Figure SC6.2.3.5 - Demonstrating the width (B), depth (A), enclosure, setback, and height above ground level (C) of a front verandah

(1) Figure SC6.2.3.6 below illustrates 100% of the front façade width containing a verandah (left), and also an example of a property with a front façade including a verandah for a minimum 60% width of the front façade, wrapping down one side, and includes an asymmetrical projecting front gable (right). Both are open verandahs and are elevated above the natural ground level.

Figure SC6.2.3.6 Illustrates examples of a front verandah

(2) Figures SC6.2.3.7- SC6.2.3.9 illustrate examples of variation in verandah design including open, enclosed, and semi-enclosed and their supporting character elements.

Figure SC6.2.3.7 Illustrates an example of a front verandah, semi enclosed with screening and a door

Figure SC6.2.3.8 Illustrates an example of an open front verandah Workers Cottage style

Figure SC6.2.3.9 Illustrates an example of an open front verandah, Grand Queenslander style

(3) Figure SC6.2.3.10 and SC6.2.3.11 shown below, may be considered as a compatible outcome in relation to PO48, and PO71 and PO 78 of the Character residential zone code. The figures illustrate an example of projecting built forms that may be incorporated into building design in character precincts that do not include a verandah.

Figure SC6.2.3.10 Illustrates an example of a front façade with projecting gable features

Figure SC6.2.3.11 Illustrates an example of a front façade with single asymmetrical projecting gable

SC6.2.3.3 Windows

(1) Figure SC6.2.3.12 shown below, illustrates examples of sympathetic window scale and proportion. These examples provide guidance for addressing outcomes PO20, PO23, PO29 PO34, PO46,PO52, PO58, PO65, PO76 and PO82 of the Character residential zone code.

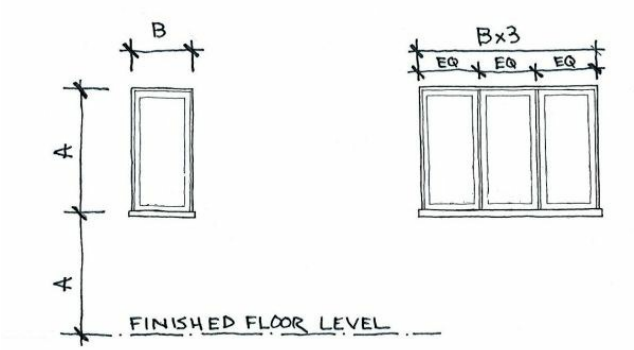


Figure SC6.2.3.12 Illustrates an example of half-height, vertically proportioned windows with one frame (left) and a set of three frames (right)

(2) Figure SC6.2.3.13 shown below, illustrates examples of window hoods in relation to the predominant character of the precinct. This information may be considered in addressing outcomes PO29 and PO34 Character residential zone code requirements regarding sympathetic window scale and proportion.

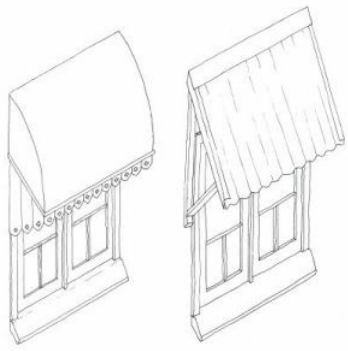


Figure SC6.2.3.13 Illustrates an example of traditional window with hood (left), and an acceptable new window with hood reflecting the same scale and proportions (right)

(3) Figure SC6.2.3.14 - SC6.2.3.17 shown below, illustrates examples of typical windows in character precincts. This information may be considered in addressing outcomes PO20, PO23, PO29 PO34, PO46, PO52, PO58, PO65, PO76 and PO82 of the Character residential zone code.

(a) casement windows and louvers;

Figure SC6.2.3.14 Illustrates an example of two vertically proportioned casements and louvers either side, centrally located under the apex of a gable projection

Figure SC6.2.3.15 Illustrates an example of five vertically proportioned casements located under the apex of a gable projection

(b) bay windows; and

Figure SC6.2.3.16 Illustrates an example of projecting bay window with four casement frames two located centrally and one either side

(c) full height windows.

Figure SC6.2.3.17 Illustrates an example of a full height window, acceptable in 1960's Defence Housing Precinct only

SC6.2.3.4 Building materials

Lightweight construction materials are typical within Townsville's character residential precincts. Lightweight construction materials are traditionally "timber and tin" products. New works within a character residential precinct can replicate lightweight construction using other materials, provided the appearance of lightweight construction is achieved. This section provides guidance on how to achieve PO15 of the Character residential zone code.

(1) Buildings and new works can use materials that are lightweight in appearance and sympathetic with the character of the streetscape. Where traditional lightweight materials are not able to used, non–lightweight materials are acceptable, provided the materials and methods used reflect the appearance of lightweight construction.

An example of an acceptable construction (Figure SC6.2.3.18, left) shows non-lightweight materials that reflect lightweight construction by referencing a raised appearance using textured cladding. An example of an unacceptable construction (right) shows a rendered wall that does not reference a lightweight appearance.

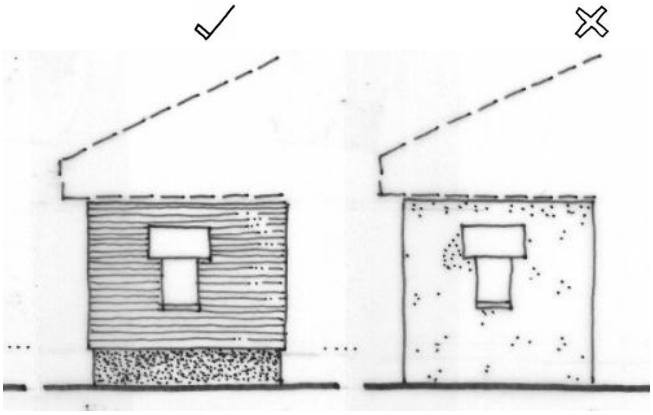


Figure SC6.2.3.18 An example of an acceptable construction (left), and an unacceptable construction (right)

(2) The design materials and principles below provide acceptable examples which can be considered for achieving PO15 of the Character residential zone code.

(a) Typical use of expressive materials in the Character residential zone precincts includes:

(i) chamferboard: A common exterior timber cladding. Several profiles of chamferboard exist, produced in several timber types, such as silky oak, cedar and hardwoods (as shown in Figure SC6.2.3.19);

Figure SC6.2.3.19 Illustrates traditional use of timber chamferboard on external walls

(ii) expressed studwork: Typical of traditional timber framed homes. A practice of fixing the weatherboards to the inner surface of the stud frame and leaving the outer surface uncovered. Evolved to be both functional and decorative (as shown in Figure SC6.2.3.20);

Figure SC6.2.3.20 Illustrates traditional use of expressed studwork walls

(iii) manufactured cladding: Exterior building veneer material. Can be used as an overlay to an existing exterior; some cladding products are known as siding. Manufactured cladding can be used to mimic traditional materials such as chamferboard (as shown in SC6.2.3.21);

Figure SC6.2.3.21 Illustrates new works using manufactured cladding in imitation of traditional lightweight materials

(iv) corrugated galvanised iron: A common roofing material in Australia (as shown in Figure SC6.2.3.22); and

Figure SC6.2.3.22 Corrugated galvanised iron is typical for roofing in Townsville Character buildings

(v) masonry is acceptable for use with external walls where it is finished in the appearance of lightweight construction, and/or used in conjunction with lightweight cladding materials (as shown in Figure SC6.2.3.23).

Figure SC6.2.3.23 Illustrates desirable outcome of a masonry constructed home with a "lightweight appearance"

SC6.2.3.5 Maintaining the street rhythm (scale and proportion)

Maintaining the street rhythm within a character residential precinct is paramount to preserving the character of any particular precinct. Street rhythm can be maintained by repeating the scale and proportions of the character buildings that are predominant in the streetscape. This can be achieved in terms of building heights, setbacks from the street, width of the front facades, and elevation of the floor levels.

Figure SC6.2.3.24 Illustrates an example of an acceptable ground floor enclosure

Figure SC6.2.3.24 illustrates an acceptable example; a raised character building that has been enclosed on the ground level, recessed the full width of the front verandah, using complementary materials and includes a valance in appropriate scale and proportion (this may be considered in addressing numerous Character residential zone code outcomes).

SC6.2.4 Non-residential contributing character buildings

SC6.2.4.1 Non-residential uses

This section of the policy provides guidance in relation to addressing outcome PO35 of the Character residential zone code. In particular, for those properties listed in Appendix 2 - Contributing non-residential properties.

In the South Townsville precinct, non-residential uses and buildings are a contributing element to the precinct's defined character. These non-residential buildings and uses reflect the early settlement and lifestyle of South Townsville.

(1) Typical elements of non-residential contributing character buildings in the South Townsville precinct include:

(a) no setback to street boundaries, and provide an awning and footpath for the full extent of the primary street frontage (as shown in Figure SC6.2.4.1 and Figure SC6.2.4.2); and

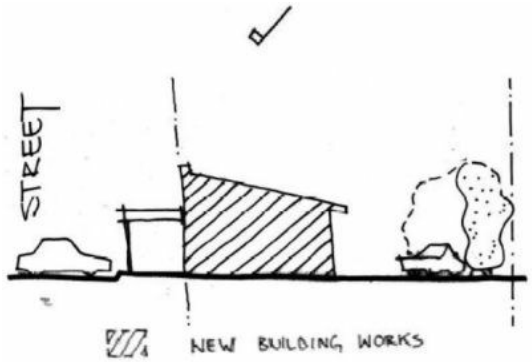


Figure SC6.2.4.1 Non-residential building with no setback to street boundary, awning over the footpath and parking on the street or behind the building

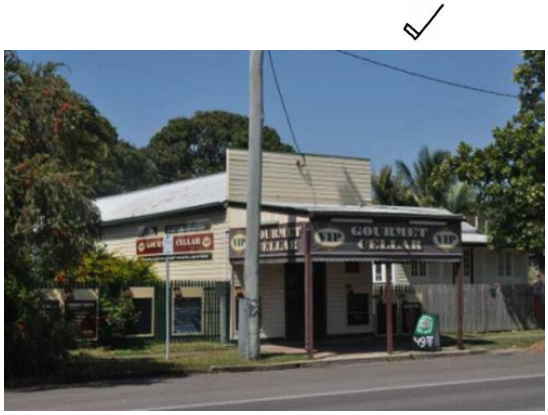


Figure SC6.2.4.2 Existing acceptable example of a non-residential use in an acceptable non-residential building (no setback to street boundary and awning over footpath)

(b) utilise on-street car parking, and/or on-site parking is behind the building and obscured by landscaping screen.

Note—where an existing non-residential non-contributing character building is not retained, the site may be converted to a residential use to match the scale and rhythm of adjacent contributing character residential buildings.

SC6.2.5 Reconfiguring a lot

The following design principle is provided as material for consideration when addressing PO11 of the Character residential zone code.

(1) To maintain the rhythm and consistency of the streetscape, the installation of a fence that is tapered in height from the street front to the front façade of the building may be considered (Figure SC6.2.5.1 illustrates an acceptable outcome).

Figure SC6.2.5.1 Illustrates access strip fencing tapered from the front façade of the building to the street boundary (measurements are provided only as an example)

SC6.2.6 Information that may support a development proposal

SC6.2.6.1 Elevations and streetscape

Development proposals should provide clear representations of the relationship between adjacent contributing character buildings and the proposed works to ensure that the design of development is undertaken with a clear understanding of the surrounding context.

Development applications should provide front/street elevations of the proposed works and of each adjoining contributing character building. References of key elements from adjoining contributing character buildings (roof type/pitch, floor elevations, windows, building materials, building height, setbacks, scale and proportions) should be made in all new works.

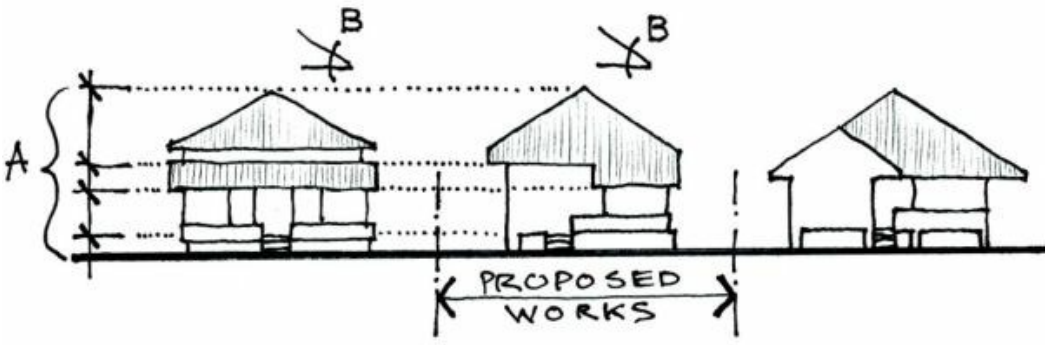


Figure SC6.2.6.1 Illustrates an example of clear elevations of the proposed works and adjoining contributing character buildings, with references made to key elements

SC6.2.6.2 Preparing an assessment report

The following is advice for preparing an assessment report for a property or building within the Character residential zone code. This may be required to demonstrate achievement with the relevant performance outcomes in the Character residential zone code.

An assessment report may provide specific information about how a proposed development will affect the character residential precinct.

The report should include the following:

(1) A brief description of the proposed development including:

- (a) type of development;
- (b) range and scope of work proposed;
- (c) timeframe for carrying out work; and
- (d) location of work in relation to the character residential precinct;

(2) A description of the setting and context of the place, including photographs and maps showing significant features that will be affected. Provide an analysis of the affect the development will have on the streetscape;

(3) A description of proposed changes to character including:

(a) what elements or aspects of streetscape are affected by the change;

(b) assessment of the proposal against the performance outcomes in the zone code;

(c) analysis of the impact of the change on the significance of the precinct;

(d) assessment of potential for detrimental impact on the significance of the precinct; and

(e) where the proposed change is assessed as having potential for detrimental impact, provide information about why the change is required, alternative solutions that were investigated, and what measures are included in the development to reduce detrimental impact that may result from the change; and

(4) References list documents referred to in the assessment report such as conservation policies, conservation management plan, condition report (i.e. demolition report), and specialist consultants' reports. (Adapted from Guideline: *Preparing a Heritage Impact Statement* Department of Environment and Heritage Protection, 2011).

SC6.2.6.3 Preparing a condition report

If an application is proposing demolition of a contributing character building, the applicant may be requested to provide a condition report. The condition report should, at a minimum, include consideration of:

(a) the structural stability of the building in the form of a structural engineer's report. The condition report must include a factual statement from an appropriately qualified structural engineer about the condition of the building; and

(b) a pest inspection report and other supporting documentation may also be provided.

Appendix 1

SC6.2 APPENDIX 1: Non-contributing properties in the Character residential zone

Precinct A – 1950's Post War Expansion

Address	Comments
79 Lancaster Street	Original house that has been re-clad with face brick, including brickwork fence. Original roof form and windows have been retained, however brickwork is out of character
18 Lockheed Street	Contemporary rendered blockwork slab on ground house with double garage facing the street and rendered masonry front fence.
62 Perroux Street	High-set house
10 McHardie Street	Blockwork house
14 McHardie Street	Blockwork house
29 Downs Street	Blockwork house

Precinct B – 1960s Defence Housing and 1960s Housing Commission

Address	Comments
55 Clements Crescent	Substantial tornado damage
2 Lancaster Street	Low-set house
3 Lancaster Street	"Ranch Style" high set house – different style to predominant character
4 Lancaster Street	Low-set house
46 Douglas Street	Oriented to other street – does not relate to rest of precinct

Precinct C – Worker's Cottages

Address	Comments
4 Fifth Street	Vacant Lot
6 Fifth Street	Vacant Lot
3 Fifth Street	High-set horizontally massed house with shallow pitched roof
2 Flowers Street	High-set horizontally massed house
16 Flowers Street	Low-set Blockwork house
26 Flowers Street	Horizontally massed with prominent carport
77 Ninth Avenue	High-set horizontally massed house
1A Doorey Street	Low-set rendered house with prominent carport to front boundary
66 Tenth Avenue	Low-set blockwork duplex
60 Eleventh Avenue	High-set horizontally massed house
63 Eleventh Avenue	High-set horizontally massed house
73 Eleventh Avenue	High-set fibre cement clad house
75 Eleventh Avenue	High-set horizontally massed duplex
12 Fourteenth Avenue	Low-set blockwork house
14 Fourteenth Avenue	Low-set blockwork house
13 Fifteenth Avenue	High-set horizontally massed house
40 Seventh Street	Low-set fibre-cement house with skillion roof
7 Third Street	Low-set blockwork house
9 Third Street	High-set horizontally massed house with shallow pitched roof
14 Third Street	Low-set blockwork house (obscured by garden)
19 Third Street	High-set horizontally massed duplex
31 Flowers Street	Low-set blockwork house
258 Boundary Street	Blockwork Duplex
288 Boundary Street	Horizontally massed high-set house
1 Cape Street	Blockwork House
2 Cape Street	Horizontally massed high-set house
2 Comet Street	Low-set fibre cement house with shallow roof pitch
6 Fourth Avenue	Low-set house with shallow roof pitch
30A Sixth Avenue	Horizontally massed house with blockwork arches
37 Sixth Avenue	Vacant Lot
26 Sixth Street East	Horizontally massed high-set house
52A Sixth Street East	Vacant Lot
53 Sixth Street East	Vacant Lot
55 Sixth Street East	Water Police Office
57 Sixth Street East	Vacant Lot
56-58 Sixth Street East	Vacant Lot
19 Eighth Avenue	Horizontally massed two storey house
26 Perkins Street	Low-set blockwork house
37 Davidson Street	Low-set block house with large setback
40 Davidson Street	Low-set coloured blockwork house
42 Davidson Street	Rendered low-set house with tiled roof and garage door on street
15 Baxter Street	Original character house – raised to two storeys and poorly enclosed front verandah.
21 Baxter Street	Low-set brick block of units
22 Baxter Street	Rendered low-set house with visually prominent garage
7A Garrick Street	High-set fibre cement house with shallow pitched front gable
12 Garrick Street	Low-set brick house
16 Garrick Street	Low-set blockwork house
9-11 Castling Street	High-set “Ranch” style fibro house with shallow pitched roof
8 Castling Street	Blockwork lowest house
15 Estate Street	Modern, unsympathetic new dwelling, inconsistent setback, subdivision not consistent with other blocks

15A Estate Street	Modern, unsympathetic new dwelling, inconsistent setback, subdivision not consistent with other blocks
17 Estate Street	Low-set house with shallow front gable
18 Estate Street	Horizontally massed house
26 Estate Street	High-set 1950s era house
28 Estate Street	Low-set masonry – only visible expression is front double carport
3 Townsville Street	High-set fibre cement clad with shallow pitched front gable
4 Townsville Street	High-set horizontally massed house
5 Townsville Street	Unsympathetically raised house
7 Townsville Street	Character house with blank blockwork wall in front
15A Townsville Street	Rendered low-set house with prominent front carport
27 Townsville Street	Vacant lot
2 Edwards Street	Low-set rendered house with very shallow roof pitch
7 Edwards Street	Recent house with disproportionate front setback and prominent front carport
7A Edwards Street	Recent house with disproportionate front setback and prominent front carport
17 Edwards Street	Gable fronted two storey units
18 Edwards Street	Low-set house with brick walls and single front gable
6 Lamington Road	Brick “six pack” unit block
12-14 Lamington Road	Blockwork units, tiled roof
13 Lamington Road	Blockwork units
6 Humphrey Street	Two storey brickwork units
14 Humphrey Street	Low-set blockwork units
15 Humphrey Street	Low-set blockwork house
25 Humphrey Street	Unsympathetically raised and renovated character house
5 Plant Street	Two storey blockwork “six-pack” units
6 Shaw Street	Oversized modern highest house with gable – out of scale
22 Shaw Street	High-set “Ranch” style
25 Shaw Street	Low-set blockwork duplex
9 Shaw Street	Blockwork units

Precinct D – South Townsville (Residential)

Address	**Comments**
66 Allen Street	Rendered two storey house with prominent carparking
75 Allen Street	Low-set blockwork house
30 Allen Street	Low-set rendered house
10 Bell Street	Low-set fibre cement house
15 Bell Street	Horizontally massed high-set house
17 Bell Street	Brick and tile house
21 Bell Street	St Andrews Villas – Brick low-set
37A Bell Street	Rendered duplex
37B Bell Street	Rendered duplex
183 Boundary Street	Horizontally massed high-set house
283-285 Boundary Street	Low-set blockwork house
1 Cannan Street	Contemporary house under construction
17 Hubert Street	Character house raised on disproportionately high stumps
41 Macrossan Street	Horizontally massed high-set house
55 Macrossan Street	Two storey blockwork house
5 Martin Street	Low-set duplex with very prominent garages
10 Martin Street	Low-set rendered duplex
7 Nelson Street	Brick and tile house
13 Nelson Street	Wide low-set rendered house
18 Nelson Street	Brick duplex with blank gable end facade
21 Nelson Street	Vacant lot
22 Nelson Street	Low-set blockwork house

43-45 Nelson Street	Brickwork units
46 Nelson Street	Contemporary skillion roofed house – lacks front verandah
50 Nelson Street	Brick and tile house
52 Nelson Street	Brick and tile house
54 Nelson Street	Low-set blockwork house
71 Perkins Street	Low-set rendered house
85 Perkins Street	Vacant lot
115 Perkins Street	Unsympathetically converted commercial building
8 Tully Street	Blockwork duplex
42 Tully Street	Two storey brickwork house
44 Tully Street	Mock heritage low-set house
73 Tully Street	Rendered two storey house – lacks shade elements
81 Tully Street	Two storey blockwork house
91 Tully Street	Low-set blockwork house
97 Tully Street	Low-set rendered house
105 Tully Street	Multiple units

Precinct D – South Townsville (Non-Residential)

Address	**Comments**
50 Allen Street	Rendered recent commercial building – built to front boundary, however lacks street activation and awnings to footpath
12-20 Bell Street	Large contemporary warehouse building – Sigma Pharmaceuticals
20A Bell Street	Shades By Prior – rendered recent commercial building built to boundaries, however lacks substantial awnings to footpath
22 Bell Street	Map to Mine – commercial offices with large front setback
8 Cannan Street	Sabre Marine – large light industrial shed with large setback to the street and front hardstand area
10 Cannan Street	Basic commercial building with large front setback and extensive front carparking area
12 Cannan Street	Basic commercial building with large front setback and extensive front carparking area
6 Hubert Street	NSS (Northern Stevedoring Services) Shed with large hardstand area to street
3-7 Macrossan Street	South Townsville Self-Storage – secure self-storage complex
11 Macrossan Street	Portside Self-Storage – secure self-storage complex
13-17 Macrossan Street	U-Store – secure self-storage complex
36 Macrossan Street	Home-grown Hardwoods – large setback to the street and prominent front hardstand and storage area
38 Macrossan Street	SSAF Sheetmetal – Light industrial shed built to front and side boundaries however lacks street activation or awnings to footpath. May be suitable for retrofitting or refurbishment to improve character values.
45 Macrossan Street	Black River Cattle Equipment – light industrial use and rear shed destroys character values of retained house.
47 Macrossan Street	Abraham Steel Fabrications – large light industrial shed.
53 Macrossan Street	C&C Motors Shed – light industrial shed
46 Morey Street	Furniture warehouse with relatively blank blockwork façade to street and lack of shade to footpath. Appears suitable for retrofitting or refurbishment to improve character values.
19 Perkins Street	Light Industrial shed setback from street with hardstand area to front
41 Perkins Street	Murphy Steel Fabrications – Open light industrial shed with general storage in fenced yard.
75 Perkins Street	Dick Yuen Wholesale – Large front setback and extensive front hardstand area
99 Perkins Street	Kirk's Automotive Service – Shed to street frontage – interrupts an otherwise consistent row of character houses. Shed to rear of site may have some character value however is not readily visible from the street.

113 Perkins Street	Hood the Sailmakers Offices – blockwork commercial building. Built to front and side boundaries however lacks street activation and awnings to footpath. Appears suitable for retrofitting or refurbishment to improve character values.
3 Tully Street	U-store – secure self-storage complex
17 Tully Street	Shed with large front setback
50 Tully Street	Commercial complex with relatively blank blockwork façade to street and prominent driveway.
58 Tully Street	Warehouse complex. Built to front and side boundaries, however blank blockwork façade and lack of shade to footpath. Appears suitable for retrofitting/refurbishment.
80 Tully Street	Woodfield Engineering – basic light industrial shed
102 Tully Street	Fenced site – otherwise vacant

Precinct E – Queenslanders

Address	**Comments**
12 The Avenue	3 storey blockwork “Six-pack” units
16 The Avenue	2 storey brick units
7 Ackers Street	Three storey blockwork units
16 Ackers Street	Brickwork units
24 Ackers Street	Blockwork units
26 Ackers Street	Blockwork units
29-31 Ackers Street	Blockwork units
32 Ackers Street	Blockwork units
39 Ackers Street	Brick and tile house
42 Ackers Street	Low-set duplex
57 Ackers Street	Blockwork units
64 Ackers Street	Low-set blockwork duplex
66 Ackers Street	Horizontally massed high-set house
68 Ackers Street	Horizontally massed high-set house
69 Ackers Street	Low-set fibre cement units
2 Ahearne Street	Vacant lot
19 Ahearne Street	Brickwork base, horizontally massed highset house
25 Ahearne Street	Horizontally massed high-set house
27 Ahearne Street	Horizontally massed high-set house
35 Ahearne Street	Blockwork units
36 Ahearne Street	Horizontally massed high-set house
38 Ahearne Street	modern duplex
47 Ahearne Street	Blockwork units
51 Ahearne Street	Two storey contemporary units – some sympathetic elements however overall bulk and prominent garages are detrimental.
52 Ahearne Street	Vacant lot
54 Ahearne Street	Blockwork Units
70 Ahearne Street	Brickwork house
7 Armstrong Street	Blockwork low-set units
16 Armstrong Street	Horizontally massed high-set house
18 Armstrong Street	Three storey blockwork units
27 Armstrong Street	Low-set brick units
28 Armstrong Street	Horizontally massed high-set house
30 Armstrong Street	Low-set brick units
39 Armstrong Street	Two storey brick units
41 Armstrong Street	Fibre cement building with shallow roof pitch – used as offices
44 Armstrong Street	Two storey blockwork with arches
50 Armstrong Street	Blockwork low-set house
54 Armstrong Street	Brickwork units

56-58 Armstrong Street	Blockwork units
64 Armstrong Street	Vacant lot
78 Armstrong Street	Low-set rendered house
36-38 Ackers Street	Two storey brick units
4 Campbell Street	Blockwork units
6 Campbell Street	Blockwork units
2 Marks Street	Horizontally massed high-set house
16 Marks Street	Two storey blockwork units
18 Marks Street	Two storey rendered units
13 Philp Street	Rendered low-set units
16 Philp Street	Blockwork low-set units
19 Philp Street	Two storey brick house
21 Philp Street	Low-set rendered house
27 Philp street	Brick two storey units
37 Philp Street	Vacant Lot, not gazetted address, part of 35 Philip but fenced off
42 Philp Street	Rendered two storey units
9 Campbell Street	Masonry rendered 2 storey house (actually rear of lot at 42 Philip St, but driveway is to Campbell & post-box has number 9 on it.
14 Summerfield Street	Vacant lot
2A Ralston Street	Low-set blockwork units
2 Ralston Street	Low-set blockwork units
16 Ralston Street	Two storey blockwork units
18 Ralston Street	Vacant lot
45 Henry Street	Two storey blockwork units
125-127 Francis Street	Church, modern brickwork
129 Francis Street	Masonry units
146 Francis Street	Low-set blockwork house with very shallow roof pitch
154 Francis Street	Low-set house with stipple render finish
36 Leigh Street	Two storey units – face brickwork with fibre cement chamfer boards
56 Leigh Street	Light industrial building
25 Stagpole Street	Prominent three storey blockwork units
30 Stagpole Street	Horizontally massed high-set house
32 Stagpole Street	Blockwork low-set house with shallow roof pitch
33A Stagpole Street	Newly reconfigured house
40 Stagpole Street	Low-set rendered units (“6 pack”)
43A Stagpole Street	Newly reconfigured house
49 Stagpole Street	Open light industrial shed
52 Stagpole Street	Low-set shallow pitched hipped roof house with high fence and low floor height
82 Stagpole Street	Horizontally massed high-set house
83 Stagpole Street	Shallow pitched skillion roofed fibre cement clad house
86 Stagpole Street	Low-set blockwork units
93 Stagpole Street	Horizontally massed 1960’s era high-set house. Front setback blocks views to “Wolverton”.

Precinct F – Interwar Gables and Queensland Bungalows

Address	**Comments**
14 Chubb Street	Rendered front parapet (addition) and tall rendered fence
16 Chubb Street	Rendered
15 Taylor Street	Horizontally massed high-set house
16 Taylor Street	Vacant lot
20 Taylor Street	Horizontally massed high-set house
12 McKillop Street	Brick house with prominent front carport
3 Mawai Street	Low-set blockwork house with high fence
8 Mawai Street	Horizontally massed high-set house

4 Mears Street	Horizontally massed high-set house
6 Mears Street	Horizontally massed high-set house
11 Mears Street	Horizontally massed high-set house
22 Mears Street	Brick and tile units
24 Mears Street	Street frontage dominated by double carport with roller doors
34 Mears Street	Two storey block of units with shallow pitched roof
30 Hammond Street	Horizontally massed high-set duplex

Precinct G – Interwar to 1950s Asymmetrical Gable

Address	Comments
34 Hooper Street	Low-set blockwork duplex
35 Hooper Street	Low-set skillion roofed house with prominent front carport
26 Hooper Street	Vacant lot
53 Princes Road	Units
14 Princes Road	Two storey units
29 Princes Road	Units
30 Princes Road	Units
16 Sussex Street	Blockwork low-set house
3 Batt Street	Modern rendered with skillion roof
9 Batt Street	Slab on ground, flagstone veneer
3 Purves Street	Slab on ground, rendered modern
21 Kenilworth Street	Low pitch mono gable horizontally massed
22 Kenilworth Street	Low-set render low pitched roof
23 Kenilworth Street	Brick veneer, two storey
24 Kenilworth Street	Not representative of character, but good tropical house
12 Kenilworth Avenue	Two storey unit development
6 Surrey Street	High-set fibre cement clad house
14 Surrey Street	Brick low-set house
16 Surrey Street	Brick low-set house
20 Surrey Street	Brick House
19A Surrey Street	High-set fibre cement clad house
21A Surrey Street	“Six pack” unit block
31 Townsend Street	Rendered blockwork house with prominent front garage
5 Burton Street	Low-set blockwork duplex
34 Townsend Street	Skillion roofed low-set house with rendered walls. Possible 1950s era
7 Burton Street	Low-set brickwork duplex
12 Burton Street	Low-set blockwork house
25 Burton Street	Low-set blockwork duplex
26 Burton Street	Horizontally massed high-set house
5 Ballard Street	Horizontally massed high-set house
11 Ballard Street	Horizontally massed high-set house
13 Ballard Street	Horizontally massed low-set house
15 Ballard Street	Rendered low-set house with shallow front gable
16 Ballard Street	Two storey, two car garage to front
40 Purves Street	Horizontally massed high-set house
51 Purves Street	Two storey unit building
55 Purves Street	Low-set blockwork house
57 Purves Street	Vacant lot
25 Mindham Street	Low-set rendered duplex

Precinct H – Churchill Street

Address	Comments
9 Churchill Street	High-set house with shallow pitched gable roof
11 Churchill Street	Low-set blockwork house with shallow pitched roof and lack of windows oriented towards street

Precinct I – Park Street

Address	Comments
22 Gladstone Street	Terrace Style Unit development. Width of building facing Park Street far exceeds character houses.
24 Gladstone Street	Pre 1946 house, however house faces Gladstone Street and does not contribute to Park Street Precinct streetscape.
20 Park Street	Unit Development. Incorporates some sympathetic features such as front verandah and fence.
21 Park Street	60's era High-set house with fake brick cladding
23 Park Street	Blockwork unit development with blank street frontage and no fence.

Precinct J – Grand Queenslanders

Address	Comment
17 Alexandra Street	3 storey brickwork units
26 Alexandra Street	Rendered house with shallow roof pitch and no front verandah
32 Alexandra Street	Low-set brick and tiled roof house
40 Alexandra Street	Two storey blockwork house
43 Alexandra Street	Two storey 1950s house with flush lower level and dominant rendered front retaining wall.
44 Alexandra Street	4 storey blockwork units
46 Alexandra Street	Rendered two storey units with tiled roof
1 Burke Street	4 storey blockwork units
2 Burke Street	Low-set masonry units
32 Paxton Street	Two storey rendered units with blank façade and prominent parking
21 Cleveland Terrace	Rendered Units – wide form/bulk, Mediterranean style
19 Cleveland Terrace	Brick unit building. Wide, horizontal massing.
11 Cleveland Terrace	Brick unit building. Setback from street does not align with neighbours
27 Cleveland Terrace	Building site – design appears to be modern house with materials that are not related to surrounding context.
34 Cleveland Terrace	Shallow gabled low-set house. Overly large front setback. Fibre cement wall cladding.
7-11 Hamilton Street	Very large site – Vacant apart from small 70s/80s era fibre cement clad dwelling.
3-5 Hamilton Street	Vacant
25 Melton Terrace	70's era fibre cement clad units. Dilapidated.
7 Victoria Street	Two storey rendered house with shallow roof pitch and prominent double garage
18-20 Victoria Street	Blockwork and tile duplex
15-19 Victoria Street	Ridgemont Motel – Blockwork and tiled roof
26-28 Victoria Street	Skillion roofed house
273 Stanley Street	Skillion roofed cottage
277 Stanley Street	Derelict cottage
279 Stanley Street	Brick units
37 Hale Street	Two storey fibre cement clad unit building – lacks front verandah.
39 Hale Street	Modest low-set house with large street setback and no front verandah.

Precinct K – French Street

Address	Comments
18 French Street	Blockwork unit block with large setback
16 French Street	Blockwork House with tiled roof
20 French Street	Modern unsympathetic units
27 French Street	Enclosed block work on ground floor and the removal of external front staircase
13 French Street	Low-set rendered masonry units

Precinct L – Mixed 1950's

Address	Comments
2 Goodwin Street	Blockwork low-set house
28 Goodwin Street	1960's era high-set house
56 Goodwin Street	Rendered contemporary low-set house
66 Goodwin Street	Horizontally massed high-set duplex
69 Goodwin Street	Blockwork low-set house
101 Goodwin Street	Blockwork low-set with tiled roof
3 McDougall Street	Horizontally massed high-set duplex
4 McDougall Street	Horizontally massed high-set duplex
27 Haig Street	3 storey unit development
3-5 Haig Street	Unit Development
2B Haig Street	Unsympathetic modern dwelling
6 Haig Street	Low-set house with prominent flat roofed extension facing Haig Street
10 Isley Street	Brick veneer, timber floor low-set house
12 Isley Street	Brick veneer on slab
146 Howitt Street	Three storey apartment complex
146 Mitchell Street	Two storey units

SC6.2 APPENDIX 2: Contributing non-residential properties

Address	Comments
38-42 Allen Street	Former Petrol Station – currently Motolec Auto Electrical. Current use of forecourt for fenced general storage is detrimental to precinct character; however, site contains former petrol station buildings that are part of the mixed precinct character. Site would benefit from refurbishment and new use with greater street activation.
39 Allen Street	Pre1941 commercial building built to front boundary with 2 shopfronts and awning over footpath.
34 Archer Street	Former basic light industrial shed – patina of weathered corrugated iron and surrounding gardens contributory.
25 Bell Street	Character house converted into two storey commercial building. No setback to front boundary and includes awning to footpath.
33 Bell Street	Pre 1941 commercial building built to front boundary. Character value reduced by added blockwork façade and lack of awning to footpath.
173 Boundary Street	Pre 1941 small chamferboard shop to street with awning. High chainlink fence to property boundary is detrimental to the character.
265 Boundary Street	Small row of shopfronts with awning to footpath. Parts appear to be pre1941. Unusual 1960's era two storey units on the same parcel of land – units appear to have potential for retrofitting/refurbishment.
32 Hubert Street	St Patrick's Catholic Church and former school building.
20 Macrossan Street	Commonwealth Hotel. Two storey corner hotel with wraparound verandahs over footpath. Very important contributor to local character.
30 Macrossan Street	St Johns Anglican Church
65 Morey Street	Bahai Community Centre
25 Perkins Street	Building materials site with pre 1941 twin gabled sheds built to Perkins Street Boundary. Current use of site for open storage is detrimental to precinct character however sheds have character value and appear suitable for retrofitting or refurbishment.
45 Perkins Street	South Side Engineering – light industrial gabled shed with some character values and appears suitable for retrofitting or refurbishment.
89 Perkins Street	Former 1950s era Art Deco influenced brick and tile house. Features curved walls and unusual plan. Currently used as offices for Family Emergency Accommodation Townsville – generally retains residential appearance.
115-147 Perkins Street	Heritage listed Warehouse building with brick components dating from 1899. Property is in relatively poor condition. Site is very large and mainly open hardstand – the heritage building occupies the Cannan Street end only. Sympathetic retrofitting or refurbishment will be required to retain the character values of this property.

SC6.3 Cultural heritage planning scheme policy

SC6.3.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Cultural heritage PSP.

SC6.3.1.1 Purpose

The purpose of the planning scheme policy is to provide applicants with additional information and guidance in meeting the requirements of the Cultural heritage overlay code and the Advertising devices code for signage in Flinders Street East.

SC6.3.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.3.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Cultural heritage overlay code and Advertising devices code.

SC6.3.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1.

SC6.3.2 Planning scheme policy details

The cultural heritage of Townsville continues to be a major contributor to the identity of the City and local communities. The Citation of Heritage Places Report provides information about each heritage place in Townsville. It highlights the criteria that were originally identified for each place and indicates its significant heritage features and eligibility for entry into Schedule 7 Places of cultural heritage value.

This planning scheme policy contains information to help individuals and groups identify, conserve and protect heritage places in Townsville. This policy provides applicants with guidance in meeting the requirements of the Cultural heritage overlay code and the Advertising devices code (where it relates to advertising devices for heritage places in Flinders Street East). The policy also details how to nominate to add a place to Schedule 7 Places of cultural heritage value and how to nominate to remove a place from Schedule 7 Places of cultural heritage value.

SC6.3.2.1 Finding your way around the policy

The policy is divided into the following nine sections:

(1) Information that may support a development proposal (SC6.3.3);

(2) Development adjoining a heritage place (SC6.3.4);

(3) Development within a heritage place, including advertising devices (SC6.3.5);

(4) Preparing a heritage impact statement report (SC6.3.6);

(5) Preparing a condition report (SC6.3.7);

(6) Preparing archival recording of a heritage place (SC6.3.8);

(7) Interpretive signage for the loss of a heritage place (SC6.3.8.3);

(8) Preparing an archaeological management plan (SC6.3.9); and

(9) Adding or removing a place to Schedule 7 Places of cultural heritage value (SC6.3.10).

SC6.3.3 Information that may support a development proposal

The information required for any development application will depend on the heritage significance of the heritage building, site or element and the proposed development. In addition to the requirements for development applications under the *Planning Act 2016* (PA) and the relevant Integrated Development Assessment System forms, the following additional information should generally be provided to council.

(1) To ensure that the design of the proposed development is undertaken with a clear understanding of the surrounding context and significance of "place", the proposed application should submit clear representations of the relationship between the heritage buildings and the proposed works.

(2) The applicant should submit a street elevation of the proposed development. The elevation is to be

(a) drawn to 1:200 scale;

(b) include the full width of the street frontage of the proposed development and the two adjacent neighbouring buildings (as shown in Figure SC6.3.3.1);

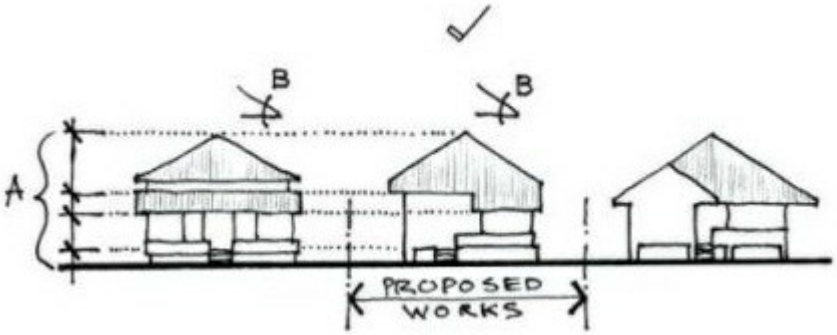


Figure SC6.3.3.1 Illustrates desirable outcome. 'A' denotes key building lines and 'B' is the referenced roof pitch. This may provide clear representations of relationship between the heritage place and the proposed works such as floor heights, dominant fascia lines, roof lines, roof pitch etc.

(c) provide accurate representations of the primary design considerations: setbacks, form, massing, height, materials, finishes, and key detail elements that contribute to the significance of the heritage place;

(d) for new buildings adjoining a heritage place, indicate key building lines in relation to the heritage place (as shown in Figure SC6.3.3.2); and

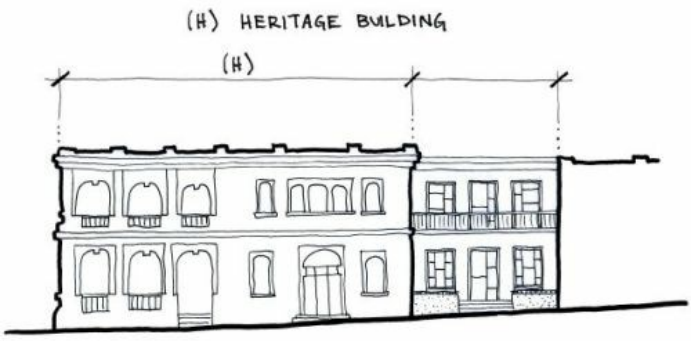


Figure SC6.3.3.2 Key building lines in relation to the heritage place

(e) for new works that are proposed to be visually obscured by a heritage feature, consider demonstrating view lines using a cross section drawing (as shown in Figure SC6.3.3.3).

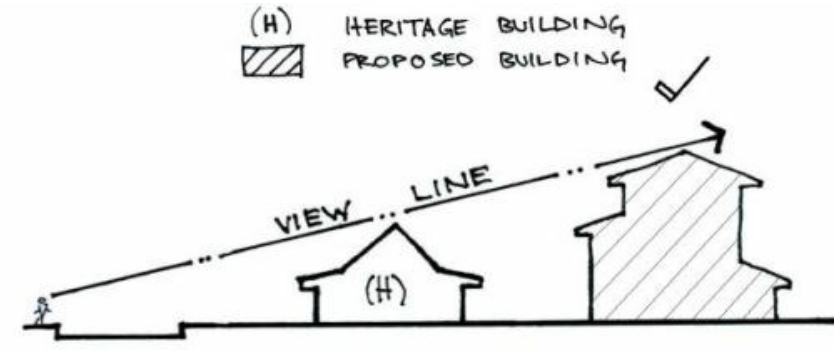


Figure SC6.3.3.3 View lines using a cross-section drawing

(3) In addition to the requirements above, for buildings with a height greater than 2 storeys, the applicant may be requested to submit:

(a) three dimensional perspective images inclusive of the adjacent neighbouring buildings; and

(b) in urban contexts in which the streetscape is of uniform height consistent with the height of the heritage place, provide an elevation drawing of the full width of the street block and nominate a "reference height".

SC6.3.4 Development adjoining a heritage place

This section of the policy provides guidance in achieving performance outcome PO13 of the Cultural heritage overlay code associated with setbacks for development, building height and scale and form of development adjoining a heritage place.

SC6.3.4.1 Setback for development

PO13 of the Cultural heritage overlay code requires that new buildings be consistent with the significant features and values of the heritage place, including, but not limited to, built form and setbacks, maintain significant views to and from the heritage place and ensure that new buildings are visually subservient.

(1) To achieve the requirements of the performance outcomes in the code and allow for significant views to and from a heritage place to be maintained, the following design guidance should be considered.

(a) in instances where the significance of the heritage place includes its setback in common with the established street pattern, the setback of new works ought to maintain this significance (as shown in Figure SC6.3.4.1);

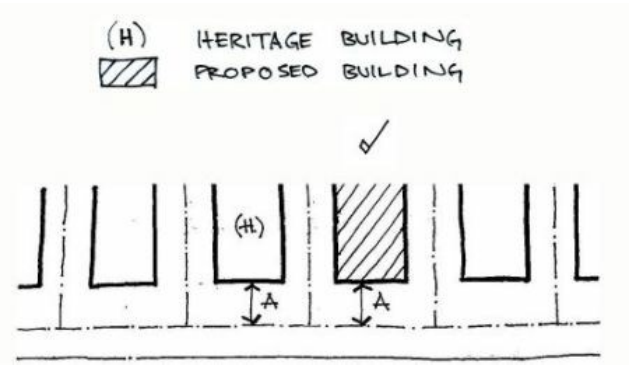


Figure SC6.3.4.1 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" is the street setback distance.

(b) in instances where the significance of the heritage place includes its difference in setback to the established street pattern, the setback of new works ought to maintain this significance (as shown in Figures SC6.3.4.2- SC6.3.4.6); and

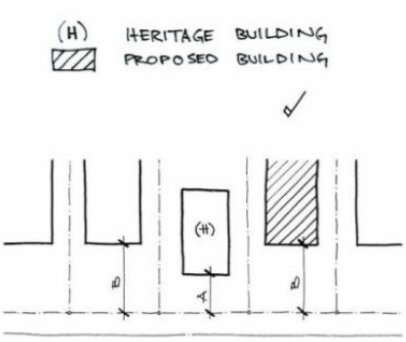


Figure SC6.3.4.2 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" and "B" is the street setback distance.

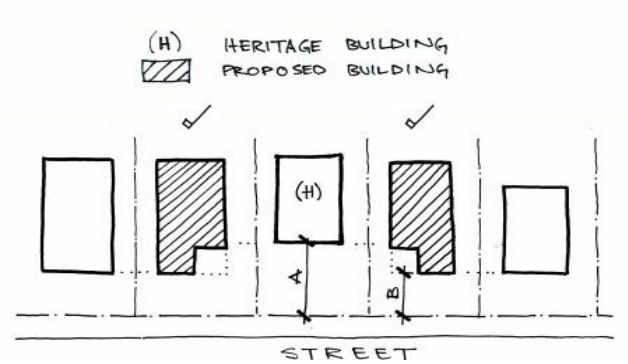


Figure SC6.3.4.3 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" and "B" is the street setback distance

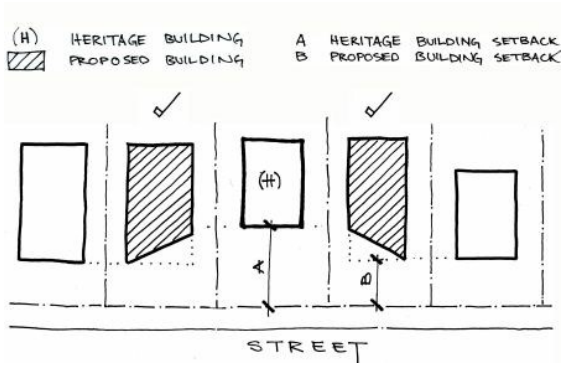


Figure SC6.3.4.4 Illustrates appropriate front setbacks for development adjoining a heritage place. 'A' and 'B' is the street setback distance

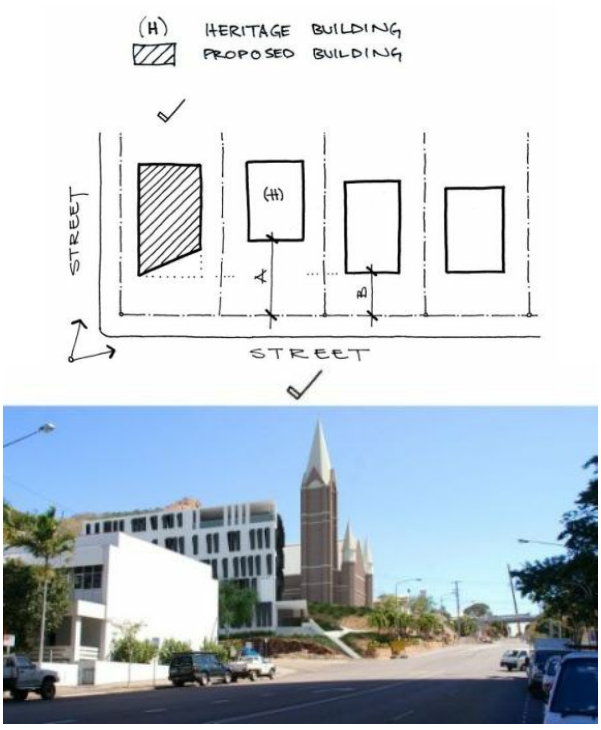


Figure SC6.3.4.5 Illustrates appropriate corner block front setback for development adjoining a heritage place. "A" and "B" is the street setback distance. The setback of new development is tapered to allow improved views to the heritage place.

(c) in order to achieve visual subservience to a heritage place in accordance with PO13, building form ought to be articulated into smaller elements to relate to scale, rhythm and spacing of the heritage place and its context (as shown in Figure SC6.3.4.6).

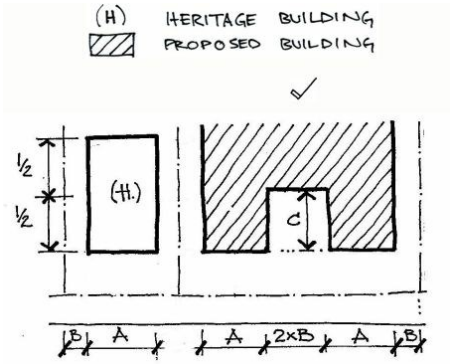


Figure SC6.3.4.6 Illustrates sympathetic building frontage rhythm. "B" is side setback; "C" (being the depth separation to get sympathetic building frontage rhythm) is 6m or ½ of "H" (heritage building depth)

SC6.3.4.2 Building height

(1) Where parts of the development are proposed to be taller than adjacent significant heritage elements, the following design guidance may be considered to demonstrate achievement of performance outcome PO13 of the Cultural heritage overlay code:

(a) proposed taller elements of the proposed new building are to be setback to diminish their impact (as shown in Figure SC6.3.4.7);

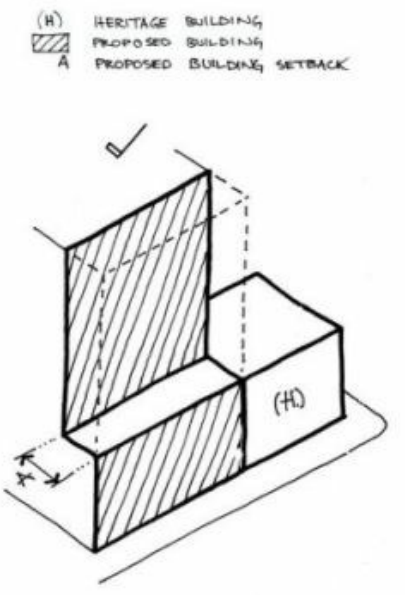


Figure SC6.3.4.7 Illustration of building setback of taller new building. "A" is equal or greater than 3m

(b) setback upper levels of the proposed new building to provide a transition between adjacent buildings of different scales (as shown in Figure SC6.3.4.8);

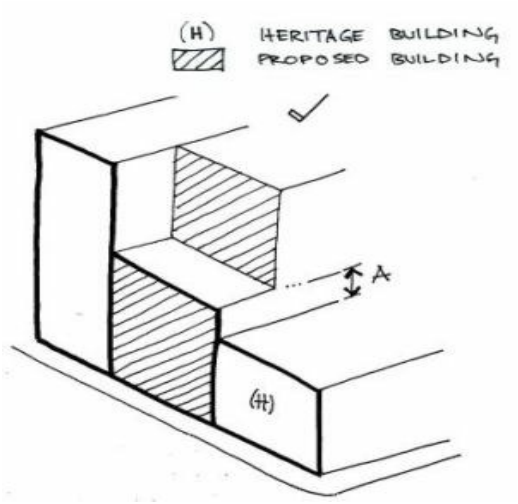


Figure SC6.3.4.8 Illustration of new building upper level setbacks. Dimension "A" is within 20% of the adjacent heritage building height

(c) provide an appropriate separation gap between the significant heritage elements and taller new elements (as shown in Figure SC6.3.4.9);

(d) building elements in the separation gap may be recessed and of lower height and/or different material than the heritage building, (as shown in Figure SC6.3.4.9); and

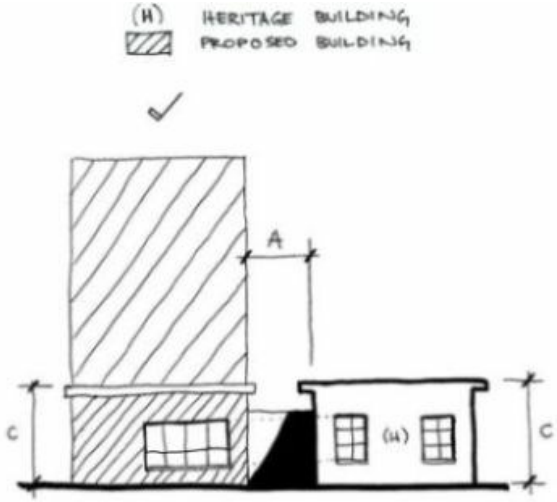


Figure SC6.3.4.9 Illustration of separation gap between contributing heritage elements and taller new buildings. "A" is Separation and "C" is the Common Reference Height

Figure SC6.3.4.10 An example of a desirable outcome – free standing tower provides a significant landscaped public piazza which acts as a separation adjacent to the heritage place

(e) new building works reflect a ‘reference height’ for the full width of the street frontage where the ‘reference height’ is consistent with the height of the adjacent heritage building (as shown in Figure SC6.3.4.11).

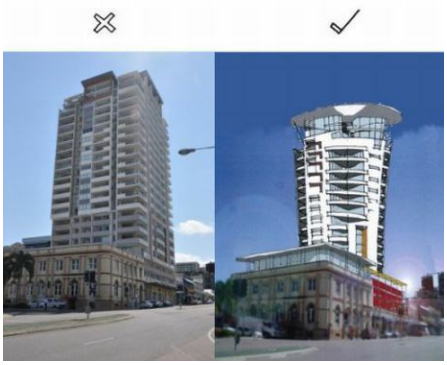


Figure SC6.3.4.11 An example of an undesirable outcome (left): tower element with no setbacks to the street boundary or adjacent heritage building which is detrimental to the otherwise uniform streetscape heights and the adjacent heritage building. An example of a desirable outcome (right): tower element setback from the street boundary and the adjacent heritage building to reduce the impact of its height and bulk. Podium element references the heights of the adjacent heritage building and streetscape.

SC6.3.4.3 Scale and form of development adjoining a heritage place

(1) The following design examples are associated with building scale and form and may be considered to demonstrate achievement of performance outcome PO13 of the Cultural heritage overlay code.

(a) in instances where the significance of the heritage place form includes its difference in scale to its setting, the scale of new works is to maintain this significance (as shown in Figure SC6.3.4.12); or

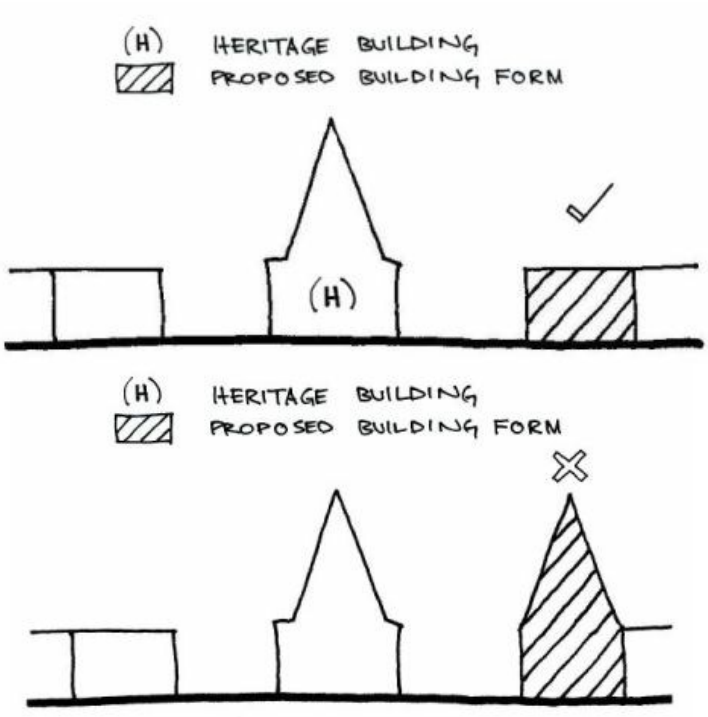


Figure SC6.3.4.12 Illustration of desirable and undesirable outcome

(b) in instances where the significance of the heritage place form includes its common scale and form to its setting, the scale and form of new works is to maintain this significance (as shown in Figure SC6.3.4.13); and

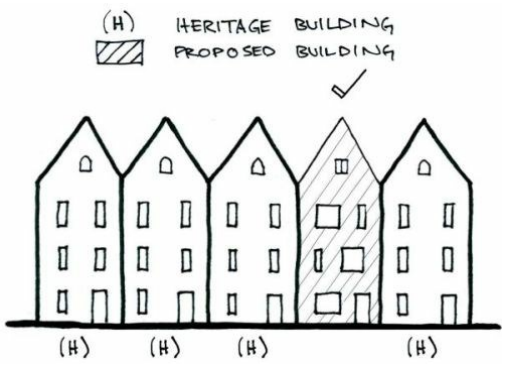


Figure SC6.3.4.13 Illustration of development maintaining common scale

(c) new building works should generally not directly copy the heritage place and as an example, should be readily distinguishable from it. Use of similar overall form, scale, proportions and materials is appropriate (as shown in Figure SC6.3.4.14 and SC6.3.4.15);

Figure SC6.3.4.14 Illustrates an example of appropriate scale and form

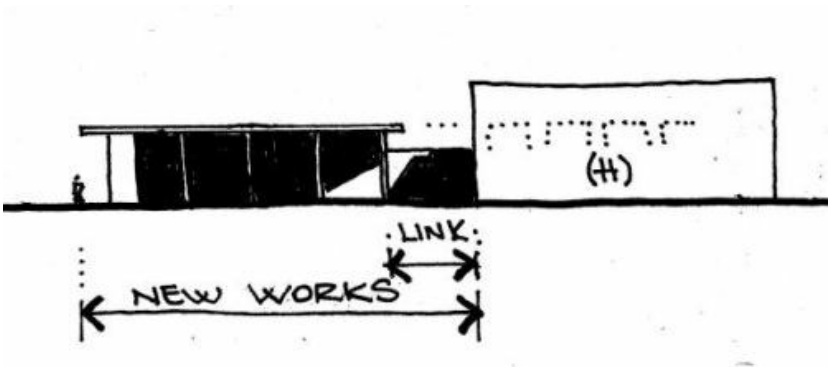


Figure SC6.3.4.15 Illustrates desirable outcome – pavilion type addition

(d) new building works should not reference non-significant features and atypical elements (as shown in Figure SC6.3.4.16 to SC6.3.4.17); and

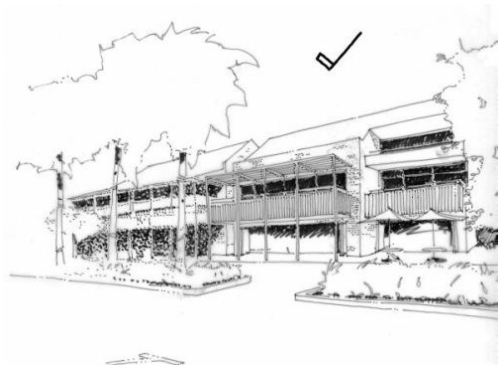


Figure SC6.3.4.16 Illustrates desirable outcome

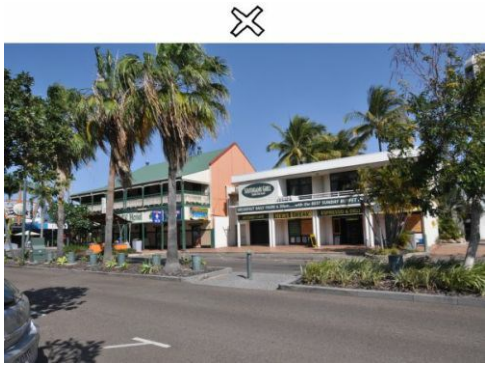


Figure SC6.3.4.17 Illustrates undesirable outcome - new building adjacent to a heritage place does not recognise characteristic articulation of materials, textures and colours (Palmer Street, Townsville)

Figure SC6.3.4.18 An example of an undesirable outcome: design of the new building referenced non-contributory features of the former streetscape, such as angled light poles that have subsequently been removed (Flinders Street East, Townsville)

(e) the quality of new materials is commensurate with those of the heritage place.

SC6.3.5 Development within a heritage place

This section of the policy provides guidance in achieving performance outcomes PO1, PO3 – PO6, PO8 – PO10 of the Cultural heritage overlay code associated with setbacks for development, building height, the scale and form of development, the heritage setting, landscaping and open space, building elements and advertising devices associated with development within a heritage place.

SC6.3.5.1 Setbacks for development

PO3 and PO4 of the Cultural heritage overlay code require that new buildings to be consistent with the significant features and values of the heritage place, including, but not limited to, built form and setbacks, maintain significant views to and from the heritage place and ensure that new buildings are visually subservient.

(1) To achieve the requirements of the performance outcomes in the code and allow for significant views to and from a heritage place to be maintained, the following design guidance should be considered.

(a) in instances where the significance of the heritage place includes its setback in common with the established street pattern, the setback of new works ought to maintain this significance (as shown in Figure SC6.3.5.1);

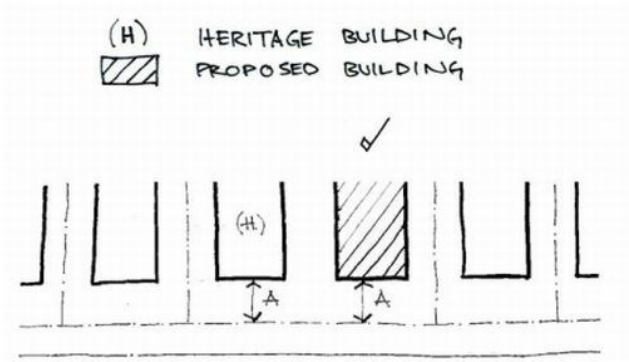


Figure SC6.3.5.1 Illustrates appropriate front setbacks for development within a heritage place, "A" is the street setbacks distance

(b) in instances where the significance of the heritage place includes its difference in setback to the established street pattern, the setback of new works ought to maintain this significance (as shown in Figures SC6.3.5.2 to SC6.3.5.3); and

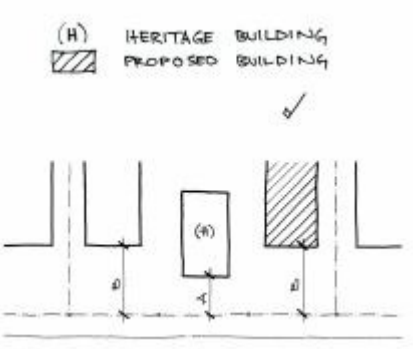


Figure SC6.3.5.2 Illustrates appropriate front setbacks for development within a heritage place, "A" and "B" is the street setback distance

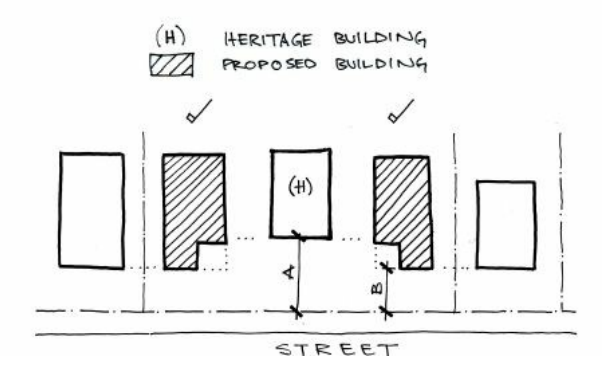


Figure SC6.3.5.3 Illustrates of appropriate front setbacks for development within a heritage place, "A" and "B" is the street setback distance

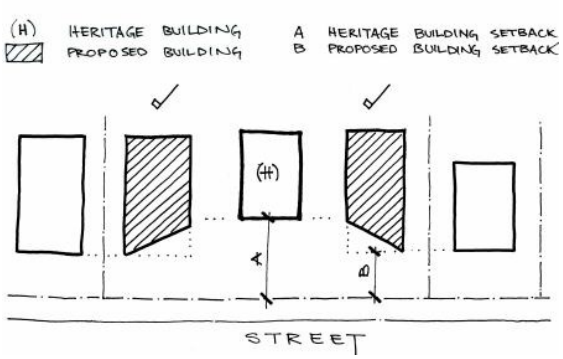


Figure SC6.3.5.4 Illustrates appropriate front setbacks for development within a heritage place and development adjoining a heritage place. "A" and "B" is the street setback distance

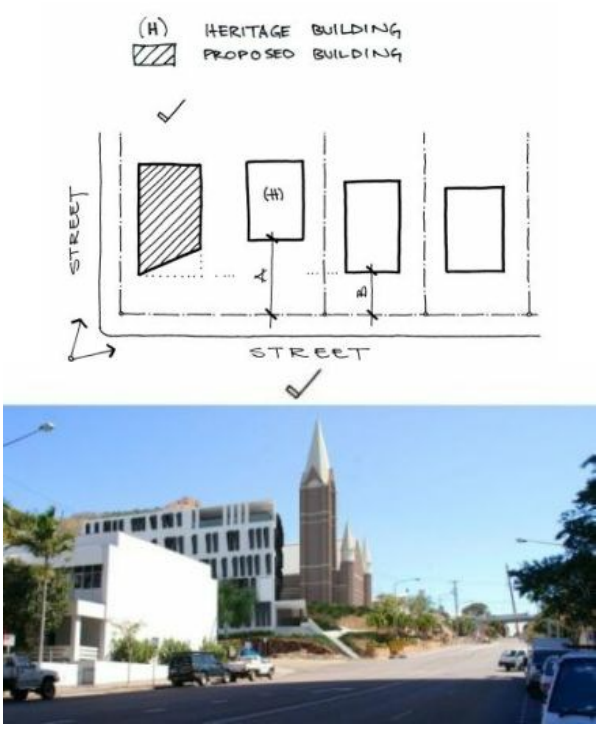


Figure SC6.3.5.5 Illustrates appropriate corner block front setback for development on a heritage place. "A" and "B" is the street setback distance. The setback of new development is tapered to allow improved views to the heritage place.

(c) new developments should adopt side setbacks that are common with the heritage place, unless this would diminish a significant feature of the heritage place (as shown in Figure SC6.3.5.6).

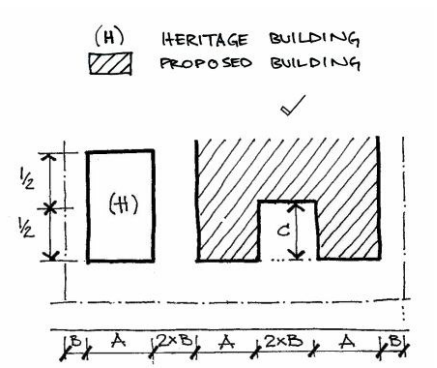


Figure SC6.3.5.6 Illustrates sympathetic building frontage rhythm, "B" is side setback and "C" (being the depth separation to get sympathetic building frontage rhythm) is 6m or ½ of "H" (heritage building depth).

SC6.3.5.2 Building height

(1) Where parts of the development are proposed to be taller than adjacent heritage elements, the following design guidance may be considered to demonstrate achievement of performance outcome PO3, PO4 and PO5 of the Cultural heritage overlay code.

(a) proposed taller elements of the proposed new building are to be setback to diminish their impact (as shown in Figure SC6.3.5.7); or

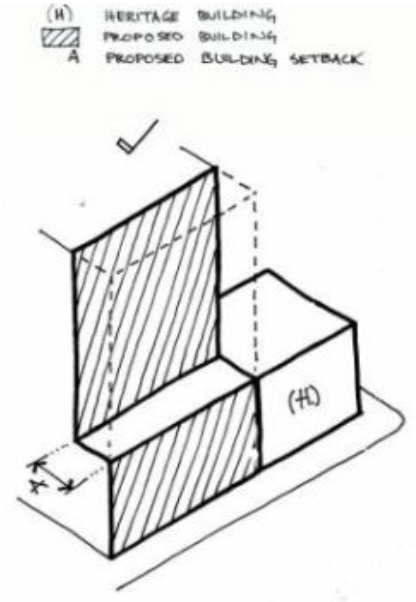


Figure SC6.3.5.7 Illustrates building setback of taller new building. "A" is equal or greater than 3m

(b) setback upper levels of the new building to provide a transition between adjacent buildings of different scales (as shown in Figure SC6.3.5.8);

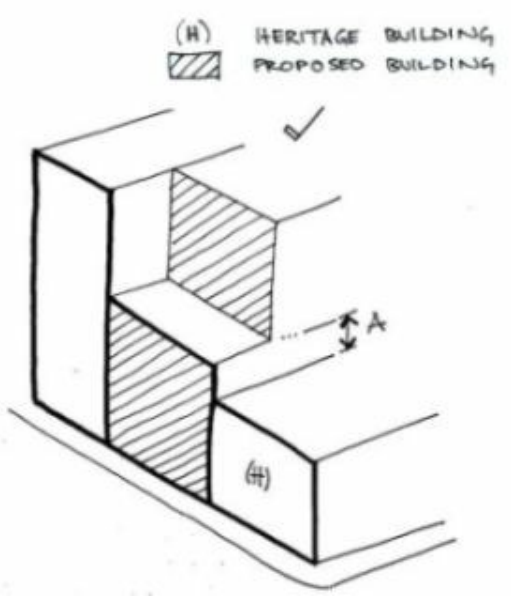


Figure SC6.3.5.8 Illustrates new building upper level setbacks. Dimension "A" is within 20% of the adjacent heritage building height

(c) provide an appropriate separation gap between the significant heritage elements and taller new elements (as shown in Figure SC6.3.5.9);

(d) building elements in the separation gap may be recessed and of lower height and/or different material than the heritage building (as shown in Figure SC6.3.5.9); and

(e) new building works may reflect a "reference height" for the full width of the street frontage where the "reference height" is consistent with the height of the adjacent heritage building (as shown in Figure SC6.3.5.9).

Figure SC6.3.5.9 Illustrates separation gap between contributing heritage elements and taller new buildings. "A" is the separation gap. "C" is the common reference height.

SC6.3.5.3 Scale and form development

(1) The following design examples are associated with building scale and form and may be considered to demonstrate achievement of performance outcome PO3 – PO6 of the Cultural heritage overlay code.

(a) in instances where the significance of the heritage place form includes its difference in scale to its setting; the scale of new works is to maintain this significance (as shown in Figure SC6.3.5.10); or

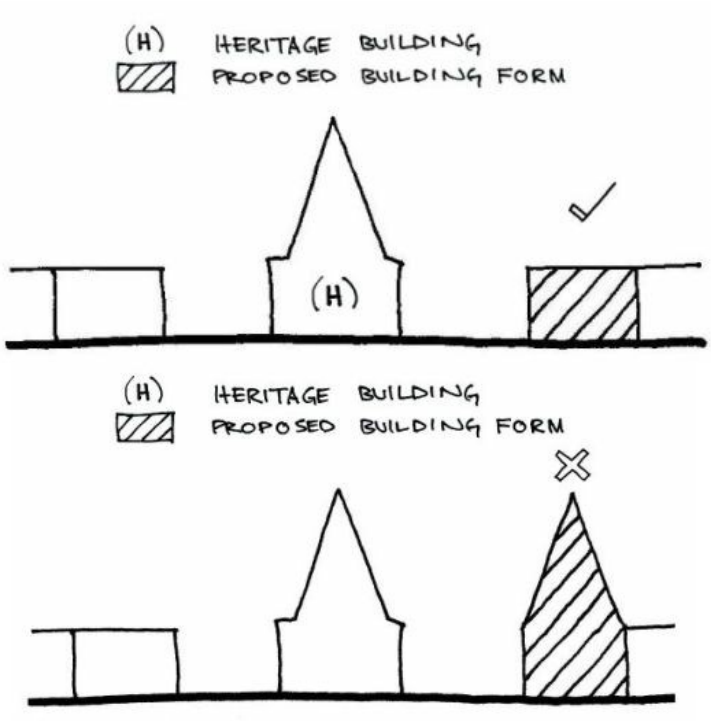


Figure SC6.3.5.10 Illustrates desirable and undesirable outcome

(b) in instances where the significance of the heritage place form includes its common scale, proportions and form to its setting, the scale, proportions and form of new works is to maintain this significance (as shown in Figure SC6.3.5.11);

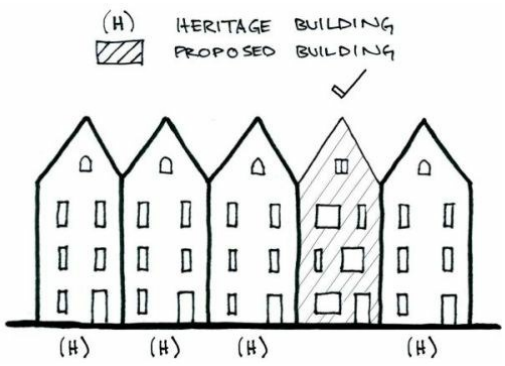


Figure SC6.3.5.11 Illustrates an example of appropriate scale and form

(c) the scale of new works should be compatible with, and not diminish the setting of the heritage place (as shown in Figures SC6.3.5.12 – SC6.3.5.14);

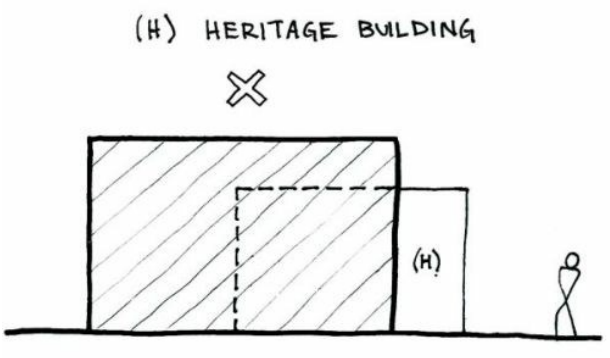


Figure SC6.3.5.12 Illustrates an example of an undesirable outcome – new works obscures the heritage place

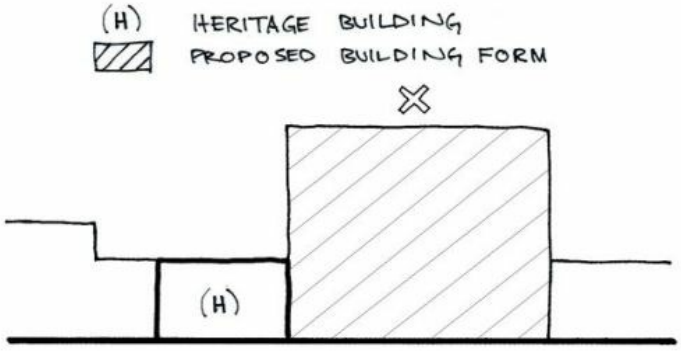


Figure SC6.3.5.13 Illustrates an example of an undesirable outcome: scale of new works dominates the heritage place and is detrimental to the settings of the heritage place

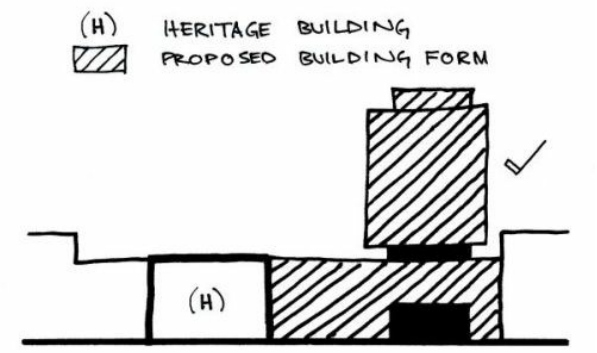


Figure SC6.3.5.14 Illustrates an example of a desirable outcome with regard to scale and form

(d) in order to achieve visual subservience to a heritage place in accordance with PO4, building form ought to be articulated into smaller elements to relate to scale, rhythm and spacing of the heritage place and its context (as shown in Figure SC6.3.5.15);

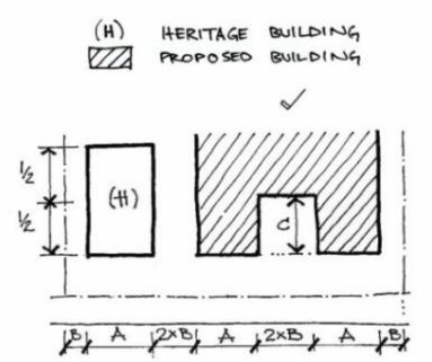


Figure SC6.3.5.15 Illustrates sympathetic building frontage rhythm, "B" is side setback and "C" (being the depth separation to get sympathetic building frontage rhythm) is 6 m or ½ of "H" (heritage building depth).

(e) new buildings should respond to existing ridge or parapet lines, roof slopes or other significant features of the heritage place (as shown in Figure SC6.3.5.16);

Figure SC6.3.5.16 Illustrates an example of an appropriate outcome. The proposed new development adopts ridge and parapet lines of the heritage place and enhances the continuity of the streetscape

(f) new building works should not reference non-significant features and atypical elements;

(g) new works should provide elements of design that are clearly distinguishable from heritage elements and that assist in representing the historical form of the heritage place (as shown in Figure SC6.3.5.17); and

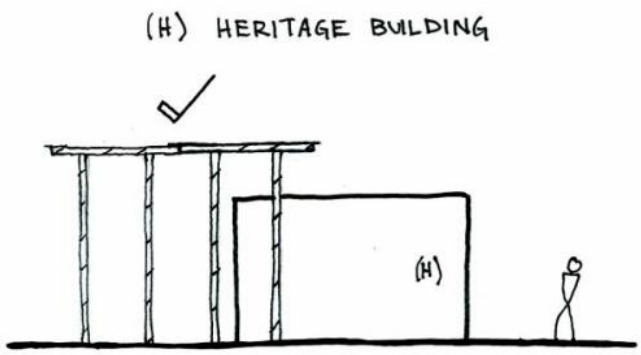


Figure SC6.3.5.17 Illustrates an example of an appropriate outcome, where new works are detached and expressed as a lightweight addition

(h) architectural expression of new works should avoid diminishing the setting of the heritage place (as shown in Figure SC6.3.5.18 and Figure SC6.3.5.19).

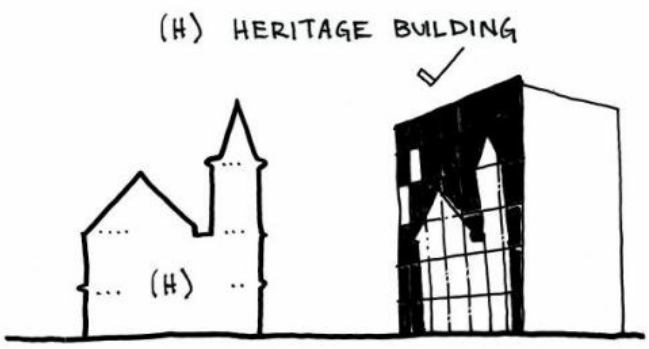


Figure SC6.3.5.18 Illustrates an example of a desirable outcome, in which a glazed or glass façade reflects the heritage place

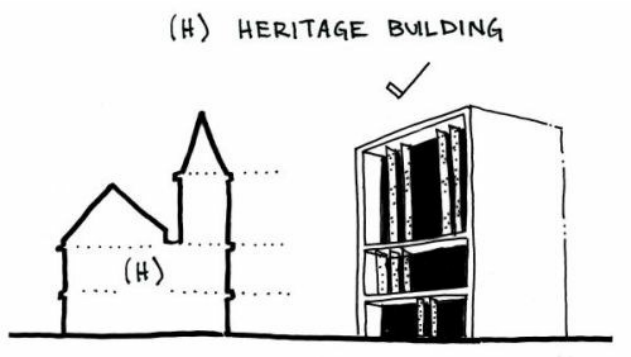


Figure SC6.3.5.19 Illustrates an example of an undesirable outcome, in which the contemporary expression of new works reference the heights of the heritage place

SC6.3.5.4 The heritage setting

The following is advice for achieving PO3, PO4 and PO5 of the Cultural heritage overlay code associated with the heritage setting.

(1) New buildings or works minimise visual impacts to the heritage place by:

(a) new buildings are set apart in a separate building (as shown in Figure SC6.3.5.20);

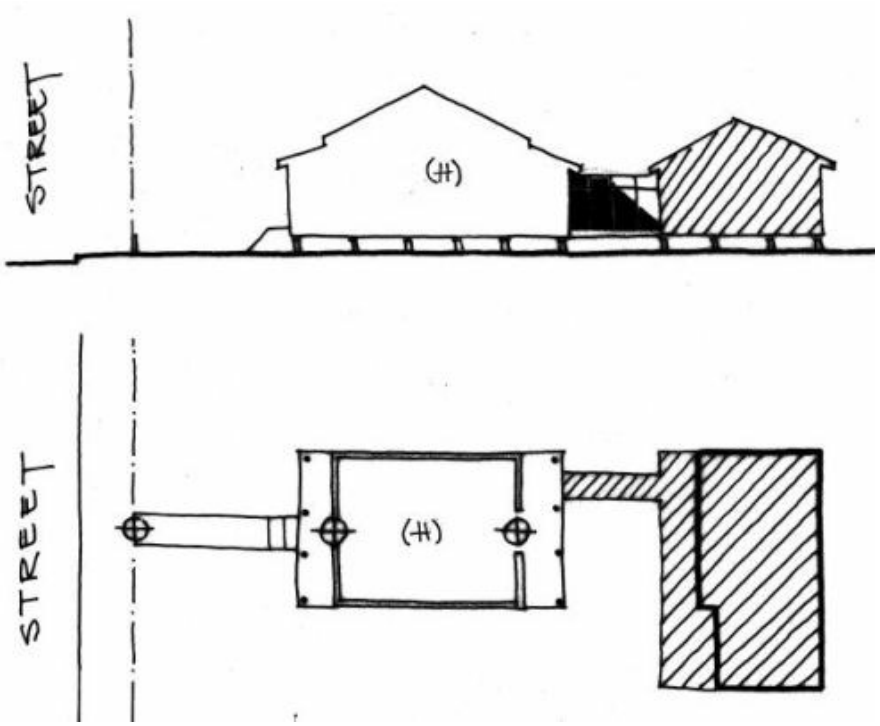


Figure SC6.3.5.20 Illustrates an example of a desirable outcome

(b) new works should design junctions between new and old fabric to be legible, reversible and may be incorporated into the overall architectural design (as shown in Figure SC6.3.5.21 and Figure SC6.3.5.22); and

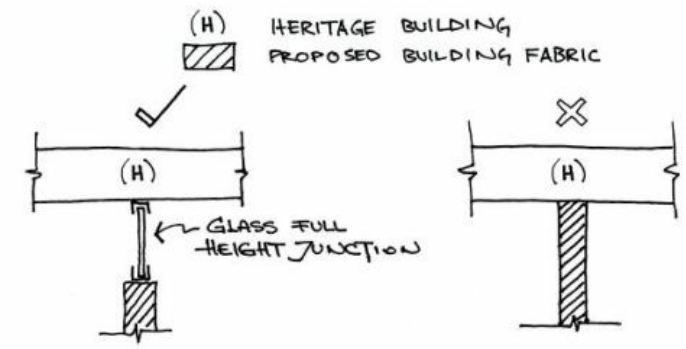


Figure SC6.3.5.21 Illustrates desirable and undesirable outcome: plan detail of old and new wall junction separation of new and old fabric using glass or other translucent light weight material

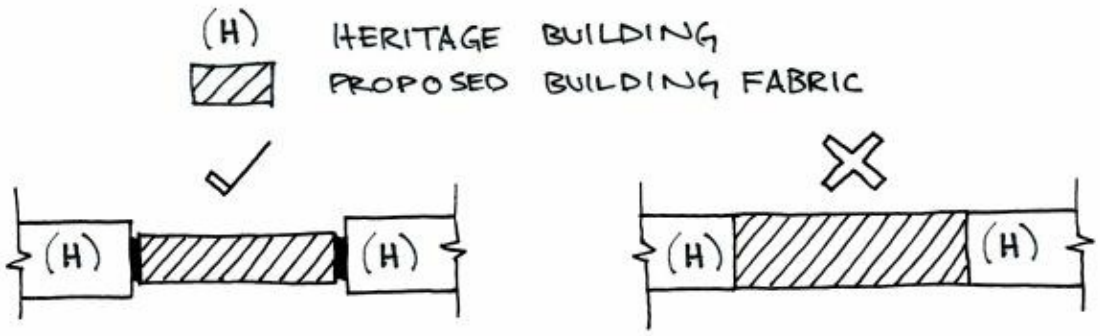


Figure SC6.3.5.22 Illustrates desirable and undesirable outcome - plan detail of the junction between the proposed/new development to the existing heritage wall opening. The new development requires a reduced wall depth to maintain the legibility of the original opening

(c) works are located within areas that are not visible from the dominant street views or other significant views, and do not diminish any significant features of the heritage place (as shown in Figure SC6.3.5.23 and SC6.3.5.24).

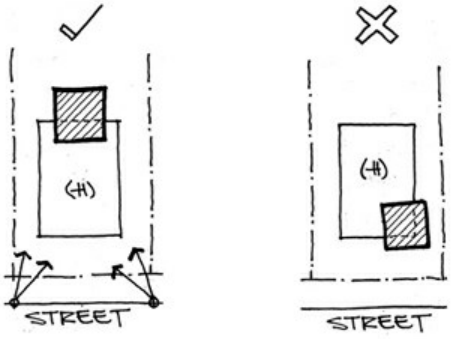


Figure SC6.3.5.23 Illustrates an example of desirable and undesirable outcome

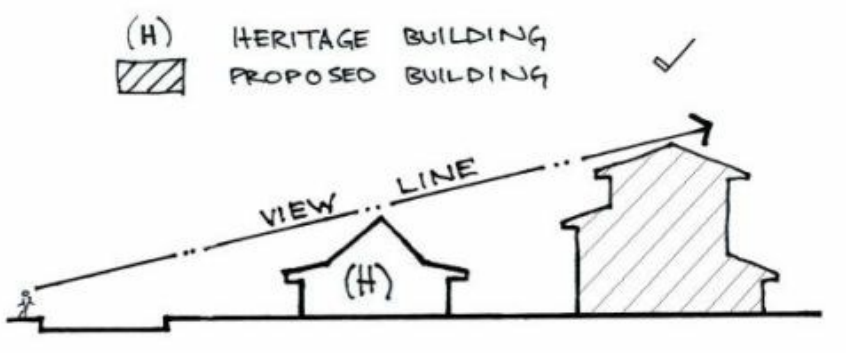


Figure SC6.3.5.24 Illustrates view line from the street. The new building at the back cannot be seen by a person standing across the street, which means that the view of the heritage building is not diminished

SC6.3.5.5 Landscaping and open space

The following advice is for demonstrating achievement of performance outcome P03 and PO8 of the Cultural heritage overlay code associated with landscaping and open space.

(1) Open space and landscaping features should maintain views to and from the significant heritage features of the heritage place (as shown in Figure SC6.3.5.25– SC6.3.5.28).

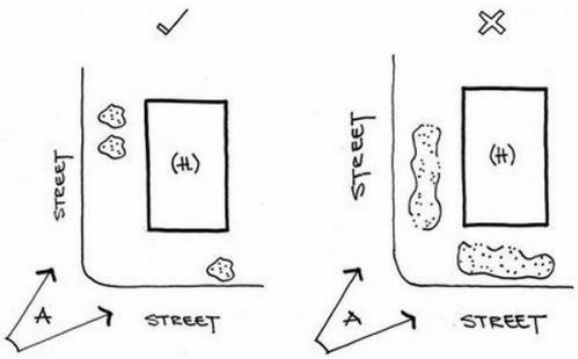
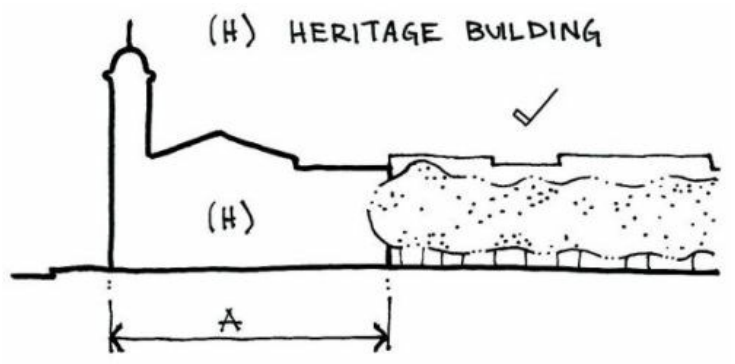


Figure SC6.3.5.25 Illustrates an example of desirable and undesirable outcome. "A" is principal view to and from heritage place



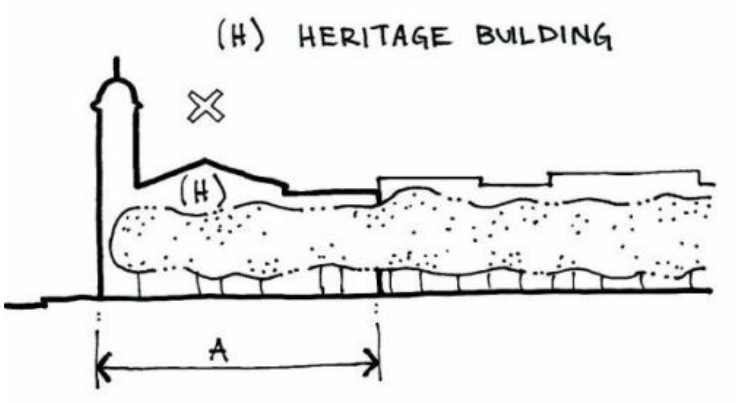


Figure SC6.3.5.26 Illustrates an example of desirable outcome "A" is street width

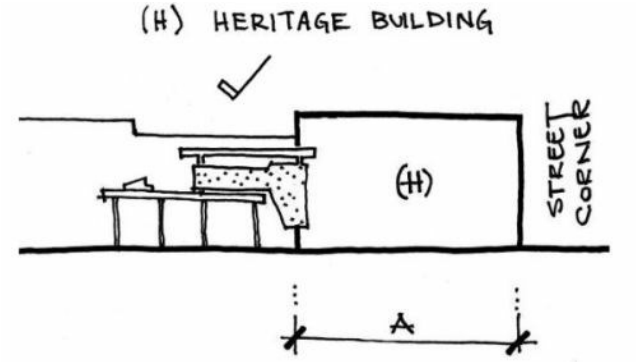


Figure SC6.3.5.27 Illustrates an example of a desirable outcome, tall street shelter element does not block views to and from the heritage place. "A" is street width of "H"

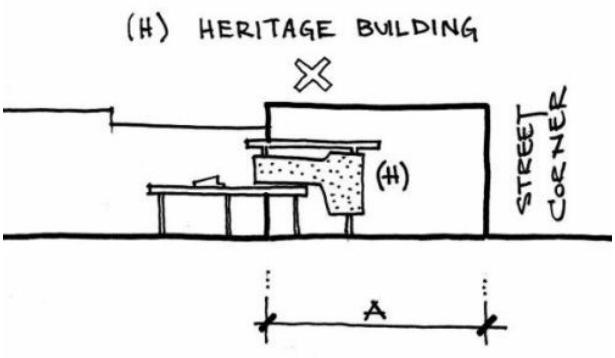


Figure SC6.3.5.28 Illustrates an example of an undesirable outcome, where a tall street shelter element blocks views to and from the heritage place. A' is street width of "H" (heritage place)

SC6.3.5.6 Heritage fabric

In order to protect the cultural significance of a heritage place, retaining the original fabric and significant fenestration patterns, finishes and decorative details should be a primary aim.

(1) The following should be considered in demonstrating achievement of performance outcomes PO1 and PO6 of the Cultural heritage overlay code.

(a) alteration or partial demolition of elements that do not contribute to cultural significance may be appropriate where there is no detrimental impact on significant features;

(b) buildings are to be retained in their three dimensional form. The inadequate retention of only the front façade may result in "facadism" and should be avoided (as shown in Figure SC6.3.5.29 and SC6.3.5.30);

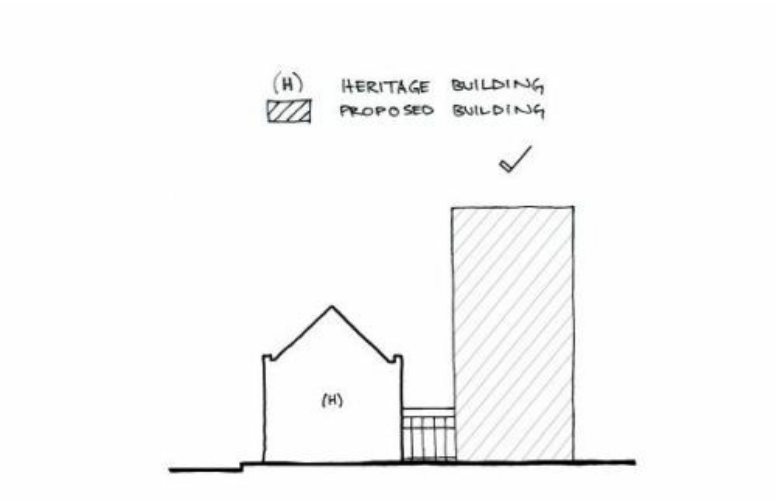


Figure SC6.3.5.29 Illustrates an example of a desirable outcome, new works with adequate retention of the three dimensional form. New works set back as a detached form.

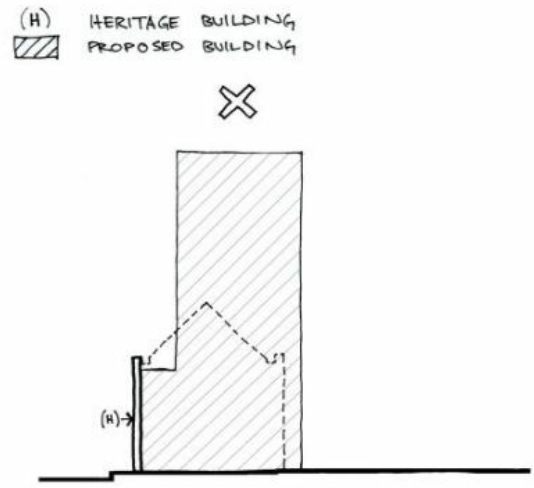


Figure SC6.3.5.30 An example of an undesirable outcome; new works have inadequate retention of the three dimensional form (only the front façade has been retained)

(c) the building fabric that contributes to the significance of the heritage place should be retained whether visible or not from the public realm (as shown in Figure SC6.3.5.31);

Figure SC6.3.5.31 "The Brewery", former Post Office (Flinders Street, Townsville). Significant features of the interior have been retained. This is an example of maintaining original building fabric.

(d) significant associations and meanings of the heritage place ought to be maintained (as shown in Figures SC6.3.5.32 and SC6.3.5.33); or

(e) new works provide interpretations for, associations and meanings of the heritage place, and its original use;

(f) where a new use is proposed for a heritage place, the new use is compatible with the cultural significance, significant features and values of the heritage place (as shown in Figures SC6.3.5.32 and SC6.3.5.33);

Figure SC6.3.5.32 Illustrates a desirable outcome: former Post Office building (Flinders Street, Townsville)

Figure SC6.3.5.33 Illustrates a undesirable outcome: former Customs House (The Strand, Townsville). Change of use to a private residence diminishes the associations and meanings of the heritage place

(g) building services may be concealed to render them not readily visible from the street or any significant views of the heritage place. If services are by necessity visible, they may be constructed using materials and details sympathetic to those of the heritage place (as shown in Figure SC6.3.5.34); and

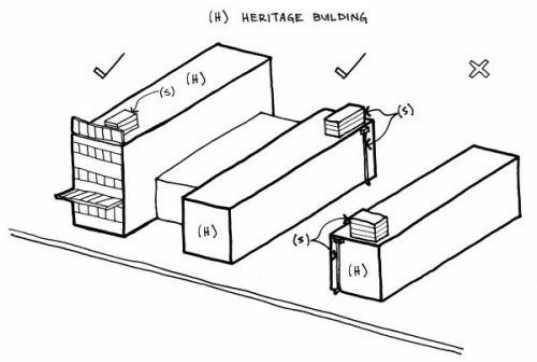


Figure SC6.3.5.34 Examples of desirable and undesirable outcome, "S" are air conditioning and drainage locations. An example of an undesirable outcome is at right, with air conditioning and drainage services positioned to the front of the building, which has a detrimental impact on visual amenity of the heritage place

(h) any changes to significant fabric necessary to accommodate a new use are reversible.

SC6.3.5.7 Building elements

This section will assist you to demonstrate achievement with PO3, PO5 and PO6 of the Cultural heritage overlay code.

Building elements refer to the components of a building which contribute to the overall character and heritage significance of the building, site or area, and may include the materials, colours and details used.

(1) Materials, colours and details used in a development should complement rather than reproduce the heritage place. The following design guidance illustrates how this might be achieved:

(a) the design of new works recognises characteristic materials, textures and colours used locally and in adjacent buildings. These may be re-interpreted and incorporated in the design of the new building (as shown in Figure SC6.3.5.35);

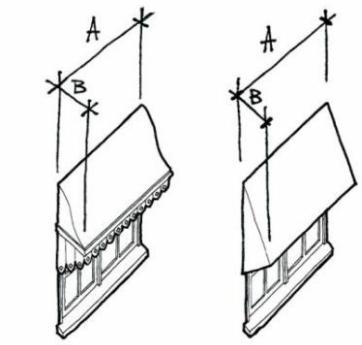


Figure SC6.3.5.35 Illustrates (left) contemporary interpretation of a typical heritage awning hood (right) where dimensions "A" and "B" have similar proportions.

(b) materials and colours of surrounding buildings generally should not be copied but used as a point of reference. Modern materials may be used if their proportions and details are sympathetic within the adjacent heritage place;

(c) colour, texture and tonal contrast of new building elements may be utilised as a unifying element with heritage features. Details that contribute to the significance of the heritage place may inform or inspire the design of new building works;

(d) modern details may be designed to reinterpret traditional details and create new relationships between new and old; and

(e) the quality of new materials is of the same quality as those of the heritage place.

(2) New materials introduced to a heritage place should generally be intentionally varied from the original and be distinguishable from the original fabric by a date stamp (as shown in Figure SC6.3.5.36).

Figure SC6.3.5.36 Illustrates an example of a desirable outcome - date stamp on new or introduced fencing panel

SC6.3.5.8 Advertising devices

(1) Advertising devices should be designed to ensure that they do not dominate the heritage place or obscure significant views or features of the heritage place. The following is advice for achieving performance outcome PO8, PO9 and PO10 of the Cultural heritage overlay code associated with advertising devices.

Note— there are specific requirements when dealing with State Heritage listed buildings. Advertising devices on heritage buildings listed on the Queensland State Heritage Register is subject to the provisions of the *Queensland Heritage Act 1992*.

(a) advertising devices should be readily removable without damaging the building fabric, (as shown in Figure SC6.3.5.37);

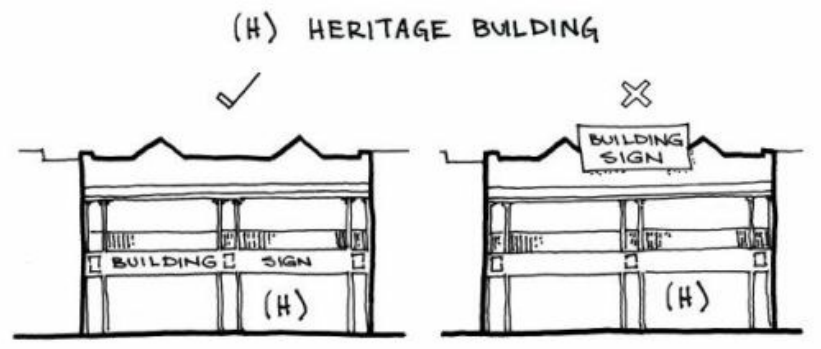


Figure SC6.3.5.37 Illustrates a desirable outcome (left) and undesirable outcome (right)

(b) advertising devices may be clearly modern yet respectful of the heritage context, associations and meanings of the heritage place;

(c) advertising devices should consider enhancing a building's architecture and setting;

(d) integrate advertising devices with architectural features of the building wherever possible;

(e) unless there is adequate evidence – physical and documentary – to reconstruct original advertising devices, new advertising devices on a heritage place should complement, not replicate, a "period" style. "Old fashioned" imitation signage would be inappropriate. Any form of signage may be considered, as long as visual and physical impacts on the heritage building are minimised;

(f) the appropriate size of signage may be relative to the specific architectural characteristics of the heritage place (as shown in Figure SC6.3.5.38); and

(g) table SC6.3.5.1 identifies advertising devices which are not suitable on a heritage building.

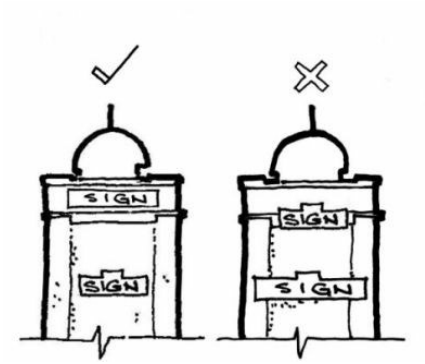
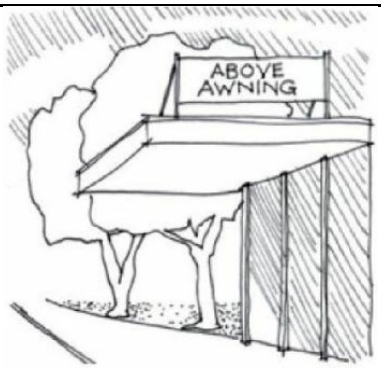
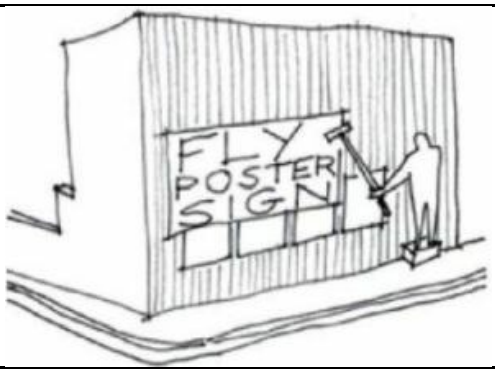
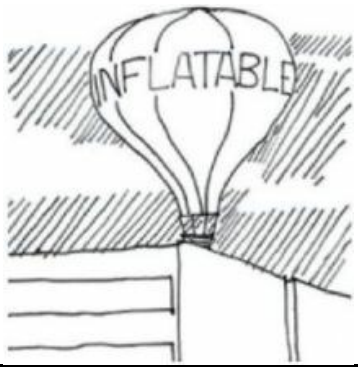


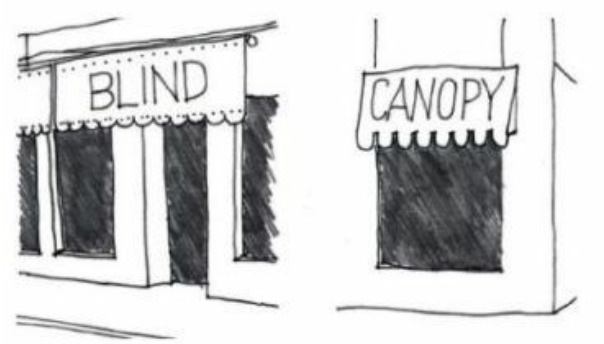
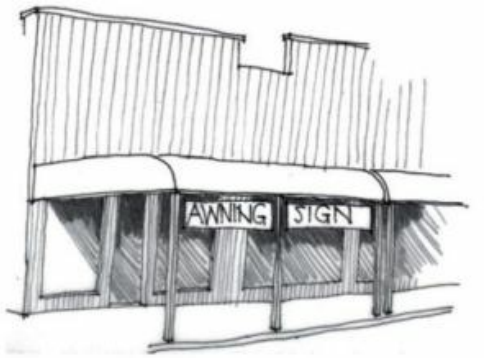
Figure SC6.3.5.38 Illustrates a desirable outcome (left) and undesirable outcome (right)

Table SC6.3.5.1 Advertising devices which are not suitable on a heritage building

Device type	An example of an undesirable outcome
Roof signs	
Above awning signs	
Wall sign	
Inflatable sign	

In accordance with AO3 of the Advertising devices code, Table SC6.3.5.2 identifies the desirable outcomes for heritage places on Flinders Street East. Advertising devices are in accordance with the advertising device types and design parameters set out within Table SC6.3.5.2.

Table SC6.3.5.2 Design parameters for supported advertising devices on Flinders Street East

Device type	Design Parameters additional to those set out in the advertising devices code	An example of an desirable outcome
Awning fascia sign		
Blind/canopy		
Under awning sign		
Under Awning sign (where an under-awning sign is affixed between posts of a footpath awning)	The under-awning sign must be contained within the spacing of posts and must not exceed 600mm in height.	

Wall sign		
Window sign		

SC6.3.6 Preparing a heritage impact statement report

A heritage impact statement may be required to demonstrate compliance with the Cultural heritage overlay code, in particular performance outcomes PO1, PO3, PO4, and PO7.

A heritage impact statement provides specific information about how a proposed development will affect the heritage place. The purpose of a heritage impact statement is to identify any potential detrimental impacts that the development may have on the significance of the place. Ultimately, a heritage impact statement should demonstrate compliance with the Cultural heritage overlay code.

A heritage impact statement is to be produced by a suitably qualified architect or cultural heritage professional, and should include the following at a minimum:

(1) Description of the proposed development
Provide a brief description of the proposed development including:

- (a) type of development;
- (b) range and scope of work proposed; and
- (c) timeframe for carrying out work.

(2) Setting and context of the place
Describe the setting or context for the place, including photographs and maps showing significant features that will be affected. Provide an analysis of the affect the proposed development will have on the setting of the heritage place.

(3) Proposed changes to the heritage place
List the changes required to the heritage place as a consequence of the proposed development and provide the following information about each change:

- (a) what elements or aspects of the heritage place are affected by the proposed change;
- (b) list the work required to effect the proposed change;
- (c) analysis of the impact of the change on the cultural heritage significance of the place;
- (d) assessment of potential for detrimental impact on the cultural heritage significance;

(e) if the proposed work will directly affect a heritage element of the place – provide details of proposed work methods; and

(f) where the proposed change is assessed as having potential for detrimental impact, provide information about the following:

(i) why the proposed change is required;

(ii) alternative solutions that were investigated; and

(iii) what measures are included in the proposed development to reduce detrimental impact that may result from the change.

(4) Applicable conservation policies

(a) some heritage places already have conservation management plans that include conservation policies. Where a heritage building has a current conservation management plan, the heritage impact statement will need to list the conservation policies that relate to the proposed development and describe how they have guided the development;

(b) where conservation policies have not been followed, give reasons why the conservation policies were not used and describe the process that is proposed to be followed; and

(c) where conservation policies are not already available, an architect or heritage consultant can provide conservation advice to help inform the planning and guide development of places.

(5) References
List documents referred to in the heritage impact statement such as conservation policies, conservation management plans, condition report (i.e. demolition reports), and specialist consultants' reports.

(Adapted from *Guideline: Preparing a heritage impact statement' Department of Environment and Heritage Protection*, 2011).

SC6.3.7 Preparing a condition report

If an application is proposing the demolition of a structure of heritage significance the applicant may be requested to provide a condition report. The condition report should, at a minimum, include consideration of:

(1) the structural stability of the building in the form of a structural engineers report. The condition report must include a factual statement from an appropriately qualified structural engineer about the condition of the building; and

(2) a pest inspection report and other supporting documentation may also be provided.

SC6.3.8 Preparing archival recording of heritage place

Archival recording may be required to demonstrate achievement of performance outcome PO2 of the Cultural heritage overlay code. Where demolition, change or relocation of a heritage building is allowed, a photographic record and measured drawings in accordance with the following of the place should be submitted to council prior to the commencement of the demolition works or relocation of the heritage building.

SC6.3.8.1 Guideline for photographic recording

The following guidelines are intended as a checklist for making an accurate photographic record of sites, buildings, objects, gardens or structures of heritage significance prior to major alterations or demolition. The recording process must be comprehensive and cover the parts specified in the approval conditions.

(1) Aim
The aim of the photographic record is to provide a sufficient number of photographs to fully illustrate the subject for which the photographic archival record is required. The purpose of the record is to provide permanent documentation of places so that future generations can benefit from and gain an understanding of Townsville's cultural history that is no longer possible to pass on to them.

(2) Method
The photographer should be informed by any available plans and documentary evidence and should have an

understanding of the history and operations of the place. If necessary the photographer should be accompanied on the site by a person familiar with the site's heritage significance and the processes related to it. The project should be planned before commencement and the photographer aware of the appropriate sequence.

The preferred shooting method is to proceed from the overall or general through to the detailed or specific. The photographic record should consist of:

(a) general views of the place.
Note—to provide its context and overall coverage of all slides – oblique shots are useful for general reference;

(b) elevation of all sides;

(c) details of all key elements including windows, doors, eaves, cornices, rainwater goods, skirtings and decorative elements;

(d) interior elevations of each space to include floor and ceiling finishes;

(e) the relationship of the elevations to any equipment or relics housed in each space;

(f) any significant items should be photographed;

(g) any features particular to the place internally and externally should be fully recorded; and

(h) when photographing landscape elements:

(i) an overall photograph is required; and

(ii) any unusual or distinguishing features should be fully recorded.

(3) Key plans
The photographic record shall include a plan or plans indicating the direction in which the photographs were taken. The positions, with a direction arrow, should be numbered and cross referenced to the photographs.

(a) The following information should be included:

(i) date of record production;

(ii) name of photographer; and

(iii) description of place (e.g. building, name, species of tree, etc.).

(b) Form

(i) photographs are to be colour and of professional quality. Digital format will be accepted. An electronic copy on CD, USB or of the like format acceptable to council, are to be submitted;

(ii) archival quality ink should be used for annotation and cross referencing. A 6B pencil should only be used for annotating on the back of prints; and

(iii) the photographic record should be submitted in an A4 archival album with photographs in archival quality plastic sleeves or pockets.

(c) Size

(i) minimum size of prints should be 100 x 150 mm, to a maximum A4 size.

(d) Report

(i) a very brief report or introduction explaining the purpose of the report, a brief description of the subject and detailing the sequence in which the photographs were taken should be included;

(ii) the report may also address the limitations of the photographic record and make recommendations for future work; and

(iii) sources of original work should be acknowledged.

SC6.3.8.2 Guideline for measured drawings
Measured drawings provide an accurate record of buildings, structures or objects and depict the physical features that contribute to their heritage significance. Measured drawings should be easy to read and suitable for reproduction. Australian Standard AS 1100 *Technical Drawing*, Part 301 and *Supplement 1*, *Architectural Drawing* provides a guide to suitable graphics.

The following guidelines are intended as a checklist for making an accurate record of a building, part of a building, or other subject at the time of production. The recording process must be comprehensive and cover the parts specified in the approval conditions.

(1) Aim

The aim of producing a measured drawing is to provide a record that is measured and drawn accurately to scale. It should be a true reflection of the existing condition and not an interpretation of a previous state (i.e. missing elements should not be included and elements which are not plumb should be recorded as such).

(2) Drawings:

(a) the measured drawings should be cross-referenced to each other, clearly titled and show scale, orientation and date of execution;

(b) drawings should not include any conjectural detail such as inaccessible elements that cannot be measured such as footings or framing;

(c) the drawings can also be annotated or hatched to reveal more about the heritage significance of the site or object – to differentiate between dates of construction, materials and finishes;

(d) record to the same standard all major fixtures such as machinery or building services; and

(e) for industrial sites, recording the position, relationship and function of all fixtures, machinery and services is particularly important and maker's names, model numbers etc. should be included.

For further information refer to *Measure for Measure: A Practical Guide for Recording Buildings and Landscapes*, published by the RAIA in 1990.

(3) Requirements

A typical measured drawing package for a build structure should include:

(a) location plan;

(b) site plan (1:500 or 1:200);

(c) floor plan/s (1:1:100 or 1:50) including basement or mezzanine levels;

(d) roof plan/s (1:100 or 1:50);

(e) elevations – showing all sides of the building (1:100 or 1:50);

(f) sections – two sections, through the building in different planes (not parallel) (1:100 or 1:50);

(g) ceiling and joinery details (1:20 or 1:10) – cornice, verandah posts, skirtings, mouldings;

(h) other significant details (rainwater heads, construction joints); and

(i) machinery and services details.

(4) Sheet sizes

Drawings should be on standard metric sheet sizes – A1, A2, A3 or A4.

SC6.3.8.3 Interpretive signage for the loss of a heritage place

In addition to archival recording, where a heritage place is to be lost, interpretive signage is to be provided. In particular:

(1) the sign should be placed at the front of the property boundary, integrated with a wall or fence;

(2) the sign should provide a photographic record and brief history of the heritage place;

(3) the sign should have a 330 mm diameter, a 3 mm thick aluminium plate with weatherproofed finish, refer to Figure SC6.3.8.57; and

(4) sign production i.e. colours used and branding should be consistent with the Townsville Heritage Trail Signage.

Figure SC6.3.8.1 Illustrates an example of a desirable outcome, an example of a Heritage Trail sign (Flinders Street, Townsville)

SC6.3.9 Preparing an archaeological management plan

The following is advice for demonstrating achievement of performance outcome PO11 of the Cultural heritage overlay code associated with archaeology.

(1) Any development with potential impact on archaeological values should provide for the following at a minimum:

- (a) the potential impact on archaeological deposits on the site is to be monitored and assessed during earthworks by an appropriately qualified person;
- (b) where archaeological deposits are identified, an archaeological management plan is to be prepared by an appropriately qualified person and approved to the satisfaction of the relevant authority, prior to the commencement of ground works; and
- (c) any archaeological management plan that is prepared should follow best practice.

SC6.3.10 Adding or removing a place from Schedule 7 Places of cultural heritage value

(1) The places of cultural heritage value in Townsville are contained in Schedule 7 Places of cultural heritage value and overlay map OM04.1 – OM04.4 of the Townsville City Plan. The process of entering and removing a heritage place from Schedule 7 and the overlay involves:

- (a) identification;
- (b) application;
- (c) assessment; and
- (d) notification.

(2) Council assesses a place based on the place fulfilling one or more cultural heritage criteria listed below. There are approximately 325 places in Townsville that meet one or more of the cultural heritage criteria stated below. These places have been incorporated into Schedule 7 Places of cultural heritage value of the Townsville City Plan. The Citation of Heritage Places Report provides information about each heritage place in Townsville. It highlights the criteria that were originally identified for each place and indicates its heritage significance and eligibility for entry into Schedule 7 Places of cultural heritage value. It should be noted that a building, site or place may be entered into Schedule 7 Places of cultural heritage value of the Townsville City Plan if it meets one or more of the cultural heritage criteria listed below.

- (a) It is important in demonstrating the evolution or pattern of Townsville's history.
- (b) It demonstrates rare, uncommon or endangered aspects of Townsville's cultural heritage.

(c) It has potential to yield information that will contribute to the knowledge and understanding of Townsville's history.

(d) It is important in demonstrating the principal characteristics of a particular class or classes of cultural places.

(e) It is important because of its aesthetic significance.

(f) It is important in demonstrating a high degree of creative or technological achievement at a particular period.

(g) It has a strong or special association with the life or work of a particular community or cultural group for social, cultural or spiritual reasons.

(h) It has a special association with the life or work of a particular person, group or organisation of importance in Townsville's history.

(i) It was constructed prior to 1910.

(3) For a heritage place to be removed from Schedule 7 Places of cultural heritage value of the Townsville City Plan the applicant must highlight that there is evidence to sufficiently demonstrate that a place has no cultural heritage significance, based on the Criteria listed Schedule 7 Place of cultural heritage value in the Townsville City Plan.

Following the lodgement of the application form titled, "Application form to add or remove a place from Schedule 7 Places of cultural heritage value of the Townsville City Plan," council will make a decision as to whether to enter, not enter, or remove a place from Schedule 7 Places of cultural heritage value. It should be noted that if a place is nominated to be included on, or to be removed from Schedule 7 Places of cultural heritage value, council will be required to undertake an amendment to the Townsville City Plan as required by the *Planning Act 2016*.

For more information refer to:

(a) Application Guide: Entering a place to Schedule 7 Places of cultural heritage value.

(b) Application Guide: Removing a place from Schedule 7 Places of cultural heritage value.

(c) Application form to add or remove a place from Schedule 7 Places of cultural heritage value of the Townsville City Plan.

SC6.4 Development manual planning scheme policy

SC6.4.1 Introduction

Short title - The planning scheme policy may be cited as Development manual PSP.

SC6.4.1.1 Purpose

The purpose of the Development manual PSP includes:

(1) specifying standards for the design and construction of development infrastructure;

(2) providing guidance and advice regarding administrative arrangements for development and development infrastructure;

(3) providing information the council may request for development applications, including standards and guidance on the preparation of specialists reports; and

(4) providing guidance or advice about satisfying an assessment benchmark in the Townsville City Plan which identifies this planning scheme policy as providing that guidance and advice.

SC6.4.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.4.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan. This planning scheme policy applies to the whole of the Townsville City Council planning scheme area and specifically relates to the assessment of any relevant development application.

SC6.4.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions of Townsville City Plan. A term used in this planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 Definitions of Townsville City Plan.

In addition to the definitions presented in Part 1.3.1 of the Townsville City Plan, each sub-section of the Development manual PSP may contain a list of terminology that is referenced in support of that specific policy sub-section.

For clarity, a reference in Development manual PSP to any act includes any regulation or instrument made under it and where amended or replaced, means the amended or replaced act. A reference in the Development manual PSP to a specific resource document or standard means the latest version of the resource document or standard.

SC6.4.1.5 Structure

The policy is arranged around seven major sections. Each major section is designed to group common themed sub-sections to improve usability of the entire document.

The seven major sections are:

SC6.4.1 Introduction – an introduction to the policy, including the purpose of the policy and relationship to the Townsville City Plan;

SC6.4.2 Development application guidelines – contains information for the preparation of reports that may be requested by council in support of development applications;

SC6.4.3 Design standards – a series of policy sub-sections that establish specific design standards, advice and guidelines for development;

SC6.4.4 Design specifications and standard drawings – technical standards for the design of infrastructure and development;

SC6.4.5 Construction management – this section sets out the broad auditing responsibilities of council, setting out procedural matters of development and the standards for construction management for development works, covering pre-construction, construction and quality management systems for the construction of development works;

SC6.4.6 Construction standards – the construction technical specifications of council; and

SC6.4.7 Acceptance of completed works – this section sets out the standards, advice and guidance to manage the donation of completed assets and works.

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SC6.4.2 Development application guidelines

SC6.4.2.1 Introduction

This section provides standards, advice and guidelines for development applications, including well made application details along with design requirements to assist applicants in achieving council's design objectives.

SC6.4.2.1.1 Definition of major and minor developments

(1) A major development consists of a combination or some or all of the following:

(a) more than six residential, commercial or industrial lots; or

(b) a single or multi-storey mixed/high density dwelling unit complex of more than six dwellings; or

(c) a multi-storey development of more than three stories; or

(d) a commercial structure where the ultimate Gross Floor Area (GFA) exceeds 2,000m^2 and is two equivalent stories or more; or

(e) a development where site filling and/or excavation exceeds 2,500m^3; or

(f) a development where site filling impacts on a known or designated 'floodplain' and requires compensatory earthworks to cater for the flows from the defined flood event in the adjacent or nearby watercourse without increasing flood levels upstream and downstream of the development site; or

(g) a development that requires more than 300 carparking spaces.

(2) A minor development consists of a combination of some or all of the following:

(a) more than two and less than six residential, commercial or industrial lots; or

(b) a single storey (or higher) mixed/high density dwelling unit complex of six or less dwellings; or

(c) a mulit-storey development of not more than three stories of approved use; or

(d) development where site filling and/or excavation is less than 100m^3; or

Editor's note—where the site filling/excavation exceeds 100m^3, but is less than 2500m^3, the combination with other criteria will determine whether the development is classified as major.

(e) a development where twenty or less carparking spaces are required.

Editor's note—where required carparking spaces exceeds 20, but is less than 300, the combination with other criteria will determine whether the development is classified as major.

Editor's note–where a development does not meet any or only one of the criteria listed in major or minor development above, council retains the prerogative to determine whether the development is major or minor.

SC6.4.2.2 General

Council's general procedures when lodging development applications are set out below.

SC6.4.2.2.1 Pre-lodgement advice guidelines

(1) Council will facilitate pre-lodgement meetings when requested to discuss development proposals prior to lodgement. Pre-lodgement meetings can comprise of informal discussions or alternatively a formal response can be arranged for more complex applications. The latter will require advanced lodgement of details including reports, drawings and any information pertinent to the proposal to ensure an effective response to an applicant. A team of specialists will attend a formal meeting followed by written minutes of the proceedings.

Editor's note—A sliding fee will be applicable where stated in council's applicable fees and charges schedule.

Editor's note—Planning and Development's Schedule of fees and charges can be found on council's website.

Pre-lodgement discussions may include, but is not limited to, consideration of the following matters:

(a) environmentally significant areas;

(b) stormwater discharge (legal point of discharge);

(c) impacts of flooding/inundation;

(d) conceptual stormwater quality requirements and tailwater conditions/levels;

(e) overall water supply and pressure;

(f) overall sewerage reticulation;

(g) existing site conditions/constraints such as steep slopes, proximity to identified watercourses, existing utilities;

(h) lot and road layout design including existing traffic issues;

(i) traffic management strategy;

(j) landscape/streetscape;

(k) building setbacks and access requirements;

(l) relevant development permit conditions e.g. preliminary approvals or identify other required approvals e.g. referral to other agencies;

(m) variation to council standards and guidelines to explore possible solutions to design issues;

(n) design and layout; and

(o) building form and layout.

It is expected that resolving the above matters may significantly reduce the time for council officers in assessing the application and expedite the approval of the designs, presupposing all other requirements are submitted in order.

The pre-lodgement process is a without prejudice meeting designed to allow an exchange of information in respect to the intended development prior to submitting a formal development application. It is not intended to provide a detailed assessment audit against applicable planning scheme codes, planning scheme polices, or to determine the likely outcome of the proposed development. Furthermore, pre-lodgement meetings cannot take into consideration other third party interests such as referral agencies or anticipate possible adverse comments received from submitters in the notification stage.

(2) Meeting minutes will normally be taken at the meeting by a council officer, which can be forwarded to the applicant after the meeting (upon request) and registered in council's records system. However, attendees are encouraged to make their own notes.

(3) Pre-lodgement meetings are conducted by appointment only and would normally be of 1-2 hours duration depending on the complexity of the proposal. To request a pre-lodgement meeting, the applicant must complete a Pre-Lodgement Meeting Request Form (refer to SC6.4.2.2 Attachment A Pre-lodgement meeting request form), which can be submitted either by email or to the Planning and Development Counter, Level 2, Council Administration Building – Walker Street. The request must be accompanied with all relevant material including concept, layout or design plans and a brief covering letter or report detailing any specific issues.

SC6.4.2.2.2 Design requisites and quality assurance guidelines

(1) The developer/applicant is encouraged to engage and nominate appropriately qualified consultants/individuals with the required expertise to undertake design work on their behalf. The consultants are expected to have systems in place to assure the quality of the designs and the reports that they produce. It is the consultant's responsibility to ensure that the design complies with and has satisfied all relevant council requirements and conditions of the associated development approval.

Concept and detailed designs must comply with the relevant conditions of the Development Approval, council policies, Townsville City Plan and relevant provisions of this Development manual planning scheme policy. All designs must be prepared and certified by an appropriately qualified professional with relevant experience.

Quality assurance personnel shall be:

(a) engineering works - Registered Professional Engineer of Queensland (RPEQ) as defined under the *Professional Engineers Act 2002*;

(b) landscape works - Registered Landscape Architect with the Australian Institute of Landscape Architects (AILA) or a Landscape Designer with the Australian Institute of Landscape Designers and Managers (AILDM); and

(c) irrigation works - Certified Irrigation Designer or Certified Irrigation Agronomist where irrigation works are within the public realm.

(2) The Consultant must retain appropriate design records including calculations in a format such that they can be understood readily by design staff with no prior knowledge of the particular design. The design file must be maintained by the developer/applicants or the developer/applicant's consultant containing records of calculations, approvals and decisions, geotechnical data and other design data which could be relevant in reviewing aspects of the design or planning future maintenance responsibilities. Copies of records are to be made available to council on request and without charge.

(3) Council retains the right to audit all processes and documents related to the development design. The developer/applicants and the developer/applicant's consultant must provide council officers all reasonable

assistance in inspecting records of designs submitted to council for acceptance.

SC6.4.2.2.3 Documentation guidelines

To further assist developers in the process of lodging development applications, a well-made application checklist has been prepared by council and the completion of a particular checklist, and submission of all relevant accompanying information, will expedite the assessment process (refer to SC6.4.2.4 Well-made application checklists).

(1) Portable long service leave (PLSL)

Development Approvals for Operational Works cannot be issued by council until appropriate evidence of payment of the Portable Long Service Leave fees are provided as prescribed by the B*uilding and Construction Industry (Portable Long Service Leave) Act 1991*

(2) Certification and design reports

All designs to be accompanied with certification and design reports which must be signed by a qualified professional with relevant experience (see SC6.4.2.2.2(1)). The Certification Report will comprise the Certificate (SC6.4.2.2 Attachment B – Certification Report) and Design Report. The Design Report must contain documentation as required by SC6.4.2.2.3(4) and SC6.4.2.2.3(5) below.

The certification and design reports will be required with preliminary designs and will require resubmission with updates when final drawings are submitted. Certification is not required with sketch plans or concept plans.

The consultant must provide a detailed justification for each variation to or non-compliance with council's design and construction requirements, local laws, Townsville City Plan planning scheme policies and Townsville City Plan and relevant development approval conditions, as part of the Certification Report.

(3) Design drawings and work specifications

The consultant on behalf of the developer must present all design drawings and specifications for the development works to council for audit purposes.

The design drawings must be complete and clearly set out so as to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built. Unless noted otherwise, the submission should comprise a full set of plans for proposed works (1 x A3 drawings and a digital copy in PDF format correctly scaled as per council-preferred sheet size).

All work specifications must be prepared by the consultant and submitted to council for review, specifying requirements not covered by council's standard work specifications.

Full design drawings and work specifications covering all aspects of the proposed works must be submitted to council for acceptance. Standard drawings and works specifications (if available) from the following sources are to be included in order of preference:

(a) Standard drawings (SC6.4.4.8);

(b) Council design specifications (SC6.4.4) and Construction standards (SC6.4.6); and

(c) Department of Transport and Main Roads.

Where council's standard specifications are used unaltered, they may be referenced as such in the documents and may be omitted from the submitted set of specifications.

All Design drawings and work specifications must be certified by an appropriately qualified professional with relevant experience (see SC6.4.2.2(1)).

(4) Design documentation for material change of use applications

Applicants should submit the following documentation where necessary in support of the proposal:

(a) site analysis plan;

(b) elevation plans, floor plans (if necessary);

(c) traffic impact assessment, hydraulic report, geotechnical reports, acoustic report, stormwater quality

management plan, waste management safety in design report and other specialist reports necessary to support the development application;

(d) water and sewer modelling (if necessary) refer to SC6.4.3.23 Water and sewer network modelling guidelines; and

(e) landscape and irrigation plans.

(5) Design documentation for reconfiguring a lot applications
Applicants for staged developments should submit master plan documentation where necessary showing a subdivision's overall design concept for:

(a) sewer and water (including pump stations);

(b) stormwater quantity and stormwater quality (SC6.4.3.8 Stormwater quality management plans for development);

(c) earthworks including conceptual erosion and soil control plan (refer to SC6.4.4.5 Earthworks (design));

(d) road network (includes hierarchy, road and carriageway widths, noise impact and traffic studies);

(e) acoustic report, geotechnical report and any specialist report necessary to support the development application;

(f) public transport;

(g) servicing details (utilities);

(h) pedestrian and cycle network;

(i) Safety in design reports for all infrastructure that does not comply with relevant sections of the Development manual; and

(j) landscape and irrigation.

For non-staged developments; applicants should submit:

(k) lot layout;

(l) proposed road and access network;

(m) servicing details (utilities);

(n) stormwater management;

(o) Safety in design reports for all infrastructure that does not comply with relevant sections of the Development manual;

(p) Safety in design reports that demonstrate that sewer connection points and maintenance structures located at rear of lots are still accessible at all times; and

(q) any specialist report necessary to support the development application.

(6) Documentation for operational works and compliance applications
Applicants should submit where necessary to support the application the following documentation as part of the application (depending on scope of development works):

(a) design drawings (1x A3 size and an electronic copy in PDF);

(b) work specifications (one copy);

(c) copy of the associated Development Approval (if any);

(d) certified detailed Schedule/Bill of Quantities by a suitably qualified and experienced professional (see SC6.4.2.2.2(1));

(e) landscape statement of intent (see SC6.4.2.5(7)(1)(c) Landscape statement of intent);

(f) landscape and irrigation plans (see SC6.4.2.5(7) Landscape drawings and SC6.4.2.5(8) Irrigation drawings);

(g) stormwater drainage design calculations including design of structures (e.g. open drains, detention basin), catchment plans (internal and external);

(h) stormwater quality management plan including the design criteria and details;

(i) water network analysis (refer to SC6.4.3.23 Water and sewer network modelling guidelines);

(j) sewer network analysis (refer to SC6.4.3.23 Water and sewer network modelling guidelines);

(k) subgrade test results and pavement designs;

(l) engineering certification of structural designs;

(m) preliminary erosion and sediment control plan (refer to SC6.4.2.2.7 Conceptual and preliminary erosion and sediment control plan);

(n) traffic management plan (if required);

(o) traffic report (if required);

(p) geotechnical reports (where relevant);

(q) conduit assessment of existing infrastructure (refer to SC6.4.2.2.6 Conduit assessment) Safety in Design; and

(r) any other information required by the associated development approval and under relevant legislation, or relevant to support the assessment of the application.

SC6.4.2.2.4 Council's acceptance of design - advice

Council does not guarantee that the submitted designs for the proposed development have been checked in detail. Upon council's acceptance of designs for the proposed development, it is assumed that the certifying professional has performed sound judgement in preparing the designs taking into consideration existing site conditions and council requirements.

Council does not accept any responsibility for the accuracy of the submitted design and that any deficiencies and non-complying works identified by council must be rectified at the cost of the developer, notwithstanding council's prior approval.

If council's audit of the design reveals the Design Certificate Report to be inaccurate or incomplete, the submission may be returned to the consultant for resubmission. A resubmission review fee may be charged.

SC6.4.2.2.5 Preparation of design drawings guidelines

The information set out in SC6.4.2.3 Design checklists, SC6.4.2.4 Well-made application checklists and SC6.4.2.5 Details on drawings should be used as a guide to prepare design drawings. The information should be used in the preparation of plans for each group of drawings to assist council in the assessment process.

SC6.4.2.2.6 Conduit assessment

Any development which proposes to construct a structure, building or undertake earthworks in the vicinity of or within the "zone of influence" of an existing conduit may be required to identify the condition of the conduit for assessment of serviceability and structural compatibility with the proposed development work. Any upgrading or replacement determined by council will be carried out at the developer's expense prior to the commencement of any development works.

(1) CCTV inspection criteria - general criteria for closed circuit television (CCTV) sewer and stormwater assessments for operational works/compliance permits are as follows:

(a) sewer:

(i) major developments (refer to SC6.4.2.1.1(1)):

(A) prior to commencement of the defects liability period; and

(B) if defects are identified they must be rectified, and the sewer, for the entire length between the upstream and downstream maintenance holes (MHs),must be assessed again prior to completion of the defects liability period.

(ii) minor developments (refer SC6.4.2.1.1(2)):

(A) systems containing two or more sewer lengths, or systems containing sewer lengths that exceed a combined service length of 60 m measured centre to centre between manholes require assessment prior to commencement of the defects liability period;

(B) if defects are identified they must be rectified, and the sewer, for the entire length between the upstream and downstream maintenance holes (MHs),must be assessed again prior to completion of the defects liability period; and

(C) where a defects liability period does not apply, CCTV assessment is mandatory prior to acceptance.

(b) stormwater:

(i) inter-allotment systems located on private property are exempt;

(ii) rubber ringed jointed pipe systems with flexible joints immediately outside chambers (includes PVC and Polythene pipe systems) will be visually assessed and are exempt subject to the system presenting defect free;

(iii) CCTV assessment of flush end RCP pipe systems is mandatory;

(iv) major developments (refer to SC6.4.2.1.1(1)):

(A) prior to commencement of the defects liability period; and

(B) prior to completion of the defects liability period.

(v) minor developments refer to SC6.4.2.1.1(2)):

(A) systems exceeding a service length of 60 m require assessment prior to commencement of the defects liability period; and

(B) where a defects liability period does not apply, CCTV assessment of the system is mandatory prior to acceptance.

(2) Qualification and training of CCTV operators and supervisors - the assessment must be undertaken by a suitably trained and qualified contractor, in accordance with the relevant sections of the current version of Water Services Association of *Australia's Conduit Inspection Reporting code of Australia* (WSA05) and the results are to be submitted to council in CD, DVD or any digital storage device acceptable to council accompanied by a written condition assessment report to be approved in writing by council prior to the issuance of any Development Approvals.

In the event of non-compliance in preparation and submission of the conduit assessment, council may require the developer to re-perform the inspections and re-submit. All costs incurred conducting these additional conduit assessments will be the responsibility of the contractor.

(3) Site establishment – the contractor is responsible for the following requirements:

(a) any necessary approvals from statutory authorities in order to complete the required work;

(b) any temporary electric light, power installations and water supply including all charges incurred;

(c) public notification if necessary – contractor must notify affected residents/adjacent property owners/commercial business owners and council (including if the area to be closed is public open space). Additional requirements may be necessary if closures are to be over an extended period of time. Notification is required prior to commencement of work;

(d) plans of existing services are to be verified by the contractor. Council does not guarantee the accuracy of the information on these plans;

(e) environmental management plan – if necessary, the contractor must prepare and implement a site specific environmental management plan, for inspections which would involve interference to live services e.g. sewer line which poses an environmental risk. The Plan must detail activities and measures to ensure that the inspection is performed in a manner which minimises risk of causing environmental nuisance or harm;

(f) reinstatement – clean-up, repair and reinstate any areas affected or impacted by the works, at their own cost;

(g) maintaining the service in all conduits being inspected;

(h) pipe cleaning – conduits being inspected must be sufficiently clean to allow proper visual identification of existing defects. The proper disposal of debris from the cleaning shall be the responsibility of the

contractor;

(i) traffic management – where the diversion of vehicular and pedestrian traffic is required, the contractor is responsible for implementing an appropriate traffic management plan; and

(j) occupational health and safety – the contractor is required to comply with all statutory and other current regulations relating to occupational health and safety.

(4) Inspection report – The production of reports (including mandatory information), detailing the condition of surveyed conduits, all coded and scored to standards that satisfy the requirements of current WSA 05 Code.

(5) Inspection software – The preferred software for use in reporting on conduit inspections is the current of WinCan, set up to report as per the current WSA 05 code. If a contractor proposes to use alternative software, a full detail of the software must be provided to council for approval which includes the capabilities must be provided and must be fully compatible with the WinCan software.

(6) Data ownership – Full ownership of the survey and report data including intellectual property rights to the digital visual records and its contents must be with council.

SC6.4.2.2.7 Conceptual and preliminary erosion and sediment control plan

Soil disturbance is inevitable in any development; it is fundamental to develop measures to reduce the impact of soil erosion in every stage of construction to an acceptable level of sediments leaving the development site.

For reconfiguring a lot, material change of use, operational works and compliance assessment applications, depending on the scope of development, associated environmental impacts, site constraints (e.g. land use, lot layout site topography, proximity to bodies of water) and other factors, the developer should identify the erosion risk level of the proposed development, which can be determined by assessing the erosion hazard of the intended development site outlined in SC6.4.3.8 Stormwater management plans for development and *Appendix F – Erosion Hazard Assessment* of the International Erosion Control Association's *Best Practice Erosion and Sediment Control (IECA BPESC).*

Where a development site of a development application was assessed as being a high-risk site, the developer should provide a conceptual erosion and sediment control plan (CESCP). The conceptual document should take into consideration the key principles of erosion and sediment control detailed in this clause, and the site planning aspects and guideline in preparing conceptual plans in SC6.4.3.8 Stormwater management plans for development.

Where a development site was assessed as being a low-risk site and where a CESP has been accepted by council, a preliminary erosion and sediment control plan (PESCP) must be submitted to council as part of the operational works or compliance applications. The PESCP must be prepared in accordance with the design standards and technique selection outlined particularly in:

(1) Chapters 2 – Principles of erosion and sediment control;

(2) Chapter 4 – Design standards and technique selection;

(3) Chapter 5 – Preparation of plans; and

(4) also including the appropriate Model Code of Practice and Specific Guidelines in:

(a) Appendix G – Model code of practice;

(b) Appendix H – Building sites;

(c) Appendix I – Instream works;

(d) Appendix J – Road and rail construction;

(e) Appendix K – Access tracks and trails; and

(f) Appendix L – Installation of services of *IECA BPESC.*

During the Pre Start Meeting, the applicability and appropriateness of the PESCP will be reviewed on-site and revisions will be required if necessary.

For general guidance in implementation of erosion and soil control plan refer to SC6.4.3.8 Stormwater management plans for development.

SC6.4.2.2 Attachment A – Pre-lodgement meeting request form
Click here to view Pre-lodgement meeting request form.

SC6.4.2.2 Attachment B – Certification report
Click here to view Certification report

SC6.4.2.3 Design checklists

SC6.4.2.3.1 - Design Checklist 1 - Base plot of existing features
Click here to obtain a copy of the following form

SC6.4.2.3.2 - Design Checklist 2 - Horizontal road alignment
Click here to obtain a copy of the following form

SC6.4.2.3.3 - Design Checklist 3 - Vertical road alignment
Click here to obtain a copy of the following form

SC6.4.2.3.4 - Design Checklist 4 - Road cross sections
Click here to obtain a copy of the following form

SC6.4.2.3.5 - Design Checklist 5 - Road and interallotment drainage
Click here to obtain a copy of the following form

SC6.4.2.3.6 - Design Checklist 6 - Signs and markings
Click here to obtain a copy of the following form

SC6.4.2.3.7 - Design Checklist 7 - Pavement design
Click here to obtain a copy of the following form

SC6.4.2.3.8 - Design Checklist 8 - Bridge major culvert design
Click here to obtain a copy of the following form

SC6.4.2.3.9 - Design Checklist 9 - Landscape and Irrigation Plans
Click here to obtain a copy of the following form

SC6.4.2.3.10 - Design Checklist 10 - Erosion and sedimentation control plans
Click here to obtain a copy of the following form

SC6.4.2.3.11 - Design Checklist 11 - QAF0477 Sewage pump station and pressure main checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.12 - Design Checklist 12 - QAF0477 Sewer reticulation checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.13 - Design Checklist 13 - QAF0478 Water reticulation checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.14 - Design Checklist 14 - QAF0479 Water and sewer model checklist
Click here to obtain a copy of the following form.

SC6.4.2.4 Well-made applications checklists

SC6.4.2.4.1 - Material Change of use - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.2 - Reconfiguring a lot - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.3 - Compliance - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.4 - Operational Works - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.5 Details on drawings guidelines

SC6.4.2.5.1 General requirements guidelines

(1) The information shown on the drawings must be logically collected on discrete sheets to avoid illogical and onerous effort in cross referencing between sheets in order to find information. This policy section details

minimal information requirements for plans and drawings submitted for assessment.

(2) Drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information.

(3) The preferred submission method is uploading to the Townsville Online Lodgement System (TOLS). The preferred sheet sizes of drawing sheets are:

(a) A1 size (841 mm x 594 mm); and

(b) A3 size (420 mm x 297 mm).

(4) The preferred scales for use should generally conform with the recommendations of AS 1100.101 *Technical Drawing – General principles*. Generally the following scales are to be used 1:10, 1:20, 1:50 and multiples of 10 of these scales.

(5) Electronic and hard copies of drawings should be true to scale A1 size sheets and be suitable for black and white printing, copying and photo reduction to A3 size without loss of clarity.

(6) The drafting should be of a standard generally in accordance with the requirements of AS 1100.

(7) Title block – All drawings must, within the boundaries of the title block, clearly indicate the following:

(a) project title e.g. estate name (if any);

(b) real property description;

(c) locality;

(d) developer's name;

(e) details on contents of drawings e.g. sewer reticulation;

(f) scales – bar scales;

(g) plan and sheet number;

(h) schedule and date of revisions;

(i) survey datum;

(j) street names;

(k) date of initial issue;

(l) legend and north point; and

(m) signed design certification.

(8) Typical scales – the following scales are suggested for particular uses but these may be varied as appropriate to the works concerned:

(a) plans – 1:1000 (rural) and 1:500 (urban);

(b) longitudinal section horizontal – 1:1000 (rural) and 1:500 (urban);

(c) longitudinal section vertical – 1:100 (rural) and 1:50 (urban);

(d) intersection details - 1:250 or 1:100; and

(e) cross sections – 1:100.

(9) Survey datum – Level information should be referenced to the Australian height datum (AHD). Position coordinates should be tied to the GDA94 datum based on the Mapping Grid of Australia (MGA) coordinate system.

(10) Dimensioning

(a) Units - All units should be expressed in metric units. Linear dimensions on all roadworks plans, with the

exemption of some details of small structures and standard details which may be in millimetres.

(b) Chainages – Chainages on plans should be expressed to three decimal places of a metre e.g. 0.123 m.

(c) Cross section intervals – Road cross sections should be provided at 20 metre intervals, with further subdivision to 10 metre or 5 metre intervals where necessary due to horizontal or vertical curvatures.

(d) Grades – Road and pipe grades should be shown to three significant figures in percentage e.g. 1.234%.

SC6.4.2.5.2 Layout and stage plan guidelines

(1) For large developments, the layout plan shows the relationship of all new roads to each other, and to existing roads adjoining the development.

(2) Where development is planned in stages, the boundaries of proposed stages are shown on the plan, and the stages identified by numbering.

(3) Existing and proposed streets which are adjacent to or fronting the proposal are included on the layout plans.

(4) All services, natural features, significant trees and the like are shown on existing road reserves.

(5) Details of the permanent survey mark, including the AHD level from which the levels were transferred, are included.

SC6.4.2.5.3 Roadworks and associated drainage drawings

(1) Plan – drawing should include the following details:

(a) road reserve boundaries;

(b) lot boundaries, both existing and proposed (levels provided at each boundary corner) and easements;

(c) centreline or other construction line;

(d) chainages on centreline or construction line or set out co-ordinates;

(e) bearings of the centreline or construction line;

(f) offsets (in tabular form) if the construction line is not the centreline;

(g) tangent point chainages or co-ordinates of each curve;

(h) radius and tangent length and superelevation of each curve;

(i) road reserve boundaries, centreline, and bearing of each intersecting road;

(j) chainage or co-ordinates of the intersection point of road centrelines;

(k) kerb lip lines, kerb types, kerb face (setout) radii and chainage or co-ordinates of all tangent points of kerb face (setout) lines;

(l) edge of pavement, where no kerb and channel is proposed;

(m) dimensioned road reserve, verge, concrete footpath and pavement widths, where these differ from the standard cross section;

(n) location and details of signs and road markings proposed;

(o) drainline locations(including interallotment drainage), diameters and class of pipes or size of box culverts, open drains and easements and invert levels;

(p) the defined flood event levels;

(q) manhole locations, chainage and offset or co-ordinates and invert and kerb levels;

(r) stormwater flow arrows;

(s) inlet pit and manhole locations tabulated to include type, type of jointing chainage;

(t) culvert/channel and other structures details;

(u) location of existing utilities or other existing works within the site;

(v) limits and levels of lot filling or grading;

(w) cut or fill depths and earthwork quantities;

(x) co-ordinates of all set out points;

(y) retaining wall (including details);

(z) location and levels of bench marks and reference pegs;

(aa) service conduits locations;

(ab) details of all existing construction on or adjoining the proposed works; and

(ac) longitudinal and cross sections with invert levels and the required flood levels including existing and proposed surface contours of constructed or natural open channels (e.g. table drains) and waterways (including landscape, construction details and maintenance).

(2) Detail plans of intersections, turnaround areas, property accesses, cul-de-sac, traffic calming (LATM) devices (if required) and the like.

(a) Intersection detail plans include all relevant information required for plans together with additional details such as tangent point chainages, kerb lip levels on all kerb returns, pavement contours and channelisation works.

(b) The plans should also include relevant information as listed for standard cross section SC6.4.2.5(3)(4)).

(3) Longitudinal sections of roads – the longitudinal section of each road includes:

(a) chainages;

(b) datum RL, existing surface and peg levels;

(c) design road centreline and lip of kerb levels and grades;

(d) cut or fill depths and earthwork quantities;

(e) design grades, length and radii of vertical curves;

(f) chainage and level of grade intersection points and tangent points of vertical curves;

(g) sight distance diagram for each direction of travel for collector or higher order roads only;

(h) line marking (where applicable);

(i) details of superelevation (where possible);

(j) drainage lines and manholes intersecting centre line;

(k) table drain grading and levels where no kerb and channel;

(l) sight distance diagram for each direction of travel;

(m) horizontal curve details;

(n) existing and proposed services; and

(o) pavement design and design speed.

(4) Type cross sections of road - a standard cross section is shown for each road, including:

(a) road reserve width;

(b) pavement widths (lip to lip dimension);

(c) road verge widths;

(d) concrete footpath and cycle paths;

(e) crossfalls of pavement and road verges;

(f) pavement depth (including subsoil drainage);

(g) type of kerb and channel;

(h) type of pavement surfacing;

(i) batter slopes; and

(j) pegged or shift centre line.

(5) Cross sections of roads – a cross section is shown for each chainage on each road.

(a) A cross section should be shown at a minimum spacing of 20 m. Where roads are in steep terrain, cross sections may be required at closer intervals. Cross sections are to be extended into the allotments for the limit of batters. The cross-section plans are to include:

(i) road reserve boundaries;

(ii) pavement centreline, and shift centre line or other construction lines;

(iii) natural surface;

(iv) design cross section;

(v) crossfall of pavement and road verge, pavement and road verge widths, and pavement depths, wherever these differ from the standard cross section, e.g. superelevation and curve widening;

(vi) pavement and subsoil drainage; and

(vii) chainages.

(b) When existing bitumen sealed roads are widened, cross sections include the full existing sealed pavement cross section at not more than 10 m intervals.

(c) Each cross section shows the percentage crossfall on the existing bitumen surface and the design crossfall to the lip of the proposed kerb and channel.

(d) Notations on drawings also require the Supervising Engineer to check for any errors between the design and the set out of the kerb and channel before the kerb and channel is constructed.

(6) Traffic signs and pavement markings plan – all required signage and pavement markings (including temporary works) are to be provided in accordance with the current version of the MUTCD, Queensland.

(7) Longitudinal sections of drainlines – a longitudinal section of each drainline should be drawn along the centre line of the drainline and should show:

(a) chainages;

(b) existing and proposed surface levels;

(c) design invert levels, hydraulic grade lines, velocity, discharge;

(d) manhole chainages, inlet and outlet invert levels, and finished surface levels of structures;

(e) distances between manholes;

(f) grade in percent, diameter, type and class of each pipe or size of each box;

(g) references to the Council's current standard drawings;

(h) class of each pipe, length and type of pipe;

(i) existing and proposed service locations and levels;

(j) all piped drainlines and constructed or natural channels used to convey run-off as part of the development are shown on drawings;

(k) longitudinal sections and cross sections of all channels show the calculated hydraulic grade line for the design frequency; and

(l) piped drainlines are included either on the road longitudinal sections where applicable or detailed separately.

(8) Stormwater drainage catchment plan – the catchment plans should indicate all catchments including external catchments contributing to the stormwater drainage design and the following:

(a) full external catchment;

(b) development layout plan showing the roads and allotment boundaries;

(c) existing and finished surface contours (in different line types). Contour intervals are to be sufficient to enable sub-catchments to be defined;

(d) contours must be extended external to the site to enable the limits of all external catchments to be fully defined;

(e) subcatchment boundaries, labels and areas;

(f) location of drainlines, manholes, inlet/gully pits, outlets, open drains etc.; and

(g) labelling of stormwater structures.

SC6.4.2.5.4 Bicycle, pedestrian and shared path drawings guidelines

(1) All plans for bicycle, pedestrian and shared paths are to be presented at the reduction ratio 1:500 minimum or 1:200 preferable. The plans are to include details of the signs and pavement markings to be used and any barriers, fences, holding rails, ramps, etc. The landscaping treatment should also be included in the plans.

(2) The cycleway bicycle path plan sheet may be incorporated into the road plan where clarity permits. Specific details are to be provided at reduction ratio 1:200.

(3) Longitudinal sections will be required for all off-road pathways where grades are greater than or equal to 3%.

(4) Longitudinal sections will have reduction ratios of 1:500 horizontal and 1:50 vertical.

(5) Cross sections will be presented at 1:100 reduction ratio (natural) and transition tables will be required where cross falls vary or superelevation is provided.

(6) A typical cross section will be detailed to indicate pavement materials and layer depths.

SC6.4.2.5.5 Sewerage drawings guidelines

(1) Sewerage layout plan - the sewerage layout plan includes:
For development consisting of two or more stages, a preliminary master layout plan showing boundaries of all stages. The plan shows proposed locations and sizes of all trunk mains, pumping stations and sewage treatment plants, where relevant.
In addition, the sewerage layout includes:

(a) boundary of the development, lot layout and numbers, easements (if required), finished surface contours;

(b) non-sewered areas;

(c) references to the council's current standard drawings;

(d) location, grades of all sewer lines, manholes (numbered) and other services where they cross;

(e) indicate trunk mains;

(f) pumping stations, maintenance structure numbers and sewer diameters;

(g) site plan for sewerage pump stations; and

(h) details of water and electricity supply, landscaping, access and control buildings, if applicable.

(2) Sewerage longitudinal sections - the longitudinal section of each sewer line includes:

(a) upstream and downstream invert levels;

(b) existing and finished surface levels, depth to invert;

(c) grade expressed as 1 in XX;

(d) diameter, type and class of pipe;

(e) chainage;

(f) distance between maintenance structures;

(g) concrete stops, where required;

(h) manhole and/or shaft number;

(i) manhole type and drop type;

(j) location and depth of all underground services; and

(k) the design invert level of each house connection branch, type and invert level of the branch.

SC6.4.2.5.6 Water drawings guidelines

(1) Water reticulation layout plan
For developments consisting of two or more stages, a master layout plan showing stage boundaries should be provided. Locations of existing or proposed trunk mains, treatment plants or reservoirs are to be shown on plan.

In addition, a water reticulation layout plan showing:

(a) pipe location;

(b) pipe material, diameter, type, class and joints, including fittings;

(c) fire hydrant, valve, bends, junction locations;

(d) size and location of all concrete anchor blocks, thrust blocks, and diaphragm walls;

(e) cut-in details;

(f) cross-road conduit locations;

(g) specific notes and instructions;

(h) boundary of the development, lot layout and numbers, including easements;

(i) proposed location for any pump stations, showing access details;

(j) references to council's current standard drawings (SC6.4.4.8 Standard drawings);

(k) dimension from road alignment boundary/property boundary;

(l) minimum clearances to other services;

(m) pipe and fitting, internal and external protection details including at road pavement crossings;

(n) trench cross section detail showing the pipes as well as bedding and filling materials for each size and type of pipe;

(o) pump curves if appropriate;

(p) complete pipe work and structural details of any pump stations, including complete details of valves and other fittings and electrical details; and

(q) technical specifications for pumps and pump stations.

SC6.4.2.5.7 Landscape drawings guidelines

(1) Applications including landscape works, detailed plans and documentation containing the following minimum amount of information should to be provided, as applicable and in support of the proposal:

(a) Demonstration of design preparation and certification by qualified personnel (refer SC6.4.2.2.2(1)).

(b) Landscape plans, providing the following minimum amount of information, as applicable:

(i) specification notes for plant establishment period and maintenance;

(ii) existing site information, boundaries, contours, underground/overhead services, easements, drainage lines, or the like;

(iii) adjoining structures that overshadow the site;

(iv) details of protected vegetation, significant trees that are proposed for retention and trees proposed for removal due to the development;

(v) the canopy height and spread of any major tree or building footprint on adjoining property which the proposed development may affect in any way. The incorporation of a qualified arborist's findings may be relevant where adjoining tree root zones or canopy extends into the development site;

(vi) specification notes either on the drawings or in an associated report that adequately outlines the quality of construction materials, and all other relevant information;

(vii) proposed location of buildings/structures including finished floor levels;

(viii) roadways, car parks, footpaths, driveways with description of materials and finishes;

(ix) all areas and their proposed treatment such as surface treatments, planting layout, planting schedule, including botanical names, stock sizes, quantities, staking and planting details;

(x) fences and screens indicating materials, heights and construction details;

(xi) location and details of street or park furniture, fixtures and lighting;

(xii) indicative cross-sections of important features or areas of the site such as entrances, waterways and retaining walls;

(xiii) details of irrigation system;

(xiv) proposed design levels and original ground levels/contours;

(xv) design details and materials of all surfaces, retaining walls, edging, embankments, furniture,

planting, lighting and other structures including entry statements;

(xvi) typical cross sections through the site; and

(xvii) construction details for planting, paving, edging and retaining structures.

(c) Landscape statement of intent, describing:

(i) how the proposed landscaping meets the intent of the (SC6.4.3.6 Landscape policy) ;

(ii) how the proposed landscaping address the sites opportunities and constraints; and

(iii) the underpinning concepts incorporated into the landscape design and how these relate to and deliver cost-effective sustainable outcomes.

(d) locality map illustrating surrounding reserves/natural areas, roads and local features.

(e) existing site conditions and base information including:

(i) site boundaries, levels and contours;

(ii) description and location of built elements, including “off street car parking”;

(iii) site analysis identifying opportunities and constraints;

(iv) description of all remnant vegetation present and any landforms (for example dunes, gullies, wetlands, waterways, rock formations);

(v) location of existing trees and identified vegetation to be retained including Vegetation Protection Zone/s and protection and management provisions as per SC6.4.5.2.1(18) Work adjacent to trees and protection of environmentally significant vegetation;

(vi) canopy height and spread of any major tree or building footprint on adjoining property which the proposed development may affect in any way. The incorporation of a qualified arborist’s findings and implementation Vegetation Protection Zone of may be relevant where adjoining tree root zones or canopy extends into the development site;

(vii) location of existing trees and identified vegetation for removal;

(viii) existing driveways, footpaths, adjoining driveways etc. including finished surface/s;

(ix) adjoining structures that overshadow the site;

(x) significant features pertaining to the application e.g. the location of refuse collection areas;

(xi) existing grading and drainage in relation to the landscaping (overland flows to be identified) with inlet and discharge points clearly shown; and

(xii) underground and overhead services (water, power, telecom and gas) easements and drainage lines.

(f) landscape details and schedules including:

(i) proposed design levels and original ground levels/contours;

(ii) typical cross sections through the site including surface grades;

(iii) method of erosion control for slopes steeper than 1:4;

(iv) grading and drainage in relation to the landscaping (overland flows to be identified) including surface and subsurface drainage, collection points, and discharge points clearly shown;

(v) surface treatment for hardscape areas including accurate location, dimensions, construction notes, details and finishes of concrete footpaths, paving, roadways, car parks, driveways, boardwalks and the like;

(vi) existing and proposed levels of building slab, hard surfaces, drainage grates and landscaped areas, especially adjacent to trees to be retained;

(vii) indicative cross-sections of important features or areas of the site such as entrances, waterways and retaining walls;

(viii) location and details of furniture, fixtures and lighting, where applicable;

(ix) fencing and screening locations including height, material and finish, to boundaries and pool area (if applicable);

(x) details and soil depth of planter boxes and podiums including inlet and discharge points for drainage;

(xi) location, dimensions and construction details for any other proposed works or structures or external elements;

(xii) calculation of the square metre area of landscape and recreation area;

(xiii) surface treatment for all softscape areas including accurate location, dimensions, planting notes, details and methods of establishment or transplanting for garden beds, lawn areas, and other softscape elements;

(xiv) planting bed preparation details/notes including excavation, cultivation, imported topsoil depths, mulch type and depth, fertiliser or soil additive type and application rate where the council specification is not being applied;

(xv) planting plan including planting layout, plant code, stock sizes, quantities, staking and planting details;

(xvi) plant schedule containing plant code, plant species, location, quantity and spacing and size of container (and approximate size of the plant if requested as part of a condition) as per Table SC6.4.2.1 below;

Table SC6.4.2.1 Example of plant schedule

Plant code	Plant name	Location	Qty	Spacing	Container size
1	Rhoeo spathacea	Garden 1	30	500mm centres	140mm
2	Carpentaria acuminata	Garden 2	3	As per plan	25 Litre
3	Callistemon Capt Cook	Garden 1 & 2	10	1 metre centres	150mm

(xvii) specification notes (either on the drawings or in an associated report) that adequately outline the quality of construction materials, and all other relevant information; and

(xviii) specification notes for the plant establishment period and maintenance including responsibility for plant replacement and maintenance.

(2) For public open space, streetscaping or works that will become council assets, council may request more detailed information including:

(a) General details such as:

(i) demonstration of design preparation and certification by qualified personnel (see SC6.4.2.2.2(1));

(ii) designer's name and/or company;

(iii) drafter's name and/or company; and

(iv) surveyor's name and/or company.

(b) Additional details pertaining to open space or streetscaping (existing and proposed) including but not limited to:

(i) geotechnical and soil test results;

(ii) site plan, including relationship to existing infrastructure and details and responsibilities relating to removal or modification of council assets;

(iii) details of type, manufacturer, materiality, and warranty of furniture, equipment and structures (such as play equipment, park furniture, shade shelters) including compliance with relevant standards where applicable;

(iv) the location and details of any stormwater quality management infrastructure to be constructed including maintenance access to the infrastructure;

(v) calculation of the square metre area of landscaping to be planted, broken down into turfed and mulched and planted areas;

(vi) other works proposed in the location/public open space, which do not form part of the detailed landscape plan, but may impact the landscape works or council assets (such as vegetation management, rehabilitation and environmental management plans);

(vii) the location and details of any stormwater discharge through or into a public open space or

waterway; and

(viii) where plantings are proposed in the road reserve, the provision of a plan showing an accurate footprint, including trunk diameter (at 1.2 m from ground level) and canopy spread of all existing trees and expected diameter at maturity for proposed street trees adjacent to the property and roads concerned, including any trees that are proposed to be removed.

(c) Maintenance plan pertaining to ongoing maintenance of public open space infrastructure or streetscaping, including but not limited to:

(i) schedule that lists the assets and associated maintenance activities, including locations, season of visit, schedule frequency and number of visits per year;

(ii) statement demonstrating alignment with council public open space management specifications;

(iii) Bill of Quantities (BOQ) that identifies the relevant types and quantities of each asset;

(iv) detailed specifications for specialist activities and/or infrastructure including, but not limited to, playground and fitness equipment, public art, ablution facilities, water features, stormwater quality infrastructure, bridges, and revegetation areas;

(v) that the landscape maintenance plan has been prepared by a suitably qualified horticulturist or landscape designer (or irrigation designer for any irrigation system component of the landscape management plan); and

(vi) an approved traffic management plan relating to all ongoing maintenance activities that will be required within the road reserve or require ongoing traffic management.

(d) Other applicable (written) approvals, including but not limited to:

(i) asset owner approval of works, including buildings and structure, where the works are within a designated parkland or affecting other council assets; and

(ii) all other approvals or certifications necessary for the completion of works in accordance with the Laws of Australia, Laws of the State of Queensland, Townsville City Council Local Laws and Ordinances.

SC6.4.2.5.8 Irrigation drawings guidelines

(1) For all irrigation works, detailed plans and documentation containing the following minimum amount of information are to be provided, as applicable:

(a) standard plan legend as shown in SC6.4.4.8 Standard drawings (Irrigation drawings).

Note—the symbols and line types shown in the Legend are the acceptable convention for design plans to be used to represent the components of the design. Additional symbols and line types may be introduced provided they are shown in the Legend on the drawing.

(b) valve key displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(c) sprinkler key displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(d) locality plan outlining the location of the site appropriately labelled with the suburb and street names;

(e) name of all adjacent roadways;

(f) location of water meter, backflow device, automatic controller, valve boxes;

(g) details of irrigation system and connection (town supply or bore water);

(h) irrigation design data displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(i) irrigation cabling/wiring schedule displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings); and

(j) design notes detailing relevant design criteria e.g. Sprinkler Type A is to be Hunter PGP; all Solenoid valves are to be Hunter ICV; descriptions of the Symbols and Line Types used from the Plan Legend.

(2) For all irrigation in public open space works, streetscapes or works that will become council assets, council may request more detailed information in addition to the general irrigation works requirements previously outlined, including:

(a) general details such as:

(i) demonstration of irrigation design preparation and certification by qualified personnel being a Certified Irrigation Designer or Certified Irrigation Agronomist including certification number;

(ii) designers name and/or company;

(iii) drafters name and/or company; and

(iv) surveyors name and/or company;

(b) additional details pertaining to irrigation within public open space or streetscapes (existing and proposed) including but not limited to:

(i) details and responsibilities relating to removal or modification of council irrigation assets;

(ii) details of type, manufacturer, materiality, and warranty of irrigation system component including compliance with relevant standards where applicable;

(iii) the location and details of any irrigation associated with stormwater quality management infrastructure to be constructed including maintenance activities and access to the irrigation infrastructure;

(iv) calculation of the square metre areas of irrigation against the irrigation system type and profile levels;

(v) other works proposed in the location/public open space, which do not form part of the detailed irrigation plan, but may impact the irrigation works or council assets; and

(vi) where irrigation is proposed in the road reserve, the inclusion of offset details from lanes of traffic to irrigation infrastructure;

(c) maintenance plan pertaining to ongoing maintenance of irrigation infrastructure or streetscaping, including but not limited to:

(i) leak and blockage checks in irrigation lines and emitters;

(ii) reprogramming the irrigation controller and restationing of emitters as plants grow, die out and are replaced;

(iii) inspection of moisture sensors;

(iv) maintenance of tanks and cisterns;

(v) checking of water pumps; and

(vi) an approved traffic management plan relating to all ongoing maintenance activities that will be required within the road reserve or require ongoing traffic management; and

(d) other applicable (written) approvals, including but not limited to:

(i) asset owner approval of works, where the works are will affect council irrigation systems or other council assets; and

(ii) all other approvals or certifications necessary for the completion of works in accordance with the Laws of Australia, Laws of the State of Queensland, Townsville City Council Local Laws and Ordinances.

SC6.4.3 Design standards

SC6.4.3.2 Building over or adjacent to services

SC6.4.3.2.1 Introduction

(1) Purpose

This sub-section outlines council's standards and guidelines for building over or adjacent to council's services. This document will supplement the Queensland Development Code *Mandatory Part 1.4 – "Building over or near relevant infrastructure"* and identifies and provides additional guidance about any information that may be required to support a development application. This section does not replace or override any aspect of the QDC.

(2) Scope

This sub-section applies to all building work proposed to be carried out over or near to a council service or underground asset.

(3) Principles

The construction and erection of a structure or the creation of a residential allotment over or near to a council service must be carried out in a way that ensures that:

(a) the function of the service is not adversely affected;

(b) no additional load is placed on the service without council approval; and

(c) maintenance access (at all times) to the service is not interfered with or restricted.

SC6.4.3.2.2 Restricted development

(1) Without exception, council will not permit building a structure over or near to:

(a) sewer pressure mains and overflow pipework; or

(b) gravity sewer trunk mains; or

(c) sanitary drainage connection points; or

(d) water supply mains; or

(e) stormwater drainage conduits (pipes or culverts) with a capacity of less than 2% average exceedence probability (AEP) or stormwater pipelines with an internal diameter of less than 375 mm; or

(f) open drainage channels or overland drainage paths.

SC6.4.3.2.3 Allowable development over or adjacent to sewerage services

(1) Council may permit building a structure over or near to the following sewerage services:

(a) gravity sewer mains, other than gravity trunk mains excluded under section SC6.4.3.2.2. The applicant is to carry out an internal closed-circuit television inspection of the main and submit it to council, prior to commencing any construction activities over or adjacent to the sewer.

If the main is assessed to be in poor condition or liable to damage from the proposed construction, the applicant may be required to replace the main to the satisfaction of council prior to commencement of any construction activities over or adjacent to the sewer; and

(b) sewer maintenance holes in commercial or industrial buildings:

If approved, the chamber is to be raised to the floor level of the building. Maintenance holes must be sealed against gas leaks, bolted down and kept clear of obstructions for maintenance access by council at all times.

SC6.4.3.2.4 Allowable development over or adjacent to stormwater services

(1) Council may permit building a structure over or near to the following stormwater services:

(a) drainage conduit with a minimum 2% AEP and with an internal diameter greater than 375 mm. The applicant must carry out an internal closed-circuit television inspection of the stormwater conduit and submit it to council, prior to commencing any construction activities over or adjacent to the stormwater conduit. If the stormwater conduit is assessed to be in poor condition or liable to damage from the proposed construction, the applicant may be required to replace the main to the satisfaction of council

prior to commencement of any construction activities over or adjacent to the stormwater conduit. Council may permit a driveway or temporary or light steel framed structure to be constructed over a storm water drain where:

(i) maintenance access to the drain can be retained;

(ii) the drain does not also form part of an overland flow path; and

(iii) no other option is available.

SC6.4.3.2.5 Clearances

The following minimum clearances apply for structures permitted to be built over or adjacent to a service:

(1) a minimum clearance of 250 mm must be maintained between the outside edge of the service footprint and the nearest projection of the foundation of the proposed structure, excluding swimming pools. Swimming pools must be located to achieve a minimum clearance of 600 mm vertically and 1 m horizontally to the outer edge of the service footprint;

(2) a minimum horizontal clearance of 1.2 m must be maintained between the outer face of the service and the nearest point of the foundation of the structure;

(3) the foundation of any structure, excluding a swimming pool, located within the zone of influence must extend a minimum of 150 mm below the projected zone or on solid rock. Pier and beam footings are generally acceptable;

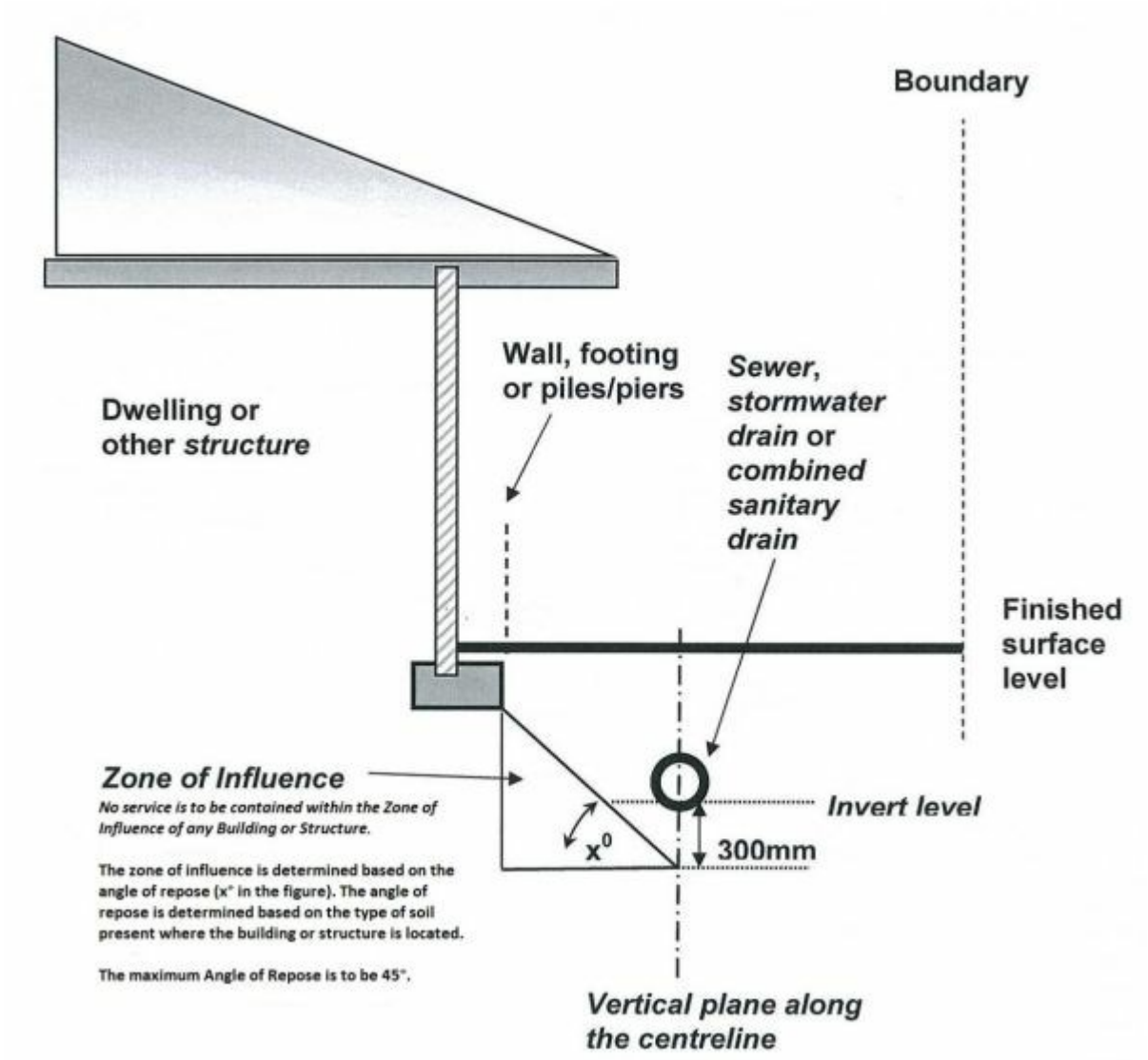


Figure SC6.4.3.2.1 Zone of influence

(4) a minimum clear vertical space above a sewer manhole of 2.4 m must be maintained above the finished ground

surface level for access purposes;

(5) a minimum horizontal clear space of 2.0 m must be maintained between structure and connection point on sewer, connection point on sewer refers to oblique branch (OB), vertical jump-up (VJU) and sewer maintenance structure; and

(6) a minimum horizontal clear space of 2.0 m must be maintained between structure and outside face of gravity trunk sewer.

SC6.4.3.2.6 Relocation of services

(1) Council will require that a service is relocated at the developer's expense where:

(a) no other site is reasonably available for the location of the proposed structure;

(b) the proposed structure is in conflict with, or likely to cause damage to, a council service.

(2) If council in its absolute discretion considers it necessary for a service to be relocated as a consequence of a proposed development, the re-design must consider:

(a) the feasibility of redesign or relocation;

(b) terrain;

(c) cost;

(d) importance of the service; and

(e) suitability for future maintenance access.

SC6.4.3.3 Footpath treatment policy

SC6.4.3.3.1 Purpose

(1) The purpose of the Footpath treatment policy is to achieve an appropriate footpath treatment and installation to achieve consistency of surfacing material located in key areas across Townsville, commensurate with the streetscape intent having regard to:

(a) the projected level of usage in a given location, such as shared-use or heavy traffic movements;

(b) activities anticipated to occur within the verge at the given location and safety requirements; and

(c) the desired streetscape character of the location, giving particular attention to the relevant zone code.

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of treatments.

(2) Reference and source documents:

(a) This subsection should be read in conjunction with other sections of the Townsville City Plan and Development manual planning scheme policy including, but not limited to:

Part 4 Priority infrastructure plan
Part 9.3.3 Landscape code
Part 9.3.4 Reconfiguring a lot code
Part 9.3.6 Works code
SC6.4.2 Development application guidelines
SC6.4.3.4 Outdoor dining design
SC6.4.3.6 Landscape policy
SC6.4.3.20 Public lighting and utility services
SC6.4.4.1 Geometric road design
SC6.4.4.2 Pavement design
SC6.4.4.7 Bicycle, pedestrian and shared path design
SC6.4.6 Construction standards

(b) The following Australian Standards are also referenced and should be read in conjunction with this sub-section:

AS/NZS 1158.3.1 Lighting for roads and public spaces
AS 1170 Structural design actions (set)
AS 1428 Design for access and mobility (set)
AS 2890.3 Parking facilities – Bicycle parking facilities
AS 3996 Access covers and grates
AS 3727 Guide to residential pavements
AS/NZS 4586:2004 Slip resistance classification of new pedestrian surface materials

(c) Other:

The following documents are also referenced and should be read in conjunction with this subsection:
Austroads, Guide to Road Design (Set):
Aust Roads – Road Design Part 4 Intersections and Crossings, section 8 Pedestrian Crossings
Aust Roads – Road Design Part 4 Intersections and Crossings, section 9 Cyclist Crossings
Aust Roads – Road Design Part 6A Pedestrian and Cyclist Paths

Department of Transport and Main Roads, Manual of uniform traffic control devices (MUTCD), Queensland.
Department of Transport and Main Roads, Traffic and Road Use Management Manual, Volume 1 – Part 6: Intersections, Interchanges and Crossings, Section 3.4-1 Pedestrian crossing facility guidelines and prioritisation system user guide Queensland Government, Crime Prevention through Environmental Design, Guidelines for Queensland, Parts A and B, 2007.

SC6.4.3.3.2 Footpath treatment

(1) The standards and requirements of this policy sub-section will achieve compliance with Townsville City Plan where the planning scheme code notes this policy as providing compliance.

Editor's note— Part 9.3.3 Landscape Code, Part 9.3.4 Reconfiguring a lot code and Part 9.3.6 Works Code each have outcomes that can be achieved by this policy sub-section, in addition to the relevant zone code.

(2) The locations where footpath treatment standards of this policy are to be met are shown in SC6.4.3.3.7 Footpath treatment location maps. In general, the following locations require footpath treatment in accordance with this policy sub-section:

(a) the Principal central (CBD) and key development areas supporting the CBD;

(b) other key activity centres (generally those in the Centre zones category and Specialised centre zone), in particular along the supporting roads and streets where attractive pedestrian streetscapes are intended by the zone and precinct;

(c) key infill areas, including medium density and higher density residential areas where there is an emphasis on creating attractive and pedestrian-oriented streetscapes;

(d) facilities with high levels of public use warranting improved footpath treatment such as: educational establishments (schools, TAFE colleges), places of worship etc., the finish of the footpath treatment shall be at the discretion of the Townsville City Council;

(e) mixed use areas that have frequent pedestrian use have a highly visible frontage or where attractive pedestrian environments are intended by the zone and precinct;

(f) special footpath type areas such as Magnetic Island, The Strand, Palmer Street and Sir Leslie Thiess Drive; and

(g) any new centres, commercial, mixed use and community uses that are not identified in SC6.4.3.3.7 Footpath treatment location maps. In such instances, the above criteria shall be used to determine the most similar development to inform the particular treatment to be applied.

Editor's note—for any other areas not covered by SC6.4.3.3.7 Footpath treatment location maps see SC6.4.4.7 Bicycle, pedestrian and shared path design.
Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for location of proposed treatments.
Editor's note—for land with the Townsville City Waterfront Priority Development Area (PDA) additional criteria applies, see the Townsville City Waterfront Priority Development Area Development Scheme.

SC6.4.3.3.3 Footpath treatment standards

(1) Footpath treatment standards for each of the nominated locations identified in SC6.4.3.3.7 Footpath treatment location maps are set out in the following Tables.

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT1 – Footpath Treatment 1	
Statement of intent - FT1	
Footpath treatment 1 serves the core retail and entertainment areas of the Principal centre (CBD). The treatment provides the highest finish intended to support high levels of pedestrian use and may provide for on street dining, and informal and formal recreational and civic spaces.	
Body of footpath and driveway crossings: FT1	
Description:	• footpath treatment FT1 shall be full width from building line to the road kerb alignment. • two kinds of stone pavers of varying length and width set in mortar on mass concrete base (see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving) • facing: split face finish to top (saw cut other edges) • image: refer to Figure SC6.4.3.3.2 Image FT1.

Pattern:	• staggered pattern as shown in Figure SC6.4.3.3.1 Conceptual diagram: FT1, and Figure SC6.4.3.3.2 Image FT1. • pavers shall be laid alternatively 200mm and 100mm wide with the basalt (darker) paver towards the building line and the granite (lighter) paver towards the kerb. • a staggered transition between the pavement types shall occur at approximately 70 per cent basalt 30 per cent granite, see Figure SC6.4.3.3.1 Conceptual diagram FT1.
Grout:	• product: CTA Polyblend G15 or approved equal. • colour: ‘Mid Grey’.
Pavers:	• basalt: 100% grey range (darker stone in Figure SC6.4.3.3.1 Conceptual diagram FT1) • granite: ‘Sindoor Brown’ (lighter stone in Figure SC6.4.3.3.1 Conceptual diagram FT1) • width: 200 mm or 100 mm (refer varying widths in Figure SC6.4.3.3.1 Conceptual diagram FT1) • length: 300 mm or 500 mm • depth: 40 mm
Driveway and pedestrian crossing point	
Description:	• driveway access through footpath shall be monolithic poured colored concrete slabs, colour to be matched to the basalt paver, with saw cut detailing to match adjacent paver pattern (scoring cuts only 5mm deep). See Figure SC6.4.3.3.3 Image FT1 driveway option. • driveway crossover shall be “plain natural” concrete with surface : broom finish. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.

Figure SC6.4.3.3.1 Conceptual diagram: FT1

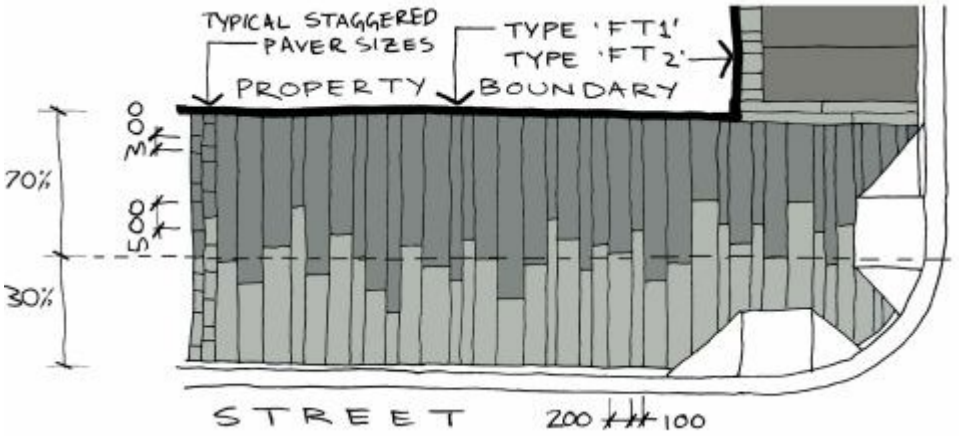


Figure SC6.4.3.3.2 Image: FT1

Figure SC6.4.3.3.3 Image FT1 driveway option

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT2 – Footpath Treatment 2	
Statement of intent	
Footpath treatment 2 serves the remainder of the Principal centre (CBD), key areas which support the CBD and areas intended for medium and higher residential densities nearby the CBD. The treatment provides a nexus with FT1 and is of a high quality to support high levels of pedestrian use and may provide for the integration of civic spaces. A reduced width option may be permitted in the medium density residential areas as indicated on SC6.4.3.3.7 Footpath treatment location maps.	
Body of footpath: FT2	
Description:	• footpath treatment FT2 shall be full width from building line to the road kerb alignment. • monolithic poured concrete slabs in approximately 5 m lengths with decorative scoring pattern and perimeter stone paver banding on mass concrete base, see SC6.4.6.14, Figure SC6.4.3.3.4 Conceptual diagram: FT2, and Figure SC6.4.3.3.5 Conceptual diagram FT2, and Figure SC6.4.3.3.5 Image: FT2. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water-based chemical retarder, see Figure SC6.4.3.3.8, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • standard drawings as noted in SC6.4.3.3.3(3)(b). • decorative scoring, see Figure SC6.4.3.3.4, Figure SC6.4.3.3.5, and noted in SC6.4.3.3.3(3) and SC6.4.3.3.3(3)(i). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Description reduced width option areas:	• reduced width which allows for a planting zone from back of curb and/or property boundary see Figure SC6.4.3.3.7 Conceptual diagram FT2 – Reduced width option. • monolithic poured concrete slabs with decorative scoring pattern and stone paver banding at approximately 5m intervals on a mass concrete base, see Figure SC6.4.3.3.7. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water based chemical retarder, see Figure SC6.4.3.3.8, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • standard drawings as noted in SC6.4.3.3.3(3)(b). • decorative scoring: see Figure SC6.4.3.3.7, and noted in SC6.4.3.3.3(3) and SC6.4.3.3.3(3)(i). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.

Pattern:	• see Figure SC6.4.3.3.4 Conceptual diagram FT2 and Figure SC6.4.3.3.5 Conceptual diagram F2 and Figure SC6.4.3.3.7 Conceptual diagram F2 reduced width option for saw cut pattern.
Colour:	• concrete colour: CCS "Onyx" at 4% dose in a grey cement base. • aggregate: Hanson “salt and pepper” or approved equivalent.
Banding: FT2	
Description:	• granite stone pavers of varying length and width on mass concrete base, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving, SC6.4.3.3.5 Banding details. • facing: split face to top, saw cut finish to all other sides. • standard drawings as listed in SC6.4.3.3.3(3)(b).
Pattern:	• staggered pattern as shown in Figure SC6.4.3.3.4 Conceptual diagram FT2, Figure SC6.4.3.3.5 Conceptual diagram FT2, Figure SC6.4.3.3.6 Image FT2 and Figure SC6.4.3.3.7 Conceptual diagram FT2 reduced width option.
Grout:	• product: Polyblend G15 sanded grout from Construction Technologies Australia or approved equal. • colour: "Mid Grey".
Pavers:	• granite: "Sindoor Brown". • width: 200 mm or 100mm. • length: 300 mm or 500mm. • depth: 40 mm.
Driveway and pedestrian crossing points: FT2	
Description:	• driveway access through foothpath shall be monolithic poured concrete slabs with decorative scoring, see Figure SC6.4.3.3.3. • finish: light wash finish 1 mm – 2 mm deep (2 mm max), using a water-based chemical retarder (CCS "reveal" 1 mm or approved equal, do not use sugar), see Figure SC6.4.3.3.5, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • driveway crossover shall be “plain natural” concrete with surface: broom finish. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b)
Pattern:	• see Figure SC6.4.3.3.4 Conceptual diagram: FT2 and Figure SC6.4.3.3.5 Conceptual diagram: FT2 for sample crossover layout and decorative scoring pattern.
Colour:	• concrete colour: CCS "Onyx" at 4% dose in a grey cement base. • aggregate: Hanson "salt and pepper" aggregate or approved equivalent.

Figure SC6.4.3.3.4 Conceptual diagram: FT2

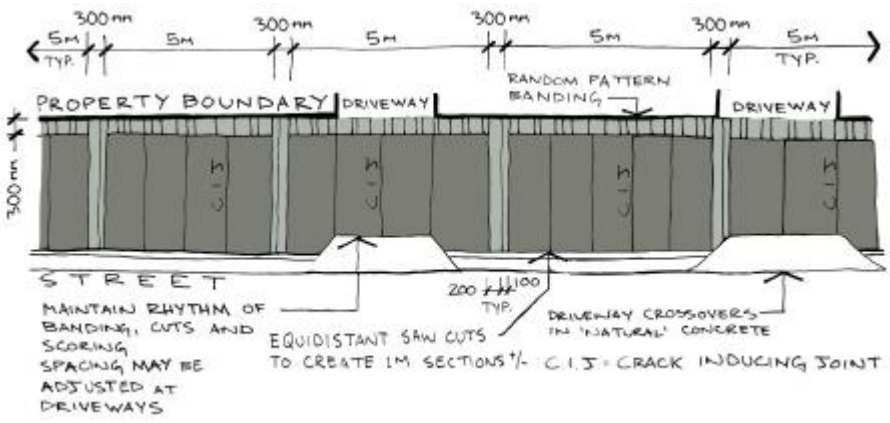


Figure SC6.4.3.3.5 Conceptual diagram: FT2

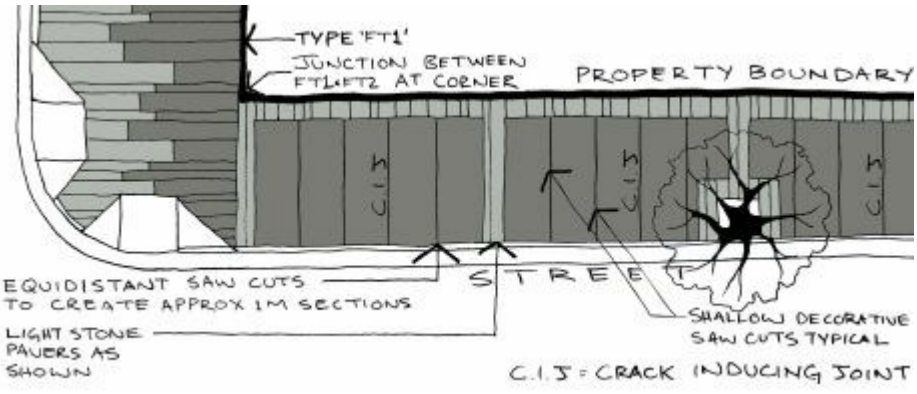


Figure SC6.4.3.3.6 Image FT2

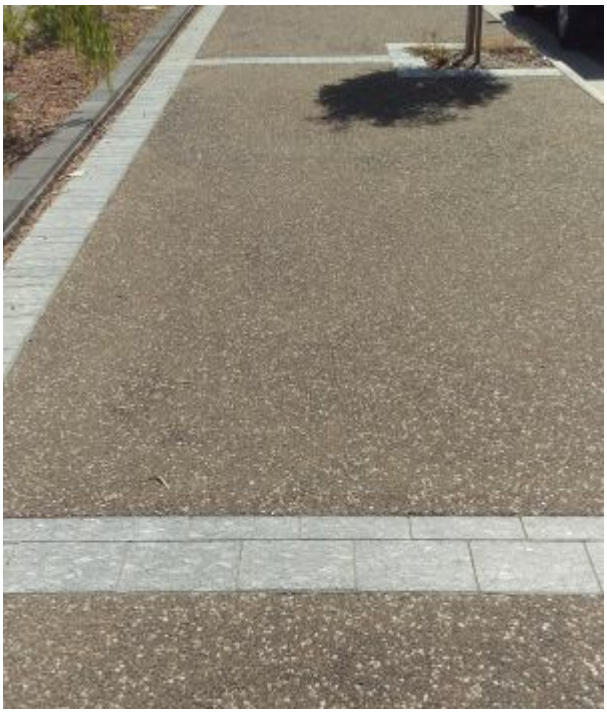


Figure SC6.4.3.3.7 Conceptual diagram FT2 reduced width option

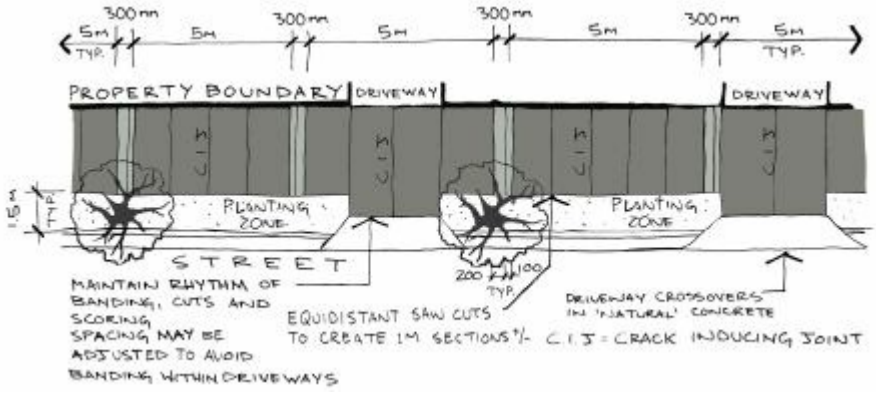


Figure SC6.4.3.3.8 Image FT2 (2 mm maximum exposure acceptable)

Figure SC6.4.3.3.9 Image FT2 (1 mm exposure - unacceptable - underexposed)
Figure SC6.4.3.3.10 Image FT2 (3 mm exposure – unacceptable - overexposed)

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments.

FT3 – Footpath Treatment 3	
Statement of intent	
Footpath treatment 3 serves many of the city activity centre areas, including major, district and local centres and some neighborhood centres, mixed use areas and specialised centres, where regular pedestrian use is anticipated for commercial and recreational purposes	
Body of footpath: FT3	
Description:	• footpath treatment FT3 shall be full width from building line to the road kerb alignment. • monolithic poured coloured concrete slabs in 5 m lengths with decorative scoring and perimeter cobble banding. • conceptual image: see Figure SC6.4.3.3.11 Conceptual diagram FT3. • finish: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i).
Description reduced width option areas:	• reduced width which allows for a planting zone from back of kerb and/or property boundary see Figure SC6.4.3.3.13 Conceptual diagram FT3 Reduced width option. • monolithic poured coloured concrete slabs with decorative scoring and cobble banding at approximately 5m intervals on a mass concrete base. • conceptual image: see Figure SC6.4.3.3.13 Conceptual diagram FT3 Reduced width option. • finish: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i).
Pattern:	• conceptual scoring pattern: see Figure SC6.4.3.3.11 and Figure SC6.4.3.3.13, • for variations such as corners, trees, doorways etc, refer: Figure SC6.4.3.3.22, Figure SC6.4.3.3.23, Figure SC6.4.3.3.24, Figure SC6.4.3.3.25, Figure SC6.4.3.3.26 and Figure SC6.4.3.3.27, • align scoring pattern with adjacent footpath scoring and/or saw cuts where applicable **Editor's note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i)
Colour:	• CCS "paperbark" at 4% dose in a grey cement base
Banding: FT3	
Description:	• pressed concrete cobbles set in mortar on mass concrete base (see SC6.4.6.14 Mass concrete subbase, SC6.4.6.18 - Segmental Paving and SC6.4.3.3.5 Banding details) • finish: proprietary non-slip finish

Pattern:	• cobbles 3x wide in stack bond pattern • conceptual image: see Figure SC6.4.3.3.11 and Figure SC6.4.3.3.13,. • for variations such as corners, trees, doorways etc. refer: Figure SC6.4.3.3.22, Figure SC6.4.3.3.23, Figure SC6.4.3.3.24, Figure SC6.4.3.3.25, Figure SC6.4.3.3.26, Figure SC6.4.3.3.27, and Figure SC6.4.3.3.29.
Colour:	• CCS "ghost gum".
Pavers:	• 100mm x 100mm square x 60 mm to 65 mm deep.
Driveway and pedestrian crossing points: FT3	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slabs. • driveway crossover shall be “plain natural” concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor’s note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), SC6.4.3.3.3(3)(i).
Pattern:	• for pattern integration of driveways, refer: Figure SC6.4.3.3.24. • align driveway scoring pattern with adjacent footpath decorative scoring and/or crack control saw cuts. **Editor’s note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), SC6.4.3.3.3(3)(i).
Colour:	• CCS "paperbark" at 4% dose in a grey cement base, kerb transition: "natural" concrete colour.

Figure SC6.4.3.3.11 Conceptual diagram FT3

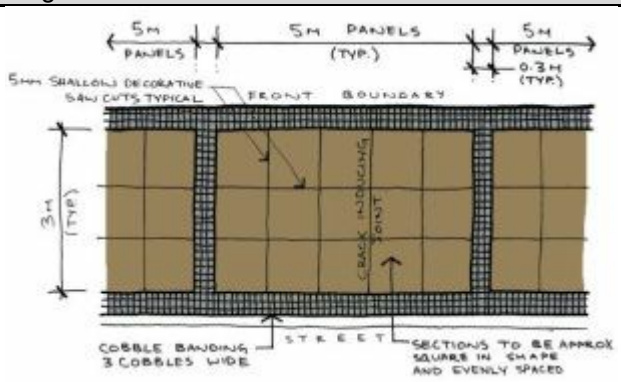


Figure SC6.4.3.3.12 Image: FT3

Figure SC6.4.3.3.13 Conceptual diagram FT3 reduced width option

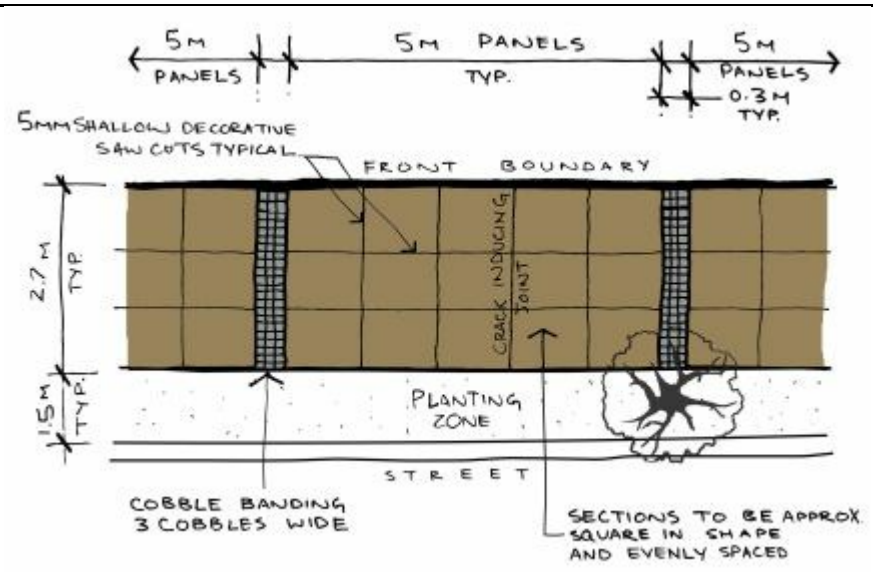


Figure SC6.4.3.3.14 Image FT3 reduced width option

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments.

FT4 – Footpath Treatment 4	
Statement on intent	
Footpath treatment 4 serves many of the city's lower order activity centre areas, mixed use areas, key corridors and key infill areas intended for increased residential densities and attractive streetscape.	
Body of footpath: FT4	
Description:	• Footpath treatment FT4 shall be full width from building line to the road kerb alignment. • monolithic, poured, full depth coloured concrete finish: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b).
Description reduced width option areas:	• Reduced width which allows for a planting zone from back of kerb and/or property boundary. • monolithic, poured, full depth coloured concrete finish: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b).
Colour:	• CCS "paperbark" at 4% dose in a grey cement base.
Pattern	• divided by crack control joints as required and decorative scoring into equal sections of approximately 1 m wide throughout the length of the footpath.
Driveway and pedestrian crossing points: FT4	

Description:	• driveway access through footpath shall be monolithic, poured, full depth coloured concrete. • driveway crossover shall be “plain natural” concrete with surface broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b)
Colour:	• CCS "paperbark" at 4% dose in a grey cement base.

FT5 – Footpath Treatment 5	
Statement of intent	
Footpath treatment 5 is a specialised treatment which serves the Palmer Street dining area.	
Body of footpath: FT5	
Description:	• footpath treatment FT5 shall be full width from building line to the road kerb alignment. • "Bluestone" stone pavers set in mortar on mass concrete base, see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving • Pattern: staggered pattern, see Figure SC6.4.3.3.15 and Figure SC6.4.4.3.16 facing: split face finish to top surface (all other sides sawn). • standard drawings: as noted in SC6.4.3.3.3(3)(b).
Pavers:	• stone type: "Bluestone" • size 1: 750 mm x 495 mm. • size 2: 495 mm x 495 mm. • size 3: 495 mm x 245 mm. • size 4: 495 mm x 155 mm. • depth: 40 mm.
Colour:	• natural stone colour.
Grout:	• product: CTA Polyblend G15 or approved equal colour: "Mid Grey".
Driveway and pedestrian crossing points: FT5	
Description:	• driveway access through footpath shall be ‘Bluestone’ cobble pavers set in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving. • facing: split face finish to top with all other sides sawn. • pattern: continuous staggered pattern, see Figure SC6.4.3.3.15 and Figure SC6.4.3.3.16. • driveway crossover shall be “plain natural” concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish.
Pavers:	• 100 mm x 100 mm square x 60 mm to 65 mm deep.
Colour:	• natural "Bluestone" colour.
Grout:	• product: Polyblend G15 sanded grout from Construction Technologies Australia or approved equal. • colour: "Mid Grey".

Figure SC6.4.3.3.15 Pattern FT5

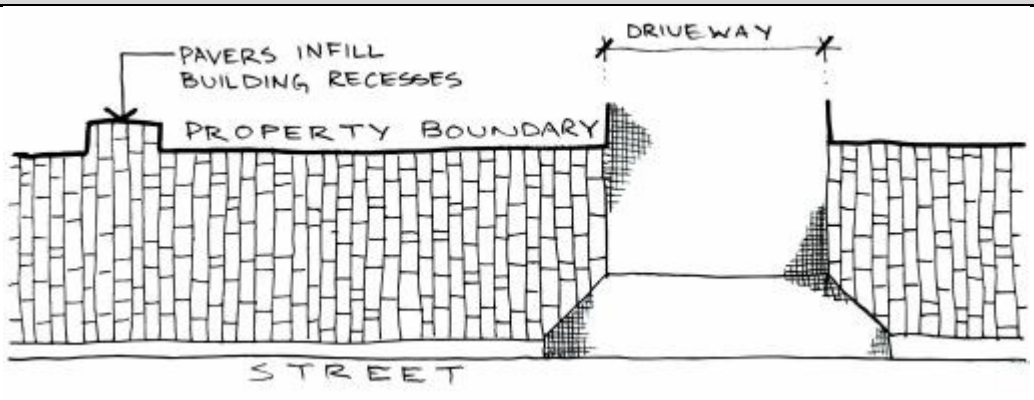


Figure SC6.4.3.3.16 Image FT5 body of footpath

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT6 – Footpath Treatment 6	
Statement on intent	
Footpath treatment 6 is a specialised treatment area which serves the southern side of The Strand through to Ross Creek.	
Body of footpath and driveway crossings: FT6	
Description:	• footpath treatment FT6 shall be full width from building line to the road kerb alignment. • pressed concrete pavers set in stack bond pattern in mortar on mass concrete base see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • image: see Figure SC6.4.3.3.18 • standard drawings: as noted in SC6.4.3.3.3(3)(b). • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28
Pattern	• laid in stack bond parallel to the kerb line, see Figure SC6.4.3.3.17, and Figure SC6.4.3.3.18
Pavers:	• Havenpave 50. • width: 200mm. • length: 200mm. • depth: 50mm. • colour: "Charcoal"
Banding to footpath: FT6	
Description:	• pressed concrete pavers in soldier course pattern set in mortar on mass concrete base, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28
Pattern:	• laid in soldier course perpendicular to the kerb line, see Figure SC6.4.3.3.17 and Figure SC6.4.3.3.18 below.
Pavers:	• Havenbrick 50. • length: 200 mm • width: 100 mm • depth: 50 mm • colour: CCS "Sunstone".
Driveway and Pedestrian Crossing Points: FT6	
Description:	• driveway access through footpath shall be pressed concrete pavers set in stack bond pattern in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving. • Standard drawings: as noted in SC6.4.3.3.3(3)(b). • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.
Figure SC6.4.3.3.17 Pattern: FT6	

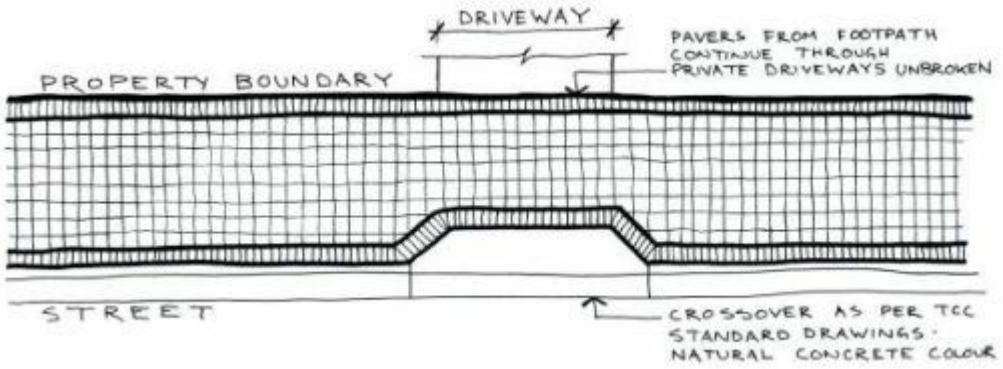


Figure SC6.4.3.3.18 Image FT6

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

FT7 – Footpath Treatment 7	
Statement of intent	
Footpath treatment 7 is a specialised treatment area which serves the Sir Leslie Thiess Drive area and the east end of the southern side of The Strand.	
Body of footpath: FT7	
Description:	• monolithic poured concrete slabs in 5 m lengths • finish: lightly exposed aggregate, refer texture only of Figure SC6.4.3.3.8 • image: see Figure SC6.4.3.3.19. • standard drawings: refer to the standard drawings noted in SC6.4.3.3.3(3)(b).
Colour:	• CCS "Coco" 4% dose in a grey cement base • aggregate: Hanson "Burdekin Red" or approved equivalent.
Driveway and Pedestrian Crossing Points: FT7	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slabs. • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.

Figure SC6.4.3.3.19 Image FT7

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

Editor's note—FT8 – Footpath Treatment 8 table describes the existing treatment, as noted on SC6.4.3.3.7 Footpath treatment location

maps this area is an investigation area. An alternate treatment is under development.

FT8 – Footpath Treatment 8	
Statement on intent	
Footpath treatment 8 is a specialised treatment area which serves the Gregory Street area in North Ward.	
Body of footpath: FT8	
Description:	• footpath treatment FT8 shall be full width from building line to the road kerb alignment. • pressed concrete pavers set in mortar on mass concrete base with perimeter banding, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28 image: see Figure SC6.4.3.3.20. • finish: proprietary non-slip finish. • sealant: two coats of penetrating sealer.
Pattern:	• stack bond as per existing adjacent pattern with alternating bands of coloured pavers separated by a 350 mm band of "natural" concrete • image: see Figure SC6.4.3.3.20.
Pavers:	• width: 400 mm. • length: 400 mm. • depth: 40 mm. • colours: CCS "Morocco", CCS "Onyx 21"
Banding: FT8	
Description:	• pressed concrete pavers set in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving.
Pattern:	• 1x wide soldier course, see Figure SC6.4.3.3.20 • stack bond as per existing adjacent pattern with alternating bands of coloured pavers separated by a 350 mm band of "natural" concrete.
Colour:	• colour of banding pavers match colour of banded square pavers colours: CCS "Morocco", CCS "Onyx 21", natural grey concrete.
Pavers:	• length: 220 mm. • width: 110 mm. • depth: 40 mm.
Supplier:	• Boral or approved equal.
Driveway and Pedestrian Crossing Points: FT8	
Description:	• Driveway access through footpath shall be pressed concrete pavers set in mortar on mass concrete base with perimeter banding, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • Driveway crossover shall be “plain natural” concrete, with surface broom finish, see Figure SC6.4.3.3.24. • Pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish.
Figure SC6.4.3.3.20 Image FT8	

Editor’s note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

FT9 – Footpath Treatment 9	
Statement of intent	
Footpath treatment 9 is a specialised treatment occurring only on Magnetic Island.	
Body of footpath: FT9	
Description:	• monolithic poured coloured concrete slabs. • primarily in eucalypt with the secondary colour black used to highlight special features such as premises entries, dining areas, etc. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water-based chemical retarder. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Description reduced width area:	• reduced width which allows for a planting zone from back of kerb and/or property boundary. • monolithic poured coloured concrete slabs. • primarily in eucalypt with the secondary colour black used to highlight special features such as premises entries, dining areas etc. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water based chemical retarder. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Colour:	• primary - CCS "eucalypt" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • secondary - CCS "black" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • aggregate: Hanson "salt and pepper" or approved equivalent.
Pattern:	• divided by crack control joints as required.
Driveway and Pedestrian crossing Points: FT9	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slab. • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.
Colour:	• primary - CCS "eucalypt" at 4% dose in a grey cement base see Figure SC6.4.3.3.21 Image FT9. • Secondary - CCS "black" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • aggregate: Hanson "salt and pepper" or approved equivalent.
Figure SC6.4.3.3.21 Image FT9	

(2) All concrete cobbles (border banding) and field pavers are to have a:

(a) depth of 60 mm to 65 mm for cobbles, 40mm for field pavers;

(b) compressive strength of 32 MPa for concrete cobbles and pavers;

(c) mass concrete subbase integral with adjacent concrete, see SC6.4.6.14 Mass concrete subbase;

(d) slip resistance in accordance with AS/NZS 3661.1, Table 5;

(e) 3 mm chamfer on the surface edges with a pressed finish for concrete pavers and cobbles; and be in accordance with AS1428.1 – Construction tolerances for abutment of surfaces;

(f) two coats of low VOC, water-based, 7-15 year recoat penetrating sealer system designed to repel grease and oil stains;

(g) cobbles and pavers are to be placed on concrete mortar; and

(h) edge of paver banding shall be filled with 10mm thick compressible filler board for full depth of slab and 20mm polyurethane based sealant.

(3) All concrete slabs shall be:

(a) integrally coloured for the full depth of the slab where colouring is noted in SC6.4.3.3.3 Foothpath treatment standards;

(b) Engineer Certified design drawings must be submitted to council for acceptance prior to approval being given showing site specific construction details of paver band designs and integrated construction joints at intervals that are generally in accordance with TCC Standard drawing SD-070. Pavements are to be constructed as per SC6.4.4.8 Standard drawings:
SD-015: Verge Service Corridors General Type Sections;
SD-020: Concrete Kerbing;
SD-025: Kerb Ramp;
SD-030: Driveway Access Urban Residential Properties;
SD-031: Driveway Access Commercial and Industrial Properties;
SD-032: Driveway Crossovers Urban Residential Properties;
SD-055: Road Crossing and Footpath Reinstatement for Trench Laid Services;
SD-060: Traffic Sign Installation;
SD-065: Street Name Sign and Installation Details;
SD-070: Concrete Pathway Reinforced Concrete (Mesh) Alternative;
SD-075: Concrete Pathway Reinforced Concrete (Fibre) Alternative; and
SD-500: Standard Bus Shelter and Footing Details,

(c) sealed with two coats of low VOC, water-based, 7-15 year recoat penetrating sealer system designed to repel grease and oil stains;

(d) proportioned in terms of 'width to length' as '1 to 1.5' between crack control joints as per standard drawings listed in SC6.4.3.3.3(3)(b);

(e) laid in accordance with standard drawings listed in SC6.4.3.3.3(3)(b);

(f) constructed so that all runoff, slurry and excess materials must be captured and disposed of appropriately, and all surrounding surfaces are protected from staining;

(g) constructed so that all decorative scoring cuts are five mm deep for the full length of the slab continuous through the end of the slab;

(h) constructed so that all crack inducing saw cuts are continuous through to the end of the slab;

(i) constructed so that all saw cuts:

  (i) are made approximately 24 hours after finishing (preferably the morning after the pour);

  (ii) are cut with a "Early Cut Saw" only;

  (iii) are cut with a "Dry Cut" method only (this requirement is to override conflicting specifications on standard drawing SD-070 (for coloured concrete only);

  (iv) are aligned where possible with any service penetrations, on at least one side of the penetration, or services to be located wholly within one saw cut square (see Figure SC6.4.3.3.32);

  (v) are constructed in accordance with standard drawings listed in SC6.4.3.3.3(3)(b) with the exception of SC6.4.3.3.3(3)(i)(iii);

  (vi) for footpath treatment type FT3, create a pattern comprised of:

    (A) both decorative scoring and crack inducing joints (as required) to create sub-panels approximately 1x1 m square or otherwise closely proportioned rectangular shapes evenly spaced throughout the panel (see Figure SC6.4.3.3.22);

    (B) minimum sub-panel dimensions of 0.8 m either width or length, generally creating rectangular, regularly spaced sub-panels evenly spaced through the primary panel; and

    (C) maximum sub-panel dimensions of 1.2 m either width or length, generally creating rectangular, regularly spaced sub-panels evenly spaced through the primary panel.

  (vii) for footpath treatment type FT2, create patterns comprised of both decorative scoring and crack inducing joints (as required) creating sub-panels approximately 1 m wide (4 cuts in 5 m lengths) evenly spaced throughout the panel (see Figure SC6.4.3.3.22, Figure SC6.4.3.3.23 and Figure SC6.4.3.3.24).

(j) coloured concrete slabs shall be grade S32 minimum. Where concrete is located in an aggressive environment (e.g. salt exposure, aggressive soils, etc.), concrete strength design shall be in accordance with AS3600;

(k) fibre reinforced concrete footing under banding shall be grade S20 minimum;

(l) concrete slab thickness shall be 100mm minimum. In areas where maintenance vehicular loading is expected, concrete thickness shall be 125mm minimum;

(m) concrete cover to steel reinforcement shall be 40mm unless otherwise noted;

(n) concrete shall be laid on minimum 50mm of compacted crusher dust / sand bedding with moisture barrier;

(o) all concrete shall be cured in accordance with the following:

  (i) AS3600;

  (ii) aliphatic alcohol must be used. The aliphatic alcohol shall be applied after screeding &and bull floating operations;

  (iii) no water shall be added to concrete;

  (iv) an impermeable membrane shall be applied. All joints in membrane are to be taped and the edges secured to prevent the ingress of air;

  (v) minimum curing period shall be not less than 7 days for strength grade S32 and not less than 4 days for high early strength concrete;

(p) exposed edges of formed concrete elements shall have a 20mm chamfer unless otherwise noted;

(q) all concrete shall be mechanically vibrated. Hand held vibrators must be held upright. Concrete must not be spread using vibrator; and

(r) all other requirements shall be in accordance with SC6.4.6.28 Minor concrete works.

(4) Tactile ground surface indicators (TGSI) where required shall:

(a) be stainless steel studs (CTA SureSteel or approved equal) with bright yellow plastic insert for type FT1, FT2, FT5 installed as per AS/NZS1428.4.1 providing slip resistance of R13 (wet/oil ramp);

(b) all other types not covered by SC6.4.3.3.3(4)(a) shall be yellow Polyurethane tactile indicator studs (warning tactiles), and bars (directional tactiles), drill and lock installation; and

(c) be supplied and installed in accordance with AS/NZS1428.4.1 providing correct illuminance contrast, and AS1428.1 and AS4586 Slip Resistance of Pedestrian Surfaces, and as per manufacturers specifications and in accordance with AS1884. Also to be in accordance with SC6.4.4.7(4) Bicycle, pedestrian and shared path design.

(5) footpath treatment shall not impede into private property.

(6) for all footpath treatment types the ground surface on the continuous accessible path of travel – construction tolerances for abutment of surface shall be in accordance with AS 1428.1. to eliminate the possibility of tripping hazards and non-compliance levels of abutting surfaces occurring.

SC6.4.3.3.4 General guidelines

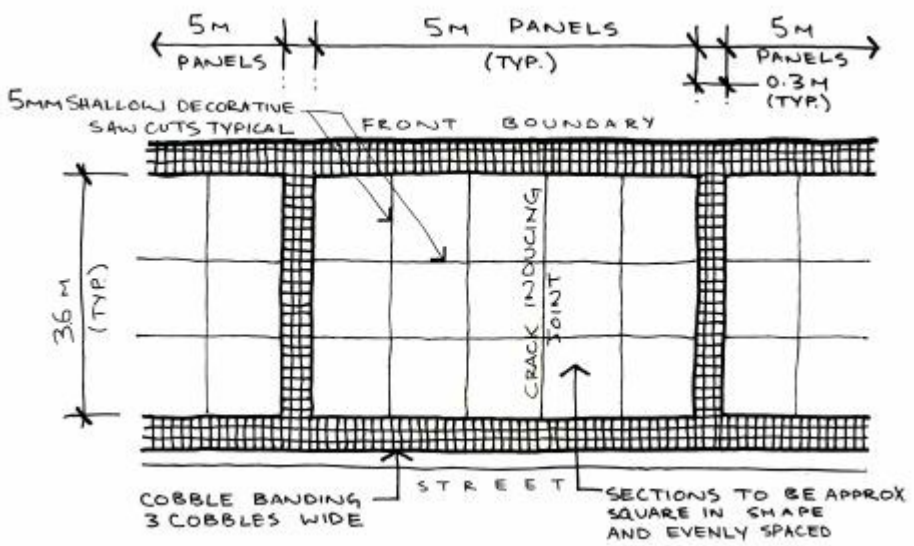


Figure SC6.4.3.3.22 Typical footpath treatment FT3

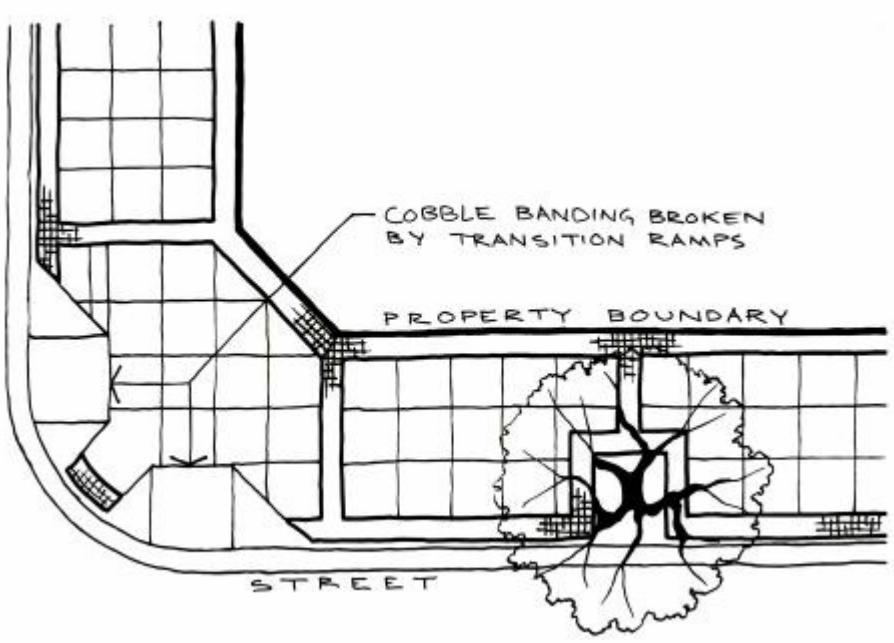


Figure SC6.4.3.3.23 Typical footpath treatment at street corners - banding is broken by kerb ramps

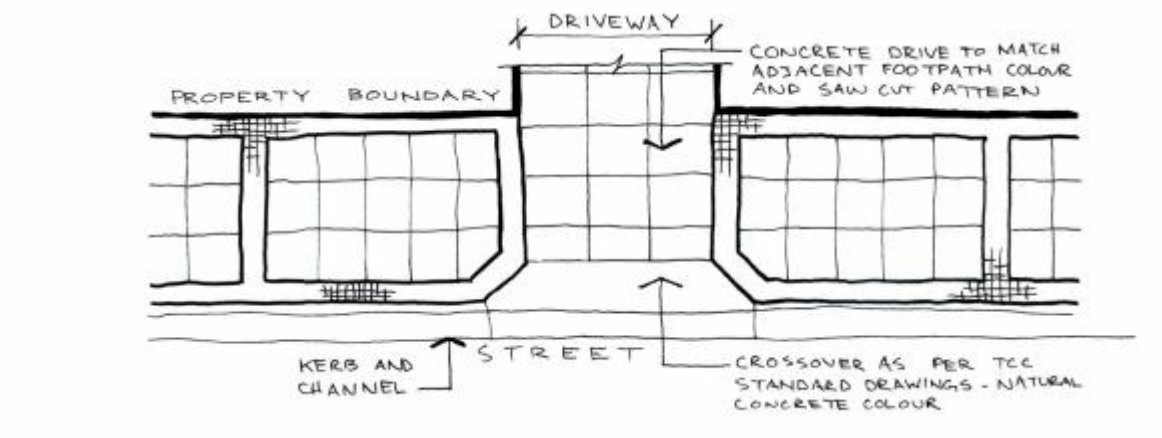


Figure SC6.4.3.3.24 Typical driveway treatment - banding to match angle of crossover

SC6.4.3.3.5 Banding details

(1) Banding is to be:

(a) continuous across tenancy or property boundaries at regular 5 m intervals (see Figure SC6.4.3.3.21 and Figure SC6.4.3.3.22) and is to retain a rectilinear alignment as illustrated in Figure SC6.4.3.3.25, Figure SC6.4.3.3.27 and Figure SC6.4.3.3.28;

(b) broken by minor built form intrusions, allowed to infill minor built form recesses, (see Figure SC6.4.3.3.25;

(c) continued around existing streetscape and landscape elements (see Figure SC6.4.3.3.26); and

(d) run parallel to property boundaries and kerb where property boundaries are not parallel to kerb, with cross-banding remaining perpendicular to line of kerb (see Figure SC6.4.3.3.27 and Figure SC6.4.3.3.28).

(2) Where banding is broken by driveways in footpath treatment types FT2, FT3, FT6 and, banding returns to the property line as per Figure SC6.4.3.3.24, Figure SC4.4.3.3.34 and Figure SC6.4.3.3.35.

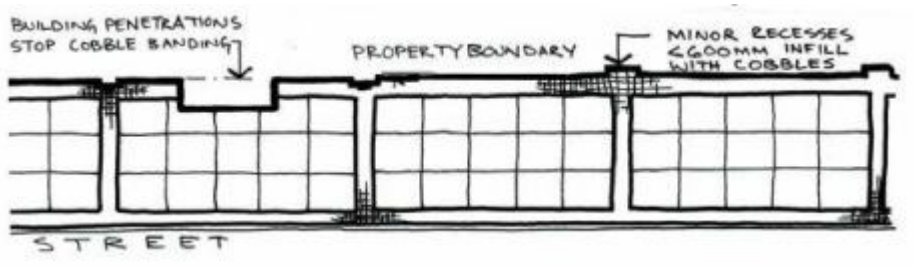


Figure SC6.4.3.3.25 Continuous footpath at uneven building lines

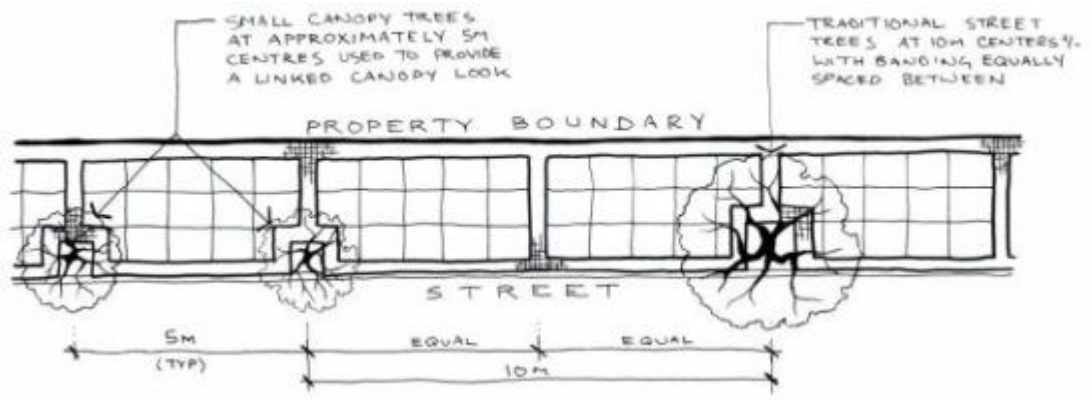


Figure SC6.4.3.3.26 Banding around landscape element

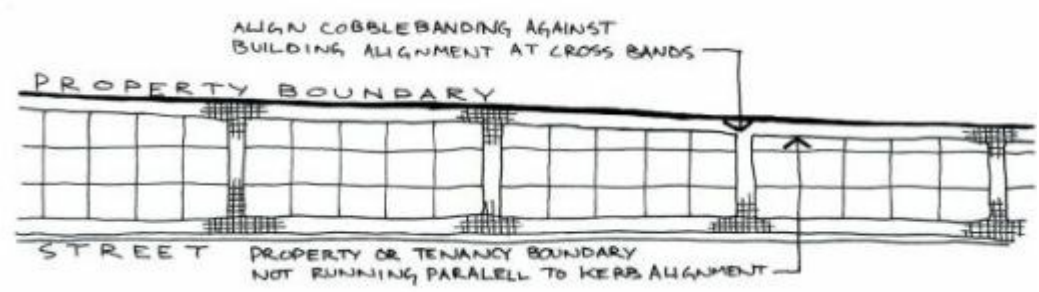


Figure SC6.4.3.3.27 Banding around poured concrete against property boundary where property boundary is not parallel to line of kerb

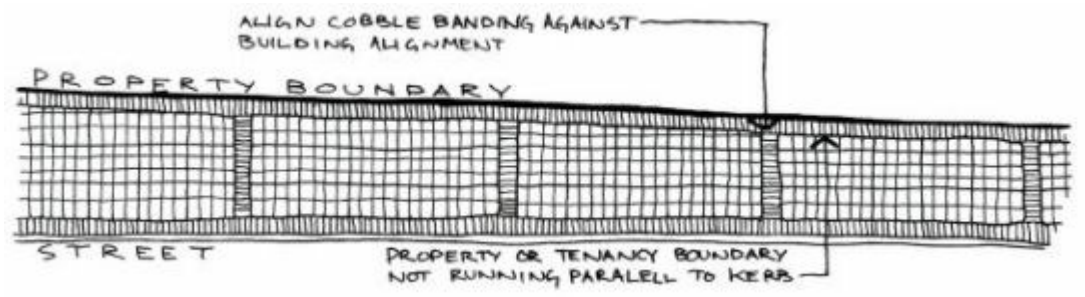


Figure SC6.4.3.3.28 Banding around pavers against property boundary where property boundary is not parallel to line of kerb

SC6.4.3.3.6 Footpath details

(1) Joint lines and trim courses are to be straight and as continuous as is practical along the footpath length regardless of individual property boundaries (see Figure SC6.4.3.3.29). Protect existing buildings as per Figure SC6.4.3.3.29.

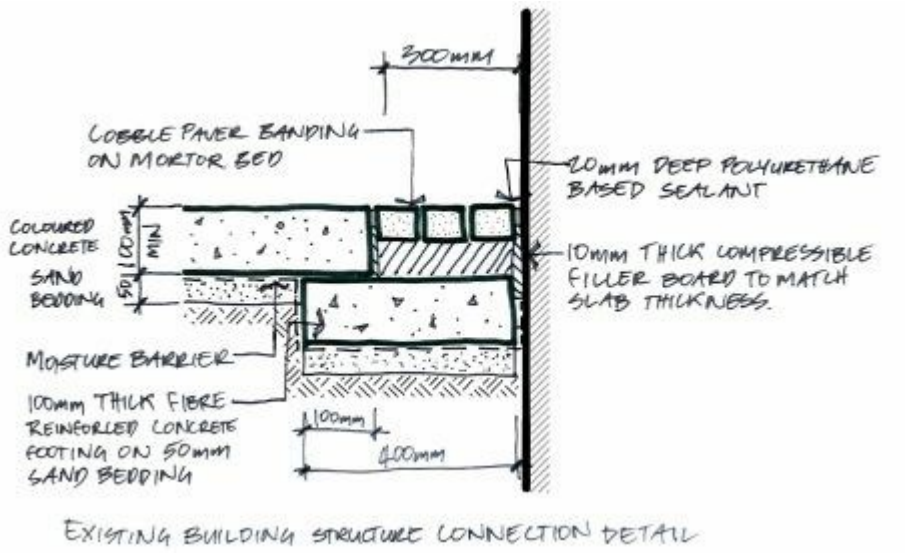


Figure SC6.4.3.3.29 Existing building structure connection detail

(2) Service access lids and inspection pits:

(a) installed within the footpath zone shall be finished and matched to the finished surface levels of the footpath treatment;

(b) which are manufactured shall be installed in accordance with manufacturer's installation instructions, having regard to the footpath pattern of the selected footpath treatment type;

(c) in footpath treatment areas FT1, FT5:

(i) be housed within an angle surround frame, which enables adjacent footpath treatments to be placed to the edge of the service penetration. The lid is to allow for matched pavers to be placed within, matching the adjacent paver material, colours and patterns flush with the top of the adjacent treatment (see Figure SC6.4.3.3.31);

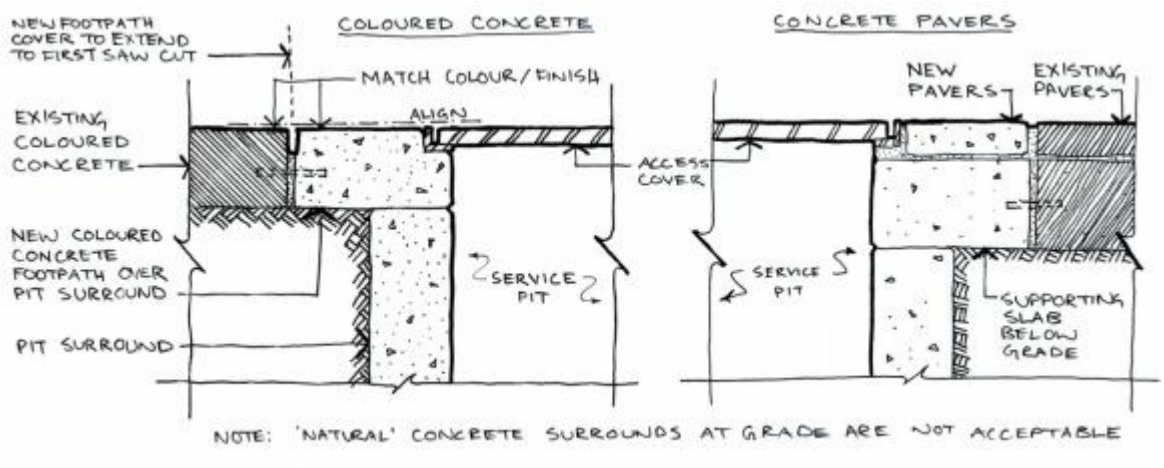
(d) in footpath treatments FT2, FT3, FT6, FT7 and FT8, have their perimeter supports resting on concrete slabs that are integral with the adjacent concrete slab without a separate surround (see Figure SC6.4.3.3.30):

(i) be housed within an angle surround frame, which enables concrete to be laid to the edge of the service penetration;

(ii) be located in and integrated with adjacent concrete slabs so service access structures limit or control cracking in surrounding concrete (see Figure SC6.4.3.3.32); and

(iii) are located where possible so future replacement or alteration of service access structures minimises disruption to adjacent concrete panels, and are aligned with existing or proposed concrete crack control saw cuts where possible, or are located wholly fully within the saw-cut panel (see Figure SC6.4.3.3.32); and

(e) when penetrating a cobbled area of FT3, be installed such that the cobbles continue to the edge of the new service access lids and inspection pits (see Figure SC6.4.3.3.31).



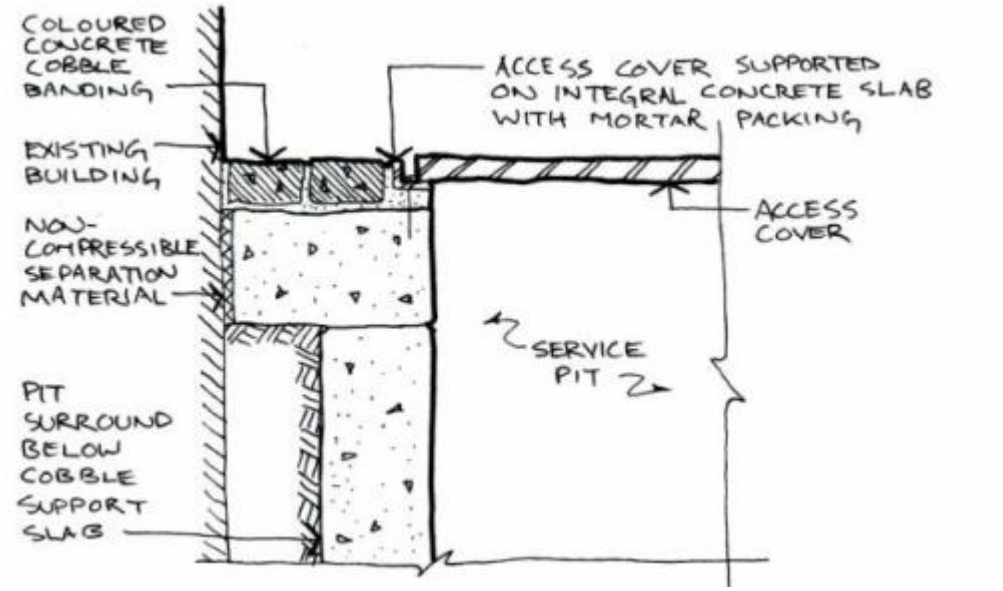


Figure SC6.4.3.3.30 Edge treatments to service access lids and inspection pits for footpath treatment areas FT2, FT3, FT4, FT6, FT7and FT8

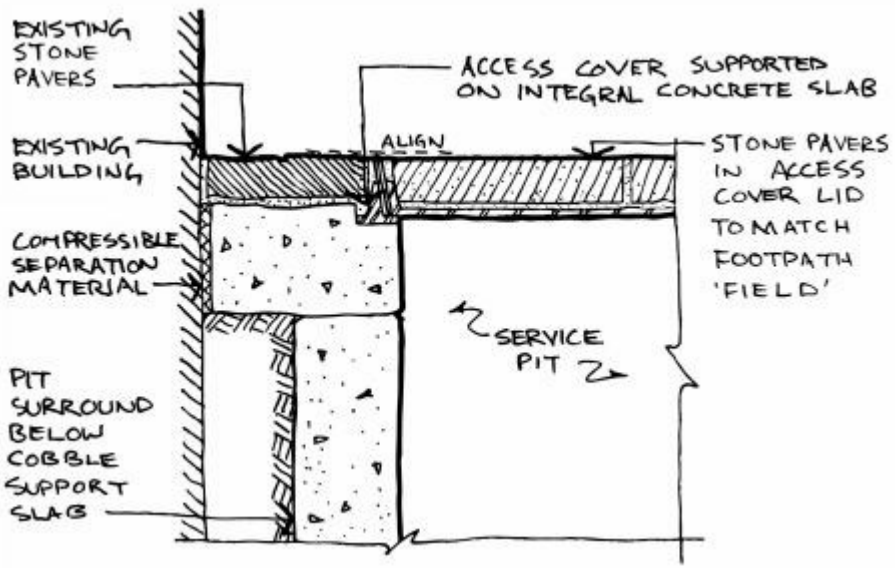


Figure SC6.4.3.3.31 Edge treatment to service access lid and inspection pits adjacent to pavers for type FT1 and FT5

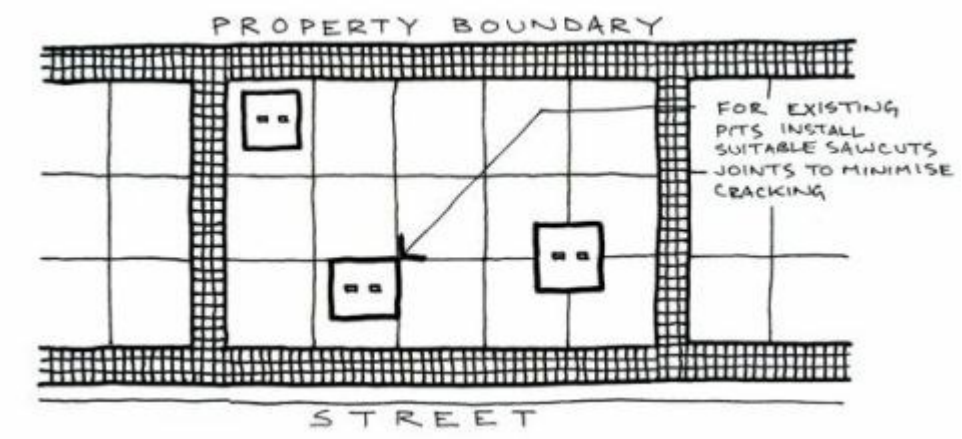


Figure SC6.4.3.3.32 Incorporate service access lids and inspection pits into decorative saw cut pattern

(3) All footpaths (see Figure SC6.4.3.3.33) shall have maximum:

(a) cross fall of 1:40 (for cross fall greater than 1:40 liaise with council); and

(b) slope of 1:20 (for slopes greater than 1:20 liaise with council).

(4) Kerb and channelling is to be provided if not currently installed for all footpath treatments covered by this policy, and shall be constructed in accordance with standard drawings listed in SC6.4.3.3.3(3)(b).

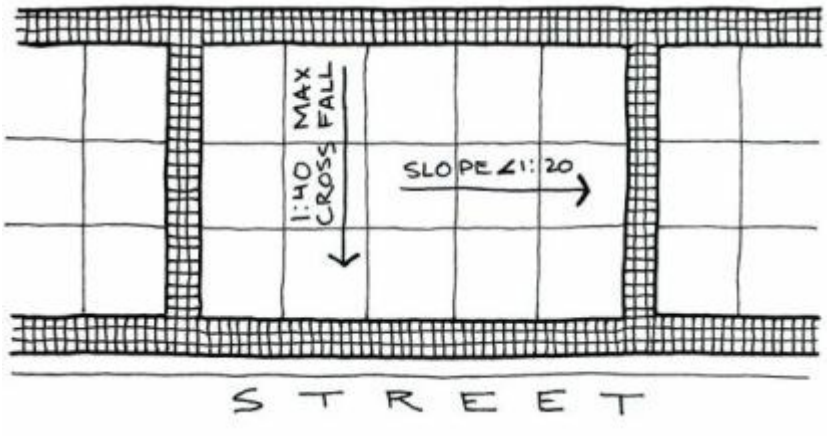


Figure SC6.4.3.3.33 Slope and cross fall

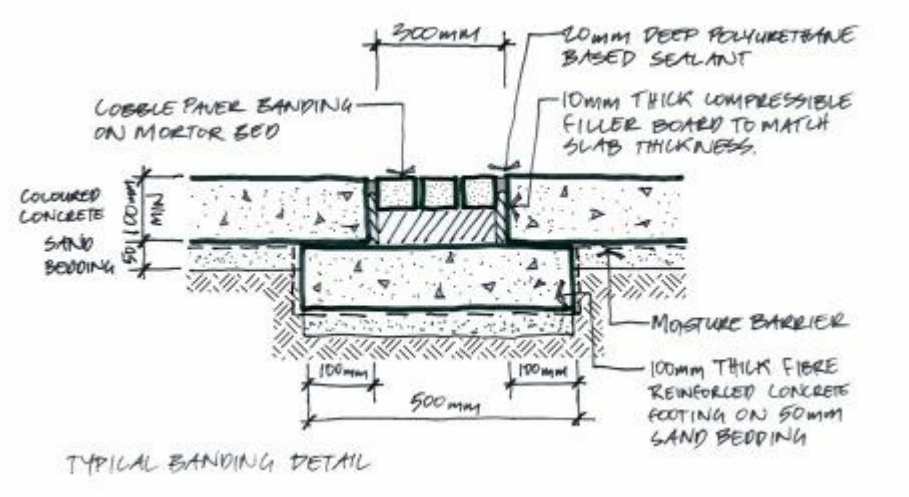


Figure SC6.4.3.3.34 Typical banding details

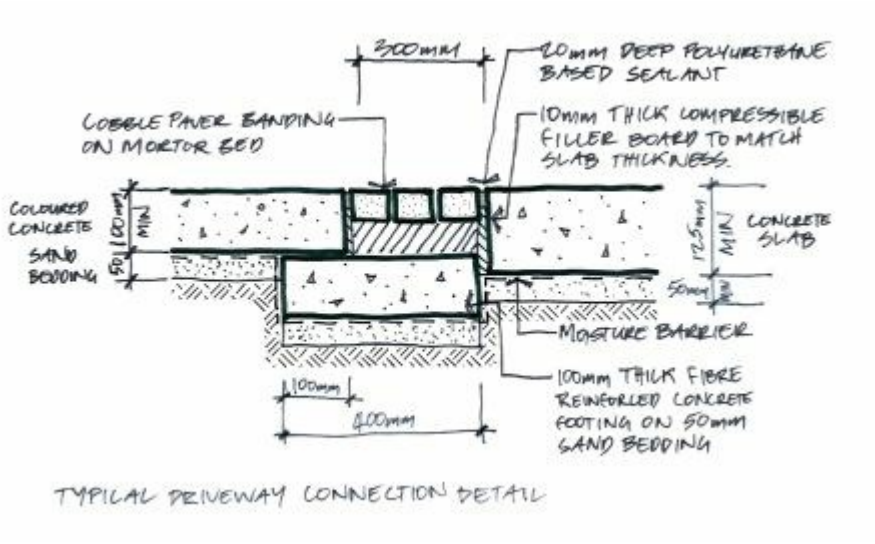


Figure SC6.4.3.3.35 Typical driveway connection detail

(5) Kerb ramps are to be:

(a) in accordance with the standard drawings see SC6.4.3.3.3(3)(b) - SD025 – Kerb Ramp,

(b) in accordance with AS1428.1 *Design for Access and Mobility, Part 1: General requirements for access – New Building Works;*

(c) installed facing the direction of travel and aligned parallel and perpendicular with opposite kerb ramp;

(d) located to suit the flow of pedestrian traffic and the position of the signal button;

(e) constructed of surface broom finished plain natural concrete;

(f) installed with sharp transitions between adjacent surfaces (top and bottom); and

(g) installed with Tactile Ground Surface Indicators (TGSIK) in accordance with AS/NZS1428.4.1 Design for Access and Mobility Part 4.1: Means to assist the orientation of people with vision impairment – Tactile ground surfaces indicators.

(6) Where the existing kerb edge is uneven:

(a) the cobble banding is to be set along a straight line. A cementitious infill material shall be used to make up for the irregularities of the kerb, as indicated in Figure SC6.4.3.3.36;

(b) ensure suitable concrete admixture (Fosroc Renderoc or approved equal) is used to create a straight and true edge if irregularity in kerb is less than 50 mm deep, see Figure SC6.4.3.3.36 and standard drawing SD-020: Concrete Kerbing; and

(c) infill is not to be formed so a tripping hazard occurs. In accordance with AS1428.1 Construction tolerances for abutment of surfaces.

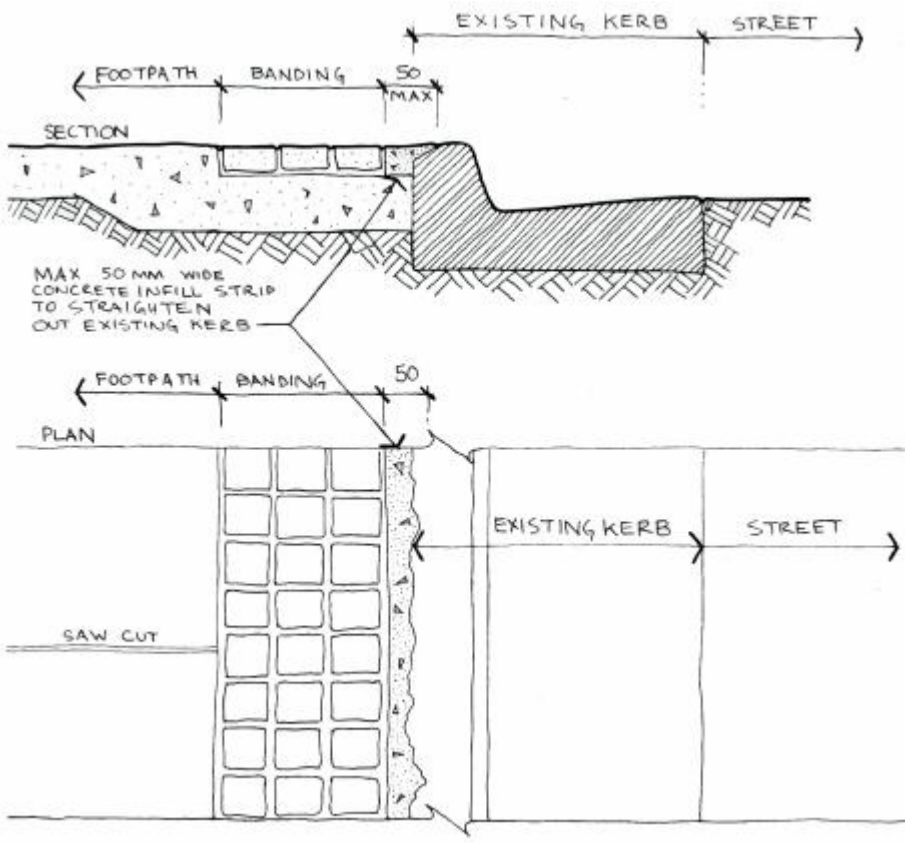


Figure SC6.4.3.3.36 Concrete infill strip for uneven existing kerb lines

(7) When providing reinstatement from trenching:

(a) where trench passes through segmented paver footpath treatment areas:

(i) remove intact pavers and store securely and safely on site;

(ii) allow for replacement and installation of any broken, cut or otherwise damaged pavers or deteriorated;

(iii) ensure paving support slabs removed for trenching purposes are reinstated in accordance with standard drawings noted in SC6.4.3.3.3(3)(b) flush with adjacent support slabs to allow level reinstatement of pavers over; and

(iv) replace original and/or new pavers over reinstated slab.

(b) where trench passes through concrete footpath treatment areas:

(i) reinstate new concrete in accordance with standard drawings listed in SC6.4.3.3.3(3)b) flush with adjacent support surface/slabs to allow level reinstatement;;

(ii) ensure new concrete matches adjacent slab colour: refer to relevant footpath type in Tables SC6.4.3.3.3, for concrete colour, aggregate, finish, etc. for types as identified in SC6.4.3.3.7 - Footpath treatment location maps; and

(iii) allow for replacement and installation of any broken, cut or deteriorated or otherwise damaged footpath treatment caused by the removal.

(8) When incorporating existing trees into new works, installing new trees, or other landscape features:

(a) incorporate elements into the paving pattern, as shown in Figure SC6.4.3.3.37;

(b) modify installation where practical in accordance with the construction detail indicated in Figure SC6.4.3.3.38; and

(c) refer to SC6.4.3.6 Landscape policy for street tree spacing, selection, root barrier treatments, root development zone, tree grates or other tree surround treatments and lighting.

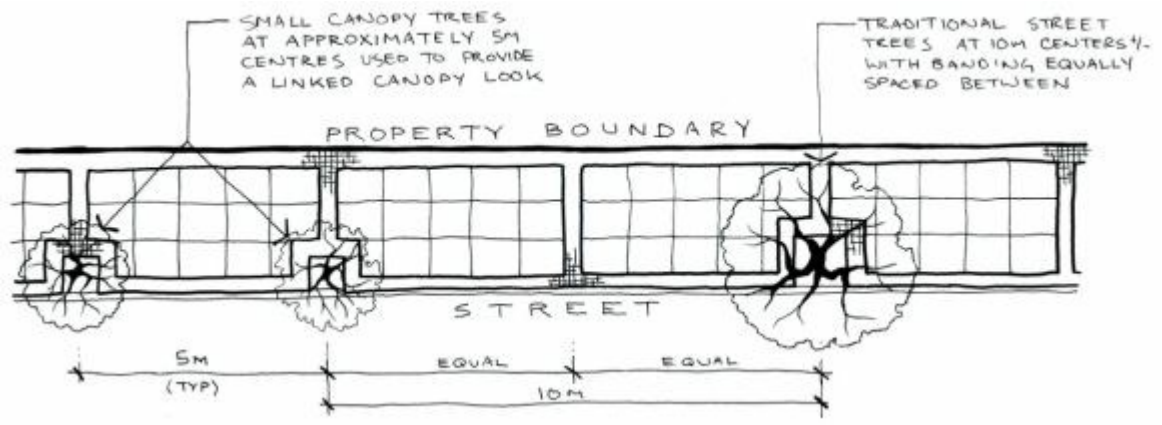


Figure SC6.4.3.3.37 Banding around tree planting

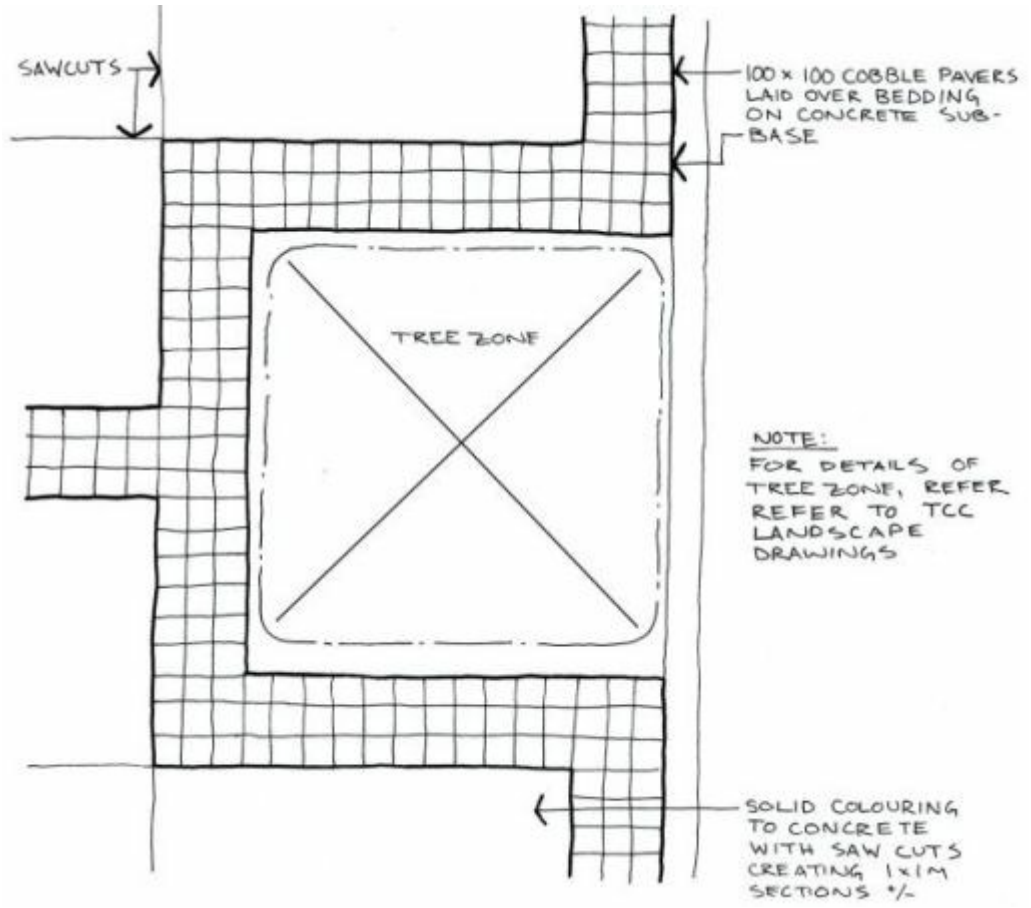


Figure SC6.4.3.3.38 Paver banding plan at tree surround

(9) When incorporating existing road transport- related infrastructure (such as bus stops, street signs and traffic signals) or providing for the placement of new road related infrastructure into any of the footpath treatment types:

(a) safety and visibility requirements shall be in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) for the placement of new such infrastructure;

(b) footpath treatments and patterns shall be modified around existing elements in order to reduce disturbance to established infrastructure;.

(c) bus stops shall be in accordance with standard drawings listed in SC6.4.3.3.3.(3)(b). Bus stop concrete slab is a reinforced solid object supporting a large size structure, therefore required to be one whole slab undisturbed. Footpath treatment to be made flush with adjacent support slabs to allow level reinstatement;

(d) street signs and traffic signals shall be in accordance with Australian Standards and guidelines; and

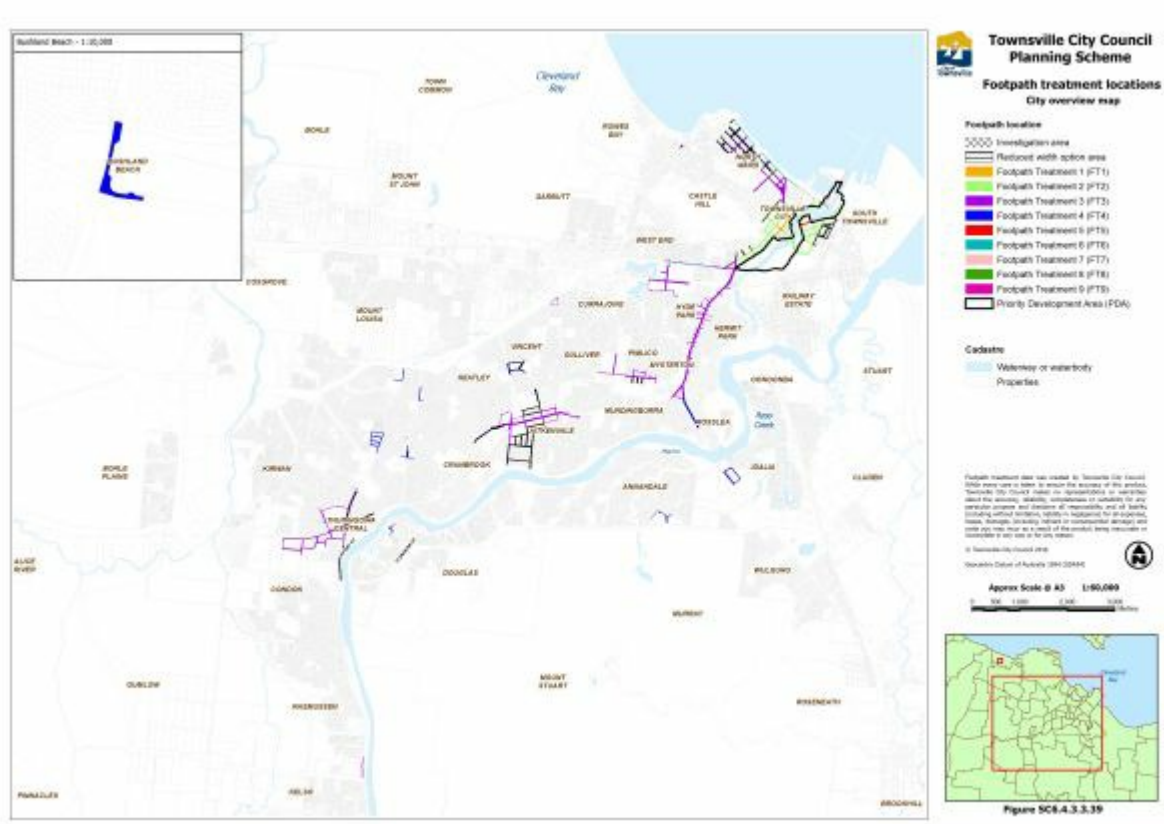
(e) street signs shall be in accordance with standard drawings listed in SC6.4.3.3.3(3)(b).

(10) When incorporating the placement of street furniture (such as , seating, rubbish bins and bollards) :

(a) installation should not impede pedestrian movement along the footpath. There shall be a 1800mm minimum clear width for the continuous accessible path of travel along the building property line, building façade and fence lines for pedestrians, especially people with a vision impairment, .in accordance with AS2890.3; and

(b) the placement of street furniture shall give consideration to minimizing the disturbance to the footpath treatment type and paving patterns.

SC6.4.3.3.7 Footpath treatment location maps



Click here to view PDF high resolution map.

Figure SC6.4.3.3.39 City overview map

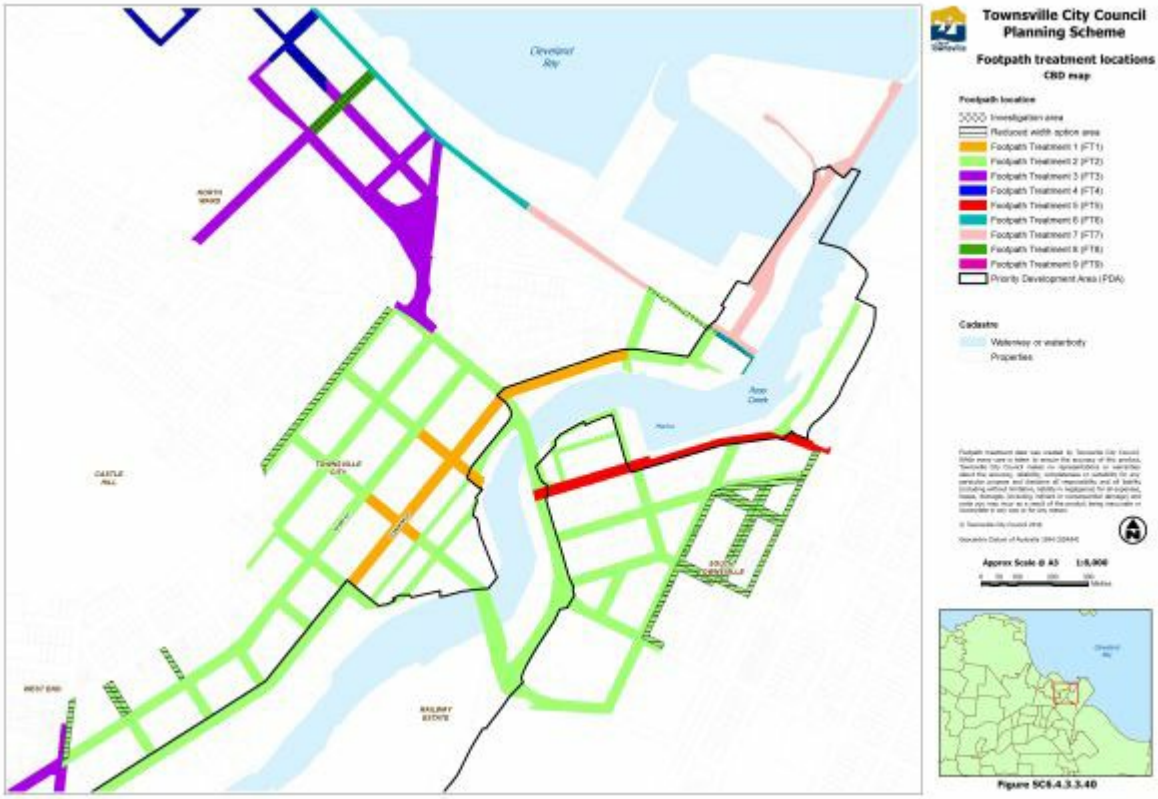


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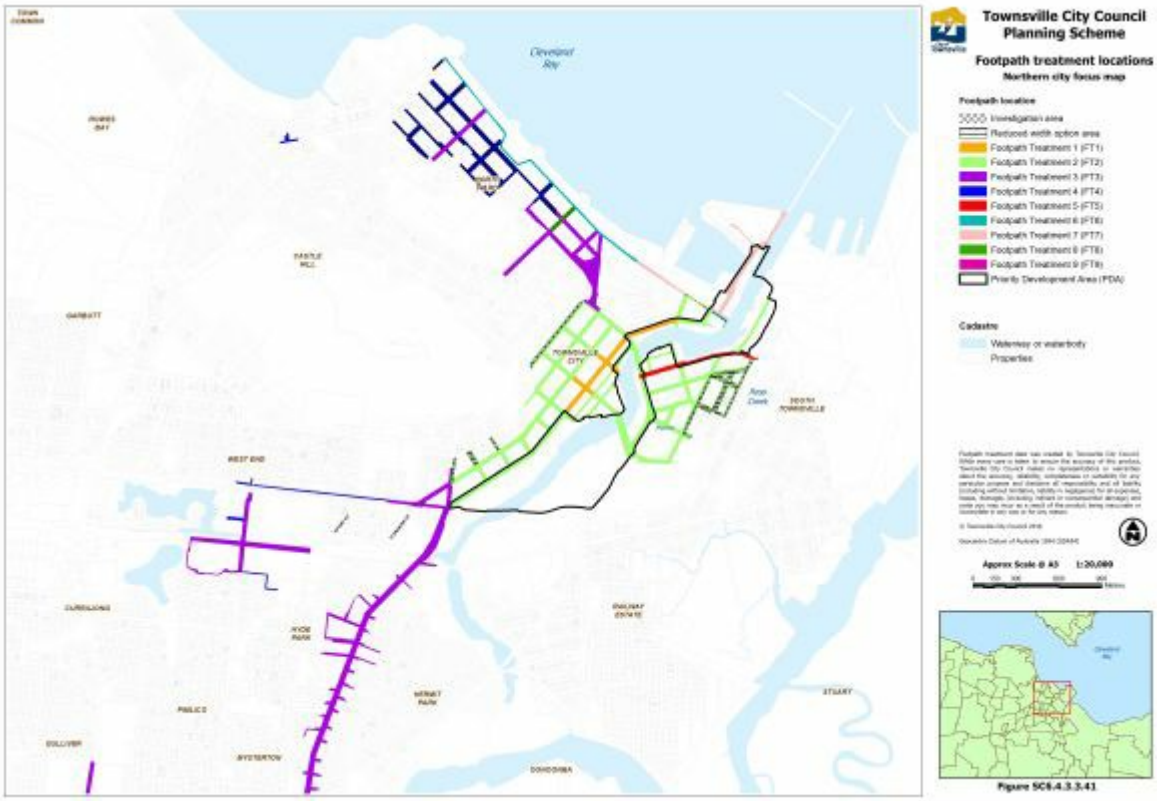
Figure SC6.4.3.3.40 CBD map



Click here to view PDF high resolution map.

Figure SC6.4.3.3.41 Northern city focus map

Figure SC6.4.3.3.42

Click here to view PDF high resolution map.

Figure SC6.4.3.3.42 Central city focus map

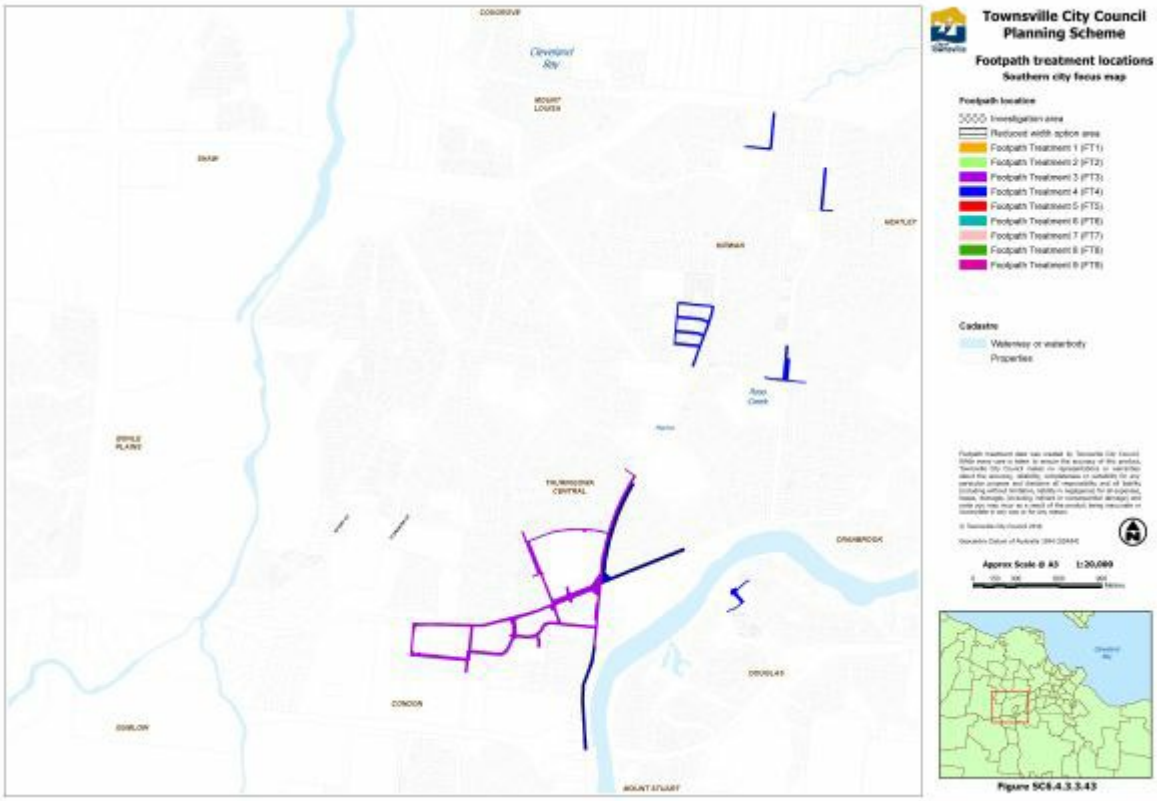


Figure SC6.4.3.3.43

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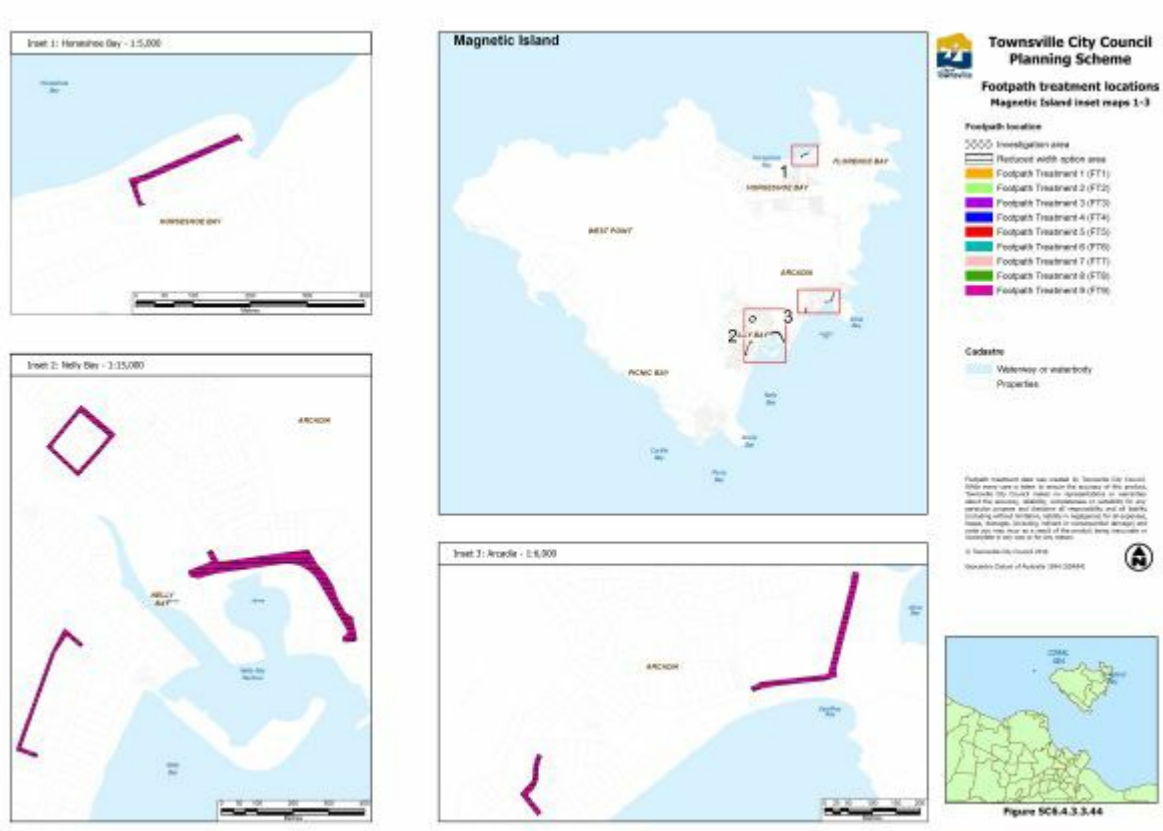
Figure SC6.4.3.3.43 Southern city focus map



Click here to view PDF high resolution map.

Figure SC6.4.3.3.44 Magnetic Island inset maps 1 - 4

SC6.4.3.4 Outdoor dining design

SC6.4.3.4.1 Introduction

(1) Purpose

(a) To protect pedestrian traffic by the introduction of shared footpath management guidelines for the purpose of providing for improved use of the area and business opportunity.

(b) To effectively address risk management issues to facilitate which relate to the introduction of additional uses, cross pedestrian traffic, and items of infrastructure or street furniture, as well as the potential interaction with vehicles as outlined in SC6.4.3.4.2.

(2) Scope

(a) When assessing an application involving outdoor dining, council will consider all relevant issues, including, but not limited to:

(i) whether the proposed outdoor dining area is located immediately adjacent to the applicant's existing premises and/or connectedness to the development;

(ii) pedestrian usage of the area, including safety and passage;

(iii) vehicular usage of the area, including separation and safety matters;

(iv) the general safety of patrons of the proposed outdoor area;

(v) the contribution towards a high amenity area and creation of active and integrated spaces and places as identified by the relevant zone code; and

(vi) how the outdoor dining integrates with the character of the locality/zone and existing or intended streetscape, including specific footpath treatments.

Editor's note—Applicants should also refer to section 9.4.1 Advertising devices code of the Townsville City Plan for additional design requirements and Table 5.8.2 Operational work being placing an advertising device on premises for application requirements regarding the control of advertising devices in outdoor dining spaces.

Editor's note—Applicants should also be aware that there may be additional related approvals required, including Outdoor Dining Licence Applications from Townsville City Council (Subordinate Local Law No. 1.2 (Commercial Use of Local Government Controlled Areas and Roads) 2011), Food Premises Licence and any liquor licencing requirements required by the Queensland Government office of Liquor, Gaming and Racing and if the outdoor dining area is on state controlled land, including road, that the applicant shall lodge other necessary documentation to the required entity.

Editor's note— Any person wishing to use any council-controlled land for outdoor dining must lodge an application for an outdoor dining licence under council's Outdoor Dining Policy, which can be found on council's website.

(b) Outdoor dining is considered to include the following:

(i) the use of the council-controlled public land for the purpose of extending the services of premises whose main function is the provision of food and/or beverages to the public; and

(ii) premises may include restaurants, cafes, bars, deli and other food outlets, but does not include roadside stalls.

(3) Terminology

Back of kerb	The point of the kerb profile away from the road, as illustrated in Figure SC6.4.3.3.6.

Crash barrier	A longitudinal or roadside barrier that has the primary function of preventing penetration by a vehicle and for which the primary purpose is to prevent or reduce the injury to occupants of an errant vehicle and restaurant patrons by safely redirecting an errant vehicle away from a roadside hazard. All roadside crash barriers must be designed to meet AS3845:1999.
Kerbside zone	The area between the trading zone and the back of kerb.
Kerbside use zone	The area between the back of kerb and the vehicle through lane. Uses within the kerbside use zone may include parking, accessible parking, bus bays, taxi ranks, drop-off zones, loading zones, no standing zones, shoulders and bike lanes. Fencing legs should not create a tripping hazard.
Pedestrian fence	A fence provided to restrict the movement of pedestrians and restaurant patrons. This can include a permanent structure or may be a portable café-style fence. Pedestrian fences must be: • A minimum height of 800 mm; • Designed and constructed so that the fence does not present a spearing hazard and is of a level of quality and design acceptable to council.
Pedestrian zone	A 1.8m wide section of footpath for the through movement of pedestrians located adjacent to the property building line (shoreline).
Trading zone	The formally defined area within which outdoor dining is permitted by council. All furniture and commercial activities relating to outdoor dining must occur within this area. Pavement markers will be installed by council to define the extents of the approved dining area (trading zone).
Traffic lane	The area of the road that is used for the through passage of vehicles in normal driving conditions. The traffic lane does not include the shoulder, parking lane or other kerbside use area.

The relationship between the key terms above is shown in Figure SC6.4.3.4.1 - Summary of guidelines and requirements.

SC6.4.3.4.2 Risk considerations associated with outdoor dining

With respect to outdoor dining, risk is increased by four significant events. Risk management through design guidelines is provided for the following four risk events:

(1) a vehicle running off road when diners are present, without sufficient separation to allow the driver of the vehicle to recover (or for diners to react and clear the path of the vehicle);

(2) a vehicle running off road when diners are not present, without sufficient separation to allow the driver of the vehicle to recover, and the outdoor dining furniture penetrates the vehicle causing injury to vehicle occupants;

(3) a vehicle running off road at a location where a crash barrier has been provided for the specific purpose of protecting footpath diners, and the crash barrier has not been designed to safely and effectively redirect the impact of a vehicle, causing either injury to outdoor diners or injury of the vehicle occupants; and

(4) a diner/staff stepping or falling onto path of vehicle due to proximity of trading zone to the traffic lane (with no fence or barrier in place), for example due to placement of a chair too close to the kerb.

SC6.4.3.4.3 Design guidelines for kerbside risk management and use

In addition to risk management issues, the guidelines include recommendations for the separation of the trading zone to accommodate the various roadside elements such as parking, and access to public infrastructure and services. Table SC6.4.3.4.1 below summarises the content of these guidelines.

Table SC6.4.3.4.1 Summary of guidelines and requirements

Guidelines	Requirements
Speed zones	See Table SC6.4.3.4.2
Barriers and fences	See Table SC6.4.3.4.3
Intersection corner	Outdoor dining should not occur within an intersection corner as defined in Figure SC6.4.3.5
Kerbside uses	See Table SC6.4.3.4.4, Figure SC6.4.3.6
Public infrastructure clearances	In general, 1 m clearance from public infrastructure unless demonstrated otherwise. See SC6.4.3.4.8
Pedestrian access though trading zone to access kerbside uses	See clause SC6.4.3.4.7

SC6.4.3.4.4 Design guidelines for risk management

Because of the increase in risk associated with higher speed limits, different levels of outdoor dining protection and separation have been recommended to manage risk appropriately. In some speed zones, outdoor dining is generally not appropriate. In lower speed zones, outdoor dining is generally always appropriate provided suitable measures are taken to separate diners from traffic by distance or a physical barrier or fence. Table SC6.4.3.4.2 below summarises the recommendations for risk management in different speed zones.

Table SC6.4.3.4.2 Summary of recommendations for risk management

Speed zone (km/h)	Appropriate for outdoor dining	Provide crash barrier guidelines	Provide pedestrian fencing guidelines
Above 60	No	-	-
60	Yes	Yes	Yes
50	Yes	Yes	Yes
40	Yes	No	Yes

Table SC6.4.3.4.3 provides the detailed design guidelines for different speed zones. Note that in the majority of cases, the need for a crash barrier can be avoided by increasing the separation distance between the trading zone and traffic. Figures SC6.4.3.4.2 – SC6.4.3.4.4 illustrate these design guidelines.

Table SC6.4.3.4.3 Guideline for crash barriers, pedestrian fencing and separation distance

Speed zone (kph)	Trading zone 3m or more from traffic lane	Trading zone 1.2m to 3m from traffic lane	Trading zone less than 1.2m from traffic lane
Above 60	Not recommended for outdoor dining	Not recommended for outdoor dining	Not recommended for outdoor dining
60	No crash barrier or pedestrian fence required	Pedestrian fence required	Crash barrier required
50	No crash barrier or pedestrian fence required	Pedestrian fence required	Crash barrier required
40	No crash barrier or pedestrian fence required	No crash barrier or pedestrian fence required	Pedestrian fence required

SC6.4.3.4.5 Design guidelines for trading zones at an intersection

In general, outdoor dining is not appropriate in the vicinity of an intersection corner. This allows corners to be used by pedestrians and cyclists, and allows access to public infrastructure and services to be maintained at all times. In some circumstances it may however be appropriate to support the zone intent and specific demonstration for intersection driving will be required.

Figure SC6.4.3.4.5 shows the area at a corner that should not be used for a trading zone.

SC6.4.3.4.6 Trading zone setbacks for kerbside use

Different kerbside uses have different spatial requirements to facilitate the movement of vehicles and pedestrians. Table SC6.4.3.4.4 summarises the recommended separation distance between the back of kerb and the trading zone for each kerbside use. Figure SC6.4.3.6 illustrates these distances.

Table SC6.4.3.4.4 Setbacks for kerbside use

Kerbside use	Minimum setback from back of kerb
No Standing/traffic lane	0.3m (if no pedestrian fence provided)
Parking - angle	0.8m
Parking - Parallel	0.8 m
Accessible Parking (Parallel)	1.5m

SC6.4.3.4.7 Pedestrian access to kerbside use and through trading zones

The design of a trading zone and any required pedestrian fencing should accommodate access through or around the trading zone for pedestrians, including persons with a disability. Where a pathway is required through the trading zone, a minimum width of 1.2 m is required. Where the kerbside use has an accessible parking bay and kerb ramp to access vehicles in the kerbside zone, a 1.5 m wide access through the trading zone must be provided. In addition, the design should consider the need for the crossing of pedestrians where the proposed outdoor dining facility is not within 20 m of a pedestrian crossing or intersection. A minimum width of pedestrian zone of 1.8 m is recommended located adjacent to the property building line. This width should be increased to a minimum of 2.4 m at locations where high pedestrian volumes are expected.

SC6.4.3.4.8 Clearances to public infrastructure

It is recommended that with the exception of service pits, in general a clearance of 1 m is desirable from all public infrastructure with the following exceptions:

(1) where a pedestrian fence is provided which separates the infrastructure and the trading zone; or

(2) where the owner of the public infrastructure asset (including council) provides written permission to relax the minimum clearance requirement.

In the case of service pits, a minimum clearance is not specified. However, it is recommended that the applicant obtains the permission of the asset owner if the applicant wishes to install outdoor dining furniture over or in the immediate vicinity of the service pit.

SC6.4.3.4.9 Risk assessment for non-conforming designs

Outdoor dining proposed within a speed zone higher than 60 km/h, or if the applicant believes that the requirements of the design guidelines are not applicable to the specific location, a risk assessment will be required by council.

The risk assessment must be prepared by a person considered by the council to have appropriate expertise in traffic engineering, and will need to demonstrate that the proposed design meets the intent of this sub-section and the relevant provisions of the Townsville City Plan, particularly the relevant zone code.

SC6.4.3.4.10 Permanent outdoor dining structures

In the case where a permanent structure (for example concrete walls, decking, awnings) are proposed, details are to be provided on plans submitted for approval.

Structures, and associated services, must be designed and constructed by suitably qualified persons in accordance with the relevant Australian Standards and the requirements of the Townsville City Plan (i.e. relevant zone code) to maintain public safety, good amenity and ease of cleaning and maintenance.

Electrical supply should have an isolating switchboard to enable the operator of the outdoor dining service to isolate the electrical supply.

Editor's note—Works within council's road reserve will require separate approvals under the relevant local laws (e.g. Road Work Permit).

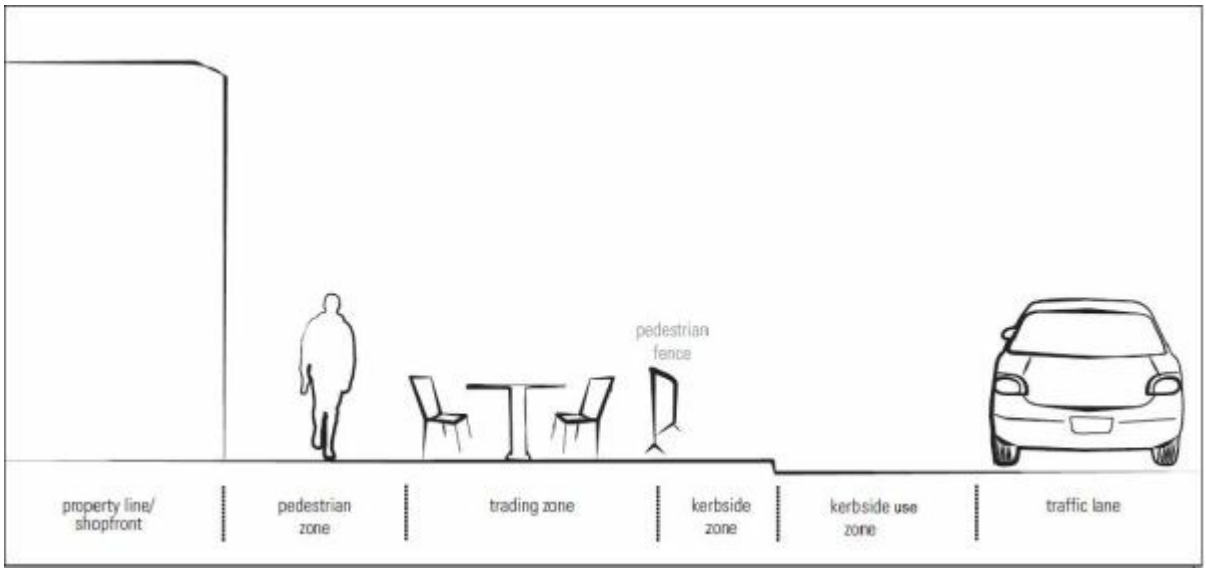


Figure SC6.4.3.4.1 Trading zone definitions

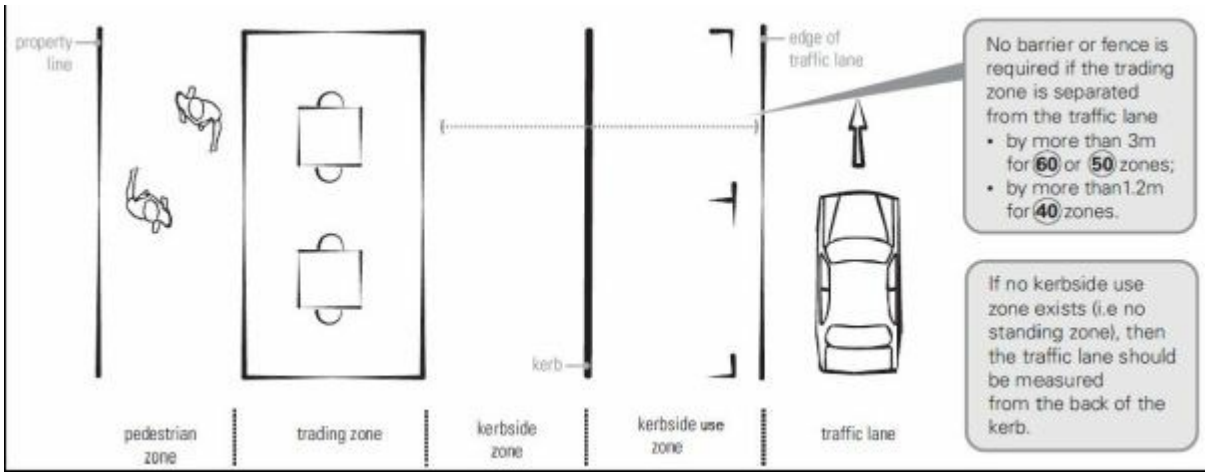


Figure SC6.4.3.4.2 Separation requirements (no barrier or pedestrian fence)

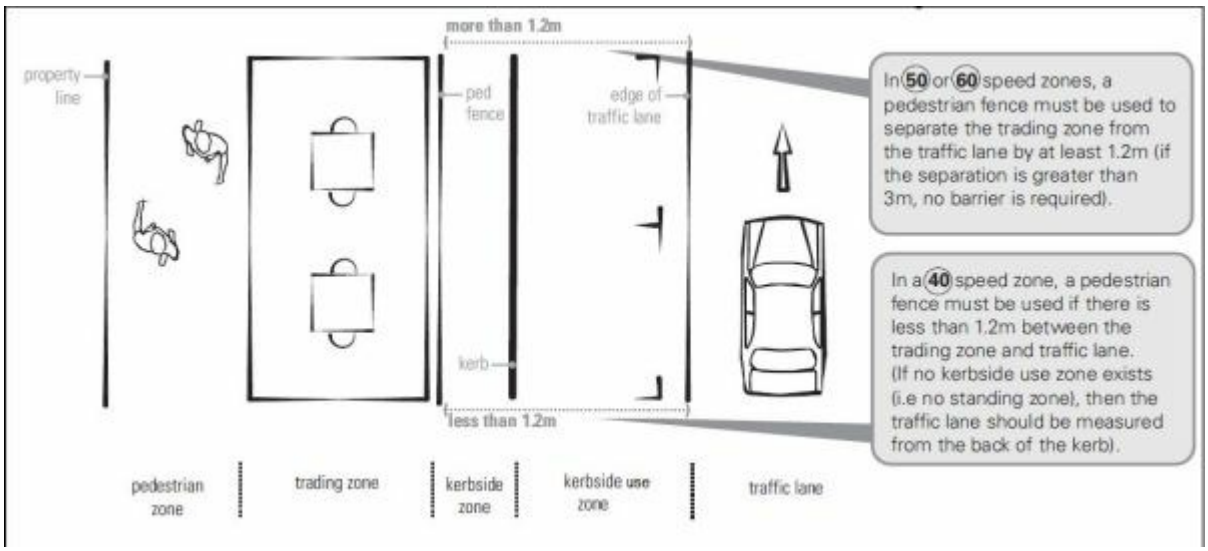


Figure SC6.4.3.4.3 Pedestrian fence requirements

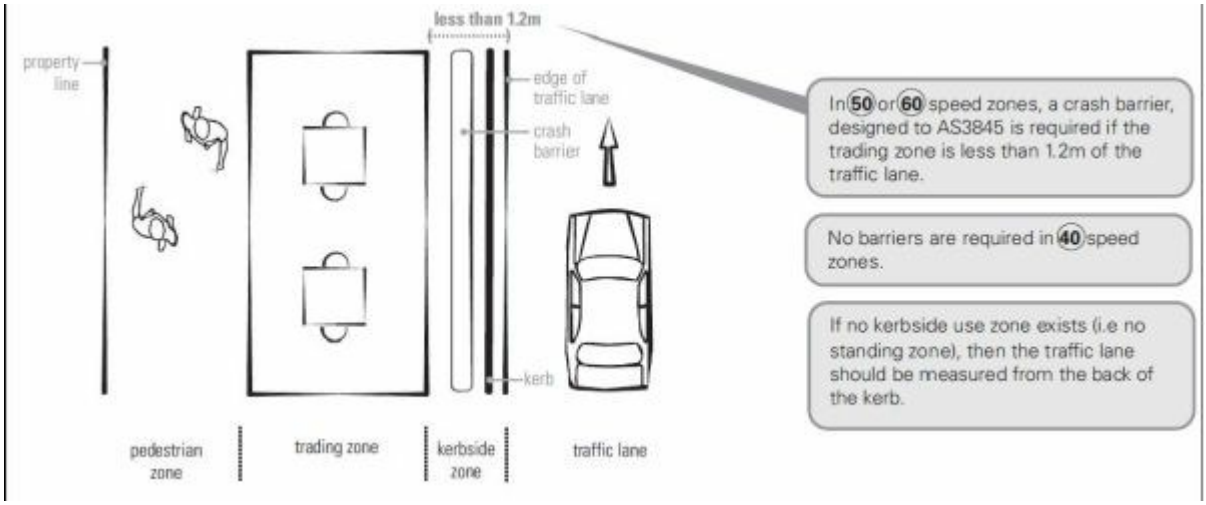


Figure SC6.4.3.4.4 Crash barrier requirements

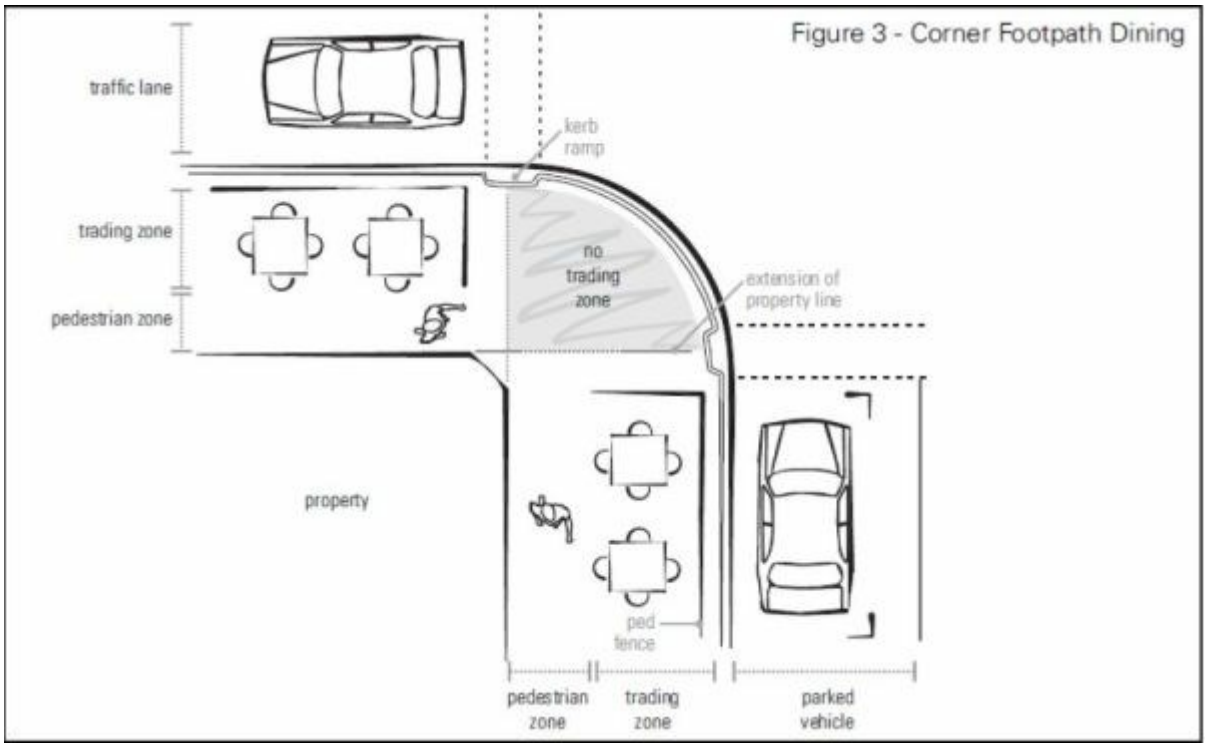


Figure SC6.4.3.4.5 Outdoor dining at intersections

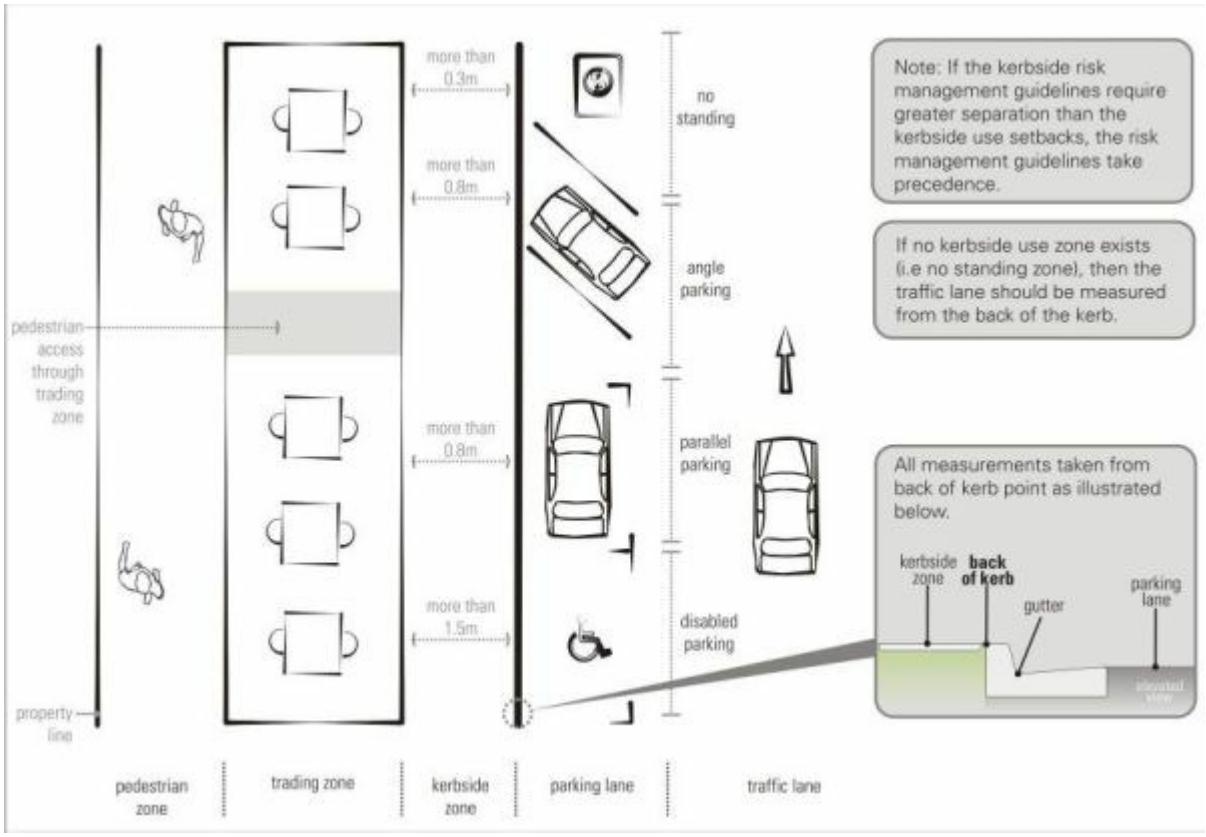


Figure SC6.4.3.4.6 Kerbside use setback requirements

SC6.4.3.4.11 Design and layout principles

(1) To ensure the safety of patrons using the indoor and outdoor areas of the business.

(2) To ensure safety and convenient passage of all pedestrians when using public footpaths.

(3) To ensure the maintenance of clear sight lines for both pedestrians and motorists, particularly near pedestrian crossings, street corners and key intersections as sought by the relevant zone code.

(4) To provide an active and integrated street front.

(5) To ensure adjoining premises are not adversely affected by any business use of footpath areas.

SC6.4.3.4.12 Plan of layout

(1) For any application involving outdoor dining, the applicant is required to provide a layout plan identifying the zones nominated in SC6.4.3.4.1(3) Terminolgy (and Figure SC6.4.3.4.1) above to a scale of 1:100.

The plan of layout must clearly identify the following:

(a) pedestrian zone - a clear pedestrian thoroughfare of not less than 1.8 m in width adjacent to the property building line;

(b) trading zone – an outline of the area intended to be used, including its dimensions;

(c) kerbside zone – area between trading zone and back of kerb;

(d) kerbside use zone – area between back of kerb and traveled path of vehicle;

(e) traffic lane – area of the road used for through passage of vehicles;

(f) any pedestrian fences that are proposed to be used;

(g) any crash barriers that are proposed to be installed;

(h) the access and exit points of the building near the intended outdoor dining area;

(i) details of any loading zones, bus zones, trees, planter boxes, fire hydrants, transformers, telephone booths, mail boxes, bus stops, bus seats and shelters, rubbish bins, pillars, posts and other obstructions; and

(j) If any structures are proposed the structures and, the location of any underground services (such as

water, electricity, etc.).

(2) In addition to submitting a plan of layout, the applicant is also required to submit:

(a) a colour photograph of the site frontage of the area; and

(b) details of all proposed signage and advertising.

SC6.4.3.4.13 Access guidelines

Outdoor dining should enrich the pedestrian experience and public life and support the purpose of the relevant zone. It is therefore important that they present an open, inviting image and are easily accessible from the public way. The layout and access must be ergonomically designed to allow safe operation of outdoor dining.

The streetscape must provide safe, equitable and dignified access for all, enabling all people to move around independently, safely and without restriction within an outdoor space. The edge of the building permits people who are visually impaired to easily locate entrances to buildings without encountering hazards. Hence, where possible and practical, the trading zone should be located on the kerb-side of the footpath, and the pedestrian zone should be located on the building side of the footpath adjacent to the property building line to provide a continuous accessible path of travel for all pedestrians.

In some locations, conditions may make siting of the trading zone on the kerb-side impractical, seriously disadvantageous or an unreasonable impediment to pedestrian traffic. In such situations, council will consider allowing the location of the trading zone adjacent to the building rather than against the kerb.

In all locations, an outdoor dining area must stay within the area identified as trading zone on the approved layout plan.

Details of required clearances to public infrastructure are provided in SC6.4.3.4.11.

Outdoor dining areas must be easily accessible from the footpath and must present an open and inviting image to entice participation. Pedestrians should not be forced onto the roadway by outdoor dining activities or other non-permanent items/structures on the footpath.

SC6.4.3.4.14 Furniture guidelines

Permanent outdoor furniture should make a positive contribution to the street environment. A furniture style that is practical and integrates well with the surrounding cityscape is encouraged.

(1) Outdoor furniture should enhance the character of the street.

(2) Outdoor furniture should be robust to withstand the wear and tear of outdoor commercial usage.

(3) Outdoor furniture should be safe in its design, compliant with Australian Standards, and not cause any hazards to the patrons, shopkeepers or pedestrians.

(4) Barricades, safety rails, bollards etc. may be required for safety reasons. All such barriers must be provided and maintained in accordance with this sub-section.

(5) The use of framed fabric or any other style of low-height barriers, including planter boxes, within public domain must be carefully designed and selected to ensure minimal impact on the use, enjoyment and safety of pedestrians and patrons.

(6) Removable furniture are to be removed when business is not open.

(7) No part of the footpath is to be used for storage.

SC6.4.3.4.15 Umbrellas/shade structure guidelines

(1) Fixtures that penetrate or damage the pavement on public footpaths will generally not be permitted. However, assessments will be undertaken on a case-by-case basis.

(2) In some cases, the applicant may wish to undertake streetscape works to accommodate an outdoor café. Such works may include footpath widening, paving, street tree planting, installation of permanent umbrellas/shade structures, pedestrian lighting and where such woks are in support of the relevant zone code of the Townsville City Plan.

(3) Umbrellas and other shade structures should not encroach upon, nor interfere with pedestrian movement or services.

(4) Umbrellas and other shade structures must have not less than 2.5 m clearance above the footpath within the obstruction free zone (AS1742.2 – 2009) from the lowest point of the extended arms (spokes) and not cause a hazard to pedestrians within a pedestrian zone.

(5) Umbrellas and other shade structures must be maintained in sound and aesthetically acceptable condition to the council's satisfaction.

(6) Umbrellas and other shade structures must be secured against high winds.

(7) Umbrellas and other shade structures must be removed when the outdoor seating area is not in use.

(8) Any advertising on umbrellas and other shade structures must comply with section 9.4.1 Advertising devices code (any relevant approval obtained for the placement of an Advertising device) and the relevant local law (*Local Law No. 1.4 Installation of advertising devices 2011)*.

SC6.4.3.4.16 Advertising guidelines

The Advertising devices code found in section 9.4.1 of the Townsville City Plan provides applicants with information regarding the placement of advertising devices. In some instances, separate approval for operational works for the placement of an advertising device may be required. Refer to Table 5.8.2 of the Townsville City Plan to determine levels of assessment for the placement of an advertising device.

SC6.4.3.4.17 Lighting

Any outdoor dining establishment approved to operate outside daylight hours must provide adequate lighting to Australian Standards, to ensure the safety and amenity of patrons and the general public. The use or reliance on council infrastructure is not permitted and the cost of maintaining, running and installing the lighting shall be the responsibility of the applicant/operator of the outdoor dining space. Any outdoor lighting must also comply with any light spillage requirements so as not to cause nuisance to adjoining properties or traffic movement areas. Lighting shall be safe and not cause obstruction or pose a hazard to pedestrians or traffic.

SC6.4.3.5 Car parking and public transport facilities

SC6.4.3.5.1 Introduction

(1) Purpose

This sub-section provides advice, guidance and standards with respect to car parking and public transport facilities to support an integrated safe, efficient and sustainable transport network.

(2) Scope

This sub-section includes the consideration of:

(a) transport impacts, including:

(i) demands for private and public transport, pedestrian and cycle usage;

(ii) impacts of future development on existing transport networks and infrastructure and the need for any improvements; and

(iii) assessment of the public transport services and the provision of facilities both on and off-site and specific high generator needs;

(b) pedestrian and cycle facilities integration with existing networks and for the provision of facilities both on and off-site;

(c) site access - accesses and driveways;

(d) parking area design provision of adequate and appropriately designed parking and circulation areas; and

(e) servicing - provision of appropriate loading/unloading facilities and manoeuvring areas both on and off-site and provision for emergency and service vehicle access.

(3) Relationship to codes

(a) Where a development application is assessable against Part 9.4.6 Transport impact, access and parking code, the application of this sub-section will assist the applicant to address the performance outcomes and acceptable solutions of that code as it contains advice, guidelines and standards.

(b) This sub-section can also be used as guidance and advice for other assessment criteria and codes including Part 9.4.4 Reconfiguring a lot code, Part 9.4.7 Works code, Part 9.4.5 Accepted works requirements code and Part 9.4.3 Landscape code.

(4) Reference and source documents that must be read in conjunction with this sub-section are as follows:

(a) Development manual planning scheme policy sub-sections
SC6.4.3.3 Footpath treatment policy
SC6.4.3.4 Outdoor dining design
SC6.4.3.6 Landscape policy
SC6.4.3.14 Traffic impact assessment guidelines
SC6.4.3.13 Townsville road hierarchy
SC6.4.3.20 Public lighting and utility services
SC6.4.3.22 Waste management guidelines
SC6.4.4.1 Geometric road design
SC6.4.4.2 Pavement design
SC6.4.4.3 Bridges and other structures
SC6.4.4.7 Bicycle, pedestrian and shared path design
SC6.4.4.8 Standard drawings

(b) SC6.10 Parking rates planning scheme policy

(c) Australian Standards
AS/NZS 2890 set *Parking Facilities*
AS1428 *set Design for Access and Mobility*

(d) Department of Transport and Main Roads Queensland
Manual of Uniform Traffic Control Devices (MUTCD)

Traffic and Road Use Management Manual (TRUM)
Guidelines for Assessment of Road Impacts of Developments, 2006
Road planning and design manual
Transport Planning and Coordination Regulation 2005
Planning for Safe Transport Infrastructure at Schools, April 2011
Public Transport Infrastructure Manual (PTIM) - TransLink Division

(e) Austroads Guides
Austroads Design Vehicles and Turning Path Templates Guide
Guide to Road Design – set
Guide to Traffic Management – set
Cycling Aspects of Austroads Guides AP-G88-14 and Quick Reference

(f) Other
Australian Government, *Disability Standards for Accessible Public Transport 2002* (DSAPT)
Australian Government, *Disability Standards for Accessible Public Transport Guidelines*
Australian Government, *Disability (Access to Premises - Buildings) Standards 2010 Premises Standards*
Disability Discrimination Act 1992 (DDA)
Australian Building Codes Board, *National Construction Code (NCC)*
Queensland Government, *Crime Prevention through Environmental Design: Guidelines for Queensland* (CPTED)
Institute of Public Works Engineering Australia, Qld Division, *Complete Streets – Guidelines for Urban Street Design,* 2010
Queensland Government, *Queensland Development Code* (QDC)

SC6.4.3.5.2 Public transport

(1) Transport network impact

(a) Applicants should assess the additional transport demands generated by the development and the capacity of the infrastructure to accommodate the additional demands by way of a traffic impact assessment report where all impacts, upgrades and alterations to the road infrastructure, including line marking and signage are identified.

(b) SC6.4.3.14 Traffic impact assessment guidelines must then be applied to the extent outlined in that report and information and plans provided on any new infrastructure or the proposed alterations/additions to the existing infrastructure for the consideration/approval of council which may be required as a result of this development. Provision should be made for the utilisation or extension of existing networks and services where required. The recommendations of the traffic impact assessment must be implemented with regard to the advice, guidance and standards identified in this sub-section. End of Trip facilities (on-site or off-site) must be provided as part of the development where identified by the relevant code and must take account of the particular characteristics of the user and service provider.

(2) Public transport

(a) Public transport demands should be assessed and consideration given to upgrading the existing transport network, services and facilities in accordance with the current and future demands.

(b) The developer is to provide council with a comprehensive assessment of the current and projected public transport demands for any new facility to be constructed as part of these works. This assessment is to be in the form of a detailed transport report and will include the particulars of any proposed upgrade to the existing transport services, routes and systems that adjoin the proposed project development. Taxi services are also considered a form of public transport and are to be considered in the model assessment of the site (if applicable). Taxi services should be integrated with other transport node facilities wherever it is possible to do so.

(c) Information and guidelines for providing public transport are provided in SC6.4.3.5 Attachment A of this sub-section. SC6.4.3.5 Attachment B of this sub-section provides advice on the consultation process with the necessary statutory authorities and service providers.

(3) Major developments

(a) Major developments which will result in high levels of public transport demand should give particular consideration to the provision and integration of services and the detail design of associated facilities on

or near the site. Facilities should be designed so as to be convenient and encourage public transport, walking or cycling. Generators may include uses such as schools, hospitals, event venues, shopping or employment centres, and high-density residential developments, aged care facilities, medical centres and retirement villages.

(b) If a development is a high level generator under SC6.4.3.14 Traffic impact assessment guidelines, a modal interchange should be provided which may include taxis. A set-back from the main road/route should be provided to ensure the site is serviced safely and directly for these facilities. Developments should present an active frontage to the transport interchange facility with wide footpaths and no conflicting vehicular accesses to ensure pedestrian and user safety is a priority.

SC6.4.3.5.3 Driveways

(1) Developments must provide for safe effective vehicular site access to and from the site, appropriate for the volume, frequency and type of vehicle usage and the function and characteristics of the surrounding road network. Separate, and clearly distinguishable, access for pedestrians should be provided where practicable.

(2) The location and characteristics of the access should be in accordance with the following documents:

(a) SC6.4.4.1 Geometric road design

(b) SC6.4.3.17 Driveways

(c) SC6.4.4.8 Standard drawings

(d) SC6.4.6 Construction specifications

(e) AS 2890 - *Parking Facilities Set*

(f) Austroads Guides

(3) The location and capacity of accesses must provide for safe and efficient pedestrian, cyclist and vehicular movement on adjacent and nearby road, and be appropriately designed so as to consider sight distances, grades, queuing, manoeuvring requirements, drainage and services. Any access must be structurally sound and built of aesthetically appealing materials for the circumstance. The impact of the access on neighbouring properties in terms of safety, streetscape and noise should also be considered.

SC6.4.3.5.4 Pedestrians and cyclists

(1) Developments are to make appropriate provision for the safe and convenient movement of pedestrians and cyclists, both on-site and to and from surrounding networks. Design should include the provision of suitable routes and end-of-trip facilities so as to encourage and facilitate these forms of movement.

(2) Major developments should provide end-of-trip facilities in accordance with the QDC Mandatory Part 4.1 *Sustainable Buildings* within the building or on-site.

(3) As well as to ensuring the safety of pedestrians, cyclists and other transport users, the design of pathways, roads, car parks and associated infrastructure (including lighting, landscaping etc) should in turn encourage overall public safety. The principles found in *Crime Prevention through Environmental Design Guidelines (Queensland)* must be given appropriate consideration for the specific development circumstances in addition to requirements of the relevant code.

SC6.4.3.5.5 Parking

(1) Parking on-site

(a) On-site parking must be provided to meet the demands of the development, including open space areas and meet the minimum rates set out in SC6.10 Parking Rates planning scheme policy (Table SC6.10.2.1 Parking rates). SC6.4.3.6 Landscaping policy provides further direction on the provision of parking to service open space areas.

(b) Any associated change to existing on-street parking controls or loading bays must also be appropriately addressed by the development. A parking layout plan must be submitted for the approval of council which accounts for the loss of any existing on-street parking bays to accommodate loading zones, bus

stops, taxi ranks or driveways required for the orderly operation of the proposed development.

(c) The design of the car park, its accesses and associated aisles are to be in accordance with AS/NZS 2890.

(d) Accesses must be designed in accordance with SC6.4.3.17 Driveways and SC6.4.4.8 Standard drawings.

(e) Where car parks are accessed through security barriers, doors or lifts, sufficient queuing space must be provided on site to accommodate all expected traffic during peak demand periods.

(f) Access ways adjacent to car park entries should have sufficient internal queuing space to prevent vehicles queuing into the street whilst waiting for a vehicle to manoeuvre into-out of a parking bay.

(g) Turning paths for cars and service vehicles must be provided in accordance with the Austroads' *Design Vehicles and Turning Path Template Guide*. Council may require the preparation of plans that demonstrate adequate turning paths in accordance with Austroads.

(h) Pavements must be sealed, line marked and constructed to a design appropriate for the anticipated vehicular loading.

(i) Parking for schools must comply with *Planning for Safe Transport Infrastructure at Schools*.

(j) Car parks must provide adequate manoeuvring and parking areas for the type of vehicles and functions served. They must be clearly signed and marked, accessible, safe and contribute aesthetically to the internal user and the streetscape character. Landscaping associated with parking facilities must be in accordance with the Landscape Code and with SC6.4.3.6 Landscape policy.

(k) All car parking spaces for people with a disability must be designed in accordance with AS/NZS 2890-6. Car parking spaces for people with a disability are to be largely located as close as possible to the point of entry into the proposed development. Provision for off-site parking may also be required. In this circumstance, the ability to safely provide this within the road reserve must also be demonstrated.

(l) Pedestrian access and movements within the car park should be separate from vehicular access and should be appropriately marked and signed and accessible by all abilities.

(m) Carwash bays must be clearly marked and signed, even though this may also be utilised as a visitor space. Run-off from the car washing bay must not discharge into the stormwater drainage system. Stormwater quality treatment for the car park run-off must be considered as part of the treatment for the whole site.

(n) Bicycle storage racks must be provided on-site in accordance with AS/NZS 2890.3.

(o) Provision of lighting in off-street car parks is to comply with AS1158.

(2) Parking on-street

(a) Developers must undertake all works identified in the traffic impact assessment report required in SC6.4.3.5.2(1) Transport network impact.

(b) If a new driveway is to be constructed in a street where parallel parking exists and it is necessary to remove parking bays and install a driveway, the remaining parallel parking bays must be remarked such that at least 3 m is left clear from the edge of the driveway on the approach side of the driveway and at least 2 m is left clear on the other side of the driveway. Remarking of the remaining on street bays and any relocation/alteration to parking control signs must be undertaken as part of this works. A parking layout plan must be submitted for the approval of council.

(c) Where a loading zone, bus stop or a taxi zone is required as a result of a development, the infrastructure, line marking and signage must be provided by the developer. The design must be submitted to council for approval prior to works commencing on site.

Editor's note—a loss of parking may occur due to access requirements by Queensland Fire and Rescue at hydrant boosters.

SC6.4.3.5.6 Servicing

(1) The development must make adequate on-site provision for the access, loading, unloading and manoeuvring of service vehicles sufficient to cater for the demand generated by the development and the service vehicles

utilised. The design must ensure the safety of other vehicles, pedestrians and cyclists and that other users are not inconvenienced. The design must also consider any adverse effect on the amenity of the development and its surroundings including the effects of visual amenity, operating hours, the generation of noise odour and dust, and proximity to sensitive uses. The design of this layout must conform to AS 2890.2.

(2) The development must make adequate internal provision within the site to allow all vehicles servicing the development to enter and exit the site in a forward direction only. In demonstration of this requirement, council may request a turning path plan to show how the intended vehicle types that are expected to use the development can enter and exit the site in a forward gear.

(3) Entry of B-double or other multi-combination vehicles servicing a proposed development will be considered by council on a case-by-case basis. In making this assessment, council will:

(a) assess the status of the roadway fronting the development;

(b) consider the zoning of the adjoining properties;

(c) design particulars of the vehicle entry and exit layout – with particular attention to the footway/verge crossing details;

(d) the internal manoeuvring capacity of the development site; and

(e) safety implications to the public and other road users.

Editor's note—road manager consent is required for travel on the road network. Applications are coordinated by the National Heavy Vehicle Regulator.

(4) Provision for refuse collection must be in accordance with SC6.4.3.22 Waste management guidelines.

SC6.4.3.5 Attachment A: Information and guidelines for public transport

(1) Bus routes are preferred along the shortest route, or up to 120% of the shortest length, between destinations.

(2) Preferred bus routes are generally located along arterial, sub-arterial and collector roads. Passenger bus services will not service an estate with only one entry/exit; as existing passengers are taken on a tourist trip through the estate without getting closer to their destination.

(3) The main criteria in determining the location of a bus route is that no more than 10% of residents should have to walk more than 400m to catch a bus within the urban area. Council may request a public transport route plan as part of the development to demonstrate this requirement. Bus services operate to a published timetable, so routes with minimal delays at intersections are preferred; routes with multiple traffic signals can cause delays to timetable service.

(4) To minimise resident objection to the placement of bus stops in front of houses, any public open space (e.g. drainage or recreational reserve) should be considered to accommodate a bus stop. This is particularly pertinent if the public open space contains a pathway. Other options include high-density residential or commercial developments where off-street parking is a component of the development. It is most desirable to establish the location of future bus stops during the design process to ensure that future development proposals recognise the implications of this infrastructure and its location. A layout plan showing the proposed locations must be submitted for the approval of council.

(5) New bus stops will be one of four standards:

(a) Minimum boarding point - bus stop sign with timetable displays (TDC), platform with tactile ground surface indicators (TGSI); or

(b) regular stop - bus stop sign with TDC, platform with (TGSI) and seat (inbound definite, outbound optional); or

(c) intermediate stop - bus stop sign with TDC, platform with TGSI and shelter with seat (inbound definite, outbound optional) – site specific; or

(d) premium stop - generally limited to high route volume locations and stops at shopping centres. As per intermediate stop, with greater care to the infrastructure finish standards and capacity requirements.

(6) New regular and intermediate bus stops are to be designed and constructed in accordance with council's standard drawings (SC6.4.4.8 Standard drawings) and meeting disability compliance standards (DSAPT and Premises Standards) or set out under the Disability Discrimination Act 1992.

(7) Bus stops should be located where there is no conflict with the location of (drainage pits/surrounds, poles, items of street furniture), street trees or driveways to properties. Drainage pits must be located away from the bus platform (concrete slab) to avoid creating a safety hazard. They are generally located in residential areas at side boundaries of adjoining properties to avoid resident concerns about loss of amenity and view, by having a stop directly in front of their property. Bus stops are generally preferred to include a location near an intersection to pick up passenger from the side streets; however, it should not impact on intersection functionality or operation. Bus stops are preferred on the departure side of intersections and major driveways.

Bus stop facilities within private property must comply with the DSAPT and associated guidelines, the Premises Standards or under the DDA. The developer must provide documentation to demonstrate consultation with the Department of Transport and Main Roads and the all impacted bus operators about future passenger bus routes servicing the facility during the design phase. A layout plan showing the proposed location with details must be submitted for the approval of council.

(8) Pathways servicing bus stops must form an integral part of a pathway network servicing the entire estate, and not just be a short connection to the corner of the nearest street.

(9) The in-bound and out-bound bus stops along the same route should be in proximity to each other on opposite sides of the street, although the bus stops do not have to be directly opposite each other (especially at intersections).

(10) All new bus stops being constructed must comply with the requirements of the DSAPT and associated guidelines (including any bus stop relocations), the Premises Standards or under the DDA. It must also have a clear continuous accessible path of travel; that is be serviced by a smooth, level and impervious surface with a 1500mm minimum width. One aspect of compliance is that the preferred cross-fall on the bus stop platform slab is 2%, and absolute maximum of 2.5%. School bus stops (mostly in a rural environment) do not need to comply with this requirement at this time.

(11) A standard bus stop is 3 m wide by 12 m long, (see SC6.4.4.8 Standard Drawings) plus entry/exit tapers on roads with a posted speed limit of 60km/h or less. A bus bay (with associated parking restrictions) is approximately 42m long (allowing for a 15m in taper and 15m egress taper). These dimensions can vary and may severely impact on the required street width (especially where no indents are to be provided), driveway access to properties and the availability of visitor/customer parking.

(12) Consideration must be also given as to how elderly and young passengers (especially school children) will safely cross the street to access the bus service. This may require the installation of a nearby refuge crossing or traffic signals, or similar measures.

(13) Bus routes should avoid having vertical or horizontal deflection traffic calming measures along the route. Any vertical deflection devices that are to be used by a bus service intended to operate in high pedestrian environment must be flat-top road humps. Council may support a bus route where speed cushions are installed.

(14) Any roundabout along a bus route must be able to accommodate a turning bus without mounting the kerb and channel or encroaching onto any landscaping on the centre island, including during a right hand turn.

(15) The developer is to prepare a draft Master Plan for the proposed development together with a traffic impact

assessment in accordance with SC6.4.3.14 Traffic impact assessment guidelines.

(16) The Master Plan will identify (as a minimum):

(a) proposed residential development lot sizes and densities;

(b) any proposed commercial development, including approx. GFA;

(c) any proposed education facility or other significant bus passenger service attractor (e.g. retirement village, hospital etc.);

(d) location, type and hierarchy of open spaces areas;

(e) the proposed road hierarchy for the development, and how it connects to the existing road network;

(f) the location of proposed footpaths and shared paths and bicycle paths throughout the development, and how they connect to the existing, and future, networks; and

(g) the route of all existing passenger bus routes within 1 km of the proposed development and through the development; and

(h) The Master Plan must be submitted for the approval of council.

(17) As part of the information required in obtaining a development approval, the developer must provide evidence of feedback from consultation with all the following stakeholders on the feasibility of potential passenger bus service route/major bus corridor through the new development:

(a) Department of Transport and Main Roads (TransLink Division);

(b) Department of Transport and Main Roads (Northern Region);

(c) local contract bus operator (Sunbus Townsville) and if necessary school bus operator/s;

(d) local taxi operator (Townsville Taxis); and

(e) council's Infrastructure Services Division.

(18) The outcome from the engagement with the stakeholders will be:

(a) advice if the development is ever likely to be serviced by a passenger bus service or school bus service;

(b) agreement of the most likely route(s) through, or servicing, the proposed development;

(c) the need and likely location of bus stops necessary to service the development;

(d) general agreement on the location and route of footpaths and shared paths servicing any future bus service along the agreed bus routes;

(e) advice on the need for any bus stop to be constructed as part of any proposed commercial centre, and the likely required standard of the facility; and

(f) the need for the developer to provide any other additional facilities to ensure the operation of an efficient and effective public transport services, including taxis. This may include required intersection treatment, bus stop locations, the possibility of joint use bus stops and the like.

SC6.4.3.5 Attachment B: Guidelines - Authority consultation for public transport, taxis, buses and school buses

(1) Taxi operations
Contact the Department of Transport and Main Roads Northern Region and the local taxi operator about taxi service operations.

(2) Taxi infrastructure

(a) Contact Townsville City Council about existing and proposed taxi rank infrastructure in the area.

(b) Any existing or new infrastructure undergoing substantial refurbishment or alteration must comply with the *Disability Standards for Accessible Public Transport 2002* and associated guidelines, the Premises Standards or under the DDA, and be in accordance with SC6.4.4.8 Standard drawings at the time of the refurbishment or alteration. It must have clear continuous accessible path of travel; that is, be serviced by a smooth, level and impervious surface.

(3) Bus routes

(a) Contact the Department of Transport and Main Roads Northern Region and the local bus operator (Service Contract holder) about current and future passenger bus routes.

(b) The developer will need to be aware of, and make provision for, future bus routes as determined through the consultation process with DTMR, council and the local bus operators.

(4) Bus stop infrastructure

(a) Contact Townsville City Council in the first instance about existing and proposed bus stop infrastructure on the road reserve, then contact the Department of Transport and Main Roads about interchange-type infrastructure.

(b) Any existing or new infrastructure undergoing substantial refurbishment or alteration must comply with the DSAPT and guidelines, the Premises Standards or under the DDA, and be in accordance with SC6.4.4.8 Standard drawings at the time of the refurbishment or alteration.

(c) Townsville City Council has prepared standard drawings for bus stop infrastructure. Also, new or relocated bus stops must have the specified branding (J Pole/ Blade signing), an identifying name approved by council's Technical Services Unit and be in accordance with SC6.4.4.8 Standard drawings and the bus stop position identified by easting and northing.

(5) School buses services

Contact the Department of Transport and Main Roads Northern Region and the local bus operator about current and future school bus route operations.

(6) School bus stop infrastructure

Contact Townsville City Council about existing and proposed school bus stop infrastructure on the road reserve.

(7) Intercity buses (long distance)

Contact Townsville City Council about existing and proposed intercity bus stop infrastructure on the road reserve, but also contact the Department of Transport and Main Roads TransLink Division about bus stop infrastructure and bus stop operations.

SC6.4.3.6 Landscape policy

SC6.4.3.6.1 Introduction

(1) Purpose

The purpose of this sub-section is to:

(a) support the purpose of Part 9.3.3 Landscape code and other elements of the Townsville City Plan and Development manual planning scheme policy;

(b) identify the application of this sub-section to landscape and irrigation design across all types of open space; and

(c) provide detailed design and construction standards, advice and guidelines for landscaping on private and public land ensuring a high standard, strong contribution to the city image and local character that are suited to site and climatic conditions and will remain fit for purpose over the long-term.

(2) Scope

This sub-section provides direction on landscape and irrigation design within open space, both within the public and private realm.

The scope of this sub-section includes:

(a) overarching design, sustainability and management principles that should be applied to open space development including:

(i) general design principles, master plans and identified design outcomes;

(ii) principles of sustainability economic, environmental, and social; and

(iii) management frameworks for public open space Public Open Space (POS) Hierarchy, Public Open Space Management (POSM) Framework and Irrigation Profile Level (IPL) Framework;

(b) the types, functions and development objectives for open space:

(i) private open space;

(ii) streetscapes; and

(iii) public open space recreation parks, sporting parks and other public open space; and

(c) design and embellishment guidelines for application in open space development.

(3) Reference and source documents

(a) This sub-section should be read in conjunction with other sections of the Townsville City Plan and Development manual planning scheme policy including, but not limited to:

Part 4 – Priority infrastructure plan
Part 8.2.5 – Natural assets code
Part 9.3.3 – Landscape code
Part 9.3.4 – Reconfiguring a lot code
SC6.4.3.3 – Footpath treatment policy
SC6.4.3.4 – Outdoor dining design
SC6.4.4.1 – Geometric road design
SC6.4.4.7 – Bicycle, pedestrian and shared path design
SC6.4.3.20 – Public lighting and utility services
SC6.9 Natural assets planning scheme policy

(b) The following Australian Standards are also referenced and should be read in conjunction with this sub-section:

AS/NZS 1158.3.1	*Lighting for roads and public spaces*
AS 1170	*Structural design actions (set)*
AS 1428	*Design for access and mobility (set)*
AS 1926.1	*Swimming pool safety – safety barriers for swimming pools*
AS 2156	*Walking tracks*

AS 2890.3	*Parking facilities – Bicycle parking facilities*
AS 3996	*Access covers and grates*
AS 4373	*Pruning of amenity trees*
AS 4422.2016	*Playground surfacing – Specifications, requirements and test methods*
AS/NZS 4486.1	*Playgrounds and playground equipment – Development, installation, inspection, maintenance and operation*
AS 4685.1	*Playground equipment – General safety requirements and test methods (and Amendment 1 – 2006, and Amendment 2 – 2008)*
AS 4685.2	*Playground equipment – Particular safety requirements and test methods for swings (and Amendments 1- 2006 and 2 - 2008)*
AS 4685.3	*Playground equipment – Particular safety requirements and test methods for slides (and Amendment 1- 2006)*
AS 4685.4	*Playground equipment – Particular safety requirements and test methods for runways*
AS 4685.5	*Playground equipment – Particular safety requirements and test methods for carousels (and Amendment 1 – 2006)*
AS 4685.6	*Playground equipment – Particular safety requirements and test methods for rocking equipment (and Amendment 1 – 2008)*
AS 4685.11	*Playground equipment – Additional specific safety requirements and test methods for spatial network*
AS/NZS 4456.9	*Masonry units and segmental pavers and flags – Methods of test – Determining abrasion resistance*
AS/NZS 4586	*Slip resistance classification of new pedestrian surface materials*

(c) Other

The following documents are also referenced and should be read in conjunction with this sub-section:

Austroads, *Guide to Road Design* (Set)

Building Code of Australia

Department of Transport and Main Roads, *Road landscape manual,* 2013

Department of Transport and Main Roads, *Manual of uniform traffic control devices* (MUTCD), Queensland

Department of Transport and Main Roads, *Traffic and Road Use Management Manual*, Volume 3.13: *Pedestrian Cross Facility Guidelines* and *Prioritisation system User Guide*.

Queensland Government, *Crime Prevention through Environmental Design*, *Guidelines for Queensland*, Parts A and B, 2007

Queensland Government, *Census of the Queensland Flora*, 2013, edited by Peter D.Bostock and Alisa E.Holland.

Western Australian Department of Sport and Recreation, *Sports Dimensions Guide for Playing Areas*

SC6.4.3.6.2 Landscape design

(1) Introduction

Landscape and irrigation outcomes should demonstrate consideration and application of the overarching principles, as described within this sub-section, Part 9.3.3 Landscape Code and other parts of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the “Landscape Statement of Intent”, as detailed in Section SC6.4.2 Development application guidelines.

(2) Master plans

For certain sites or localities, council may formally adopt Master Plans that identify specific strategies and plans to deliver key design and construction outcomes in the built environment.

At sites or locations where these Master Plans apply, any landscape design outcomes must be in accordance with the requirements for that site or area.

The following plans contain site specific outcomes that must be complied with:

(a) Thuringowa Riverway Master Plan (2003); and

(b) Riverway Sustainable Development Policy (2003).

Details of the above listed plans are contained in SC6.4.3.6 Attachment B – Adopted Master Plans

Editor's note—applicants should refer to all applicable sub-sections within the Development manual planning scheme policy which identify specific design principles and outcomes required across individual open space typologies as well as other infrastructure.

Editor's note—outcomes identified in an adopted master plan take precedence over all other design guidelines, unless approved otherwise. Where proposals deviate from the desired outcomes of the adopted master plan, applicants must justify this deviation for council's assessment and approval.

(3) Identifiable character and/or identified design outcomes
For key sites or localities where council has **not** formally adopted area specific plans and strategies but there is an identifiable character and/or desired design outcome, planning and design for new open space development in these areas should seek to be consistent or complementary to this established direction.

Identifiable character and/or design outcomes may include:

(a) an established colour or furniture palette;

(b) a dominant tree, plant species or planting style;

(c) heritage features or an identifiable character;

(d) significant natural features, materials, or environmental setting (e.g. natural bushland or coastal settings); and

(e) a consistent, hierarchical-based landscape design style (e.g. all "main roads" to be developed in "tropical boulevard" style).

Editor's note—statements pertaining to identifiable character or design outcomes for particular locations or land uses are contained within Townsville City Plan. Where applicable, landscape design outcomes are to comply with these statements and must be addressed within the "Landscape Statement of Intent". Where proposals will deviate from the desired outcomes, applicants must justify this deviation for further assessment and approval by council.

SC6.4.3.6.3 Economic sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of economic sustainability principles, as described within this sub-section, Part 9.3.3 Landscape code and other areas of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(1) General principles
Principles for consideration should include, but are not limited to:

(a) promoting opportunities for business and investments by:

(i) designing quality streetscapes that promote local business and attract patrons; and

(ii) creating opportunities for marketing initiatives such as festivals, events and community based activities (e.g. provision of event spaces within public open space areas);

(b) developing and implementing an integrated and strategic approach to the long term provision of open space infrastructure by:

(i) aligning new public open space development with council's Public Open Space Embellishment Framework and priority infrastructure plans; and

(ii) designing and developing new infrastructure and open space that improves the quality and value of the built environment within both the public and private realm (e.g. creating more liveable spaces that promote the city as an attractive place to live and invest); and

(c) establishing economically sustainable infrastructure outcomes by:

(i) identifying the lifecycle costs of open space infrastructure (e.g. the costs to plan, develop,

maintain, replace and demolish a recreational facility are established); and

(ii) identifying and developing new infrastructure with consideration of the ongoing operational requirements (e.g. identify and design a new open space development in line with defined maintenance resources).

(2) Lifecycle costing

Editor's note—currently, no framework or standard format for establishing lifecycle costs is developed. Applicants requested to submit lifecycle costing information should refer to best-practice examples until a formal framework is established.

(3) Ongoing operational requirements

(a) Where requested, applicants are required to identify the ongoing operational requirements in a maintenance plan, as detailed in Section SC6.4.2 Development application guidelines.

(b) For public open space, maintenance plans should be aligned with Public Open Space Management (POSM) Framework, as outlined in SC6.4.3.6.9(2)(b) POSM Framework and developed with consideration of the Public Open Space Embellishment Framework, as per Table SC6.4.3.6.1.

SC6.4.3.6.4 Environmental sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of environmental sustainability principles, as described within this sub-section, Part 9.3.3 Landscape Code, other areas of the Townsville City Plan and council's Corporate Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

Editor's note—currently, no framework has been developed for identifying and documenting outcomes against the environmental sustainability objectives listed. Until a formal framework or best-practice examples are identified, applications will be considered on a case by case basis. This includes recognition of independent certification under incentive-based branding and certification frameworks (e.g. EnviroDevelopment) designed to increased sustainability in developments.

(1) Principles for consideration should include, but are not limited to:

(a) conservation and substitution of non-renewable resources, by:

(i) responsible use of finite resources; and

(ii) implementation of efficiency mechanisms and strategies, (e.g. reduction of potable water use through water wise landscape and irrigation design);

(b) efficient and sustainable use of renewable resources, such as:

(i) prioritising and promoting innovative use of new, renewable materials or substitutes (e.g. plantation timber); and

(ii) transitioning to renewable energy sources and infrastructure where practicable (e.g. solar powered lighting);

(c) direct and indirect reduction in resource consumption and waste generation, by:

(i) implementing opportunities for waste reduction and reuse (e.g. concrete recycling for gabion walls);

(ii) prioritising and promoting use of recycled materials (e.g. recycled plastic composites);

(iii) promoting means for reducing carbon emissions and improving opportunities for carbon offsets and sequestration (e.g. reducing land clearing by promoting protection of existing trees and vegetation areas and incorporation of natural areas into public open space design); and

(iv) promoting environmentally sustainable design principles to directly and indirectly reduce resource consumption (e.g. increased street tree plantings to support passive cooling of streetscapes and buildings whilst improving amenity to promote pedestrian and cyclist activity); and

(d) protection, rehabilitation or enhancement of existing natural assets and systems through methods such as:

(i) responsive planting design and species selection;

(ii) protection of remnant vegetation, significant trees and habitat areas;

(iii) promotion of ecological design and responsible urban forestry management; and

(iv) implementation of integrated water cycle management practices.

(2) Responsive planting design principles and species selection
The following are provided as general guidelines for responsive planting design and species selection for all types of open space.

(a) Aesthetic requirements

(i) Planting design principles such as scale, proportion, repetition, balance, contrast, focal points and transition should be applied in the development of all planting designs.

(ii) The design qualities of the plant species including size, scale, form, line, texture and colour should be considered and maximised through the planting design process.

(iii) Plant selection and design should promote urban landscapes that reflect Townsville's climate, its natural environment, the existing local character, and any specific vegetation themes of a local area.

(b) Suitability and functional requirements

(i) Plant selection based on the biophysical attributes of the plant, the ideal growing conditions of the species and its appropriateness for the site conditions and the region's dry tropics climate.

(ii) The intended function and location of the plant species should be appropriate to its growing habit, size and other design qualities, in particular ensuring the expected size of the mature specimen can be support in the available planting space.

(iii) The quantity and density of planting proposed should consider the expected mature plant size, the density required to achieve the desired effect, account for expected die out during establishment, and avoid any foreseeable maintenance issues.

(iv) Planting location and/or species selection should not create any foreseeable, adverse impacts on access, circulation or critical sightlines.

(v) Plant habit and location should not have any foreseeable, adverse impact on adjacent properties, built assets, services, roads, drainage or other infrastructure.

(vi) The irrigation, maintenance and other resource inputs necessary to maintain the functionality and longevity of planting design outcomes and species should be sustainable, cost-effective and analogous with the available resources.

(c) Ecological requirements

(i) Plant selection and design should promote the use of local native and non-invasive introduced plant species.

(ii) Additional considerations and specifications applicable to plantings are detailed in sub-section SC6.4.6.26 Landscaping and other requirements of this sub-section.

(3) Retention of remnant vegetation and significant trees

(a) Site planning and landscape design should be used to protect and integrate significant vegetation or trees of the site including, but not limited to:

(i) large, existing mature trees;

(ii) vegetation in intact natural areas;

(iii) trees or vegetation protected by heritage listing;

(iv) trees or vegetation not formally protected by heritage listing but where the size and/or quantity present has a significant character impact;

(v) marine plants including mangroves;

(vi) vegetation in riparian zones or on slopes, especially where the vegetation is performing a stabilisation role; and

(vii) vegetation external to the development site but where activities within the site may impact its long-term sustainability.

(b) Where species/areas are identified as significant, all applicable tree and vegetation protection requirements are to be implemented, as per clause SC6.4.5.2(16) Work adjacent to trees and protection of environmentally significant vegetation.

(c) Additional detail on how the retained species will be protected and integrated into the proposed landscape works may need to be addressed in a vegetation protection plan, the "Landscape Statement of Intent" and included on the associated landscape plans.

Editor's note—refer Section SC6.4.2 Development application guidelines and clause SC6.4.5.2(14) Work adjacent to trees and protection of environmentally significant vegetation.

(4) Ecological buffers

(a) All buffer works to environmentally significant areas should be provided in accordance with Part 8.2.5 Natural assets code and SC6.9 Natural assets planning scheme policy.

(b) All buffers and ecological designs should be prepared in consultation with an appropriate specialist for the local region.

Editor's note—due to the variable nature of ecological design, no further guidelines or specifications are currently developed for the establishment of ecological buffers within open space. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable ecological, landscape and irrigation standards, legislation, and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal of this nature.

(5) Integrated water cycle management and water efficiency

Editor's note—currently, no framework or standard principles for establishing integrated water cycle management and water efficiency objectives are developed specifically for open space. Applicants should refer to other requirements within the planning scheme, this sub-section and other sub-sections of the Development manual planning scheme policy.

SC6.4.3.6.5 Social sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of social sustainability principles, as described within this sub-section, Part 9.3.3 Landscape Code and other areas of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(1) General principles

Principles for consideration should include, but are not limited to:

(a) community development principles, such as:

(i) promoting social interaction and inclusion (e.g. well-designed civic spaces that promote social activities and community gatherings);

(ii) design for universal access where possible (e.g. applying universal design principles in the design and construction of recreation facilities to promote inclusion of users of different abilities);

(iii) equitable distribution of open space opportunities and resources (e.g. equitable distribution of different open space facilities throughout the city);

(iv) designing for community diversity (e.g. promoting open space design that responds to the varying needs of the community and creates a diversity of experiences suitable for different cultures and demographics); and

(v) engaging with the community on design proposals (e.g. working with the local community/groups in the design or development of facilities within open space); and

(b) public health and safety principles, such as:

(i) creating opportunities for community health and well-being activities (e.g. provision of outdoor activity elements that promote physical activity for all ages through structured or unstructured recreation);

(ii) applying principles for crime prevention through environmental design (CPTED), refer to SC6.4.3.6.6 Crime prevention through environmental design; and

(iii) complying with all standards and safety requirements to ensure safe open space for the community and maintenance personnel.

(2) Universal access

Unless not practicable or cost prohibitive, open space development, embellishment provision and location must cater for accessibility and mobility requirements in accordance with AS 1428 Design for access and mobility (Set of standards), and as required by Part 9.3.3 Landscape Code. This should include, but is not limited to:

(a) providing an appropriate number of certified accessible items at key activity areas/locations;

(b) providing appropriate surface treatments that enhance safety, mobility and accessibility, whilst also being aesthetically pleasing and promoting sensory stimulation where required;

(c) providing appropriately sized concrete slabs that are designed to facilitate wheelchair and pram access around open space furniture and other infrastructure items;

(d) providing all ancillary infrastructure such as ramps and pathways to ensure access and compliance with applicable standards; and

(e) incorporation of all other universal design principles, as applicable.

SC6.4.3.6.6 Crime prevention through environmental design

Crime Prevention Through Environmental Design (CPTED) provides a common-sense approach to designing environments (new or redevelopment) in ways that help to create safer spaces and reduce crime. CPTED may be applied to any built environment or facility. For example, parks, toilet blocks, public areas, shopping centres, car parks and even residential dwellings. Implementing CPTED principles will not always eliminate crime but it is one of many different techniques that Council employs in a holistic approach to reduce and prevent criminal activity.

The design and landscaping associated with development for, parks, gardens, streetscapes or other public open space areas, shall be considered against the key CPTED elements.

Editor's note—further guidance on implementing CPTED principles can be found in the following locations: Queensland Government, *Crime Prevention through Environmental Design, Guidelines for Queensland, Parts A and B*, 2007 and CPTED Association website.

SC6.4.3.6.7 Private open space

Private open space is considered to be a usable outdoor area within a private development. It may include back and front yards, courtyards, gardens, balconies, terraces, decks, and communal areas in multi-unit developments. These spaces provide important private places for residents and other users to play, entertain, relax or seek respite from urban living.

Landscaping and irrigation within private open spaces assists in creating a shaded and attractive setting that is comfortable and usable, whilst also improving residential amenity and character. The significant environmental benefits of private open space are also recognised, noting the potential positive contribution of the spaces to reducing runoff, increasing biodiversity, heat amelioration and passive cooling.

Private open space does not include fully enclosed spaces, vehicle parking areas and verges. Open space contribution from roof gardens and vertical gardens will assessed on a case-by-case basis and with consideration of other on-site open space and landscaping provision.

Editor's note—further details of design outcomes for private open space are contained with the relevant development codes of the

SC6.4.3.6.8 Streetscapes

Streetscapes refer to the street or road landscape including all public open space within the road reserve. The design and development of streetscapes will vary according to the road or street hierarchy, its associated function, as well as the surrounding land use and built environment.

Editor's note - Applicants should refer to SC6.4.4.1 Geometric road design for more information.

It is noted, however, that there is interdependency between elements within the private realm and the overall streetscape. Critically, elements with the private realm (e.g. residential or commercial frontages) contribute to the appearance and function of a streetscape. It is important, therefore, that any streetscape design proposal is integrated and responsive to the surrounding context.

SC6.4.3.6.9 Public open space

The landscape and character design outcomes associated with the development of public open space are required to demonstrate alignment with the standards set out in this sub-section and addressed in accordance with Section SC6.4.2 Development Application Guidelines.

(1) General

Public open space includes all areas of open space that are publically owned and/or accessible. Public open space includes parks and land that has been reserved for the purpose of sport and recreation, ecological function and natural environment protection, infrastructure corridors and stormwater management and the general provision of green space.

Public open space and the provision of dedicated parks contribute significantly to community well-being, urban place-making and the general amenity and liveability of a city. Parks and other open space typologies also perform dual or multifunctional roles. This includes supporting the provision and buffering of roadways, detention basins and other infrastructure networks such as bikeways, and utility services, particularly within corridor parks.

Public open space excludes open space not publically accessible, not for community use or within the road reserve. However there are some areas that are designated Special Use Parks or Facilities, these parks provide specialised recreation use. This includes where the nature of the recreation activity only allows controlled access and precludes free, unrestricted access to members of the public, or where the land and facility result in a single use activity.

(2) Public Open Space Frameworks

(a) Public Open Space (POS) Hierarchy

The public open space hierarchy refers to the size, form and function of public open space which will vary significantly across different park types and other public open space typologies. As such, public open space networks are usually defined by various open space typologies that are rationalised, planned and designed against a “Public Open Space Hierarchy”.

This approach ensures the distribution, development and management of public open space occurs in a strategic and structured manner that reflects the differing classifications and importance of the each open space typology

Group and individual typologies within the Public Open Space Hierarchy reflect the diversity of functions and uses between different open space typologies within the city. Council’s open space hierarchy has been divided into three functional groups:

(i) recreation parks;

(ii) sports parks; and

(iii) other public open space.

Importantly, it should be recognised that one area of public open space may contain more than open space typology function across the different functional groups.

For example, a park may contain two formalised sports fields (district sporting function), a local recreation node (local park function) and a drainage corridor (utility function). In instances such as this, the public open space may be:

- classified based on the most dominant function (e.g. classified a district sports park, with the presence of a local recreation node recognised but not separately designated), or
- split into different functional areas, where each area is separately recognised and designated.

Classification of public open space against the hierarchy is reached through a strategic audit and evaluation of the open space, its characteristics and the standards of embellishment. Profile, accessibility and usage catchments are also a key determinant in hierarchy classifications, with typologies generally being categorised on a local, district or regional basis.

The POSM classifications subsequently inform council's management, development and all future planning for the public open space and the wider open space network.

To support these classifications, council has developed a Public Open Space Embellishment Framework that defines what level of embellishment and infrastructure is "essential" to different public open space typologies. The purpose of this framework is to support equitable, cost-effective and sustainable development of public open space that is functional and meets the needs of the community.

The Public Open Space (POS) Embellishment Framework is further defined in Table SC6.4.3.6.1 Open space embellishments and the balance of this sub-section.

Editor's note—Open Spaces classified as being of District or Regional significance have been determined as priority trunk infrastructure. (Refer Part 4 Priority infrastructure plan of the Townsville City Plan).

The proposed landscape design and character outcomes associated with the development of public open space are required to demonstrate alignment with the standards set out in this sub-section and address this through landscape design outcomes and in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(b) Public Open Space Management (POSM) Framework

A key objective of the Public open space management and associated levels of service is to ensure that the level of embellishment is consistent and sustainable with the available resources to maintain them.

Associated with the Public Open Space Hierarchy, council has developed a Public Open Space Management (POSM) Framework that specifies acceptable maintenance levels of service against different open space typologies. This POSM Framework and associated levels of service are also applied against the road hierarchy.

In order for council to properly assess future POSM requirements for each public open space development proposal, council may request the provision of a maintenance plan for maintenance activities not already detailed in the POSM Framework, as detailed in Section SC6.4.2 Development application guidelines. Where requested, this maintenance plan should seek to demonstrate alignment with the adopted POS Embellishment and POSM Frameworks.

Maintenance levels of service under the POSM Framework are defined by the public open space or road hierarchy classification and the frequency of maintenance services required. Associated with this, maintenance activities and frequencies are assigned, based on the public open space or road hierarchy classification and/or embellishments present.

A key objective of both the POS Embellishment and POSM Frameworks is to ensure that the level of embellishment is consistent and sustainable with the available resources to maintain them. As such, infrastructure must not be provided where the necessary maintenance required exceeds the allocated

maintenance level of service in order to ensure the public open space or items remain serviceable and safe for public use (e.g. dynamic fitness equipment that requires weekly safety inspections or electric barbeques that require daily cleaning to remain hygienic should not be installed in a park that has assigned fortnightly maintenance service). Further, the cost to establish, maintain and ultimately renew the infrastructure must be sustainable and cost effective for council and the community in the long-term.

In order for council to properly assess future POSM requirements for each public open space development proposal, council may request the provision of a maintenance plan, as detailed in Section SC6.4.2 Development application guidelines. Where requested, this maintenance plan should seek to demonstrate alignment with the adopted POS Embellishment and POSM Frameworks.

Editor's note—the POSM Framework is currently under review to align the maintenance frequency with the (POS) hierarchy review and further development. As such, detailed specifications relating to maintenance activities and frequency are not available at the present. Enquiries relating to this should be directed to Construction and Maintenance Operations.

(c) Irrigation Profile Level (IPL) Framework

As part of council's commitment to efficient, cost effective and responsible use of natural resources, council has developed an Irrigation Profile Level (IPL) Framework to categorise and define irrigation water usage within public open space.

The IPL Hierarchy identifies and defines a number of "profile levels" based on the level of irrigation applied, an indicative "functional application" based on open space typologies, and the performance indicators associated with each irrigation application rate. Refer to SC6.4.3.6 Attachment C for IPL Hierarchy.

Supporting this, the IPL Matrix identifies a number of criteria and "influences" used in the determination of an assigned IPL. Refer to SC6.4.3.6 Attachment D for the IPL Matrix.

Importantly, it must be recognised that the level of irrigation required is directly dependent upon the landscaping which it must support. As such, in the development of new public open space, the landscaping should be designed with consideration of the typical IPL classification for the public open space typology as well as the extent of landscaping and irrigation defined by the POS embellishment standards. Additional requirements are identified in SC6.4.3.6.34 Irrigation design and system requirements.

For existing public open space, the IPL classification must be based upon the required irrigation application rate necessary to support the health and longevity of the existing landscaping. Where a change to the IPL is proposed, this must include consideration of the open space typology, the intended use of the open space area and the impacts of reduced water application rate on existing plant specimens and include changes to the landscaping plantings where required.

Critically, an area of public open space may have more than one IPL (e.g. "high" IPL level around the activity node or within the minimum usable space, and then a "medium" or "low" profile for the balance of the open space). To achieve this in an efficient and effective manner, however, the associated landscaping and irrigation systems must be purpose-designed for this outcome (i.e. separate irrigation systems consistent with species selection and placement based on principles of hydro-zoning).

SC6.4.3.6.10 Recreation parks

Recreation parks includes the following:

(1) pocket parks: are small open space parklands that offer a limited range of recreational activities for local residents. Pocket parks are generally associated with specific urban design outcomes, e.g. to support small lot housing.

(2) local recreation parks: are moderately small open space parklands that offer local residents a communal open space to complement their own backyards. Local recreation parks are ideally located within 400m walking distance from residential properties and are generally accessed by non-motorised transport. These parks contain only basic infrastructure for recreational use, refer to the embellishment table for details.

(3) district recreation parks: are much bigger than local sized parks that can service several suburbs, or a whole community and or a community event. The parks provide for a variety of passive and active recreation and/or contain facilities to cater for a wider user group of all age and levels of ability. The parks are well known destinations for those people living within their catchment, enabling the park to become a significant social hub.

(4) regional recreation parks: are large open space parklands that offer a wide variety of both active and passive recreation opportunities to a broad section of the community.. The park area is capable of hosting large community events such as festivals, and unique functions. These parks have major embellishments features designed to attract visitation from a wider catchment area and encourage extended stay. It provides unique recreational experiences and is a major landmark and/or destination where people may spend (4+hours) in these parks.

(5) recreation corridors: are usually a linear open space that follows creeks, drainage channels, service corridors or green belts. Corridor parks traditionally have a dual functionality and may include opportunities for cycling, walking and other recreational activities. It can also provide an important ecological link for flora and fauna. Corridor parks are intended to provide a safe connection between two or more destination points.

Editor's note—currently, further definitions and intent statements are not developed for all individual recreation park typologies. Refer Part 4 Local government infrastructure plan of the Townsville City Plan for definitions, distribution and land areas relating to trunk recreation parks.

SC6.4.3.6.11 Sporting parks

Sporting parks includes the following:

(1) district sporting parks: are large sized open space parks that provide facilities that are suitable for the practicing and playing of structured or organised sports. These parks may not have the quality of playing surface or amenities of a regional sports park. The park generally contains a good level of embellishment provision. To service a wider user group the sporting areas are often lit, spectator facilities may include a club house, toilets, change rooms and off- street car parking. These parks may also include a limited range of informal recreation activities to cater for unstructured recreation.

(2) regional sporting parks: are large quality sports parklands that meet state regulations for the sport and can comfortably host either regional (or State competitions). Generally these sports parks cater to a large number of sporting organisation's and spectators who share the site. People may spend (4+hours) in these parks. The playing field may be lit to the required standard for the dedicated sport. Regional Sports parks also have a high level of player and spectator facilities, including clubhouse, canteen, toilets, change rooms, off-road car parking The park may also include a limited range of informal recreation activities for other park users such as playgrounds and BBQ areas.

(3) special use parks or facilities; are specialised recreational use and facility spaces where the nature of the activity precludes free, unrestricted access to members of the public, or where the land and facility result in a single use activity. These park spaces may be controlled by either Council or private organisation's (User Pays). Specialised use parks include (but are not limited to);Water parks/Privately Owned or Leased Swimming Pools, Equestrian, Archery/Bow hunting/Sport Shooting, Golf, Tennis, Lawn bowls, Model Planes and Motor Vehicle Sports.

Editor's note—Refer Part 4 Local government infrastructure plan of the Townsville City Plan for definitions, distribution and land areas relating to trunk sports parks.

SC6.4.3.6.12 Other public open space

Other public open space includes the following:

(1) amenity parks: are small landscaped areas with a strong focus on visual. Traditionally Amenity parks may include monuments, memorials or gateway treatments. The park area may also include opportunities for passive recreation such as seating areas. An example of an Amenity Park is Garbutt Park, Garbutt, which acts as an entrance statement welcoming visitors and residents to Townsville.

(2) civic parks and spaces: are relatively small areas generally associated with a high level of built infrastructure. While recreation use is minimal they provide landscape and amenity values for the general community. Civic parks provide an urban respite for social interaction and community gatherings. Often characterized by hard surface treatments associated with its setting and high activity use levels, these spaces may be used for social events such as community markets.

(3) natural and bushland areas: are set aside primarily for conservation purposes to protect and retain natural vegetation and habitat areas. Size may range from small to large areas that reflect the importance of the environmental value. These parks may also provide opportunities for outdoor recreation activities such as bushwalking, trail running, mountain biking, nature viewing and appreciation. Embellishment improvements are generally limited infrastructure associated with the above activities such as seating, lookouts and signage. Some of the park areas may also include cleared areas intended to be rehabilitated to improve habitat corridors.

(4) utility spaces: are areas that are often owned or maintained by council, for specific utility services such as electrical transmission, telecommunications, water and sewerage pump stations or other infrastructure purposes. These spaces may offer some dual functionality for recreation activities such as walking, cycling or civic amenity.

(5) unallocated open space: may be any reserve area of land and/or water reserve which has not been named or developed at present, but which has been deemed important enough to be set aside for future park development. The park area is usually substantially undeveloped with no built infrastructure and only minor improvements such as rural fencing.

(6) cemeteries: are an area under the control of council that is dedicated for the burial of the dead, or containing graves, tombs, funeral urns and interment of ashes.

Editor's note—currently definitions and intent statements are not developed for individual typologies within other public open space hierarchy categories.

SC6.4.3.6.13 Open space embellishments

(1) General requirements

A key objective of the POS Embellishment and POSM Framework is to ensure that the level of embellishment is consistent and sustainable.

As such, infrastructure must not be provided where the necessary maintenance required exceeds the allocated maintenance level of service. This is to ensure that the public open space or items remain serviceable and safe for public use (e.g. dynamic fitness equipment that requires weekly safety inspections or electric barbeques that require daily cleaning to remain hygienic should not be installed in a park that has assigned fortnightly maintenance service intervention). Further, the cost to establish, maintain and ultimately renew the infrastructure must be sustainable and cost effective for council and the community in the long-term.

(a) Open space embellishment levels should be consistent with the assigned public open space typology (refer Table SC6.4.3.6.1 public open space embellishment framework) and / or road hierarchy classification or the characteristics of the associated land use.

(b) Where private open space is associated with development, the private open space shall be considered on a case-by-case basis with consideration of the design points set out below.

(c) The quantity and amount of the embellishment level will be dependent on the available area of open space and the spatial requirements of the selected embellishment facility.

(d) The following key characteristics should be considered in the design process when selecting the level of embellishment:

(i) comply with any adopted master plan, environmental, heritage and character requirements;

(ii) consider the context, functionality and purpose for use (e.g. particular open space usage patterns for the site such as regular use for community events, or shared usage by multiple tenants in a large residential complex);

(iii) consider the setting, durability and aesthetic requirements for the intended area (e.g. specific materiality requirements for areas with a risk of vandalism, or more ornate detailing for intimate private courtyard space);

(iv) cater for the expected usage rates, demographic/s and their associated needs (e.g. reduced intervals between accessible bench seats along a pathway at a location with large senior user group);

(v) be located at appropriate locations or intervals, clustered near activity nodes and/or to

complement any distinguishing site features (e.g. seating situated to maximise a vista or allow surveillance of a play area by carers);

(vi) be climatically appropriate and consider localised conditions of the site (e.g. dynamic activity elements in coastal areas are not located in areas exposed to high onshore winds and salt spray);

(vii) ideally be located under natural or built shade to allow day long use through reduced exposure, glare and heat absorption, particularly on metal or dark coloured surfaces (e.g. metal playground slides to be shaded and/or swapped for plastic slides, or, communal gathering areas located under shelters in private unit complex);

(viii) complement natural materials or features and/or incorporate these where possible (e.g. grass mounding for seating; feature rock retaining walls consistent with local geology);

(ix) be vandal resistant;

(x) be installed on an appropriate surface material, on well drained ground and with an appropriate level of flood immunity (e.g. playgrounds not installed in an area surrounded by a retention basin); and

(xi) prioritise use of recycled, sustainable materials where practicable and available (e.g. decking to be constructed of recycled plastic and composite fibre supports).

(2) Public open space and streetscape embellishment standards

(a) Within public open space, embellishment selection must be in accordance with council's Public Open Space Embellishment Standards Framework, as detailed in Table SC6.4.3.6.1.

(b) For streetscapes, landscape treatments shall be provided per SC6.4.3.6.31 Streetscape design and landscape treatments.

(c) For public open space and streetscapes, embellishment standards must:

(i) be analogous to the Public Open Space Hierarchy, road hierarchy, or centre classification;

(ii) be consistent with any overarching design and embellishment strategy (e.g. adopted furniture suite against Public Open Space/Road Hierarchy);

Editor's note—other than landscape treatments as noted above, currently, detailed standards and specifications are not developed for other infrastructure items (e.g. shelters and seating) within streetscapes. Applications will therefore be assessed on a case-by-case basis and with consideration of the principles and standards outlined in this sub-section, and other sections of the Townsville City Plan. Refer to SC6.4.3.3 Footpath treatment policy and SC6.4.3.4 Outdoor dining design guidelines for requirements specific to these elements of a streetscape.

(iii) complement those facilities in nearby precincts or parks, ideally providing diversity in the facilities available to the community;

(iv) be consistent with any an existing style that is already established unless approved otherwise;

(v) only include high quality, fit for purpose, proprietary items for which replacement parts are readily available from an Australian distributor;

(vi) for district and regional level parks, custom suites or items may be permitted at particular sites, where the profile and location of the park warrants it. The decision will be made on a case by case basis at the discretion of council with consideration of the individual site characteristics and public open space classification

Editor's note—this decision will be made on a case-by-case basis, at the discretion of council and with consideration of the individual site characteristics and public open space classification

(vii) minimise the use of timber elements unless approved otherwise. Where timber is permitted for use, only hardwood timber or painted pine should be used and all furniture items should ideally be undercover, protected from direct exposure to the sunlight and other elements;

(viii) utilise high quality finishes that will reduced ongoing maintenance requirements and/or frequency (e.g. 2PAC epoxy paint in lieu of powder coating where items are not easily dissembled or repainted); and

(ix) for all foreshore locations and other locations subject to salt spray or prolonged wet conditions, embellishments must be constructed of marine grade materials, including 316L stainless steel fittings, to ensure improved asset longevity and lifecycle cost reduction.

Editor's note—the above are provide as guidelines to be considered in the course of public open space and streetscape development. Additional areas within this sub-section provide specifications for individual open space infrastructure types and for landscape treatments in streetscapes.

SC6.4.3.6.1 Public Open Space Embellishment Framework

		RECREATION PARKS					SPORTS PARKS			OTHER PUBLIC OPEN SPACE				
		POCKET	LOCAL	DISTRICT	REGIONAL	CORRIDOR	DISTRICT	REGIONAL	SPECIALISED	AMENITY	CIVIC SPACES	NATURAL /BUSHLAND	UTILITY	UNALLOCATED
CATEGORY	EMBELLISHMENT TYPE													
Activity elements	**Outdoor fitness equipment**			**Expected** (Max 6 Pieces)	**Expected** (Min 6 Pieces)	**Desirable** (Max 6 Pieces)			Embellishment standards not defined due to custom nature of specific sport activity and facility requirements - to be assessed on a case by case basis					
	Informal sports/courts (e.g. basketball half court; table tennis table)		**Desirable** (Max 1 informal sport facility)	**Expected** (Max 2 informal sports facilities)	**Expected** (Max 2 informal sports facilities)		**Desirable** (Max 2 informal sport facility)							
	Playground (all abilities)				**Desirable** (Max 1 play facility)									
	Playground (mixed ages)	**Desirable** (Max 1 Combination unit)	**Expected** (Max 1- 3 Pieces)	**Expected** (Min 3-5 Pieces)	**Expected** (Min 6-10 Pieces suitable for the catchment)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)								
	Skate facilities			**Desirable** (Max 1500 sqm, Suitable to meet the catchment zone, approved on a case by case basis	**Desirable** (Min 3000 sqm, Suitable to meet the catchment zone, approved on a case by case basis									
	Water-play				**Desirable** (Appropriate facility suitable to meet the needs of the catchment zone, approved on a case by case basis)									
Electrical	**3 phase power (events usage)**			**Desirable** (Max 1 unit)	**Expected** (Min 2 Units)		**Expected** (Max 1 Unit)	**Expected** (Min 2 Unit)			**Expected** (Min 1 Unit)			

	Activity node lighting		**Expected** (Max 1 Lighting node as required for the activity)	**Expected** (Min 2 Lighting nodes as required for the selected activity areas)	**Expected** (Multiple lighting nodes as required for selected activity areas)	**Desirable** (Min Lighting nodes as required for CEPTED along pathway links)	**Expected** (Min 2 Lighting nodes as required for the selected activity areas)	**Expected** (Multiple lighting nodes as required for selected activity areas)			**Expected** (Multiple lighting nodes as required for selected activity areas)				
	Pathway lighting (ex. designated bikeways/shared pathways)			**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)		**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)			
	Sports field/court lighting						**Expected** (Multiple lighting nodes as per AS2560 Sporting Facilities Manual - Part 1 Sports Lighting)	**Expected** (Multiple lighting nodes as per AS2560 Sporting Facilities Manual - Part 1 Sports Lighting)							
Fencing	**Fencing (inc. bollards; post and rail; panels)**	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)		**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Essential** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)
	Maintenance access gate	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)		**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)
Furniture	**Bench seats**	**Desirable** (Max 1 Park bench seat)	**Expected** (Max 2 Park bench seat)	**Expected** (Min 4 Park bench seat)	**Expected** (Min 8 Park bench seat)	**Expected** (Min 2 park bench seats, or number as required spaced at approx. 400m intervals along pathway links)	**Expected** (Min 4 Park bench seat)	**Expected** (Min 8 Park bench seat)		**Expected** (Max 2 Park bench seat)	**Expected** (Min 8 Park bench seat)	**Expected** (Min 2 park bench seats, or number as required spaced at approx. 400m intervals along pathway links)		

	Barbeques (electric)			**Expected** (Max 2 Double Plate BBQ Units)	**Expected** (Min 4 Double Plate BBQ Units)									
	Bins	**Desirable** (Max 1 Bin unit)	**Expected** (Max 1 Bin unit)	**Expected** (Min 2 Bin units)	**Expected** (Min 4 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)	**Desirable** (Min 2bins, or number as required spaced at approx. 800m intervals along pathway links)	**Expected** (Min 2 Bin units)	**Expected** (Min 4 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)		**Desirable** (Max 1 Bin unit)	**Expected** (Min 2 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)			
	End of trip facilities (e.g. bicycle racks)			**Expected** (Min 1 bike rack unit)	**Expected** (Max 2 bike rack units)		**Expected** (Min 1 bike rack unit)	**Expected** (Max 2 bike rack units)			**Expected** (Min 1 bike rack unit)			
	Picnic tables and seats	**Desirable** (Max 1 Picnic Table Set)	**Desirable** (Min 2 Picnic Table Sets)	**Expected** (Min 4 Picnic Table sets)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)	**Desirable** (Min 2 picnic table sets, or number as required spaced at approx. 800m intervals along pathway links)	**Expected** (Min 2 Picnic Table sets)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)		**Desirable** (Max 1 Picnic Table Set)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)		
	Water bubbler/tap (inc. connection; drainage inlet; soakage well)	**Desirable** (Max 1 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 1 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Desirable** (Max 1 Drinking Fountain along pathway link- must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)			**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)		
Irrigation	**Irrigation**	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated. Provision of required irrigation to ensure all key activity high use areas are covered. To be considered on a case by case basis)	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (Provision of appropriate irrigation to be considered on a case by case basis, to ensure adequate coverage of key sporting and high activity use areas. designated playing fields to be irrigated at 100 % of field coverage)	**Expected** (Provision of required irrigation to be considered on a case by case basis, to ensure adequate coverage of key sporting and high activity use areas. designated playing fields to be irrigated at 100 % of field coverage)		**Desirable** (Provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated. Provision of required irrigation to ensure all key activity high use areas are covered. To be considered on a case by case basis)			

Landscaping and surfacing	**Earthworks (e.g. grassed mounds)**	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 2 Mound, suitable mounding for play space relief and considered on a case by case basis)		**Expected** (Min 2 Mounds, suitable mounding for Spectator viewing and considered on a case by case basis)	**Expected** (Min 2 Mounds, suitable mounding for Spectator viewing and considered on a case by case basis)			**Desirable** (Min 2 Mound, suitable mounding for play space relief and considered on a case by case basis)			
	Garden beds (excluding natural vegetation areas)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)		**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)			
	Shade trees	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for corridor parks shall be min 35% coverage along pathway linkage alignments)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 20% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 20% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)		**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Desirable** (The desirable natural shade coverage will consist of the predominant existing natural vegetation cover)	**Desirable** (Shade Trees should not impact on operation of services or facility structure)	

	Turf areas (Inc. events/activity lawns)	**Desirable** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 70% coverage of park area, including a 100% cover of the playing fields. The turf coverage shall be adequate to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 70% coverage of park area, including a 100% cover of the playing fields. The turf coverage shall be adequate to meet the intended usage and anticipated demand		**Desirable** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand			
Signage	**Park name sign**	**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)		**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access)		
	Information signage (inc. regulatory, directional and interpretive signage)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)		**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)
Sporting	**Indoor sport and recreation facility**						**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)						
	Outdoor spectator facilities						**Expected** (Min 20 Spectator Seat Capacity)	**Expected** (Min 100 Spectator Seat Capacity)						

	Motorised sports facilities						**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)							
	Sports courts/fields (formal)						**Expected** (Min number of formal courts or fields required to undertake the sport, will be considered on a case by case Basis)	**Expected** (Min number of formal courts or fields required to undertake the sport, will be considered on a case by case Basis)							
Structures and buildings	**Picnic shelters/gazebos**		**Desirable** (Max 1 Picnic Shelter or gazebo)	**Desirable** (Max 2 Picnic Shelter or gazebo)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)	**Desirable** (Max 1 Picnic Shelter or gazebo, generally kept to a minimum)	**Desirable** (Max 2 Picnic Shelter or gazebo)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)		**Desirable** (Max 1 Picnic Shelter or gazebo, generally kept to a minimum)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)				
	Clubhouse/change rooms/canteens						**Desirable** (Adequate developable land of a min 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)	**Desirable** (Adequate developable land of a min 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)							

	Community buildings			**Desirable** (Within the available park space adequate total developable land to a max 200 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)	**Desirable** (Within the available park space adequate total developable land to a max 400 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)		**Desirable** (within the available park space an allowance for total developable land to a maximum 400 sq m. (includes clubhouse/change room 200 sq m) of a minimum 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)	**Desirable** (within the available park space an allowance for total developable land to a maximum 800 sq m. (includes clubhouse/change room 400 sq m) of a minimum 400 sq m. for approved clubs to develop their relevant facility requirements for their respective club)			**Desirable** (Within the available park space adequate total developable land to a max 400 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)			
	Commercial facilities				**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			
	Shade sails		**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Expected** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)		**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Expected** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)			**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)			

	Toilet block			**Desirable** (Max 1 toilet facility, to be considered on a case by case basis)	**Expected** (Max 2 toilet facility, to be considered on a case by case basis)		**Desirable** (Max 1 toilet facility, to be considered on a case by case basis)	**Expected** (Max 2 toilet facility, to be considered on a case by case basis)			**Expected** (Max 2 toilet facility, to be considered on a case by case basis)			
Transport and access infrastructure	**Car parking (off-street)**			**Expected** (Minimum 20 car parking bays, , or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)	**Expected** (Minimum 30 car parking bays, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)		**Expected** (Minimum of 125 car parking bays – total on and off street. Minimum of 50% to be off-street parking bays. Parking may be angled or at 90 degree, including allowance for additional space for bus parking, turnaround and pull out zone)	**Expected** (Minimum of 300 car parking bays – total on and off street. Minimum of 50% to be off-street parking bays. Parking may be angled or at 90 degree, including allowance for additional space for bus parking, turnaround and pull out zone)			**Desirable** (Minimum 20 car parking bays. May be angled or 90 degrees, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)			
	Car parking (on-street)	**Expected** (Minimum 5 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 15 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 20 car parking bays kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 50 car parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)	**Expected** (Minimum 10 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Maximum 75 parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)	**Expected** (Maximum 150 parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)		**Desirable** (Minimum 15 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 20 car parking bays. May be angled or indented at 90 degree, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis. Including space for bus pull out zone where required)	**Desirable** (Minimum 5 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)		

	Drainage and service connections	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)		**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	
	Internal concrete pathways (min. 1.5m wide)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)		**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)			
	Internal roads/vehicle access pathways			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	
	Walking tracks (dirt)				**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the facility has been identified)							**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the facility has been identified)		

	Dog off leash park (fenced)			**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).	**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).	**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).								
	Fishing platform/pontoons/ boat ramps and Jetty's			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)								
Other Infrastructure	**Lookout platforms**			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)							**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)		
	Public art			**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)	**Expected** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)			**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)		**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)	**Expected** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)			
	Swimming pools						**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the service has been identified)	**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the service has been identified)						

	Water features				**Desirable** (To be kept to a minimum and considered on a case by case basis)						**Desirable** (To be kept to a minimum and considered on a case by case basis)			

Expected infrastructure – critical to the intended function of the open space classification.

Desirable infrastructure – not considered essential but may compliment the function of the park space and is dependent on location, need and adjacency to other infrastructure/services.

Indoor and aquatic sports facilities are not included in the Public Open Space Hierarchy, largely due to the enclosed, custom nature and high level of built form.

Editor's note—Table SC6.4.3.6.1 indicates items that are considered "essential" to the function of each open space typology and therefore should be provided with the development of that type of public open space. Importantly, the embellishment standard set for each typology is considered an "average" standard and therefore variation between locations with the same hierarchy classification may occur. However, whilst some locations may include less or additional infrastructure items, the overall level of embellishment cannot exceed the "average" to the point where the location would be delivering a standard equivalent to another typology. (e.g. a local park embellished to the standard of an district park). Items considered "desirable" and/or "conditional" are to be considered on a case-by-case basis, and provided as required, dependent on location, need, affordability and adjacency to other infrastructure/services. Where there is a co-location of open space typologies with the one open space area, embellishment infrastructure can be "shared" between the two functional areas.

SC6.4.3.6.14 Activity elements

(1) General requirements

(a) Activity elements may include, but are not limited to the following:

(i) outdoor fitness equipment;

(ii) play spaces and play equipment;

(iii) softfall surfacing;

(iv) skate and parkour elements and facilities; and

(v) informal sporting facilities.

(b) All activity elements must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for activity elements.

(2) Outdoor fitness equipment

(a) Outdoor fitness equipment may include a combination of:

(i) static fitness equipment such as step ups, hurdles and sit up benches; and

(ii) dynamic fitness equipment such as bench presses, leg presses and pull downs.

(b) Within public open space, outdoor fitness equipment shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

Editor's note—currently no further guidelines and standards are developed for the provision of outdoor fitness equipment across the public open space network. Inclusion of fitness equipment within public open space will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of outdoor fitness equipment, all development proposals will be assessed against the provisions within that plan.

(c) Fitness equipment selection

(i) All fitness equipment shall be designed, manufactured, installed, certified and maintained in accordance with all applicable Australian Standards, including:

(A) AS4685 – *Playground equipment – General safety requirements and test methods*;

(B) AS2555 – *Supervised adventure playground – Guide to establishment and administration*;

(C) AS4422 – *Playground Surfacing – Specification, requirements and test methods*; and

(D) AS4486.1 – *Playgrounds and playground equipment – Development, installation, inspection,*

maintenance and operation.

(ii) Equipment selection should take into account the existing demographics and cater for multiple age groups, subject to the population profile within the local area. Projected changes to the local demographic and/or aging of the original groups that will utilise the equipment should also be considered.

(iii) A diversity of exercise activities should be developed within the site.

(iv) Future inspection and maintenance requirements of the fitness equipment must be considered and the more onerous, dynamic equipment must be limited to district or regional level public open spaces only.

(v) Longevity of materials must be considered, particularly within the context of the local conditions (e.g. only include equipment of a high quality design and materials, particularly for moving parts and where intense usage is anticipated).

(d) Fitness equipment siting

(i) Fitness equipment should be located away from play spaces to reduce the temptation for children to play on the equipment.

(ii) Ideally, the equipment should be located along or in close proximity to a primary access path, with the fitness units to be offset from this for the comfort of users.

(iii) Individual units may be clustered together or spaced separately in a circuit along a pathway, dependent on the equipment, design and usage intent.

(iv) All fitness equipment is to have concrete slabs, all required shock pads, and wet-pour rubber surfacing in accordance with AS/NZS 4422 *Playground Surfacing – Specifications, requirements and test method*.

(3) Play spaces and play equipment

(a) Play spaces are to be provided in order to:

(i) provide a wide range of quality play opportunities that meet the needs of the local children and young people alike;

(ii) aid children's development by providing spaces and elements for physical coordination activities such as balancing, climbing, jumping, crawling and running;

(iii) assist in the development of social skills such as sharing and cooperation;

(iv) promote children's use of their imagination and development of problem solving skills; and

(v) provide a place for meeting and socialising amongst children, parents and other care givers.

(b) Play spaces shall include a combination of:

(i) active, equipment based play structures (e.g. swings);

(ii) active, non-structured play areas (e.g. kick-around areas or grass mounding);

(iii) imaginative and creative play areas (e.g. trees or natural "cubby" areas);

(iv) a parent or care-givers area (e.g. picnic settings or bench seats); and

(v) special features that cater for children and young people of all abilities (at select locations only).

(c) Within public open space, play spaces and play equipment shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

(d) Playground equipment selection

(i) All playground equipment shall designed, manufactured, installed, certified and maintained in accordance with all applicable Australian Standards, including:

(A) AS 4685 – *Playground equipment – General safety requirements and test methods, including AS 4685 parts 1- 6 and part 11*;

(B) AS 4486 – *Playgrounds and playground equipment – Development, installation, inspection, maintenance and operation*; and

(C) AS/NZS 4422 – *Playground surfacing –Specifications, requirements, and test method*.

(ii) Equipment selection should take into account the existing demographics and cater for multiple age groups, subject to the population profile within the local area and the likely park users. Projected changes to the local demographic and/or aging of the original groups that will utilise the equipment should also be considered.

(iii) Diversity of play experiences between sites within the local area should be provided where possible.

(iv) Future inspection and maintenance requirements of the play facilities must be considered and elaborate, more complicated equipment limited to locations with a higher maintenance level of service.

(v) Longevity of materials must be considered, particularly within the context of the local conditions (e.g. plastic coated chains are to be avoided due to accelerated deterioration in North Queensland sun).

(vi) Equipment selection and orientation should take into account the potential for vandalism. As such, equipment with significant amounts of hard, non-transparent panels should be avoided, except where this can be mediated through orientation and casual surveillance opportunities.

(e) Playground equipment siting

(i) Active and passive play areas should be integrated but physically separated to promote more cohesive use of the space and facilitate quiet areas for creative and imaginative play activities.

(ii) Play spaces, particularly toddler areas, should be sited within close proximity to the main activity node to maximise accessibility and casual surveillance from parents, carers and adjacent users.

(iii) Play spaces should ideally be located within close proximity to the main access path. Care should be taken, however, to not create a point of conflict by locating a busy activity area on a main thoroughfare of the open space, as per below.

(iv) Play spaces should be located away from potential safety hazards such as car parks or trafficable areas, watercourses or steep slopes.

(v) Play spaces should be located away from adjacent properties to limit potential nuisance from ongoing noise. A minimum buffer of 15 m from adjacent property boundaries should be applied.

(vi) Sun safety and protection opportunities including natural and built shade options should be addressed in accordance with SC6.4.3.6.19 Shelters and shading devices. Shading opportunities should consider sun orientation and ensure that shading of the equipment is maximised during the highest UV risk period of the day and over the highest need elements (e.g. metal slides).

(vii) Natural elements such as turf mounding, trees, shrubs and rocks should be safely integrated into the play space where possible.

(viii) Fencing of the play space is to be considered on a case-by-case basis and established as required, in accordance with SC6.4.3.6.16 Fencing.

(ix) At larger playgrounds of a district or regional level, consideration should be given to the location of public toilets within short walking distance of the play space.

Editor's note—public toilets should be installed at select locations only. Refer SC6.4.3.6.21(2) Public toilets for further details.

(x) Large, purpose built, "all-abilities" play areas are to be considered on a case by case basis and established as required.

(f) All playground equipment must be installed in accordance with the manufacturer's specifications. Certification of the equipment must also be provided.

(4) Softfall surfacing

(a) Softfall surfacing shall be provided in order to:

(i) create a safe, impact absorbing surface underneath activity elements; and

(ii) provide textual stimulation through different surfacing types (e.g. sand and rubber softfall).

(b) Softfall surfacing may include a combination of:

(i) wet-pour rubber softfall or approved rubber alternatives, including shock pads beneath;

(ii) astro turf, including shock pads beneath; and

(iii) certified softfall sand.

(c) Softfall surfacing shall be installed under all play spaces/equipment where a fall zone has been identified. Within public open space, the provision of equipment, and therefore softfall surfacing shall be at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

(d) Organic softfall surfacing such as woodchips is not considered an acceptable softfall outcome.

(e) Rubber softfall surfacing

(i) Rubber softfall must be installed in accordance with the equipment fall zone requirements, manufacturer's specifications and council approved standard drawings. Certification of the softfall installation must also be provided.

(ii) Shockpads shall be installed under all rubber softfall layers, as required by the applicable Australian Standards.

(iii) Rubber softfall colour selection shall minimise large areas of bright colours prone to fading in the sun. Rubber softfall mixes shall contain a minimum 70% EPDM rubber due to higher UV rating of this product.

(iv) Small, narrow and intricate designs (e.g. less than 300 mm in width) within the rubber softfall should be avoided due to ongoing deterioration of such designs.

(v) Rubber softfall shall be prioritised to areas requiring higher levels of accessibility or underneath high wear items.

Editor's note—currently, no standard drawings are formally adopted for rubber softfall surfacing.

(5) Informal sporting facilities
Informal sporting facilities may include but are not limited to:

(a) basketball half courts;

(b) outdoor table tennis tables; and

(c) handball courts or rebound walls.

Editor's note—currently no specific requirement relating to informal sporting facilities are developed.

(6) Skate facilities and parkour practice areas

Editor's note—currently no specific requirement relating to skate facilities and parkour practice areas are developed.

SC6.4.3.6.15 Electrical and lighting

(1) Lighting

(a) All lighting must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for lighting.

(b) Lighting requirements within public open space will be advised by council in accordance with the hierarchy classification of the public open space or pathways involved.

(c) Power supply options (mains or solar) will be considered on a case-by-case basis, subject to the nature of the proposal, the existing supply opportunities and the site context.

(d) All lighting works must be undertaken in accordance with SC6.4.3.20 Public lighting and utility services.

(e) Pathway lighting
Bicycle paths or pedestrian paths within public open space that require lighting shall be lit to the applicable pathway lighting category, as per AS 1158 Lighting for roads and public spaces and SC6.4.3.20.2(2)(c) Lighting for bicycle, pedestrian and shared paths.

(f) Activity node lighting
Pathways within public open space that require lighting shall be lit to the applicable pathway lighting category, as per AS 1158 Lighting for roads and public spaces and SC6.4.3.20.2 Public lighting (urban and rural).

Editor's note—currently, no further standards are set for lighting of activity nodes. Council will negotiate these requirements on a case-by case basis until formal standards are set.

(g) Sports field and court lighting in accordance with SC6.4.3.20.2(2)(e) Lighting for sports grounds and sports complexes .

Editor's note—currently, no further standards are set for lighting of sports fields and courts. Council will negotiate these requirements on a case-by case basis until formal standards are set. Guidance on the recommended levels of illumination for each sport can be found in external references such as the Western Australian Department of Sport and Recreation Sports Dimensions Guide for Playing Areas.

(2) Electrical
All electrical works must be undertaken in accordance with SC6.4.3.20 Public lighting and utility services, all applicable Australian Standards and legislative requirements.

SC6.4.3.6.16 Fencing

(1) General requirements

(a) Fencing may include, but is not limited to the following:

(i) fencing panels;

(ii) bollards;

(iii) post and rail systems;

(iv) rural type fencing; and

(v) other crash barriers.

(b) Fencing is to be provided in order to:

(i) provide a legible definition of the open space boundaries and limits;

(ii) provide enclosure of a space appropriate to its function (e.g. fenced playgrounds);

(iii) prevent encroachment into open space by adjacent private properties;

(iv) prevent unwanted vehicle access by the provision of barriers along the road frontage, including into drainage reserves, parks and other public open spaces; and

(v) restrict access to unsafe locations or private property.

(c) All fencing must be of a high standard, and designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for fencing.

(d) Fencing materials, design and location

(i) Fencing materials, design and location should not unreasonably hinder pedestrian circulation through open space, with sufficient pedestrian access points to be provided.

(ii) Where vehicle access prevention is required along pathways or bikeways, bicycle deflections rails are the preferred method and removable bollards should be avoided. Refer to SD-066 - Miscellaneous traffic details – bicycle path terminal treatments deflection rail and intersection at side street.

(iii) For public open space or streetscapes, proposals should seek to be consistent with any existing fencing style that is already established unless approved otherwise.

(iv) Fencing materials, design and location should be considered in the context, functionality and purpose for fencing use (e.g. post and rail installed where prevention of vehicle access, including motorbikes, is required).

(v) Public playground area and pool fencing must be in accordance with AS1926.1 *Swimming pool safety – safety barriers for swimming pools*.

(vi) Where appropriate, use of plants to screen or soften the fencing is recommended, except where this will conflict with CPTED requirements.

(e) Within public open space and streetscapes, fencing alignment and type shall include consideration of ongoing maintenance requirements and ensure:

(i) access for maintenance and other authorised vehicles shall be provided through a lockable gate or removable bollard, including provision of a kerb ramp or crossover at a safe location acceptable for council;

(ii) where provided in turf, a minimum 2 m wide clearance to other infrastructure (including trees) shall be maintained on either side of the fencing alignment to allow efficient mowing activities;

(iii) where bollards are provided in concrete, construction joints shall be provided to minimise damage to concrete slabs due to collisions, and allow ease of removal and replacement to damaged bollards; and

(iv) fencing is to be located within the surveyed boundary of the open space allotment; or

(v) where open space borders private property, fencing is to be located within the surveyed boundary of the private allotment.

SC6.4.3.6.17 Furniture

(1) General requirements

(a) Furniture may include, but is not limited to the following:

(i) barbeques (gas, electric and wood-fired);

(ii) benches, seats and picnic settings;

(iii) refuse bins;

(iv) bicycle parking facilities;

(v) water bubblers and taps; and

(vi) tree grates and guards.

(b) All furniture must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for furniture.

(2) Electrical and gas barbeques

(a) Within public open space, gas and electric barbeques are to only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1 Public Open Space Embellishment Framework.

Editor's note—Deviation from council's Public Open Space Embellishment Framework provisions for barbeques may only be considered where sufficient benefit to the wider community is demonstrated and supplementary conditions are satisfied. Proposed deviations must be discussed with council at preliminary approval stage and will only be approved where all community expectations have been considered; an extended maintenance period has been successfully negotiated and all other conditions are satisfied.

Editor's note—currently, no standard drawings are formally adopted for electrical and gas barbeques.

(b) Where permitted, gas and electric barbeques must be provided in accordance with council approved standard drawings.

(c) The following are the preferred specifications for outdoor gas and electric barbeques:

(i) cooktops to be all stainless steel construction, including high efficiency mono pressed stainless steel hotplate with laminated heat dispersion coating, high contact heating element and all stainless clamp plate;

(ii) timing, ignition and temperature control functions should feature on all hotplates to ensure optimum cooking temperature is constantly maintained and to maximise performance and efficiency. Visual and audible indication of operation and mode change should also be a key feature;

(iii) safety push button/stop systems are a mandatory requirement. These should ideally be located above the bench top, out of reach of children and fitted with a safety delay feature to ensure units cannot be inadvertently turned on;

(iv) hotplates are to be enclosed in a raised hob elevated and isolated above the bench top and with a minimum 100 mm protection zone. Benches should be designed without protrusions or ledges that may assist climbing;

(v) hotplates should be non-porous with no welds, creases or deep corners to trap food and bacteria. An automatic pre-heat mode should also feature and deliver minimum sterilising temperature;

(vi) enclosure frames are to consist of high strength, powder-coated aluminium extrusions. Cladding to be 18 mm compressed fibre cement backing panels with 0.55 mm stainless steel decorative fascia panels or approved similar. All doors to be stainless steel powder-coated or brushed stainless steel and fitted with a door lock matching council's preferred security key system;

(vii) barbeques are to be ideally located underneath a shelter, mounted on a concrete slab with minimum 450 mm clearance around the bench top on all sides;

(viii) units should be fitted with a fat collection tray and unobstructed access through fat tray access doors. Components should be designed to be easily unbolted and lifted out for maintenance and easy replacement;

(ix) electric components to be all fully sealed and power requirements are to be 240 volt A.C., 3.6 Kw, per plate or approved similar. All electrical works to be undertaken by a qualified electrician and in accordance with all relevant Australian Standards and legislation;

(x) gas barbeques may only be permitted by council where electricity power supply is restricted or

where connection to an electrical supply is cost prohibitive. Gas supply to be installed by a qualified plumber and in accordance with all relevant Australian Standards and legislation;

(xi) a water tap should be readily accessible to the barbeque cooking and eating area for ease of use during barbeque operation and cleaning; and

(xii) a minimum 2 year warranty must be provided with all barbeques installed within public open space.

(3) Wood fire barbeques and open fire areas

(a) Wood fire barbeques or open fire areas are NOT to be provided unless approved by council.

(b) "Natural settings" will be the only exception where wood fire barbeques or open fire areas may be permitted. Adequate environmental, fire and other safety measures must be included as part of any provision proposal to council.

(c) Where permitted, wood fire barbeques must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for wood fire barbeques and open fire areas.

(4) Benches, seats and picnic settings

(a) Where provided, benches, seats and picnic settings must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for benches, seats and picnic settings.

(b) All benches, seats and picnic settings are to be flange mounted on an appropriately sized concrete slab unless approved otherwise.

(c) Where within public open space or streetscapes, furniture should be consistent with any existing or adopted furniture suite for the public open space or streetscape, unless approved otherwise.

Editor's note—currently, no city-wide adopted furniture suite is developed. Some individual locations do, however, have formally adopted furniture suites and colour schemes. Others have informally established suites and colour schemes that have developed over the years. In both instances, new furniture selection should be consistent with these suites unless reasonable justification for deviating from the palette can be established.

(5) Refuse bins

(a) Where provided, refuse bins must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for refuse bins.

(b) For district and regional level parks, civic spaces and amenity parks, acceptable bin provision includes 240 L rubbish and recycling wheelie bins, with single or dual bin enclosures, mounted on a concrete slab. Cigarette Butt bins may be attached where deemed appropriate.

(c) For local recreation parks and all other public open space, acceptable bin provision is restricted to 240 L rubbish and recycling wheelie bins, mounted on a concrete slab with a metal security bin stand unless approved otherwise.

Editor's note—refuse bin style and design for streetscapes will be considered on a case by case basis until further standards and design guidelines are developed.

(d) For all public open space and streetscapes where bin enclosures are provided, these must be fitted with a door lock matching council's preferred security key system.

(e) For all public open space, variations to size and quantity standards may be approved, as required to

support the associated waste collection requirements, particularly at locations of high usage or where sporting and community clubs are co-located.

(f) All bins and enclosures are to be appropriately screened and located to ensure ease of accessibility for use and waste collection, without compromising the amenity of the public open space or adjacent land uses.

(g) All bins and enclosures are of a design, construction and location that minimises any likely impacts, or the risk of hazards due to vandalism or fire.

(6) Bicycle parking facilities
Bicycle parking facilities are to be provided in accordance with AS 2890.3 *Parking facilities – Bicycle parking facilities*.

Editor's note—refer also SC6.4.4.7 Bicycle, pedestrian and shared path design

(7) Water fountains and taps

(a) For all public open space, ready access to a potable water source is to be provided as part of any open space development, including at activity nodes and at reasonable intervals along corridor parks or recreational pathways.

(b) All water fountains and taps should be located near existing services and water supply points wherever possible, focused around activity nodes or areas of high use.

(c) Dog bowls should be included as part of water fountain provision where necessary. Separate stand-alone units may be required where anticipated usage will be very high (e.g. in dog off-leash area).

(d) All water fountains should be installed on a concrete slab, above a drainage well and with adequate surface drainage inlets to prevent water pooling on adjacent surfaces.

(e) For all public open space, water fountains and taps should be designed, constructed and installed as per council specifications detailed in SC6.4.6.27 Irrigation. Each water fountain/tap is to have a water meter connected.

SC6.4.3.6.18 Signage

Signage may include, but is not limited to the following:

(1) park name signs;

(2) information signs;

(3) directional signs;

(4) regulatory signs; and

(5) entry statements (private developments and public statements).

Editor's note—currently no specific requirements relating to signage are developed. For signage within public open space, consideration should be given to the Public Open Space Embellishment Framework and council's corporate branding requirements, as detailed in council's Graphic Standards Manual (GSM). Signs within streetscapes should be as per requirements detailed in sub-section SC6.4.6.24 Signposting.

SC6.4.3.6.19 Shelters and shading devices

(1) General requirements

(a) Shelters and shading devices may include, but is not limited to the following:

(i) awnings;

(ii) picnic shelters or gazebos; and

(iii) shade sails.

(b) All shelters and shading devices must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for shelters and shading devices.

(2) Awnings

Editor's note—due to the place-specific, custom nature of awnings, no standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all applicable building and engineering requirements, Australian Standards and council's overarching design and management principles. Applicants should refer to SC6.4.3.4 Outdoor dining design for shading requirements applicable in this situation.

(3) Shade sails

(a) All shade sails are to be:

(i) designed, engineered, built and certified against Building Code of Australia, C2 wind rating requirements as per AS1170 *Structural design actions* and all other applicable standards;

(ii) located with consideration of shading requirements, sun orientation and natural shading opportunities on site. As such, provision must be considered on a case-by-case basis, and account for the existing versus desired extent and daily duration of shade cover (natural and built); and

(iii) provided in public car parking areas as a substitute to natural shading when there is insufficient available planting space or shade sails are deemed a more practicable and/or cost effective shading system.

Editor's note— Refer SC6.4.3.6.32 Car park plantings and shading for additional information

(b) All shade sails within public open space are to:

(i) be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in SC6.4.3.6.13 Open space embellishments, unless approved otherwise;

Editor's note—currently no further guidelines and standards are developed for the provision of shade sails across the public open space network. Inclusion of shade sails will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of shade sails, all development proposals will be assessed against the provisions within that plan.

(ii) be primarily provided over high use activity elements, where practicable and not cost prohibitive. Demand and need for shade sails is likely to be higher in greenfield sites or where there are minimal mature shade trees. In these instances, shade sail provision should be supplemented by ancillary shade tree plantings to ensure both natural and built shade are developed in the long term;

(iii) be located to minimise proximity to trees that may increase maintenance due to leaf drop or pose a risk to the sail structure from falling limbs during storm events;

(iv) have a 2.5 m minimum clearance between the highest accessible standing point of the shaded equipment/item and the lowest point of the shade sail. Access opportunities from adjacent structures should also be avoided, in order to reduce potential vandalism and damage to the structure or sail;

(v) within playground areas, all poles are to be located outside equipment fall zones and, where practicable, outside the softfall surfacing area provided this will not conflict with mowing activities or circulation;

(vi) be of premium quality shade fabric made of 100% monofilament yarns with a 10 year fabric warranty unless approved otherwise;

(vii) include hot-dipped galvanised and powder coated poles of a colour consistent with any existing colour palette or adjacent park infrastructure;

(viii) pole profile and diameter should inhibit climbing of the poles or anti climbing devices should be installed;

(ix) include marine grade fittings for all locations; and

(x) include quick release mechanisms on all sails for ease of removal during storm events and all necessary edge reinforcement and hardware to ensure longevity of the shade sail.

(4) Shelters and gazebos

(a) All shelter structures are to be designed, engineered, built and certified against Building Code of Australia, C2 wind rating requirements as per Australian Standard AS 1170.2 *Structural design actions – wind actions* and all other applicable standards.

(b) All shelter installations within public open space are to:

(i) be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1 Public Open Space Embellishment Framework;

(ii) have a minimum 300 mm clearance from the edge of the roofline to the edge of the slab to reduce erosion around the structure;

(iii) be design and installed without roof gutting systems unless specified otherwise;

(iv) have a frame constructed of oiled hardwood timber, painted pine or marine grade metal materials;

(v) include marine grade fittings for all locations; and

(vi) where painted, be of a colour consistent with any existing colour palette or accompanying furniture suite.

SC6.4.3.6.20 Outdoor sporting facilities

Outdoor sporting facilities may include, but is not limited to the following:

(1) sports fields and courts;

(2) outdoor spectator facilities;

(3) specialised sports facilities;

(4) motorised sports facilities;

(5) aquatic facilities; and

(6) equestrian facilities.

Editor's note—currently no further guidelines and standards are developed for the provision of outdoor sporting facilities across the public open space network. Inclusion of outdoor sporting facilities will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan for the provision of outdoor sporting facilities, all development proposals will be assessed against the provisions within that plan.

SC6.4.3.6.21 Structure and buildings

(1) General requirements

Structures and buildings may include, but are not limited to the following:

(a) public toilets;

(b) community facilities;

(c) commercial facilities;

(d) clubhouses, change rooms or canteens; and

(e) sheds and shipping containers.

Editor's note—currently no further guidelines and standards are developed for the provision of structures and buildings across the public open space network. Inclusion of structures and buildings will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan for the provision of outdoor sporting facilities, all development proposals will be assessed against the provisions within that plan.

(2) Public toilets

Editor's note—currently no further guidelines and standards are developed for the provision of public toilets across the public open space network. Inclusion of public toilets will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan or design guidelines for the provision of public toilets, all development proposals will be assessed against the provisions within these documents.

SC6.4.3.6.22 Surface treatments

Surface treatments within all open space are to be:

(1) of an appropriate extent and material that will be durable under the local climatic and site conditions;

(2) of an appropriate extent and material that will mitigate the effects of large areas of impervious surfaces on run-off infiltration;

(3) fit for the intended purpose of the surface, its location, and the anticipated type and level of usage;

(4) shaded wherever possible and not prone to excessive heat retention, reflectivity and glare;

(5) not conducive to water pooling or slippery when wet;

(6) designed and located with consideration of the need for softening of hard surfaces with plantings; and

(7) be practical to maintain.

Editor's note—currently no further requirements relating to surface treatments are developed. Compliance with relevant sections of the Development manual planning scheme policy is required.

SC6.4.3.6.23 Transport and access infrastructure

(1) General requirements

(a) Transport and access infrastructure within open space is considered to include:

(i) car parking, both on and off street, associated with the open space or facilities;

(ii) internal roadways;

(iii) pedestrian paths, bicycle paths, shared paths;

(iv) public transport facilities;

(v) end of trip facilities;

(vi) walking tracks; and

(vii) boat ramps.

(b) All transport and access infrastructure within public open space must be designed, constructed and installed in accordance with:

(i) the provisions within the Townsville City Plan, planning scheme policies, sub-section SC6.4.4.7 Bicycle, pedestrian and shared path design and this sub-section of the Development manual planning scheme policy;

(ii) all applicable Australian Standards and legislation;

(iii) all applicable council local laws; and

(iv) council's approved standard drawings.

Editor's note—refer to SC6.4.3.6.31 Streetscape design and landscape treatments for requirements relating to areas of a designated road reserve.

(c) Bicycle, pedestrian and shared paths within public open space are to connect to activity areas within the open space and to the on-street verge pathway network. Where a verge pathway network does not exist, consideration may be given towards the future design and establishment of such a network in order to establish the best outcome for connectivity.

Editor's note—refer to SC6.4.4.7 Bicycle, pedestrian and shared path design for design guidelines for consideration of the type of paths to be provided through/within public open space. Consideration should be given to connectivity of bicycle paths and pedestrian path networks.

(d) All landscaping and irrigation associated with transport and access infrastructure is to be in accordance with the provisions of this sub-section, and sub-sections SC6.4.6.26 Landscaping and SC6.4.6.27 Irrigation.

Editor's note—with the exception of the below, currently no further guidelines and standards are developed for the provision of transport and access infrastructure specifically within open space. Proposals will be assessed against the policies and standards contained in the Townsville City Plan other sub-sections of and the Development manual planning scheme policy. Where proposals are within public open space, consideration of the Public Open Space Hierarchy and Embellishment Frameworks will be given. Refer clause SC6.4.3.6.9 Public open space.

(2) Walking tracks
Walking track provision is to:

(a) be provided in accordance with infrastructure design requirements, track markers and signage, in accordance with AS 2156 *Walking tracks*;

(b) be at select locations only, where construction of the walking track/s will not create any foreseeable adverse impacts including unsustainable maintenance requirements, public safety and liability concerns, habitat destruction, land slip or slope destabilisation; and

(c) be provided in accordance with any council adopted walking track strategy.

Editor's note—currently no further guidelines and standards are developed for the provision of walking tracks within public open space. Inclusion of walking tracks will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of walking tracks, all development proposals will be assessed against the provisions within that plan.

(3) Boat ramps
Boat ramp provision is to:

(a) be permitted in limited circumstances only, at specific locations, and where all relevant considerations are reasonably satisfied; and

(b) include engagement with, and approval from all relevant authorities and asset owner/s.

Editor's note—due to the place-specific, custom nature of boat ramps, no standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable engineering, water safety and transport standards, legislation, and council's overarching design and management principles.

SC6.4.3.6.24 Dog off-leash facilities

Dog off-leash facilities are designated spaces under council's local law where within an open space dogs can recreate with their owners. Dog off-leash areas provide a safe and fun environment for owners and their dogs to enjoy parks and open spaces.

Dog off-leash facilities are to be built to a high standard that meets community expectations. Facilities where proposed Dog off-leash areas are proposed to be established shall have due regard for;

(1) Site selection

(a) within public open space, dog off-leash facilities shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1;

(b) an appropriate sized large dog off-leash fenced facility should range between 2000 to 4000 m^2;

(c) an appropriate sized small dog off-leash fenced facility should range between 1000s m^2 to 1500 m^2. It should be noted that small dog off-leash fenced facilities will not be installed as stand-alone facilities by themselves;

(d) dog off-leash facilities should have adequate drainage and should have reasonable flood immunity;

(e) dog off-leash facilities should have cross fall drainage of at least 2%. This will ensure that water will not pond within the dog off-leash area;

Editor's note—the surface cover all dog off-leash facilities will primarily consist of turf. In most instances open turfed areas above 2000 m^2 should be considered as a minimum for dog off-leash areas. Turf cover shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with a 25 mm depth of topsoil. The type of turf to be used will be selected from the SC.6.2.6.26 – Attachment A list of preferred plant species.

(f) the use of native groundcovers, shrubs and trees should be incorporated into the overall design of the dog off- leash areas. The usage of existing established trees can provide visual amenity to the park and will provide protection from the wind and sun;

(g) landscaping and plants add to the amenity of the park, but it is important to ensure that plants are non-toxic and non-irritating to dogs. Some plants may have seeds, stems, leaves, fruits or flowers that are irritating and/or toxic to dogs;

(h) all dog off-leash enclosures are required to be irrigated with pop up sprinklers; and

(i) all dog off-leash facilities must be of a high standard, being designed, constructed and installed in accordance with:

  (i) the provisions within the Townsville City Plan and this sub-section;

  (ii) manufacturer specifications;

  (iii) all applicable Australian Standards and legislation;

  (iv) all applicable council local laws; and

  (v) council's approved standard drawings.

Editor's note—Currently there are no approved standard drawings for dog off-leash areas.

(2) Siting of dog off-leash facilities

(a) dog off-leash facilities should be located away from play spaces to minimise the temptation for children to have unsupervised interaction with dogs;

(b) dog off-leash facilities should also be located away from other non-congruent recreation activities (e.g. barbeque areas and fitness equipment). As a general guide it is recommended that a spatial buffer of approximately 40 m is considered appropriate. However, other factors such a site gradient and vegetation coverage can be utilised to lessen the spatial buffer;

(c) dog off-leash areas should also be sited to minimise noise nuisance into residential areas. As a general guide it is recommended that a minimum spatial buffer of approximately 40 m is considered appropriate. However, other factors such a site gradient and vegetation coverage can be utilised to lessen the spatial buffer;

(d) a variety of open and shaded spaces should be created within a dog off-leash facility. There should be enough space to include active running areas as well as quieter environments where dogs can sniff, play and interact with their owners. As a guide it is recommended that a dog off-leash area have shade coverage (both natural and artificial) of approximately 35 per cent;

(e) effective dog off- leash areas disperse the dog and human traffic throughout the park, and spread the wear and tear on the underlying surface evenly across the facility;

(f) in all instances dog off-leash facilities should be supported by sufficient car parking spaces to

accommodate the amount of vehicle traffic likely to be generated by the particular use of the site. Refer to Table SC6.4.3.6.1 Public Open Space Embellishment Framework;

(g) to enhance site accessibility and convenience, locate dog off-leash areas in close proximity to the available car parking. Additionally, equitable access ramps and a connecting path from the car parking to the dog off-leash facility should also be installed; and

(h) The placement of Dog off-leash facilities and planting treatments, shall take into account the maintenance requirements for maintaining such a facility (e.g. allow minimum 2m between perimeter fence and facility item such as a seat).

(3) Design - entry way

(a) double-gated entry to prevent dog escapees is required at all access points. Consideration should be given to the installation of multiple access points, to minimise congestion.

(b) access points are high wear areas and appropriate sized concrete pads will be installed. These concrete pads should cover the entire entrance areas and extend out past the arc of the gate openings.

(c) gates should be fitted with self-closing child-proof locks to prevent dog escapees and unsupervised children from entering the facility.

(d) a separate entry for a maintenance gate (which should be 3-3.5m wide) will be installed within the perimeter fence line. This should be located away from all the other user access points.

(e) other physical structures to support amenity such as shelters, benches or drinking fountains should be located at a suitable distance away from the access points to discourage dogs and people from congregating.

(4) Design - fencing

(a) secure perimeter fencing will be installed that discourages canines from escaping under, over or through the fence;

(b) the fence alignment shall avoid acute angles that can result in entrapment issues for dogs and humans;

(c) fencing around all Dog Off-Leash Facilities will be approximately 1.2m – 1.5m in height; and

(d) fencing materials must provide good visibility so that park users can see activity inside and around the park. Standard powder coated fencing panels traditionally used in pool fencing should be utilised as fence panels.

Editor's note—Be aware that smaller dog breeds may be able to run through the gaps in the panels of traditional pool fencing.When designing small dog off-leash areas give consideration to the installation of alternatives or undertaking modifications to the fencing panels to ensure that the enclosure is fit for purpose.

(5) Design Amenities - Seating

(a) as a minimum, four bench seats should be installed within the large dog off-leash areas, and two bench seats within small-dog off-leash areas;

(b) seating should be placed in areas to maximise the benefit of any nearby shade;

(c) seating should be aligned and in close proximity to the fencing of the off-leash area. This ensures that the majority of the dog activity will occur in front of where the owner is sitting. A mowing strip of 2 m should be allowed between the fence and the seating. Finally seating should be located away from entry/exit gates to avoid congestion;

(d) the type of seating used within the dog off-leash will be consistent with any existing or adopted furniture suite within the nearby park open space;

(e) however, consideration should also be given to the space between the slat sizes utilised on the bench seat. Minimum gaps should be utilised to avoid dog paws entrapment points; and

(f) picnic tables should not be located inside dog off-leash areas as this encourages food to be brought into the facility.

(6) Design Amenities - Drink facilities

(a) as a minimum, two drink fountains should be installed within dog off-leash areas. These fountains should be accessible by dogs and people, but should be located away from the main entry gates to discourage

congregation in high traffic areas;

(b) dog water bowls should be fixed to the drink fountain and be hinged so that owners can tip water out of the bowl. Adequate drainage around the water bowl should be installed to ensure that water logging and muddy areas do no occur. All drinking fountains are required to be installed on a concrete slab, above a drainage well with adequate surface drainage inlets;

(c) drinking fountains should be aligned and in close proximity to the fencing of the off-leash area. This ensures that that drinking dogs are not impacting activity areas. A mowing strip of 2 m should be allowed between the fence and the drink fountains; and

(d) water fountains and taps should be designed, constructed and installed as per council's specification, Drink Fountain and Water Tap (SC.6.4.6.27 Irrigation).

(7) Design Amenities - Waste facilities

(a) as a minimum, two dog faeces bag dispensers should be installed within dog off-leash areas;

(b) dog faeces bag dispensers should have a locking device to prevent bags being pulled continuously and scattered in the park. Dog faeces bag dispensers should be located in close proximity to the access points (but should also not impede access). However, dog faeces bag dispensers should also be located in positions that ensure an ease of refill, which does not require council staff to enter the enclosure;

(c) two covered rubbish bins should be installed outside of the dog off leash area, in close proximity to the main gate access point (but should also not impede access).Bin position should also ensure easy collection: and

(d) generally, the acceptable bin provision will be a 240L rubbish wheelie bin, mounted on a concrete slab with a metal security bin stand. Variations to size and quantity standards may be approved, as required to support the associated waste collection requirements, particularly at locations of high usage.

(8) Design Amenities – Lighting

(a) most dog off-leash facilities do not require lighting. In many instances one security light may be installed to link the entrance of the dog off-leash area to the adjacent car parking will be sufficient;

(b) full lighting of dog off-leash facilities will be accepted where there is a demonstrated need and where the lighting will not have a negative impact on adjacent residential areas; and

(c) all lighting shall be carried out to the applicable lighting category, as per the Australian Standard AS11580 – Lighting for roads and public spaces.

(9) Design - Agility Equipment / Separate Small Dog Area / Specialised Play

(a) not all dog off-leash facilities require agility equipment or a dedicated small dog off-leash area. These facilities will only be supported where there is a demonstrated demand on a case-by-case basis;

(b) if agility equipment is considered appropriate it should be located away from access points and high running areas. Consultation with agility dog groups should be undertaken prior to assist in the design of appropriate agility facilities within dog off-leash areas;

(c) small dogs are considered to be dogs that weigh less than 8 kilograms or are less that 35cm in height when measured from the floor to the top of the dog's front shoulders;

(d) small dog off-leash areas will not contain agility equipment; and

(e) specialised canine recreation equipment will be considered on a case-by-case basis. Consideration of ongoing maintenance costs, asset replacement costs and any potential impacts on canine health will be the major considerations when determining the request to install specialised canine recreation equipment.

(10) Design - Signage

(a) council information signs on dog off-leash area rules are required to be installed in close proximity to all access points;

(b) council has standard information signs on dog off-leash and small dog off-leash areas for usage and behavioural requirements that shall be used at dog off-leash areas;

(c) park name signage should be installed in close proximity to the dog off-leash area so that people utilising the facility are able to readily recognise the name of the facility. Generally, dog off-leash areas will not have a separate specialised park name; and

(d) when dog off-leash facilities are not readily visible from the road frontage, directional signage from car parking facilities or areas of high visibility should be utilised.

Editor's note—For further information on the construction of dog off-leash facilities, refer to the detailed landscape specification standards as provided in SC6.4.6 Construction Standards, in particular SC6.4.6.26 Landscaping.

SC6.4.3.6.25 Drainage and service connections

Editor's note—currently no specific requirements relating to drainage within open space are developed. All drainage requirements should be determined in accordance with sub-section SC6.4.4.4 Stormwater drainage design along with the relevant construction specifications.

SC6.4.3.6.26 Landscape entry statements

(1) Landscape entry statements may be of the following types:

(a) sign/graphics on a wall or acoustic fence;

(b) a structure;

(c) public art; and

(d) landscaping plantings only.

(2) Landscape entry statements to public open space, residential or commercial estate developments are to meet the following requirements:

(a) landscape entry statements are to be suitably located to clearly identify the public open space, an individual neighbourhood or development, or area of distinctive character;

(b) landscape entry statements are to be of a high quality urban form that is easily maintained;

(c) landscape entry statements are to be of a scale appropriate for the hierarchy classification and surrounding landscape character;

Editor's note—refer to Table SC6.4.3.6.1 Public Open Space Embellishment Framework relating to entry statement and signage in public open space.

(d) where involving a wall entry statement, the wall is to be located within the private property on the property boundary, unless relating to public open space or designated park;

(e) any private properties containing wall/s or other landscape entry statements require a covenant protecting the wall or feature and outlining maintenance responsibilities, and a Property Note in council's rates system to ensure owners are aware of the existence of the wall or feature;

(f) other entry statements of an alternative nature or located within the road reserve will be considered on merit and must meet requirements for visibility and frangibility;

(g) landscape entry statements for residential or commercial estates are to be provided and maintained by the developer for the life of the development (i.e. off maintenance of the final stage); and

(h) landscape entry statements will not include water features.

(3) Landscape entry statements are be provided in accordance with the following hierarchy and requirements:

(a) "Suburb" level landscape entry statements:

(i) generally be located on public land and owned by council after completion of any applicable maintenance period; and

(ii) conform with corporate graphics standards;

Editor's note—refer to council's Graphics Standards Manual.

(b) Estate" level landscape entry statement:

(i) walls or acoustic fence located within private property; and

(ii) structures, public art or landscaping may be located on public land subject to operational works (landscaping) approval;

Editor's note—public art needs to be coordinated through the Manager Gallery Services in accordance with council's Public art policy.

(c) Neighbourhood/village" level landscape entry statement:

(i) generally a sign wall located on private property; and

(d) "Street" level landscape entry statement:

(i) generally not acceptable.

SC6.4.3.6.27 Lookout platforms and fishing pontoons

(1) Lookout platforms and fishing pontoons will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied.

(2) Where the proposed lookout platforms or fishing pontoons are associated with public open space, council owned land or will involve potential future council assets, infrastructure may only be permitted at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1. Approval from the relevant council asset owner/s will also be required.

(3) In order to properly assess any such proposals, council may request the provision of a maintenance plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

Editor's note—due to the place-specific, custom nature of lookout platforms and fishing pontoons, no further standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with necessary requirements defined by all applicable engineering and water safety standards, legislation, and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal.

SC6.4.3.6.28 Public art

(1) Public art is considered to be "a concept or work created by an artist/s in any medium, permanent, temporary or ephemeral, which enables stimulation of one or more of the senses and is situated in a place of public access".

(2) Public art will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied.

(3) All public art proposals must demonstrate alignment with any council adopted public art policy.

Editor's note—refer to council's Public art policy.

(4) Where the proposed public art is associated with public open space, streetscapes, council owned land, or will involve potential future council assets, the public art may only be permitted at approved locations and where the following overall requirements are also satisfied:

(a) the provision of the public art adds interest to the public open space or streetscape, reinforces the unique identity of Townsville, and contributes significantly to the sense of place;

(b) the public art is used as a medium to interpret the social and cultural values of the community, reflecting Townsville's diverse heritage and cultural identity, as well as the social context of the site;

(c) the public art responds to the environmental context of the site, and is integrated into the overall landscape or streetscape, being well-chosen and appropriately sited;

(d) the provision of public art within public open space is in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1, unless approved otherwise;

Editor's note—where a public art strategy has been formally approved by council for a precinct or development, this may take

precedence over the Public Open Space Embellishment Framework provisions.

(e) the provision of public art within streetscapes and at centres is aligned with the expected levels of embellishment and characteristics of the road or centre hierarchy classification;

(f) all public art should not create a public safety risk to the community or council maintenance staff;

(g) engagement and approval from the relevant council asset owner/s and other stakeholders is required;

(h) for all public art proposals, council may request the provision of a concept statement and details including, but not limited to the following:

  (i) concept images or models;

  (ii) detailed description of the artwork/theme/concept;

  (iii) materiality;

  (iv) scale;

  (v) structural detailing and footing designs;

  (vi) public safety considerations;

  (vii) ongoing maintenance requirements;

  (viii) project budget/costs; and

  (ix) previous works and references; and

(i) for all public art proposals, council may request the provision of a maintenance plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

Editor's note—due to the place-specific, custom nature of public art, no further specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable engineering and electrical standards, legislation, and council's overarching design and management principles.

SC6.4.3.6.29 Screening

Screening may include, but is not limited to the following:

(1) acoustic screening;

(2) vegetated visual screening; and

(3) architectural visual screening.

Editor's note—currently no specific requirements relating to acoustic and visual screening has been developed. Reference should be made to Department of Transport and Main Roads' *Road landscape manual*. Per SC6.4.2 Development application guidelines, council may ask for a description of any ongoing maintenance requirements to ensure that the stated noise attenuation performance of the measure does not deteriorate with time.

SC6.4.3.6.30 Soft landscaping

(1) General requirements

Soft landscaping may include, but is not limited to the following:

  (a) plant species selection;

  (b) earthworks and mounding;

  (c) garden beds;

  (d) shade trees; and

  (e) turf areas.

(2) Plant species selection

  (a) Preferred plant species

    (i) Plant species used are to be those recommended in the Preferred plant species list in SC6.4.3.6 Attachment A – Plant species schedules.

Editor's note—the Preferred plant species list found in SC6.4.3.6 Attachment A has been prepared as an inclusive list that takes into account council's requirements and those of relevant service providers, and is acceptable for use in most circumstances. The species list does not account for frangibility requirements relating to street tree plantings in streets or roads. This, along with all other relevant considerations associated with the site context must be considered in the development of the landscape plan and species selection. Refer to sub-section SC6.4.6.26 Landscaping for further detail relating to planting construction specifications.

(ii) Plant species are to be selected by a suitably qualified and experienced horticulturist, landscape architect or designer to suit each of the site's hydro zones, so that direct rainfall supplies all or most of their water needs.

(b) Undesirable plant species
Plant species are not to include undesirable species listed in the undesirable plant species list.

Editor's note—currently, no undesirable plant species list has been developed.

(c) Declared weed species
Plant species used are not to include prohibited species listed in any declared weeds list.

Editor's note—refer to the Department of Agriculture, Fishers and Forestry for a declared weed species list. Currently, no design guidelines relating to other soft landscaping elements are developed.

SC6.4.3.6.31 Streetscape plantings

(1) General requirements

(a) Landscape treatments may include, but is not limited to the following:

(i) street trees;

(ii) planted and/or mulched garden areas;

(iii) turf areas;

(iv) irrigation;

(v) artificial turf;

(vi) stencil-crete;

(vii) concrete (plain or coloured); and

(viii) other associated hard landscape treatments.

Editor's note—refer to the streetscape requirements under SC 6.4.3.3 Footpath treatment policy.

(b) All streetscapes must be of a high standard, being designed, constructed and planted in accordance with:

(i) the provisions within the Townsville City Plan, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) all applicable Australian Standards and legislation;

(iii) all applicable council local laws; and

(iv) all council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for landscape treatments.

Editor's note—where streetscape outcomes are within roads managed by the Department of Transport and Main Roads, applicants should refer to the Department of Transport and Main Roads' *Landscape Design Manual* (2013). Requirements of the Department of Transport and Main Roads' Landscape Design Manual will take precedence in these instances. Engagement and

approval from other stakeholders/authorities may additionally be required as part of any development proposal.

(c) All streetscape outcomes should be underpinned by and contribute to the following strategic objectives:

(i) safety – streetscapes do not introduce risk to road users, must contribute positively to a safe road environment and be safe to maintain and construct;

(ii) functionality – proposed outcomes are fit-for purpose and comply with landscape and road planning and design principles, appropriate to the road hierarchy and function;

(iii) environment - ecological and sustainable design principles are incorporated to mitigate the environmental impacts of the road and maintain or improve the intrinsic value of the streetscape;

(iv) aesthetics – streetscapes provide high visual amenity and are contextually sensitive to the character of the surrounding built and natural environment;

(v) community – proposed outcomes are responsive to the needs and concerns of stakeholders and maintain or improve the quality of life and liveability of communities; and

(vi) economic – streetscapes represent value for money and provide cost effective design outcomes that seek to minimise costs over whole of life cycle.

Editor's note—whilst the above strategic objectives are relating specifically to streetscape outcomes, these objectives are aligned with the overarching sustainability principles outlined at the beginning of this sub-section and within Part 9.3.3 Landscape code. Alignment with both the above strategic objectives and the overarching sustainability principles are to be expressed in the proposed streetscape design outcomes and detailed in the "Landscape statement of intent" per SC6.4.2 Development application guidelines.

(2) Safety

(a) Streetscapes shall create a safe road environment by ensuring:

(i) a safe system approach to road safety is used, as detailed by Austroads;

(ii) safe and efficient pedestrian, cyclist and vehicle movement is facilitated through the integration of all infrastructure and landscape elements within the road corridor;

(iii) hazards, safety or security risks are not introduced;

(iv) safe sight distances are applied and maintained as per Austroads Part 3 and Part 4. At intersections, use of Minimum Gap Sight Distance, and at roundabouts, criteria 1 and 2, are mandatory;

(v) clear zones and frangibility requirements are met in accordance with clear zone criteria as per Austroads Part 6;

(vi) setbacks and other clearances are met;

(vii) signage and other road furniture is not obscured;

(viii) safety and traffic management is enhanced through the functional use of landscape plantings;

(ix) surface treatments are slip-resistant and non-reflective;

(x) effects of glare and shadowing are minimised;

(xi) CPTED principles are incorporated into all streetscape designs; and

(xii) a safe work environment for maintenance personnel is achieved and requirements for traffic control are minimised.

(b) Associated with the above, the following definitions apply.

(i) "Frangible" vegetation - is plants (including trees) with a stem or trunk diameter equal to or less than 100 mm in diameter at maturity, measured from 300 mm above the finished ground level. Shrubs and ground covers are considered frangible except for shrubs that exceed 3.5 m in height.

(ii) "Non-frangible" vegetation - is plants (including trees) with a stem or trunk diameter greater than 100 mm in diameter at maturity, measured from 300 mm above the finished ground level. This includes shrubs greater than 3.5 m in height and most trees.

(iii) Setback - is the distance measured from the outer edge of the specified component to the centre

of the vegetation trunk.

(iv) Clearance - is the distance measured from the edge of the specified component to the perimeter of the second component or vegetation.

(v) Canopy clearance – is the vertical distance measured between the finished ground level and the underside of the tree canopy.

Editor's note—the above definitions are based on Austroads' *Guide to Road Design*, Part 6B: Roadside Environment (2009) and Department of Transport and Main Roads' *Landscape Design Manual* (2013) – Appendix 4.

(3) Functional

Streetscape outcomes must be fit-for-purpose and shall:

(a) be supported by all other ancillary infrastructure requirements that are essential to the overall functionality and longevity of the streetscape, including but not limited to irrigation, subsoil drainage and root barrier; and

Editor's note—refer to sub-sections SC6.4.6.20 Subsoil, foundation and pavement drains, SC6.4.6.21 Subsurface drainage, SC6.4.4.1 Geometric road design, SC6.4.6.26 Landscaping and SC6.4.6.27 irrigation.

(b) demonstrate sound application of design theories including legibility, form, function, connectivity, way-finding, accessibility and mobility, robustness, place-making and imaging.

Editor's note—where proposed streetscape outcomes deviate from the outlined requirements of this sub-section, the merit for this deviation must be detailed. Notes documenting how all safety, functional and operational requirements are satisfied by the design exception must be included for further consideration. Any variances will be assessed on a case by case basis relative to the situation. Approval will not be granted where the design exception opposes safety requirements or increases safety risk. All plans are required to be signed off by a RPEQ registered engineer.

(4) Environment

Ecological and sustainable design principles shall be incorporated by:

(a) applying an appropriate planting approach such as: structured, naturalistic, and water sensitive planting; grass seeding; or turfing;

(b) integrating street trees in the streetscape that will create shade for all users (including pedestrians and cyclists) and ameliorate the urban heat island effect;

(c) providing a buffer between the road and surrounding land uses;

(d) integrating the streetscape within natural areas through planting approaches with a natural appearance and naturalistic, informal distribution;

(e) improving the health and resilience of the urban forest by establishing green corridors along streets or roads and providing habitat corridors within the urban matrix;

(f) incorporating functional landscape components such as the use of vegetation to screen headlight glare;

(g) using varied vegetation treatments to highlight progression or transition to a different speed environment;

(h) designating feature areas or nodal points by creating a marker or landmark element at interchanges, intersections, major structures and entry gateways;

(i) using vegetation and other components to maintain or frame views;

(j) establishing economical ways to treat large areas;

(k) assisting with integrated stormwater management by establishing vegetation that will reduce erosion and large expanses of impervious surface; and

(l) incorporating vegetation and other treatments in ways that minimise maintenance in high risk areas, require reduced maintenance interventions and become self-sustaining over time.

(5) Aesthetics

Streetscapes shall be contextually sensitive and provide high visual amenity by:

(a) establishing streetscape characters themes that address, retain, reflect and where possible enhance the local context of the project area (architectural themes, colours, visual heritage values etc.);

(b) creating balance in term of scale and mass between new streetscape components and the existing natural features and urban building forms;

(c) integrating natural elements that recognise and promote the value of the urban forest in all streetscapes;

(d) establishing innovative approaches to providing functional, high amenity outcomes whilst maintaining and enhancing the safety and operational function of the road;

(e) responding to changes in road conditions and promoting legibility under varied road conditions or different design speeds;

(f) presenting a visually cohesive and unified suite of treatments that are simple, refined and without unnecessary, non-functional embellishment;

(g) creating treatments that are visually recessive except where intended to be highly visible feature elements;

(h) maintaining an uncluttered road environment with limited visual intrusion that will minimise risk of road user distraction and conflict with official traffic signs and signals; and

(i) devising colouration and surface treatment solutions that shall mitigate the visual impact of dirt, staining and adhesion of other pollutants.

(6) Community

Proposed streetscaping shall be responsive to stakeholder needs and concerns by:

(a) identifying and addressing community values and associated interests, perceptions and preferences as part of transport and road landscape planning and design process;

(b) promoting participation and contribution by implementing effective community engagement processes;

(c) enhancing public amenity for all users through improvements to user comfort, way finding and walkability;

(d) promoting the health and well-being of the community by improving the useability of pedestrian networks through provision of shade or boulevard treatments;

(e) improving accessibility, connectivity and security within the streetscape;

(f) establishing streetscapes that are functional and facilitate equitable access to a variety of multi-modal transport systems;

(g) seeking design outcomes that create a sense of community and reinforce local character, identity, and cultural heritage; and

(h) improving experiences both for users traveling within the transport infrastructure corridor itself and the community beyond.

(7) Economic

Streetscapes will represent value for money and minimise costs over whole of life cycle by:

(a) implementing appropriate designs that provide balanced outcomes across all strategic objectives;

(b) creating iconic gateway entry statements, in strategic locations only, which emphasise the urban or regional identity and enhance tourism, business potential and associated economic benefits;

(c) promoting increased usage and visitation to business and services through the provision of user friendly vehicular, pedestrian, cyclist and public transport networks which incorporate a high level of amenity and deliver a high quality experience;

(d) ensuring the ongoing cost and level of service for operational requirements associated with the streetscape is appropriate for the hierarchy and profile of the road;

(e) minimising the overall cost of operational activities through responsive design that reduces high cost, high risk, high frequency and high intensity activities;

(f) creating designs that will evolve into a self-sustaining streetscape and have a progressive reduction in the number of maintenance interventions over the operational life of the corridor; and

(g) promoting innovation in the development of alternative treatment types that achieve a balance between the desired aesthetic and reduce maintenance outcomes.

(8) Streetscape treatment provision

(a) Requirements relating to all safety objectives such as clear zones, sight distances and frangibility will take precedence and determine the placement and control of landscaping elements within the streetscape.

(b) All hard and soft landscape treatment construction must be in accordance with the specifications set out in sub-sections SC6.4.6.26 Landscaping and SC6.4.6.27 Irrigation.

(c) Kerb types will be as per SC6.4.4.8 Standard drawings (Typical Road Cross Sections SD-001, SD-002, SD-003, SD-004, SD-005, SD-006, SD-010), and SC6.4.4.1 Geometric road design.

(d) Where a zero object height is necessary, only hard landscape areas must be established, subject to meeting all other requirements within this sub-section and other sub-sections of the Development manual planning scheme policy.

(e) A minimum 1.2 m width of hard surface treatment (which may be inclusive of road pavement, kerb, concrete, mountable aprons etc.) must be provided between soft landscaping and the edge of the traffic lane, unless approved otherwise.

(f) In areas >70 km/hr, an increase to 3 m in width of hard surface treatment may be required between soft landscaping and the edge of the traffic lane, subject to assessment of the associated risks of the road environment.

Editor's note—the above widths are based on standard clearances between traffic lanes and work sites, as detailed in *Manual Uniform Traffic Control Devices* (MUTCD), Queensland. These clearance requirements may be subject to reduction or increase dependent on the road speed environment being assessed and subject to council approval. The intention for all standard clearances is to ensure a safe work environment, reduced inconvenience to road users and reduced the reliance on traffic control and the associated costs.

(g) Installation of decorative walls, entry signs, rocks or other fixed objects in the medians or central island of roundabouts will only be approved in select locations and where:

(i) the median or roundabout is larger than 10 m in width/diameter;

(ii) vehicles are not likely to run off the road;

(iii) placement of the fixed objects will not distract drivers;

(iv) maintenance or repairs to the fixed objects will not put maintenance personnel at risk;

(v) all requirements (including frangibility, clear zones, sight triangles etc.) per Austroads are satisfied; and

(vi) green walls or vine trellises shall only be provided in limited circumstances and where all design, construction, safety and maintenance conditions are satisfied.

Editor's note—due to the custom nature of green walls, vertical gardens and façade greening, no design and construction standards are provided. Each site will be assessed on a case-by-case basis. Generally the majority of these type of planting features are to be within private property and should be under the maintenance regime of the owner. All engineering and hydraulic certification must be provided with any structure proposed.

(h) For medians, specific requirements apply being:
Streetscape treatments shall be provided in accordance with Table SC6.4.3.6.7 Treatment application based on median width and other requirements of this policy.

Table SC6.4.3.6.7 Treatment application based on median width

Treatment	Appropriateness of treatment application by median widths (including width of kerbs)				
	< 2.5 m	**2.5 m – 3.5 m**	**3.5 m – 6.0 m**	**6.0 m – 10.0m**	**> 10.0m**
Hard landscape (Stencil-crete, artificial turf, concrete or similar) [1] where the width of hard landscape treatments may exceed 6.0m, a combination of hard and soft landscape treatments should be applied to avoid large expanses of hardscape, subject to satisfaction of all safety requirements	Yes	Yes	Yes	Yes[1]	Yes[1]
Turf (Zoysia spp. or approved alternative) [2] may be approved in select locations only, minimum clearances may still apply subject to road speed environment. Unless approved otherwise, turf areas must be a minimum width of 2.0m to support an irrigation system in a safe and efficient manner and facilitate efficient operational maintenance. Turf areas greater than 6.0m in width should be combined with other hard and soft landscaping treatments	No	No[2]	Yes	Yes	Yes
Garden areas (Shrubs/ground covers below 3.5m in height) *Frangible* [3] may be approved in select locations only, minimum garden area width and clearances may still apply subject to road speed environment, subject to satisfaction of all safety requirements	No	Yes[3]	Yes	Yes	Yes
Small trees/ large shrubs (Mature canopy between 5.0 – 10.0m in height or large shrubs greater than 3.5m in height) *Frangible or* *Non – frangible*	No	No	Yes	Yes	Yes
Medium trees (Mature canopy between 10.0 – 15.0m in height) *Non – frangible*	No	No	No	Yes	Yes
Large tree (Mature canopy greater than 15.0m in height) *Non – frangible*	No	No	No	No	Yes
Palms *Frangible or* *Non – frangible* [4] select locations only, minimum setbacks may also apply subject to species selection and mitigation of risks associated with frond drop	No	No	No	Yes[4]	Yes[4]

Editor's note—appropriateness of treatment application is based on clearance and setback requirements in a 60 km/h speed environment. Council approval of design outcomes that deviate from the above may be granted at select locations, dependent on the road speed

environment being assessed and that all safety and operational requirements are satisfied. This includes requirements outlined in MUTCD (Queensland) relating to work sites, with the intention being to design streetscapes to minimise reliance on traffic control during regular, routine maintenance operations.

(i) For the roundabouts, specific requirements apply being:

(i) streetscape treatments shall be provided in accordance with Table SC6.4.3.6.8 and other requirements of this sub-section;

(ii) splitter or blister islands should not accommodate any soft landscaping unless approved otherwise (generally, islands must be an average width of 6 m or greater and all safety and operational requirements must firstly be satisfied); and

(iii) where garden areas and trees are provided, plant species in the central islands of roundabouts should only consist of ground covers, low growing shrubs and/or mulched areas with clean trunked trees unless approved otherwise.

Table SC6.4.3.6.8 Treatment application based on roundabout diameter

Treatment	Treatments application by roundabout diameter (including width of kerbs and mountable apron)			
	< 7.0 m	**7.0 m – 10.0 m**	**10.0 m – 14.0m**	**> 14.0m**
Hardscape (Stencil-crete, artificial turf, concrete or similar) [1] where the width of hardscape treatments may exceed 10.0 metres, a combination of hard and soft landscaping treatments must be applied to avoid large expanses of hardscape	Yes	Yes	Yes[1]	Yes[1]
Turf (Zoysia spp. or approved alternative) [2] may be approved in select locations only, minimum clearances may still apply subject to road speed environment. Unless approved otherwise, turf areas must be a minimum width of 2.0m to support an irrigation system in a safe and efficient manner and facilitate efficient operational maintenance. Turf areas greater than 6.0m in width should be combined with other hard and soft landscaping treatments	No	No	Yes[2]	Yes[2]
Garden areas (Shrubs/ground covers below 3.5m in height) *Frangible* [3] may be approved in select locations only, minimum garden area width and clearances may still apply subject to road speed environment	No[3]	Yes	Yes	Yes
Small trees/ large shrubs (Mature canopy between 5.0 – 10.0m in height or large shrubs greater than 3.5m in height) *Frangible or* *Non – frangible*	No	Yes	Yes	Yes
Medium trees (Mature canopy between 10.0 – 15.0m in height) *Non – frangible*	No	No	Yes	Yes
Large tree (Mature canopy greater than 15.0m in height) *Non – frangible*	No	No	No	Yes
Palms *Frangible or* *Non – frangible* [4] select locations only, minimum setbacks may also apply subject to species selection	No	No	Yes[4]	Yes[4]

(9) Hard landscape treatment requirements

(a) Hard landscape treatments must:

(i) comply with all requirements relating to:

(A) appropriate abrasion resistance in accordance with test methods stipulated in AS/NZS 4456.9 - *Masonry units and segmental pavers and flags - Methods of test - Determining abrasion resistance*; and

(B) appropriate slip resistance capability as required by AS/NZS 4586 - *Slip resistance classification of new pedestrian surface materials*; and

(ii) be colour-fast, UV resistant and non-reflective.

(b) Where the width of hard landscape treatments may exceed 6 m, it is desirable that a combination of hard and soft landscape treatments is used to avoid large expanses of hard surface. This excludes roundabouts below 10 m in diameter.

(10) Turf area requirements

(a) Turf areas shall be in accordance with all applicable council approved standard drawings for turf areas.

Editor's note—currently, no standard drawings are formally adopted for streetscape treatments.

(b) Turf areas may form part of clear zones, provided all other requirements are satisfied.

(c) Turf areas must be a minimum 1.5 m **clear** width to allow for mowing access unless approved otherwise (noting minimum 2 m **total** widths are desirable for irrigation purposes).

(d) Where the width of the medians exceed 6 m, it is desirable that turf areas are combined with other hard and soft landscape treatments to provide balance against the median width.

(e) Turf species must be low maintenance and Empire Zoysia or an approved equivalent species.

(11) Garden area requirements

(a) Garden areas (planted or mulched only) shall be in accordance with all applicable council approved standard drawings for garden areas.

Editor's note—currently, no standard drawings are formally adopted for garden areas.

(b) All garden areas must be a minimum width of:

(i) 1 m where combined with other soft and hard landscaping treatment; and

(ii) 1.5 m where provided as full width planting.

(c) Where garden areas are **within** the sight triangle, plantings should only consist of ground covers and low shrubs with a maximum mature height of 600 mm or less in order to preserve sight lines.

(d) Where garden areas are **outside** the sight triangle, plantings expected to exceed 600 mm in mature height may be provided where all clear zone and frangibility requirements are satisfied and plantings are provided:

(i) as screen planting or buffers along fence lines or acoustic barriers;

(ii) for functional reasons such as a visual barrier for headlight glare, a windbreak or a physical barrier to human movement; and

(iii) where screening or accent planting is desired.

(e) Approval of full width planting may be provided:

(i) for strategic locations only;

(ii) where the garden area will be a minimum width of 1.5 m; and

(iii) where garden areas will be located behind road safety barrier system; or

(iv) where the road speed and required clearances between the edge of the traffic lane and the garden area complies with MUTCD (Queensland) requirements for work sites (Short-term Low Impact - Built Areas or Static Work Areas) and will not require the use of traffic control.

Editor's note—approval for full width planting will only be for select locations, subject to the satisfaction of all safety and operational maintenance requirements. Approved locations will generally be associated with central median screening or buffering plantings, key entry gateways or high profile roads, and/or associated with centres or commercial precincts. Where the road speed is 40 km/h or less, full width plantings may be provided in medians between 2.5-3.5 m, subject to achieving the

minimum garden area width and council approval.

(f) Where full width plantings are approved, plants must setback (from back of kerb) at least half the mature plant diameter, in order to mitigate potential encroachment into the roadway, reduce obstructions that compromise safety and increased maintenance requirements.

(g) All species selection should have regard to aesthetic, suitability, functional and ecological selection criteria and include consideration of:

(i) appropriateness for the planting approach (e.g. structured or naturalistic);

(ii) mature spread dimension and required density, noting encroachment into road shoulder must be avoided;

(iii) mature height and compliance with sight triangle requirements, noting reliance on frequent maintenance to maintain sight lines must be avoided;

(iv) frangibility requirements;

(v) drought resistance/water requirements;

(vi) suitability for prevailing soil type;

(vii) lifespan, noting long-lived species are desired and annuals are not to be used unless approved otherwise;

(viii) salt tolerance;

(ix) pollution resistance;

(x) environmental and habitat value of particular species;

(xi) ongoing care and maintenance requirements; and

(xii) the intended purpose of the planting and the species' suitability for this, including uses such as:

(A) headlight screen planting;

(B) buffer screening;

(C) visual screening;

(D) visual guidance planting;

(E) user perceptions of speed;

(F) shade and sunlight control;

(G) windbreak;

(H) physical barrier;

(I) erosion control;

(J) safety; and

(K) noise attenuation.

(h) Garden areas (mulched only) shall:

(i) be provided where shrubs and groundcovers are not desired or cannot be planted without impacting sight lines; and

(ii) where tree planting is incorporated in the mulched garden area.

(12) Street tree requirements

(a) Street trees should be provided at the following rate:

(i) a minimum of one tree per standard building lot or spaced at approximately 20 m intervals; and

(ii) a maximum of four trees per standard building lot or spaced at approximately 7 m intervals.

(b) The above rates may be altered where:

(i) there is insufficient available space based on safety and setback requirements; or

(ii) existing street trees will be retained; and

(iii) subject to council approval of the reduced rate.

Editor's note—in locations where lot sizes are below the standard lot width, street tree provision rates will need to be assessed on a case by case basis. In these instances, a balance between provision rates, reduced setback requirements and appropriate mitigation measures to reduce potential damage to adjacent infrastructure must be sought.

(c) Street trees shall be planted in accordance with:

(i) all applicable council approved standard drawings for tree planting; and

Editor's note—currently, no standard drawings are formally adopted for landscape treatments.

(ii) all setback requirements, being:

(A) a minimum 5 m from an electricity pole or pillar box;

(B) a minimum 7 m from a street light pole;

(C) a minimum 2 m from side entry stormwater pits;

(D) a minimum 2.5 m from either side of a driveway;

(E) a minimum 1.05 m from back of kerb; and

(F) a minimum 0.5 m from a footpath.

Editor's note—the above requirements are based on cross sections outlined on SD-015 Verge Service Corridors and other longitudinal setbacks intended to mitigate risk of conflict between street trees and other infrastructure. Setbacks from all utility services should be confirmed with the relevant asset owner/service provider. For setbacks on the approach and departure sides of bus stops, refer to SC6.4.4.8 Standard drawings (SD-515 Standard bus stop urban location layout details Type 1 and 2). For setbacks from intersections, refer to Austroads minimum gap acceptance and sight distance criteria. For setbacks on the approach and departure sides of pedestrian crossings and other designated crossing points, refer to crossing sight distance (CSD) requirements in *Traffic and Road Use Management Manual – Pedestrian Cross Facility Guidelines* and *Prioritisation System User Guide*.

(d) In addition to the above, the following apply:

(i) When street trees are to be planted in medians or roundabouts, extended planting setbacks (from back of kerb or adjacent hard surface treatments) apply, being:

(A) for small trees or large shrubs (mature canopy between 5 – 10 m in height or large shrubs greater than 3.5 m in height), setback at a distance of 2 m or half the mature canopy diameter, whichever is greater;

(B) for medium trees (mature canopy between 10 – 15 m in height), setback at a distance of 4 m or half the mature canopy diameter, whichever is greater; and

(C) for large trees (mature canopy greater than 15 m in height), setback at a distance of 6 m or half the mature canopy diameter, whichever is greater.

(ii) Where setbacks cannot be achieved, appropriate mitigation measures such as root barrier must be included.

(iii) Where species proposed have a known invasive root system, increased setbacks are required and mitigation measures such as root barrier are to be provided as per arborist advice.

(iv) Street tress will not be planted in clear zones, except where:

(A) Tree species are considered frangible and the mature trunk diameter will not exceed 100 mm; or

(B) where non-frangible tree species will be located behind road safety barriers.

(v) When planted in the CBD, commercial zones, or where the planting area is completely surrounded by impervious surfaces, a minimum root development zone of 4 m^3 must be provided for each street tree. This may be achieved through the use of structural soils, root cell products, pervious pavements or a combination of these treatments.

(e) Street tree species selection should:

(i) be selected with consideration of suitability criteria, including:

(A) whether there is an existing dominant species in the street or suburb that contributes to the streetscape or suburb character;

(B) size of the available planting space as some tree species are better able to survive in restricted growing areas;

(C) location of the new tree, the species growing habit and branch structure;

(D) whether the new tree will be planted under power lines as only a limited number of species are suitable in this situation;

(E) tree species water requirements and drought resistance;

(F) suitability for prevailing soil type;

(G) pollution resistance;

(H) species with minimal fruit, leaf and limb drop;

(I) species with high shade potential;

(J) species with higher resilience to cyclone damage; and

(K) environmental and habitat value of particular species;

(ii) be appropriate for the available planting space, accounting for all setback, offset and clearance requirements (overhead, longitudinally and horizontally across the road cross section);

(iii) only consist of trees that will achieve canopy clearance heights applicable to the streetscape situations outlined in Table SC6.4.3.6.9 Canopy clearance heights and exhibit a 1.2 m clear trunk at the time of planting;

Table SC6.4.3.6.9 Canopy clearance heights

Streetscape situation	Minimum vertical clearance height (at maturity)
Standard pedestrian and car park environment	2.4m
Cyclist environment	2.7m
Main and arterial roads	5.4m
Other roads	4.6m
High clearance routes	5.9m
Very high clearance routes (with no alternative)	6.5m

Editor's note—above clearances are based on minimum vertical clearances detailed in Austroads *Guide to Road Design*, Part 3: Geometric Design.

(iv) in established areas, the street trees species are to be nominated by council;

(v) in new development areas, the street trees species are to be nominated by the developer and approved by council; and

(vi) include palms in select locations only where:

(A) palm species are self-cleaning; or

(B) sufficient area beneath the palms are provided to mitigate risks from falling palms fronds; and

(C) the plantings will not impose an unsustainable maintenance requirement.

(f) Selection of the street tree stock size for planting should consider:

(i) the planting location such as whether it is in a median, roundabout or on the footpath (e.g. more mature stock may be required in roundabout plantings where sight lines will be impeded by the foliage of a young tree);

(ii) the optimal size to achieve best establishment (e.g. smaller stock typically establish better, larger stock may be required to meet visibility requirements at time of planting); and

(iii) the size of the original tree where replacing a removed tree (e.g. in instances were a large,

significant tree is removed, a larger sized and/or increased quantity of replacement stock may be considered).

(13) Tree guards

(a) Tree guards may be used in order to temporarily, semi-permanently or permanently protect trees during establishment and ongoing growth.

(b) Trees guards should consist of proprietary available products and be installed as per manufacturer specifications.

(c) Where new trees are to be planted within known areas of high vandalism, more durable, vandal resistant, temporary tree guards may need to be selected and installed to reduce potential loss of new plantings during establishment.

(d) Where tree guards are to be provided semi-permanently or permanently and/or in conjunction with tree grates, tree guards are to be designed, constructed and installed as an integrated component of the tree grate system. In these instances, all requirements for tree grates detailed below should be considered, where applicable.

(14) Tree grates and surrounds

(a) Tree grates and tree surrounds are to be provided in accordance with the following;

(i) tree grates are to be designed, constructed and installed in accordance with AS 3996 – Access covers and grates;

(ii) tree grates and alternative tree surrounds are to be provided in order to increase the usable walking space, protect tree and root systems and provide a cost effective solution to reduce maintenance requirements;

(iii) installation of tree grates and tree surrounds is to be limited to high trafficable areas of streetscapes (as detailed in SC6.4.3.3 Footpath treatment policy), regional level parks and civic spaces, unless approved otherwise;

(iv) the tree grates or surrounds should be of an appropriate material, size and colour suitable for the location, tree type and available space. Tree grate or surround design must allow for the penetration of air and water to the soil, whilst minimising potential trip and slip hazards and rubbish trapping. Consideration should be given to the growing habit of the selected trees, trunk shape, "off centre" trunks and expected changes to trunk and root diameter, allowing for variation or future modification with tree growth;

(v) tree grates or surrounds must be installed flush with adjacent surfaces, with grate metal support frames and appropriate fixings to be installed at the time of construction, as required to meet the specified loading capacity;

(vi) tree plantings with grates or other surrounds must be supported by all other necessary elements including but not limited to, structural root cell, root barrier, drainage gravel, and perforated pipe;

(vii) permeable paving is considered to be a suitable tree surround option, particularly for installation around existing, mature trees;

(viii) where the sub-section SC6.4.3.3 Footpath treatment policy applies, permeable paving is considered to be an alternative option for tree grates. In these instances, the specified colours must be used, in accordance with the pavement treatment hierarchy as per SC6.4.3.3 Footpath treatment policy. Table SC6.4.3.6.2, Table SC6.4.3.6.3, Table SC6.4.3.6.4, Table SC6.4.3.6.5, Table SC6.4.3.6.6 identify the corresponding permeable paving colours against the Footpath treatment policy pavement hierarchy; or

(ix) where SC6.4.3.3 Footpath treatment policy does not apply, alternative colours may be proposed.

Table SC6.4.3.6.2 P1 - Central business district (CBD) - Central and P2 Central business district (CBD) - Fringe

P1 – Central Business District (CBD) – Central **P2 – Central Business District (CBD) – Fringe**	
Permeable Paving Tree Surrounds: P1 AND P2	
Colour: “Dove”	

Table SC6.4.3.6.3 P3 - Commercial and activity areas: Biscuit, P4 - Commercial and activity areas: Paperbark, P5c - The Strand North, and P5e - Gregory Street North

P3 – Commercial And Activity Areas: Biscuit **P4 – Commercial And Activity Areas: Paperbark** **P5c – The Strand North** **P5e – Gregory Street North**	
Permeable Paving Tree Surrounds: P3, P4, P5c AND P5e	
Colour: “Sunset”	

Table SC6.4.3.6.4 P5a - Palmer Street

P5 a – Palmer Street	
Permeable Paving Tree Surrounds: P5a	
Colour: “K-Hill Blue”	

Table SC6.4.3.6.5 - P5b - The Strand South and P6 - Industrial Areas

P5 b – The Strand south **P6 – industrial areas**	
PERMEABLE PAVING TREE SURROUNDS: P5b and P6	
COLOUR: “K-Hill Grey”	

Table SC6.4.3.6.6 P5c - Sir Leslie Thesis Drive

P5 c – Sir Leslie Thesis Drive	
Permeable Paving Tree Surrounds: P5c	
Colour: “Desert Rose”	

(15) Operational requirements

(a) Streetscape designs must seek to minimise the ongoing costs and operational maintenance requirements by:

(i) ensuring treatments are durable, weatherproof, UV resistant and of robust construction and finish to reduce repair or replacement frequency;

(ii) minimising the potential to create litter traps;

(iii) promoting resistance to damage, vandalism, unauthorised use and removal;

(iv) promoting easy cleaning and are fully accessible and responsive to maintenance activities including mechanical cleaning procedures;

(v) incorporating erosion and sediment control measures to reduce clearing out of drains;

(vi) minimising the need for herbicide applications and brush cutting around furniture such as guard rail posts or signs;

(vii) ensuring effective access for maintenance and to critical road infrastructure is integrated into the streetscape design to support easy, time efficient operations;

(viii) ensuring all turf areas are of the minimum specified width to facilitate safe and efficient operation of mowing vehicles and reduce the requirement for "on foot" maintenance;

(ix) complying with all clearance and setback requirements to ensure maintenance can be safely undertaken without a reliance on traffic control;

(x) considering the plant maintenance regimes needed to maintain all safety requirements. Ongoing pruning requirements and frequency to maintain all clearances (particularly within clear zones and sight triangle) should be minimised through appropriate planting and species selection. All costs associated with these maintenance regimes should be built into the whole of life design cost;

(xi) using planting design to progressively reduce the number of maintenance interventions required over time for planted areas. This should include reducing weed and vegetation management activities through improved plant layout and layering, densities and species selection that establish quickly to choke out competing weeds and require no pruning or shaping;

(xii) identifying any traffic control requirements associated with ongoing maintenance operations in early design stages. This should include any lane or road closures, detours, and the ongoing cost to implement any such requirements. All options to reduce identified traffic control requirements should be explored in order to reduce ongoing operational costs; and

(xiii) mitigating any potential for streetscape elements to cause significant damage to other road infrastructure such as driveways, kerb and channel, road pavement and utility services.

(b) In order to properly assess maintenance requirements associated with streetscape proposals, council may request the provision of a maintenance plan and approved traffic management plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

SC6.4.3.6.32 Car parking plantings and shading

(1) Landscaping is to be provided to on-street and off-street car parking areas so as to improve the aesthetic and climatic properties associated with these sites. The prevailing climatic conditions in Townsville demand that shade is provided to car parking areas to improve the comfort and reduce the urban heat island effect from large areas of hard surface.

(2) Planting and shading options
Dependent on site and safety considerations, shading of car parks can be in the following manner:

(a) in single sided, angle or parallel bays – 1 tree per 3 car parks;

(b) in double sided – 1 tree per 6 car parks; and

(c) shade structures may be used in conjunction with low shrubs and low groundcovers internal to the parking area; and trees, low shrubs and ground covers on the periphery of the car park.

(3) Tree planting in car parks

(a) Trees planted within off-street car parking areas are provided with:

(i) a minimum surface planting area of 1.2 m^2, or are incorporated into continuous garden beds; and

(ii) planting pits for trees in car parks surrounded by hardstand are to provide a minimum of 4 m^3 for root zone development, at no greater depth than 1 m. The use of structural soils or root cell type products is highly recommended to achieve acceptable growth and form in shade trees.

(b) Trees planted within road reserve angle car parking areas are provided with garden bed areas between parking bays, which are to be kerbed and no less than 1.2 m wide internally.

(c) Trees must be planted in accordance with any approved standard drawings.

(d) Trees must be allowed to mature naturally and only pruned in accordance with AS4373.

Editor's note—currently, no standard drawings are formally adopted for tree planting. Refer also to SC.6.4.3.3 Footpath treatment policy.

(4) Landscape design and species selection

All car parking plantings must satisfy the following landscape design and species selection requirements:

(a) ground cover and shrubs should have a maximum height of 600 mm to preserve sight lines;

(b) tree canopies should achieve a minimum clearance above ground of 2.4 m above pedestrian and parking zones, or 4.6 m over vehicle movement zones;

(c) in public parking areas, trees are to be a species as nominated by council;

(d) in private parking areas, trees species are to be nominated by the developer and approved by council;

(e) trees and garden beds within car parking areas are protected by raised kerbs, wheel stops or bollards;

(f) all plantings in streetscapes and car parks are to comply with the specific design and construction requirements as detailed in sub-section SC6.4.6.26 Landscaping.

SC6.4.3.6.33 Green roofs, wall and vertical gardens

(1) Green roofs

Editor's note—due to the custom nature of green roofs, no design and construction standards are provided. Each site will be assessed on a case-by-case basis.

(2) Green walls, vertical gardens and façade greening

Editor's note—due to the custom nature of green walls, vertical gardens and façade greening, no design and construction standards are provided. Each site will be assessed on a case-by-case basis. Generally, planting features these types are to be within private property and should be under the maintenance regime of the owner. All engineering and hydraulic certification must be provided with any structure proposed.

SC6.4.3.6.34 Irrigation design and system requirements

(1) Introduction

Intent: Irrigation systems solely exist for the purpose of providing water to maintain the soil moisture content above the horticultural assets permanent wilting point and below the maximum field capacity. These conditions are required to maintain the health and growth of the horticultural assets.

(a) These guidelines, supported by SC6.4.6.27 Irrigation, set out the scope of work, workmanship standards and the responsibilities for the supply and installation of irrigation systems within private open space and public open space and streetscapes that will become a council asset on handover.

(b) In addition to this requirement council seeks to minimise water usage within all open space and reduce maintenance and operational costs associated with the council owned irrigation systems.

(c) Product and brand names for components in this sub-section and SC6.4.6.27 Irrigation are used to define a standard and quality acceptable to council, with particular emphasis on long term maintenance requirements. Components other than those specified may only be used if the components are of equal or better standard and quality of those specified and an authorised change has been approved by council.

(d) Where the developer/applicant has installed an unauthorized irrigation system not approved by Council, the developer/applicant will be required to remove such irrigation systems and rectify at their expense.

(e) Developer/applicants must aquaint themselves with Townsville's water restrictions of the time, and where required obtain written permission from Council to implement landscape treatments that require establishment water treatment. Such water treatment permissions shall be in line with Townsville's water restriction policy requirements for the establishment period.

(2) Irrigation design objectives:

(a) to ensure that irrigation systems are designed to the highest industry standards with the goal of maximising the efficient usage of water;

(b) to ensure that irrigation systems and components are installed in accordance with the relevant industry standards and tradesman like workmanship; and

(c) to ensure that the irrigation systems and components installed are of a quality and standard acceptable to council, with regard to the life of the system, the ongoing ease of maintenance and operational costs of the system and its components.

(3) General requirements

(a) All irrigation must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

(b) All irrigation systems are to be:

(i) designed to achieve an even and efficient supply of water to the nominated Hydro-Zone areas;

(ii) designed with consideration of local conditions such as topography, prevailing winds, micro-climate, rainfall volumes and seasonal dry and wet periods;

(iii) constructed using quality materials and components;

(iv) automated to allow for efficient water usage;

(v) programmed to operate in accordance with any council water restrictions;

(vi) designed to operate efficiently and effectively based on the water supply pressure and flow volume available to the system;

(vii) The minimum industry accepted standard by TCC for turf sprinkler uniform cover is a Distribution Uniformity (DU) of 75% cover; and

(viii) The minimum industry accepted standard by TCC for sportsfield turf sprinkler uniform cover is a Distribution Uniformity (DU) of 100% cover for all of the sport playing surface with a 85% cover of the surrounding safety zone of the playing field surface.

(c) All irrigation in private open space that is to be:

(i) installed and operated by a **private entity**, is **not** required to comply with the specific design and construction standards, however such systems that are connected to the reticulated water network is required to comply with Townsville's water restrictions of the time.

(ii) installed and/or operated by council, is to be designed and constructed as per requirements detailed in this sub section and SC6.4.6.27 Irrigation.

(d) All irrigation systems in public open space and road landscaping are to:

(i) be designed by qualified professionals, being a certified irrigation agronomist or a certified irrigation designer;

(ii) constructed using quality materials and components to ensure a robust, reliable, and long asset life;

(iii) be designed to minimise life cycle costs through reduced operational and maintenance requirements;

(iv) be designed and apply volume that should not cause foreseeable damage to the road structure or surface; and

(v) be designed and constructed as per requirements detailed in this sub–section and SC6.4.6.27 Irrigation.

(e) All irrigation systems in streetscapes and car parking areas are to:

(i) in a "main street" or "special character" situation where council owns and operates an irrigation system or has agreed to accept irrigation assets, the irrigation is to be provided in accordance

with SC6.4.6.27 Irrigation, and will be subject to the acceptance of works procedure as per Section SC6.4.7 Acceptance of completed works; and

(ii) in all other locations where irrigated turf or plantings are required as a condition of development, the irrigation system is to be connected to the adjacent private development.

(f) Irrigation systems in public open space and streetscapes should be designed in conjunction with all landscape elements to ensure that:

(i) landscape design and plant selection ensures the required level of irrigation to maintain the function and longevity of landscape is analogous with the assigned irrigation profile, as detailed in SC6.4.3.6 Attachment C Irrigation Profile Level Hierarchy and SC6.4.3.6 Attachment D Irrigation Profile Level Matrix;

(ii) landscape design and plant selection facilitates hydro-zoning;

(iii) landscape features are designed to maximise water infiltration through use of appropriate landforms, soil types and mulches;

(iv) landscape features are designed and constructed to ensure ease of irrigation coverage in the short and long term; and

(v) landscape features are designed to contribute to an integrated water management system.

(4) Irrigation types requirements

(a) All turf areas shall be irrigated with pop-up sprinklers or subsurface drip irrigation with the following specific requirements:

(i) all turf areas in roundabouts and median strips that border roadways shall be irrigated by drip irrigation;

(ii) all turf areas within 5 m of a roadway and within 50 m of the centre of an intersection shall be drip irrigated; and

(iii) where a site specific risk analysis recommending either method has been provided and accepted by council.

(b) All garden areas shall to be irrigated with subsurface drip irrigation, except for areas containing plants or trees with vigorous root systems such as palms or lilies which shall be irrigated by pop-up sprinklers.

(5) Agronomic requirements

For all irrigation systems the approved hours of operation shall be between 10.00pm and 5.00am, the operation of such irrigation systems shall also comply with Townsville's water restrictions of the time.

(a) For pop-up sprinklers the total time taken to deliver 7 mm of equivalent precipitation when each station is operated individually and consecutively shall not exceed a 7 hour period for all stations on a given system. Variations to this requirement may apply for stations operated simultaneously.

(b) For drip irrigation the total time taken to deliver 7 mm of equivalent precipitation when each station is operated individually and consecutively shall not exceed a 7 hour period for all stations on a given system. Variations to this requirement may apply for stations operated simultaneously.

(c) The irrigation application rate shall not exceed the infiltration rate of the soil.

(d) The operation of irrigation systems must avoid operating in strong winds, excessive or poor irrigation mains pressure, poor irrigation design or lack of maintenance, which all contribute to system delivery inefficiency.

(e) All irrigation systems that are to become Council assets to maintain must be fully commissioned and operating efficiently in accordance with the approved irrigation design plans for a minimum of 3 months prior to acceptance "Off Maintenance".

(6) Environmental requirements

The system shall not have excessive runoff which causes erosion or pollution of surrounding native areas and/or storm water drains.

(7) Automation requirements

(a) The irrigation controller shall be chosen from the units outlined in Table SC6.4.3.6.10.

Table SC6.4.3.6.10 Controller Selection list

Controller Name	Power Type / Source	Valve Capacity
AC Irrinet M Slave 12 - 24	AC / 240V Mains	12 to 24
AC Irrinet M Slave 36 - 48	AC / 240V Mains	36 to 48
AC Irrinet M 12 - 24	AC / 240V Mains	12 to 24
AC Irrinet M 36 - 48	AC / 240V Mains	36 to 48
AC Irrinet ACE 24 - 48	AC / 240V Mains	24 to 48
XR 1 - 4	DC / 6V Solar	1 to 4

(b) A maximum of three stations may be operated simultaneously (by programming only) given the follow conditions:

(i) irrigation type and precipitation rate of the stations to be operated simultaneously shall be the same;

(ii) the soil type, vegetation and topography of the stations to be operated simultaneously shall be the same; and

(iii) all stations to be operated simultaneously shall be able to supply the manufacturer's recommended pressure.

(c) Only one valve per controller output is acceptable.

(8) Separation of irrigation zones

(a) Irrigation zones shall be classified in the following vegetation types:

(i) turf grass;

(ii) garden bed; and

(iii) native vegetation or revegetation plantings.

(b) A single irrigation valve shall water no more than one irrigation zone.

(9) Safety requirements

The system shall not have runoff onto roadways, footpaths or other pedestrian areas to such an extent that it may result in a hazard to traffic and/or pedestrians.

(10) Temporary irrigation design

Temporary irrigation is exempt from the technical design and installation conditions outlined in this document provided it meets all other legislated requirements.

(a) All temporary irrigation installed in the public realm must be removed and terminated in accordance with council specifications prior to the area being accepted "off maintenance". All terminations and disconnections of temporary irrigation must be inspected by a council officer prior to backfilling.

(11) Existing Council Irrigation Assets

(a) Council's Irrigation Operations Unit must be notified of any disruptions to council owned irrigation assets prior to works commencing on these assets;

(b) Works in areas containing existing council irrigation assets are required to have plans for the deconstruction and isolation of the existing irrigation to ensure the system is not unnecessarily damaged and account for the ongoing watering requirements of the soft landscaping serviced by that irrigation;

(c) All existing council irrigation affected by development works must be reinstated to standards current at the time of the works;

(d) Any extensions to existing mainline require the installation of an isolation valve;

(e) Council shall charge costs for water usage based on agreement with the developer. Options include the installation of a sub-metering device or use of Irrinet flow data.

(f) Upon activation of any additions to council owned irrigation, revised flow data must be provided to council's Irrigation Operations Unit.

Editor's note—For further information on the construction of all irrigation systems, refer to the detailed landscape specification standards as provided in SC6.4.6 Construction Standards – in particular SC6.4.6 26 Landscape Construction and SC6.4.6.27 Irrigation

SC6.4.3.6.35 Water features and water play areas

(1) Water features and water play areas will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied, and will be considered on a case-by-case basis.

(2) Where the proposed water features and water play areas are associated with public open space, council owned land, or will involve potential future council assets, the infrastructure may only be permitted at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1. Approval from the relevant council asset owner/s will also be required.

(3) In order to properly assess any such proposals, council may request the provision of a maintenance plan and a life-cycle costing as part of the development application, as per SC6.4.2 Development application guidelines.

(4) Where water features are proposed as a development entry statement, applications may only be approved where the water feature will be within private property and the developer will remain, for the life of the asset, solely responsible for all aspects relating to the water feature (including ongoing maintenance and water costs).

(5) All water features and water play areas must be designed and installed to comply with all relevant Australian Standards.

Editor's note—due to the place-specific, custom nature of water features and water play areas, no further specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with necessary requirements defined by all applicable engineering, electrical, drainage, swimming pool and water safety standards, legislation, local laws and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal.

SC6.4.3.6 Attachment A: Preferred plant species list

CATEGORY	BOTANICAL NAME1	COMMON NAME	STREET TREES 3m wide desirable planting width (1m min)2	STREET TREES- 3-6 m desirable planting with (2m min)2	STREET TREES for ≥ 6m desirable palnting width (5m min)2	STREET TREES Suitable for planting under powerlines2	STREET TREES Suitable for avenue plantings2	TREES Suitable as features or specimen trees in parks & open space3	Suitable for COASTAL FOREHSORE AREAS	Suitable in and near NATURAL AREAS4	Suitable for Council PARKS AND OPEN SPACE (greater than 5m of space required for trees)3	Suitable for COMMERCIAL AND DOMESTIC PREMISES where space permits5
	Blank = does not fit criteria or	N.A.• = fits criteria.	TREES (BY LOCATION SUITABILITY)						ALL VEGETATION (BY 'SETTING' SUITABILITY)			
Large Trees over 10m (Native)												
	Acacia auriculiformis	Black Wattle		•	•			•		•	•	•
	Acacia crassicarpa	Beach Wattle							•	•	•	•
	Acacia mangium	Hickory Wattle						•		•	•	
	Acacia melanoxylon	Blackwood			•			•		•	•	•
	Adenanthera pavonina	Red Bead Tree		•	•			•		•	•	•
	Agathis robusta	Kauri Pine			•			•		•	•	•
	Aidia racemosa	Archer Cherry								•	•	•
	Albizia procera	Forest Siris			•					•	•	•
	Allocasuarina torulosa	Forest Oak						•		•	•	
	Alstonia actinophylla	Cape Milkwood						•		•	•	
	Alstonia scholaris	Milky Pine			•			•		•	•	
	Araucaria bidwillii	Bunya Pine			•			•		•	•	
	Araucaria cunninghamii	Hoop Pine			•		•	•		•	•	•

Bombax ceiba	Native Kapok Tree			•		•	•			•	
Brachychiton acerifolius	Flame Tree	•	•			•	•		•	•	•
Calophyllum inophyllum	Beauty Leaf			•			•	•	•	•	
Cananga odorata	Ylang Ylang Tree						•		•	•	
Canarium australasicum	Mango Bark		•	•			•	•	•	•	
Canarium australianum	Melville Island White Beech		•	•			•	•	•	•	•
Castanospermum australe	Black Bean			•			•		•	•	•
Casuarina cunninghamiana	River she-oak						•		•	•	
Corymbia citriodora (syn. Eucalyptus citriodora)	Lemon-scented Gum			•			•		•	•	
Corymbia clarksoniana (syn.Eucalyptus clarksoniana)	Clarkson's Bloodwood						•		•	•	
Corymbia erythrophloia (syn. Eucalyptus erythrophloia)	Red-barked Bloodwood						•		•		
Corymbia ptychocarpa (syn. Eucalyptus ptychocarpa)	Swamp Bloodwood						•			•	
Corymbia setosa (syn. Eucalyptus setosa)	Rough Leaf Bloodwood						•		•	•	
Corymbia tessellaris (syn. Eucalyptus tessellaris)	Moreton Bay Ash			•			•	•	•	•	•
Eleocarpus angusitfolius (syn E. grandis)	Blue Quandong			•			•	•	•	•	
Eucalyptus camaldulensis	River Red Gum						•			•	
Eucalyptus crebra	Narrow leafed Ironbark						•		•	•	
Eucalyptus drepanophylla	QLD Grey Ironbark						•		•	•	
Eucalyptus miniata	Darwin Woollybutt		•	•			•			•	•
Eucalyptus pellita	Red Mahogany		•	•			•		•	•	
Eucalyptus platyphylla	Poplar Gum						•		•	•	
Eucalyptus raveretiana	Black Ironbox						•		•	•	
Eucalyptus similis	Inland Yellow Jacket		•	•			•		•	•	
Eucalyptus tereticornis	Blue Gum						•		•	•	
Euroschinus falcatus	Ribbon Wood		•	•					•	•	
Ficus benjamina	Weeping Fig			•			•			•	
Ficus microcarpa var hillii	Hills Weeping Fig			•			•		•	•	
Ficus racemosa	Cluster Fig						•		•	•	
Flindersia brayleyana	Queensland Maple		•	•			•			•	
Ganophyllum falcatum	Scaly Bark Ash		•	•			•	•	•	•	
Gossia bidwillii (syn. Austromyrtus bidwillii)	Python Tree		•	•						•	•
Grevillea hilliana	White Silky Oak		•	•			•		•	•	
Lophostemon confertus	Brush box			•			•		•	•	
Lophostemon grandiflorus	Northern Swamp Mahogany		•	•			•		•	•	•
Melaleuca dealbata	Cloudy or Silver-leaved Paperbark		•	•			•		•	•	•
Melaleuca fluviatilis	Weeping Paperbark		•	•		•	•		•	•	
Melaleuca leucadendra (fine leaf form included)	Paperbark		•	•			•		•	•	•
Melaleuca quinquenervia	Broad leaved paperbark		•	•			•		•	•	•

	Nauclea orientalis	Leichhardt Tree			•			•		•	•	•
	Peltophorum pterocarpum (Nth Aust. Form)	Yellow Flame Tree			•			•			•	•
	Pittosporum ferrugineum	Rusty Pittosporum			•			•	•	•	•	•
	Pleiogynium timorense	Burdekin 87vPlum			•		•	•	•	•	•	•
	Rapanea variabillis	Muttonwood		•	•		•	•			•	•
	Syzygium forte	White Apple		•	•			•			•	•
	Syzygium fortes subsp. Potamophilum	Flaky Barked Satinash		•	•		•	•			•	•
	Syzygium francisii	Francis's Water Gum		•	•			•			•	
	Syzygium hemilamprum (Syn. Acmena hemilampra)	Broad-leaved Lillpilly	•	•				•		•	•	•
	Sygyzium luehmannii	Small leaved Lillypilly		•	•			•		•	•	•
	Syzygium tierneyanum	River Cherry			•			•		•	•	•
	Terminalia arenicola	Damson Plum			•			•		•	•	•
	Terminalia catappa	Sea Almond			•			•	•	•	•	
	Terminalia complanata	Cape York Terminalia			•			•			•	
	Terminalia melanocarpa	Sea Almond			•			•		•	•	
	Terminalia porphyrocarpa	Sea Almond		•	•			•		•	•	
	Terminalia sericocarpa = T. microcarpa	Damson Plum			•			•		•	•	
	Timonius timon	Tim Tam Tree		•	•			•		•	•	•
	Toona ciliata (syn. T. australis)	Red Cedar						•			•	
	Xanthostemon chrysanthus	Golden Penda	•	•	•			•		•	•	•
Large Trees over 10m (Exotic)												
	Caesalpinia ferrea	Leopard Tree		•	•			•			•	•
	Cassia javanica	Pink Cassia		•	•		•	•			•	
	Ficus benghalensis	Banyan Fig						•			•	
	Khaya senegalensis	African Mahogany						•			•	
	Mangifera indica	Mango		•	•			•			•	•
	Mesua ferrea	Ceylon Ironwood		•	•		•	•			•	•
	Pterocarpus indicus	Rosewood			•			•			•	
	Pterocarpus indicus 'Pendula'	Weeping Rosewood		•	•			•			•	•
	Handroanthus impetiginosus (syn.Tabebuia palmerii)	Pink Trumpet Tree		•	•			•			•	•
	Samanea saman (syn. Albizia saman)	Rain Tree						•			•	
	Swietenia mahoganii	Mahogany						•			•	•
	Tamarindus indica	Tamarind		•	•			•			•	•
	Tectona grandis	Teak						•			•	
Trees 5-10 m (Native)												
	Acacia flavescens	Yellow Wattle, Toothed Wattle							•	•	•	•
	Acmena smithii = Syzygium smithii	Lillypilly		•	•						•	•
	Alphitonia excelsa	Red Ash		•	•				•	•	•	•
	Antidesma bunius	Herbert River Cherry		•	•					•	•	•
	Arytera divaricata	Rose Tamarind	•	•	•		•			•	•	•
	Atalaya hemiglauca	Whitewood		•						•	•	•
	Atractocarpus fitzalanii (Syn. Randia fitzalanii)	Brown Gardenia		•						•	•	•
	Backhousia citriodora	Lemon Scented Myrtle			•					•	•	•
	Barringtonia acutangula	Freshwater Mangrove	•	•	•			•	•	•	•	•
	Barringtonia asiatica	Fish Killer Tree		•	•			•	•	•	•	•

Barringtonia calyptrata	Cassowary Pine	•	•	•		•	•	•	•	•	•
Barringtonia racemosa	Fish Poison Tree	•	•	•			•	•		•	•
Brachychiton australis	Broad-leaved Bottle Tree		•	•			•		•	•	•
Brachychiton discolor	White Kurrajong	•	•	•			•			•	•
Brachychiton rupestris	Bottle Tree		•	•		•	•			•	•
Buchanania arborescens	Little Gooseberry Tree					•	•			•	•
Buckinghamia celsissima (NQ Form)	Ivory Curl Tree	•	•	•		•	•		•	•	•
Bursaria spinosa	Prickly Box, Native Blackthorn		•	•	•			•	•	•	•
Carallia brachiata	Corkwood	•	•	•			•	•	•	•	•
Cassia brewsteri	Brewster's Cassia	•	•	•			•		•	•	•
Cassia queenslandica	Queensland Cassia	•	•	•			•			•	•
Cassia sp. (Paluma Range)	Paluma Range Cassia	•	•	•			•		•	•	•
Casuarina equisetifolia	Horsetail She-oak, Beach Casuarina			•				•	•	•	
Chionanthus ramiflorus	Native Olive	•	•	•					•	•	•
Cochlospermum gillivraei	Native Kapok							•	•	•	•
Cordia dichotoma	Glue Berry			•				•			
Cordia subcordata	Sea Trumpet	•	•	•			•	•		•	•
Corymbia peltata (syn. Eucalyptus peltata)	Rusty Jacket		•	•				•	•	•	•
Cupaniopsis anacardioides	Tuckeroo	•	•	•	•	•	•	•	•	•	•
Davidsonia pruriens	Davidson's Plum			•				•	•	•	•
Deplanchea tetraphylla	Golden Bouquet Tree		•	•			•		•	•	
Dillenia alata	Red Beech		•	•			•	•	•	•	•
Elaeocarpus eumundi	Eumundi Quandong	•	•	•			•		•	•	•
Eleocarpus reticulatus	Blueberry Ash		•	•			•			•	
Erythrina vespertilio	Bat Wing Coral Tree						•	•	•	•	
Eucalyptus phoenicea	Scarlet Gum		•	•						•	•
Eucalyptus pruinosa	Silver Box		•	•			•		•	•	•
Eucalyptus shirleyi	Shirley's Silver Leaved Ironbark			•					•	•	•
Ficus platypoda	Rock-cracker Fig			•					•	•	•
Geijera salicifolia	Scrub Wilga		•				•		•	•	•
Glochidion philippicum	Daintree Cheese Tree							•	•	•	•
Grevillea baileyana	Findlay's Silky Oak	•	•			•			•	•	•
Grevillea parallela	Beefwood								•	•	•
Grevillea pteridifolia	Golden Grevillea								•	•	•
Grevillea striata	Beefwood								•	•	•
Harpullia hillii	Tulipwood		•	•					•	•	•
Harpullia pendula (NQ Form)	Tulipwood/ Tulip Lancewood	•	•	•		•	•		•	•	•
Hibiscus tiliaceus	Cottonwood							•	•	•	•
Hymenosporum flavum	Native Frangipani	•	•	•					•	•	•
Lysiphyllum hookeri = Bauhinia hookeri	Native Bauhinia	•	•		•	•	•		•	•	•
Macaranga tanarius	Heart Leaf								•	•	•
Mallotus phillipensis	Red Kamala		•	•					•	•	•
Maniltoa browneoides	Handkerchief Tree		•	•			•			•	•
Maniltoa lenticellata	Silk Handkerchief Tree		•	•			•			•	•

	Melaleuca bracteata	Black Tea-tree	•	•		•	•			•	•	•
	Melaleuca linariifolia	Narrow-leaved Paperwork	•	•		•	•				•	•
	Melaleuca nervosa	Paperbark								•	•	•
	Melaleuca 'Revolution Green' & M. 'Revolution Gold'	Revolution Green & Revolution Gold	•			•						
	Melaleuca viminalis & cultivars (syn. Callistemon viminalis)	Bottlebrush	•	•		•				•	•	
	Melaleuca viridiflora	Broad-leaved Paperbark				•				•	•	•
	Melicope elleryana	Corkwood		•	•						•	•
	Melicope rubra (syn. Evodiella muelleri)	Little Evodia	•	•						•	•	•
	Micromelum minutum	Lime Berry								•	•	•
	Millettia pinnata (syn. Pongamia pinnata)	Pongamia or Indian Beech		•	•			•		•	•	•
	Mimusops elengi	Red Coondoo	•	•	•	•	•	•	•	•	•	•
	Mimusops elengi 'Street Elegance'	Variegated Mimusops	•	•	•		•				•	•
	Morinda citrifolia	Cheese Fruit							•	•	•	•
	Pararchidendron pruinosum	Snow Wood	•	•	•					•	•	•
	Petalostigma pubescens	Quinine Bush								•	•	•
	Pipturus argenteus	Native White Mulberry								•	•	•
	Planchonia careya	Cocky Apple							•	•	•	•
	Premna serratifolia	Creek Premna							•	•	•	•
	Scolopia braunii	Brown Birch	•	•	•	•	•	•		•	•	•
	Sterculia quadrifida	Peanut Tree	•	•	•		•			•	•	•
	Syzygium angophoroides	Yarrabah Satinash		•	•					•	•	•
	Syzygium australe & cultivars	Lillypilly	•	•						•	•	•
	Syzygium cormiflorum	Bumpy Satinash			•			•		•	•	•
	Syzygium johnsonii	Rose Satinash		•	•					•	•	•
	Syzygium oleosum	Blue Lillypilly		•	•					•	•	•
	Terminalia muelleri	Mueller's Damson			•			•		•	•	•
	Waterhousea floribunda = Syzygium floribundum	Weeping Lillypilly	•	•	•			•			•	•
	Waterhousea unipunctata = Syztgium unipunctatum	Roly Poly Satinash	•	•	•					•	•	•
	Vachellia bidwillii (syn. Acacia bidwillii)	Corkwood								•	•	•
Trees 5-10m (Exotic)												
	Cassia 'Rainbow Shower'	Rainbow Shower Cassia		•	•			•			•	•
	Delonix regia	Poinciana, Flamboyant Tree		•	•			•			•	•
	Fraxinus griffithii	Flowering Ash	•	•	•	•	•				•	•
	Kigelia pinnata	Sausage Tree						•			•	•
	Lagerstroemia speciosa	Queens Crepe Myrtle, Pride of India		•	•		•	•				
	Magnolia champaca (syn. Michelia champaca)	Michelia	•	•	•	•	•	•			•	•
	Plumeria obtusa and cultivars	Evergreen Frangipani	•	•	•	•	•	•			•	•
	Plumeria rubra and cultivars	Frangipani	•	•	•	•	•	•			•	•
	Polyalthia longifolia "Pendula'	Indian Mast Tree	•	•	•		•	•			•	•
	Schotia brachypetala	Drunken Parrot Tree	•	•	•		•	•			•	•

	Tabebuia aurea syn. T. argentea	Silver Trumpet Tree	•	•	•	•	•	•			•	
	Tabebuia heterophylla (syn. T. pallida [in part))	Pale Pink Trumpet Tree	•	•	•		•	•			•	•
	Tabebuia pallida	White Trumpet Tree	•	•	•		•	•			•	•
	Various tropical fruit, nut and spice trees	tropical fruit, nut and spice trees										•
Small Trees & Shrubs to 5m (Native)												
	Acacia leptostachya	Townsville Wattle								•	•	•
	Acacia jackesiana	Jackes Wattle								•	•	•
	Acacia podalyriifolia	Mt Morgan Wattle								•	•	•
	Acacia simsii	Sims Wattle								•	•	•
	Acmena smithii var. minor = Syzygium smithii	Lillypilly	•			•	•				•	•
	Acmena smithii 'Hot Flush'	Lillypilly - Hot Flush	•			•	•				•	•
	Antidesma parvifolium	Currant Bush								•	•	•
	Babingtonia spp. = Baeckea spp.	Baeckea									•	•
	Babingtonia virgata (Complex) syn. Baeckea virgata & cultivars	Twiggy Baeckea									•	•
	Banksia robur	Swamp Banskia								•	•	•
	Brachychiton bidwillii	Little Kurrajong	•	•		•	•				•	•
	Breynia oblongifolia (& 'Iron Range')	Coffee Bush (& Bronze Coffee Bush)								•	(•)	(•)
	Bursaria incana	Prickly Pine								•	•	•
	Bursaria tenuifolia	Native Mock Orange	•	•	•	•				•	•	•
	Clerodendrum floribundum	Lolly Bush	•			•		•	•	•	•	•
	Clerodendrum inerme	Scrambling Clerodendrum							•	•		
	Cleistanthus apodus	Weeping Cleistanthus	•	•	•						•	•
	Cleistanthus hylandii	Bernie's Cleistanthus		•		•	•				•	•
	Dodonaea lanceolata	Hop Bush								•	•	•
	Dodonaea viscosa	Sticky Hop Bush								•	•	•
	Gossia floribunda (syn. Austromyrtus floribunda)	Cape Ironwood	•			•					•	•
	Graptophyllum excelsum	Scarlet Fuchsia								•	•	
	Graptophyllum ilicifolium	Holly Leaved Fuchsia								•	•	
	Hibiscus divaricatus	Pink Native Hibiscus								•		•
	Hibiscus tiliaceus 'Rubra'	Bronze Cottonwood									•	•
	Jasminum simplicifolium subsp. australiense	Stiff Jasmine							•	•		•
	Larsenaikia ochreata	Native Gardenia								•	•	•
	Leptospermum madidum ssp. madidum syn. L. longifolium (in part)	Northern Weeping Tea Tree			•						•	•
	Leptospermum parvifolium syn. L. longifolium (in part)	Weeping Tea Tree		•	•						•	•
	Leptospermum petersonii	Lemon-scented Tea Tree									•	•
	Leptospermum polygalifolium syn. L. flavescens and cultivars	Yellow Tea Tree								•	•	•
	Leptospermum Cultivars	Tea Tree									•	•
	Leea indica	Bandicoot Berry								•	•	•

	Melaleuca linariifolia cultivars 'Purpurea', 'Claret Tops' and similar	Claret Tops									•	•
	Melaleuca sp. (Mount Stuart) (syn. Callistemon sp. (Mount Stuart))	Mount Stuart Bottlebrush								•	•	•
	Melaleuca thymifolia & cultivars	Thyme Honey Myrtle									•	•
	Melaleuca viminalis (Cultivars to 5m) (syn. Callistemon viminalis)	Bottlebrush	•	•	•	•	•			•	•	•
	Melastoma affine	Blue Tongue								•		•
	Melicope rubra	Little Evodia								•	•	•
	Murraya ovatifoliolata	Native Murraya	•			•				•	•	•
	Neofabrica myrtifolia	Yellow Tea Tree	•	•		•				•	•	•
	Phyllanthus cuscutiflorus & cultivars	Pink Phyllanthus	•	•		•		•			•	•
	Phyllanthus lamprophyllus	Phyllanthus								•	•	•
	Scaevola taccada	Cardwell Cabbage						•	•	•		•
	Sophora tomentosa	Silverbush						•	•	•		•
	Syzygium australe 'Aussie Southern'	Lillypilly	•	•		•	•				•	•
	Syzygium 'Elite'	Lillypilly	•	•		•	•				•	•
	Syzygium australe (Cultivars to 5m)	Lillypilly	•	•		•	•				•	•
	Thespesia populneoides	Beach Hibiscus						•	•			
	Xanthostemon 'Daintree Gem'	Varigated Penda	•	•	•	•	•	•			•	•
	Xanthostemon verticulatus	Cream Dancer									•	•
	Vitex trifolia	Native Lavender						•	•	•	•	•
Shrubs to 5m (Exotic)												
	Abelia spp.	Abelia									•	•
	Acalypha spp. and cultivars	Acalypha									•	•
	Barleria obtusa and cultivars	Purple Dazzler and Purple Gem									•	•
	Brunfelsia australis (syn. B. latifolia & B. bonodorata)	Yesterday, Today and Tomorrow									•	•
	Calliandra spp and cultivars	Pom pom Bush									•	•
	Codiaeum variegatum	Croton									•	•
	Duranta repens and cultivars	Duranta										•
	Eugenia uniflora	Surinam Cherry									•	•
	Euphorbia leucocephala	Snow Flake									•	•
	Euphorbia pulcherrima	Poinsettia									•	•
	Gardenia spp. and cultivars	Gardenia									•	•
	Graptophyllum pictum and cultivars	Caricature Plant									•	•
	Hibiscus spp and cultivars	Hibiscus									•	•
	Ixora spp. and cultivars	Ixora									•	•
	Mussaenda spp. & cultivars	Bangkok Rose									•	•
	Polyscias spp and cultivars	Ming Aralias									•	•
	Raphiolepis 'Apple Blossum' and similar	Indian Hawthorn									•	•
	Russelia equisetiformis and cultivars	Coral Plant									•	•
	Various tropical fruit, nut, spice, condiments and herbs	Tropical fruit, nut, spice,condiment & herbs										•

Palms, palm like and tropical foliage (Native)												
	Archontophoenix alexandrae	Alexandra Palm								•	•	•
	Archontophoenix cunninghamiana	Bangalow Palm									•	•
	Asplenium australasicum	Birds Nest Fern								•	•	•
	Asplenium nidus	Birds Nest Fern								•	•	•
	Alpinia caerulea	Native Ginger								•	•	•
	Alpinia modesta	Narrow-leaf Ginger								•	•	•
	Bowenia serrulata	Byfield Fern									•	•
	Bowenia spectabilis	Zamia Fern								•	•	•
	Carpentaria acuminata	Carpentaria Palm							•		•	•
	Cordyline cannifolia	Palm Lillies									•	•
	Curcuma australasica	Native Turmeric, Cape York Lily									•	•
	Cyathea cooperi	Tree Fern								•	•	•
	Cyathea rebeccae	Rebecca's Tree Fern								•	•	•
	Cycas media subsp. media	Australian Nut Palm								•	•	•
	Cycas spp	Cycad									•	•
	Lepidozamia hopei	Hopes Lepidozamia									•	•
	Lepidozamia peroffskyana	Peroffskys' Lepidozamia									•	•
	Licuala ramsayi	Australian Fan Palm								•	•	•
	Livistona australis	Cabbage Palm								•	•	•
	Livistona decora [syn. L. decipiens]	Weeping Cabbage Palm						•	•	•	•	•
	Livistona drudei	Fan Palm						•	•	•	•	•
	Livistona lanuginosa	Cape River Fan Palm						•		•	•	•
	Livistonia muelleri	Dwarf Fan Palm									•	•
	Macrozamia spp	Cycad									•	•
	Pandanus cookii [syn. P. whitei]	Screw Pine						•	•	•	•	•
	Pandanus spp	Pandanus							•		•	•
	Ptychosperma elegans	Solitare Palm								•	•	•
	Ptychosperma macarthurii	Macarthur Palm									•	•
	Wodyetia bifurcata	Foxtail Palm						•			•	•
	Xanthorrhoea johnsonii	Grass Tree								•	•	•
	Xanthorrhoea glauca	Grey Grass Tree									•	•
Palms, palm like and tropical foliage (Exotic)												
	Alpinia spp. and cultivars	Shell Ginger									•	•
	Alpinia galangal	Galangal									•	•
	Ananas comosus 'Variegatus'	Variegated Pineapple									•	•
	Beaucarnea recurvata	Ponytail Palm									•	•
	Bismarckia nobilis	Bismarckia Palm									•	•
	Calathea spp and cultivars	Calathea									•	•
	Chamaedorea spp	Bamboo Palms									•	•
	Codiaeum variegatum cultivars and forms	Garden Croton									•	•
	Cordyline fruticosa and cultivars	Ti-Plant									•	•
	Crinum spp. & cultivars	Crinum Lily									•	•
	Ctenanthe spp and cultivars										•	•
	Curcuma spp and cultivars	Ornamental Tumeric									•	•
	Cyathea spp and cultivars	Tree Ferns									•	•
	Cyrtostachys lakka	Lipstick Palm, Sealing Wax Palm						•			•	•
	Cycas revoluta	Cycad									•	•
	Dictyosperma album	Princess Palm						•	•		•	•
	Dypsis lutescens	Golden Cane Palm									•	•

	Dypsis spp	Palms									•	•
	Dracaena spp and cultivars	Dragon Tree						•			•	•
	Furcraea foetida and cultivars	Mauritius Hemp									•	•
	Heliconia spp and cultivars	Crab Flowers									•	•
	Hippeastrum spp and cultivars	Amaryllis									•	•
	Hyophorbe lagenicaulis	Bottle Palm									•	•
	Hyophorbe verschaffelti	Spindle Palm									•	•
	Licuala grandis	Ruffled Fan Palm									•	•
	Maranta spp and cultivars	Prayer Plants									•	•
	Neodypsis decaryii	Triangle Palm									•	•
	Pandanus spp	Screw Pines						•	•		•	•
	Philodendron spp and cultivars	Philodendron									•	•
	Phoenix roebelenii	Dwarf Date Palm									•	•
	Pitcairnia spp and cultivars	Stappy-leaved Bromeliads									•	•
	Pleomeles spp and cultivars	Lance Dracaena						•			•	•
	Pritchardia pacifica	Fijian Fan Palm							•		•	•
	Roystonea regia	Royal Palm									•	•
	Rhapsis excelsa and cultivars	Lady Palm									•	•
	Spathiphyllum spp and cultivars	Peace Lilly									•	•
	Strelitzia spp and cultivars	Bird of Paradise									•	•
	Veitchia merrelii	Christmas Palm									•	•
	Yucca spp. and cultivars	Yucca						•			•	•
	Verscaffeltia splendida	Stilt Palm									•	•
	Zamia furfuracea	Cardboard Plant							•		•	•
	Zamiaoculcas zamifolia	Zanzibar Gem or ZeeZee Plant									•	•
	Zingiber spp.	Ginger									•	•
Groundcover, border and tufted plants (Native)												
	Abelmoschus moschatus ssp.tuberosus	Native Rosella								•	•	•
	Acmena smithii 'Hedgemaster' , 'Allyn Magic','Mini Magic' and similar	Dwarf Acmena									•	•
	Bothriochloa bladhii subsp. bladhii	Local Native Grass								•	•	•
	Bothriochloa decipiens	Local Native Grass								•	•	•
	Bothriochloa ewartiana	Local Native Grass								•	•	•
	Bothriochloa spp. (other)	Native Grass									•	•
	Canavalia maritima	Beach Bean							•	•	•	•
	Casuarina glauca 'Cousin It'	'Cousin It'							•	•	•	•
	Crinum pedunculatum	Swamp Lily							•		•	•
	Crinum uniflorum	Small Swamp Lily							•		•	•
	Cajanus reticulatus	Rusty Rattlepod								•	•	•
	Canavalia rosea	Beach Bean							•	•		•
	Cymbopogon ambiguus	Australian Lemon-scented Grass								•	•	•
	Cymbopogon bombycinus	Silky Oil Grass								•	•	•
	Cymbopogon queenslandicus	Queenland Lemon-scented Grass							•	•		•
	Cymbopogon refractus	Barbed Wire Grass							•	•		
	Dianella atraxis	Flax Lily								•	•	•
	Dianella caerulea	Blue Flax Lily								•	•	•

	Dianella caerulea 'Little Jess'	Dwarf Flax Lily									•	•
	Eleocharis atropurpurea	Purple Spikerush								•	•	•
	Eleocharis dulcis	Water Chestnut								•	•	•
	Eleocharis geniculata	Spike Sedge								•	•	•
	Enchylaena tomentosa	Ruby Salt Bush							•	•	•	•
	Enneapogon polyphyllus	Leafy Nineawn							•	•	•	•
	Enteropogon unispiceus	Northern Kennedy Windmill Grass							•	•	•	•
	Enneapogon spp.	Bottle Washers or Pappus Grass							•	•	•	•
	Eustrephus latifolius	Wombat Berry							•	•	•	•
	Ficinia nodosa syn.Isolepis nodosa	Knobby Club-rush							•		•	•
	Haemodorum coccineum	Blood Lily								•		•
	Heteropogon contortus	Black Spear Grass								•		
	Juncus usitatus	Common Rush								•		
	Indigofera pratensis	Forest Indigo								•	•	•
	Ipomea pes-caprae	Beach Morning Glory or Goat's Foot							•	•	•	•
	Lomandra confertifolia	Little Lomandra								•	•	•
	Lomandra hystrix	Slender Mat Rush								•	•	•
	Lomandra longifolia	Mat Rush								•	•	•
	Melaleuca 'Little John' syn. Callistemon 'Little John' & similar cultivars	Little John Bottlebrush									•	•
	Phyla nodiflora	Phyla or Frog Fruit								•	•	•
	Proiphys amboinensis	Cardwell Lily								•	•	•
	Schoenoplectus validus	Lake Club-rush								•		
	Spathoglottis plicata	Ground Orchid									•	•
	Spinifex sericeus	Silky Spinifex							•	•	•	•
	Syzygium australe 'Tiny Trev' and similar ciltivars	Dwarf Lillypilly									•	•
	Themeda triandra	Kangaroo Grass								•		
	Thuarea involuta	Beach Grass							•	•	•	•
	Vigna marina	Beach Pea							•	•	•	•
	Vitex rotundifolia (syn. V. ovata)	Beach Vitex							•	•	•	•
	Viola hederaceae	Native Violet									•	•
	Xanthostemon 'Little Goldie' and similar cultivars	Little Goldie Penda									•	•
Groundcover, border and tufted plants (Exotic)												
	Aglaonema spp and cultivars	Aglaonema									•	•
	Arachis pintoi	Peanut Pinto									•	•
	Austromyrtus 'Copper Tops' and similar cultivars	Dwarf Midyim									•	•
	Cuphea hyssopifolia	Mad Hatter									•	•
	Dianella 'Silver Streak' & 'Silver'	Stripped Dianella									•	•
	Dietes bicolour	Butterfly Iris									•	•
	Dietes grandiflora	Wild Iris									•	•
	Evolvulus pilosus 'Blue Sapphire'	Blue Sapphire									•	•
	Gardenia florida 'Radicans'	Gardenia									•	•
	Gazania spp and cultivars	Treasure Flowers									•	•
	Hemigraphis spp	Red Ivy									•	•
	Hippeastrum spp and cultivars	Hippeastrum									•	•

	Hymenocallis littoralis	Spider/Seaside Lily									•	•
	Hymenocallis 'Thai Spider'	Varigated Spider Lily									•	•
	Hymenocallis speciosa	Green-tinged Spider Lily									•	•
	Impatiens 'New Guinea' spp and cultivars	Impatiens										•
	Liriope spp. and cultivars	Liriope									•	•
	Ipompea batatas 'Rust Red' & ' Bright Ideas Lime'	Ipompoea									•	•
	Murraya paniculata 'Min-A-Min' and similar cultivars	Dwarf Mock Orange									•	•
	Ophiopogon spp and cultivars	Mondo Grass									•	•
	Pandanus pygmaeus 'Aurea Nana'	Pygmy Pandanus									•	•
	Phyllanthus multiflorus	Fountain Plant									•	•
	Rhoeo 'Hawaiian Dwarf'	Dwarf Rhoeo/Moses in the cradle									•	•
	Trachlospermum jasminoides 'Tricolor'	Creeping Star-Jasmine									•	•
	Tulbaghia violecea	Society Chives									•	•
	Zephyranthes candida	Autumn Crocus or Rain Lily									•	•
	Zephyranthes grandiflora	Rose Pink Rain Lily									•	•
	Zoysia tenuifolia	No Mow Grass									•	•
	Vegetables (various)											•
Vines and scrambling plants (Native)												
	Aristolochia acuminata (syn. A. tagala)	Native Dutchman's Pipe								•	•	•
	Cissus antartica	Kangaroo Vine								•	•	•
	Jasminium didymum	Coastal Jasmine							•	•	•	•
	Jasminium simplicifolium	Simple-leaved Jasmin								•	•	•
	Pandorea jasminoides	Bower of Beauty									•	•
	Pandorea pandorana	Wonga Vine								•	•	•
	Tecomanthe hillii	Fraser Island Creeper									•	•
	Tecomanthe spp and Cultivars										•	•
Vines and scrambling plants (Exotic)												
	Dipladenia spp and cultivars	Dipladenia									•	•
	Mandevilla spp and cultivars	Mandevilla									•	•
	Mucuna bennettii	Scarlet Jade Vine									•	•
	Petrea volubilis	Purple Weath									•	•
	Pyrostegia venusta	Orange Trumpet Vine									•	•
	Strongylodon macrobotrys	Jade Vine									•	•
	Trachelospermum jasminoides	Star Jasmin									•	•
	Thunbergia mysorensis	Lady Slipper Vine									•	•
	Various climbing & scrambling fruit, vegetables and condiments											•
Lawn grasses												
	Axonopus affinis	South Johnson Buffalo									•	•
	Axonopus compressus	Broad-leaf Carpet Grass or Nthn Buffalo Grass							•		•	•
	Cynodon dactylon	Couch							•		•	•
	Digitaria didactyla	Blue Couch									•	•
	Stenotaphrum secundatum 'Sir Walter'	Sir Walter Soft Buffalo							•		•	•

	Zoysia 'Empire' and similar	Zoysia Turf									•	•
	Zoysia mutrella	Manila Grass									•	•

Click here to view PDF of SC6.4.3.6 Attachment A: Preferred plant species list

Note—

1. Nomenclature generally based on Census of the Queensland Flora 2013, edited by Peter D. Bostock and Ailsa E. Holland found on the Queensland Government data website = indicates where plant name differs from Australian Plant Name Index at http://www.anbg.gov.au/cgi-bin/apclist
   Synonyms included where superseded name is still in common use in trade.
2. Refer streetscape design and treatments section for location and setback requirements. Case by case assessment of species suitability will be required dependent on location (verge, central median etc.)
3. Refer public open space section for requirements in these locations.
4. Species with a natural distribution within North Kennedy Pastoral District. Distribution checked against Census of the Queensland Flora 2010.
5. Refer to development codes for offset distances from property boundaries.

SC6.4.3.6 Attachment B: Adopted Master plans

Thuringowa Riverway Master Plan
Stage 1: Pioneer Park and Loam Island
February 2003

Riverway Sustainable Development Policy
City of Thuringowa Planning Scheme Policy 2003

SC6.4.3.6 Attachment C: Irrigation Profile Level (IPL) Hierarchy definition

The TCC Irrigation Profile Level (IPL) Hierarchy includes the following types: High, Medium, Low, Non.

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

High	• Provides irrigation to Townsville City Councils landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets,
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• Formal gardens irrigated to (IPL) levels High and Medium only.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Promote**:
		  • **Vigorous plant growth,**
		  • **Best plant health,**
		  • **Best presentation.**
		
		Visual Indicators - **turf**:
		  • **Lush thick turf,**
		  • **Rich even green appearance.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 28 - 38mm/week.**
		  • **Garden 18 – 28mm/week.**	

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Medium	• Provides irrigation to Townsville City Councils landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets,
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• Formal gardens irrigated to (IPL) levels High and Medium only.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Promote**:
		  • **Good plant growth,**
		  • **Good plant health,**
		  • **Good presentation.**
		
		• Visual Indicators - **turf**:
		  • **Mostly medium thickness turf,**
		  • **Mostly green appearance, with some patches of green/brown.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 18 - 28mm/week,**
		  • **Garden 15 – 25mm/week.**	

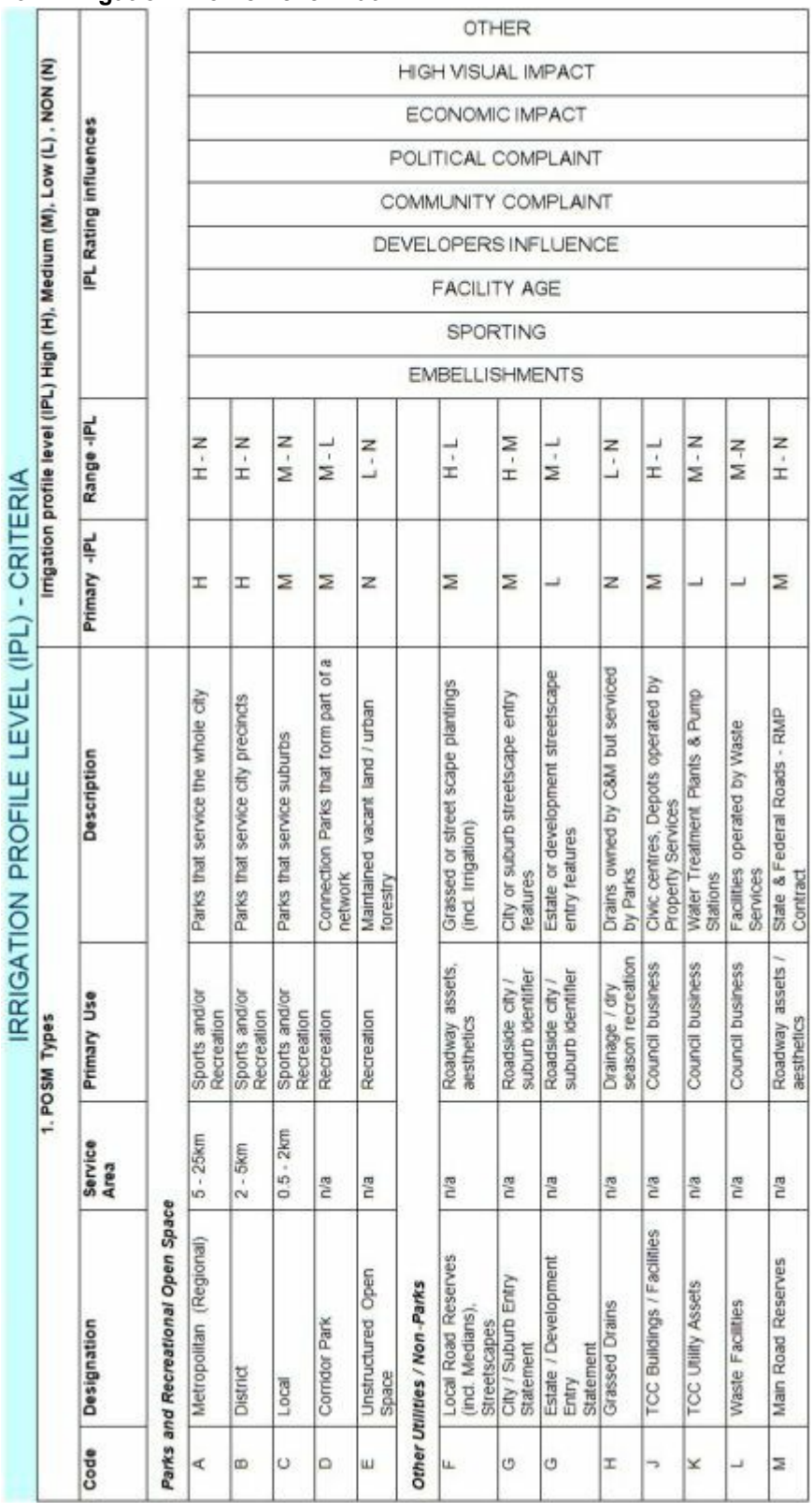
IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Low	• Provides irrigation to Townsville City Council's landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• **Formal gardens irrigated to (IPL) levels High and Medium only**.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Sustain**:
		  • **Minimal plant growth,**
		  • **Minimal plant health,**
		  • **Minimal plant presentation.**
		
		• **Significant seasonal influences on landscaping**.
		
		• Visual Indicators – **turf**:
		  • **Thin coverage of turf,**
		  • **Mostly brown with green tinge appearance, some patches of brown.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 12 - 20mm/week.**	

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Non	• Areas where no irrigation is required:
	  • Natural areas
	  • Naturally landscaped areas such as native plantings,
	  • Open grass areas such as drainage swales,
	  • Other areas deemed not requiring irrigation.
		• Areas depend solely on rain and naturally occurring moisture. **Seasonal plant growth, health and presentation**.	

SC6.4.3.6 Attachment D: Irrigation Profile Level Matrix



IRRIGATION PROFILE LEVEL (IPL) - CRITERIA

1. POSM Types					Irrigation profile level (IPL) High (H), Medium (M), Low (L) , NON (N)		IPL Rating influences									
Code	Designation	Service Area	Primary Use	Description	Primary -IPL	Range -IPL	EMBELLISHMENTS	SPORTING	FACILITY AGE	DEVELOPERS INFLUENCE	COMMUNITY COMPLAINT	POLITICAL COMPLAINT	ECONOMIC IMPACT	HIGH VISUAL IMPACT	OTHER
Parks and Recreational Open Space															
A	Metropolitan (Regional)	5 - 25km	Sports and/or Recreation	Parks that service the whole city	H	H - N									
B	District	2 - 5km	Sports and/or Recreation	Parks that service city precincts	H	H - N									
C	Local	0.5 - 2km	Sports and/or Recreation	Parks that service suburbs	M	M - N									
D	Corridor Park	n/a	Recreation	Connection Parks that form part of a network	M	M - L									
E	Unstructured Open Space	n/a	Recreation	Maintained vacant land / urban forestry	N	L - N									
Other Utilities / Non -Parks															
F	Local Road Reserves (incl. Medians), Streetscapes	n/a	Roadway assets, aesthetics	Grassed or street scape plantings (incl. Irrigation)	M	H - L									
G	City / Suburb Entry Statement	n/a	Roadside city / suburb identifier	City or suburb streetscape entry features	M	H - M									
G	Estate / Development Entry Statement	n/a	Roadside city / suburb identifier	Estate or development streetscape entry features	L	M - L									
H	Grassed Drains	n/a	Drainage / dry season recreation	Drains owned by C&M but serviced by Parks	N	L - N									
J	TCC Buildings / Facilities	n/a	Council business	Civic centres, Depots operated by Property Services	M	H - L									
K	TCC Utility Assets	n/a	Council business	Water Treatment Plants & Pump Stations	L	M - N									
L	Waste Facilities	n/a	Council business	Facilities operated by Waste Services	L	M -N									
M	Main Road Reserves	n/a	Roadway assets / aesthetics	State & Federal Roads - RMP Contract	M	H - N									

Click here to view PDF of SC6.4.3.6 Attachment D: Irrigation Profile Level Matrix

SC6.4.3.7 Steep land development design guidelines

SC6.4.3.7.1 Introduction

(1) Background

(a) Development on steep land requires additional considerations for design, in particular, geotechnical considerations, as well as safety, servicing, environmental and economic considerations for the provision of development and associated infrastructure services.

(b) The stability of land which is steep, erosion prone, prone to slip and other geotechnical problems can be adversely affected by the following actions or development:

(i) earthworks (filling and excavation);

(ii) vegetation clearing;

(iii) construction of buildings and other structures (retaining walls);

(iv) construction of roads and driveways;

(v) on-site disposal of waste water; and

(vi) changes to the existing flow of surface or groundwater.

Inappropriate development on land subject to landslide hazard can result in significant risk to people and property on the subject site, on surrounding land and land down slope of the site. To ensure that these matters are appropriately considered when making decisions, geotechnical investigations are required and appropriate design solutions implemented. In some circumstances development may be avoided.

(c) This sub-section provides guidelines and advice for undertaking development on steep lands and the application of suitable design practices and design considerations.

Editor's note—this policy sub-section should also be read in conjunction with the AGS (2007e), *The Australian GeoGuides for slope management and maintenance*, Australian Geomechanics Society, *Australian Geomechanics*, Vol 42, No 1 and the planning scheme policy sub-section SC6.4.3.18 Geotechnical investigations.

(d) Wherever practical to do so, best practice techniques for construction and development techniques are expected to be demonstrated.

(e) In a broad sense, development should seek to achieve the following objectives:

(i) avoid unstable or hazardous sites and protect lives and property from hazardous conditions such as rock falls, excess stormwater run-off, erosion etc.;

(ii) minimise infrastructure maintenance requirements and costs to the community and residents;

(iii) provide practical and safe access for residents, visitors and service providers;

(iv) complement the scenic hillside character of the surrounding area by integrating unique or special natural features such as landforms, rock outcroppings, existing trees and vegetation, water features, hilltops and ridgelines and avoid further expansion onto scenic features, particularly ridgelines;

(v) minimise the footprint of development during and after construction;

(vi) protect wildlife habitat, corridors and environmentally sensitive areas; and

(vii) be compatible with existing adjacent development.

The creation of good amenity, when viewing the development from streetscapes and surrounding areas, should be a key consideration in all designs to avoid development on steep slopes that is visually dominant.

SC6.4.3.7.2 Development on steep land

As a general and overall consideration, the design of development on steep land should consider the following.

(1) Safety

(a) Major considerations in relation to safety are:

(i) landslide risk; and

(ii) debris flow.

(b) The location and/or form of development and infrastructure should not increase the extent or severity of any landslide hazard or present any unacceptable risk to life, property, the community, or the environment. Risks may arise internally or externally to the site, or affect the subject site or adjacent sites.

(c) Safety of the development should be addressed though appropriate investigations and design.

Editor's note—the preparation of a site specific geotechnical investigation is to be undertaken in accordance with SC6.4.3.18 Geotechnical investigations.

(d) The findings, recommendations and specific works of the geotechnical investigation report must be implemented and complied with to ensure that the risk level for the development will be no more than "low" in accordance with SC6.4.3.18 Geotechnical investigations. If the engineer's assessment report finds that the site will be "low risk" after development without the need for specific works to achieve this, certification need not be required.

Editor's note—risk level "low" in accordance with "Landslide Risk Management", Australian Geomechanics Volume 42 No 1 March 2007.

(e) Any recommendations contained in the geotechnical investigation report must be adopted in the final approved design.

(2) Servicing

(a) Development should provide for the safe and efficient servicing of the site by appropriate infrastructure and minimise ongoing costs to the final user and community. Specific designs for earthworks, roads, drainage, water and sewerage, water quality treatment, and site access may need to be demonstrated at an earlier stage than comparable developments on flatter land.

(b) Stormwater, in particular, should be controlled and conveyed in a manner that mitigates potential problems and emulates the area's natural water cycle, rather than shifting increased flows and issues downstream. Post development flows must not exceed pre-development flows. Particular attention should be paid to designing practical and robust inter-allotment drainage systems. Groundwater flows should also be a key consideration in relation to drainage systems and the potential for landslide risk.

(c) Any public infrastructure developed should not result in unsustainable increases in infrastructure operation and maintenance costs relative to the number of rateable units created (e.g. high level water systems, high maintenance drainage systems). Retaining walls in road or drainage reserves are discouraged and will only be accepted in exceptional circumstances where there is demonstrated benefit for the protection of public infrastructure. All retaining structures must be certified by an RPEQ and constructed of material that ensures public safety and minimised maintenance costs for the design life and should be designed to achieve good streetscape amenity.

(d) Road geometry should be designed in accordance with SC6.4.4.1 Geometric road design and Austroads with particular attention to grades, property accesses, design speeds and sight distances to ensure the safety of all road users. Where variations are sought to council's standards strong justification must be given to support the application. Long distances of steep roads or sharp curves without adequate sight distances or turning paths will not be approved. Road aesthetics are valued as a significant contributor to the character and quality of development and should be a key consideration.

(e) Access to all properties must be safe and functional. The design of the accesses must be shown in the overall development design to ensure the safety, practicality and impact on the public and private

domains. Lot levels should reflect the requirement of accesses to meet minimum grade requirements and allow for additional near level on-site parking for visitors, service vehicles and other parking needs. Access designs should be in accordance with the SC6.4.3.17 Driveways. Where lot accesses may be problematic to construct later, they should be constructed with the roads.

(f) Pedestrian, cyclist and public transport infrastructure design should also be considered at the overall development design as these means of movement are often restricted on steep lands. Alternate facilities to standard road routes and footpaths (e.g. pedestrian connections stairs) may require special design considerations due to grade and safety needs. Residential streets are designed to create low speed environments and to facilitate and encourage pedestrian and cyclist use.

(3) Sustainability

(a) Hillside development can add its own positive character to the particular region however it can also have negative effects on the natural and built environment. Development should seek to enhance positive site characteristics and should enhance the natural qualities of hillsides (e.g. skylines, vistas, landscape form, vegetation, rock outcrops and other topographic features) whilst negative effects (e.g. scarring and a lack of respect for natural terrain and aesthetics) should be contained and avoided. Scenic natural features should be incorporated into the subdivision design as natural open space or through the use of larger allotments that can contain the features.

(b) The layout of a development should be sympathetic to the area's natural terrain and hazardous conditions. It should endeavour to maintain sensitive natural areas and protect and preserve the scenic characteristics of hillsides. Where possible the clustering of development should be used to restrict the impact on the natural state, improve the financial efficiency of the development and assist in creating a variety of the housing forms.

(c) The effect of slope on built form should be identified in the initial stages of the development's design and appropriate types of construction should be encouraged through suitable lot sizes, site and access works, building envelopes, and covenants. This will help ensure the development can be built as proposed and reduce the likelihood of conflict or compromise at a later date.

(d) The extent of earthworks (cut and fill) is a major consideration in the design of developments on steep slopes, not just for reasons of site stability but in terms of cost and efficient use of land as well as visual impact. Constructed slopes should be stable and capable of re-vegetation and effective maintenance. They should also not be so high as to be obtrusive to the streetscape or scenic quality of the development. Heights between the streets and site levels should not be so great as to provide a disconnect between housing and the street or prove impractical for regular movement. Long stretches of high cuts or fill adjacent to road edges will not be approved. Site grading and retaining walls respect existing terrain; that is, large cuts/fills are not used to create “build-able lots” or flat yards. Final lot grades should wherever practical mimic the natural slope.

(e) Where disturbance from future site development is likely to be problematic then earthworks to individual sites should occur at the subdivision stage. For subdivision, this may include providing level building pads to accommodate a future dwellings, associated filling and the construction of private retaining walls. This may occur where there are large cuts and fills, repeated or close accesses, or where future blasting may be required.

(f) Retaining walls should be minimised and should not be of heights that detract from the amenity and human scale of the development. Generally, walls should not exceed one metre in height adjacent to roadways on property boundaries. High walls should be articulated, be constructed with appealing materials or finishes (complementing natural materials where possible), and have sufficient landscaping to screen the wall and should be set back from the road boundary to permit landscape treatment. Where possible a series of smaller stepped walls should be utilised and designed to permit landscaping of the terraces. Retaining walls can be used to reduce slope disturbance, rather than modify natural terrain – lot sizes should increase as the natural slope increases. Constructed slopes can be placed behind buildings if needed, however, consideration should be given to the principle of reduced earthworks in the first instance.

(4) Economic

(a) The volume of cut and fill over the development should be minimised and a cut and fill balance over the

site as a whole should be achieved where possible.

(b) It is expected that with any new public infrastructure the cost of ongoing maintenance should generally be no more for steep sites than for flat sites on a per lot basis. Where there may be a special requirement for non-standard or higher maintenance infrastructure it is expected that a full life cycle cost comparison would be provided (e.g. high level pumps or reservoirs, drainage structures, access to landscaped areas, etc.).

SC6.4.3.7.3 Development applications advice

Particular steep land issues that must be addressed at various application stages are indicated below.

(1) Council encourages applicants to discuss development proposals with council during initial design phases.

(2) It is important that the design reflect all the recommendations of the geotechnical report and that sufficient design detail is provided to demonstrate that the proposed road and lot layouts will work in practice and result in infrastructure and built form outcomes that comply with these guidelines. In particular, there should be enough certainty provided to be sure that the layout will not require significant change due to technical design constraints, i.e. it should not be left to the operational works stage to prove the development will work. Sufficient drawings and design data (including multiple sites and building sections) should be provided to determine this.

(3) The technical design of all earthworks and infrastructure should reflect the recommendations of the geotechnical report and all relevant design guidelines and standards. Where the initial MCU/ROL geotechnical report outlined further detailed investigation prior to design as necessary then this must be carried out. The operational works design should be certified by a geotechnical engineer as complying with the recommendations of the geotechnical report.

SC6.4.3.8 Stormwater management plans for development

SC6.4.3.8.1 Introduction

The development of effective site based stormwater management plans is imperative to the understanding of stormwater quality and quantity during the land development phase to minimise the risk of causing environmental harm to receiving waters, damage to council infrastructure, and unnecessary financial burdens to council and the community.

Where a development is required to demonstrate how proposed stormwater management is protecting water quality and quantity, an applicant will be requested to undertake and prepare a conceptual site based stormwater management plan (CSBMP) or a site based stormwater management plan (SBMP) which addresses the likely impacts of the proposed development and suggests measures to avoid or mitigate against unacceptable risk and other impacts.

(1) Objectives

(a) Ensure that land-use activities potentially discharging contaminated run-off or wastes to waterways during land development, construction and operation phases are sited and managed to minimise such discharges and to protect the quality and quantity of water entering natural and constructed waterways, natural and constructed wetlands, as well as groundwater resources.

(b) To assist planning and decision making on development that may result in stormwater erosion of disturbed soil and sediment transport to land and waters, potentially having an impact on receiving waters environmental values under the *Environmental Protection (Water) Policy 2009* (the EPP Water).

The environmental values established under the EPP Water need to be protected, in part, by:

(i) providing natural water infiltration and flows;

(ii) using water sensitive urban design (WSUD) principles and effective erosion and sediment control; and

(iii) using best practice urban stormwater quality and quantity management.

(2) Terminology

In addition to the definitions presented in Part 1.3.1 of the Townsville City Plan, the following terminology is referenced in support of this policy sub-section.

Site based stormwater management	land development controls identified by a site assessment report. Examples of land development controls include: • erosion source control; • sediment traps; • wetlands for nutrient control; • stabilised temporary drainage lines; • riparian management; and • site rehabilitation.
Wetland	area of permanent or periodic/intermittent inundation, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which a low tide does not exceed 6 m. AS/NZS 1547:2000 Onsite domestic waste water management.

(3) References and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.3.9 Water sensitive urban design guidelines

SC6.4.4.4 Stormwater drainage design

SC6.4.6.1 Water sensitive urban design construction and establishment guidelines

(b) Queensland guidelines
Queensland Government (1999) *Strategy for the conservation and Management of Queensland Wetlands*
Queensland Government (2010) *Urban Stormwater Quality Planning Guidelines*
SEQ Healthy Waterways Partnership, *Construction and Establishment Guidelines*: Swales, Bioretention Systems and Wetlands

(c) Other guidelines
Water by Design, *Construction and establishment guidelines*; Swales, Bioretention Systems and Wetlands
International Erosion Control Association (2008), *Best practice erosion and sediment control*.
Water by Design, *MUSIC modelling guidelines*, June 2012 (as amended)

Note—where local guidelines exist and these include modifications to the Queensland or other guidelines based on local knowledge or investigation, these shall take precedence over Queensland or other guidelines.

SC6.4.3.8.2 Planning and concept design guidelines

(1) Pre-lodgement development guidelines

(a) Prior to the lodgement of a development application it is recommended that the applicant meet with council to confirm acceptable stormwater management practices (for example, wetland, sediment basin and bioretention system designs) and discuss how stormwater treatment may influence overall development design.

(b) In order to make pre-lodgement more beneficial, it is recommended that applicants undertake a preliminary site assessment and provide a range of baseline information to council to assist and inform the pre-lodgement discussions.

(c) This baseline information ideally will include accurate survey plans which demonstrate information on pre-development site conditions including:

(d)

topography	a suitable ground survey of the site is required to allow an assessment of existing grades and flow pathways;
drainage characteristics	drainage infrastructure and flowpaths upstream, within, and downstream of the development must be surveyed for size, location and level;
proposed discharge points and invert levels	define likely flow paths and the level of the receiving drainage system or waterway. Critically, levels must be collected for inverts of drainage systems that will accept treated water from the stormwater treatment systems. If water is ponding in these drainage systems, the water level must also be surveyed;
wetlands	if the site contains wetlands identified through council wetland mapping (refer to Part 8 Overlays and SC2.5 Overlay maps), they should be identified on preliminary plans;
soils	a soil evaluation undertaken in accordance with AS/NZS 1547:2000. Clause 4.1.3 will assist in selecting and locating treatment devices. The soil evaluation should identify soil types, hydraulic conductivity, presence of potential acid sulphate, sodic or saline soils, presence of rock, and general groundwater details; and
site disturbance	an indication of the current extent of disturbance across the site during the previous 12 months.

(e) This baseline information is critical to facilitate designs which suitably respond to site constraints and opportunities. Consideration of constraints and opportunities early in the design process minimises redesigns and expedites the assessment process. The recommended approach allows the information request stage to then be used to clarify minor issues in the report (should this practically be required).

(2) General guidelines

(a) It is recommended that the above information is included with the lodgement of an application to manage stormwater quality and quantity. This will ensure that stormwater treatment matters are suitably addressed prior to a decision notice being issued and do not contribute to extended assessment timeframes.

(b) The design and location of stormwater treatment measures has the potential to greatly influence a

number of things, including lot configuration and as a result, needs to be resolved prior to the presentation to council for approval of any site development plans. Designers should be aware that the design of stormwater treatment measures will not only influence site design due to the footprint but also potentially due to their specific drainage requirements. Ensuring that treatment systems can freely drain becomes an increasingly important issue on sites with flat topography and must be resolved on every site prior to plan approval.

(c) A conceptual site based stormwater quality management plan (CSBMP) should be submitted for material change of use (MCU) and reconfiguring a lot (ROL) applications to demonstrate that there are feasible measures available to adequately manage the impacts of development as they are understood and relevant to those stages and to the degree required to protect the environmental values. See Table SC6.4.3.8.1 for a checklist of items to be included in a CSBMP.

(d) Table SC6.4.3.8.1 has been provided as a check list to outline the minimum standards for creation and preparation of a SBMP. Further, SC6.4.3.8.5and SC6.4.3.8.6 provide additional information to that provided in Table SC6.4.3.8.1 and should be read in conjunction when preparing a SBMP.

(e) This also informs the developer of the economic consequences of impact management at the outset of the development process. As site constraints increase, the cost-effectiveness of best practice control measures decrease. Where the conceptual plan cannot substantiate that best practice control measures are feasible and still achieve the environmental performance objectives, the proposed nature, layout and intensity of development should be reconsidered, for example—by fitting the development more to the terrain, rather than fitting the terrain to the development, to reduce the need for clearing and earthworks.

(f) The designer is to consider the site characteristics, constraints and opportunities relating to stormwater management at the initial planning phases of the development. This is to ensure that sufficient area is allocated within the development site for appropriate stormwater management infrastructure during land development, construction and operational stages.

SC6.4.3.8.3 Development Applications

(1) Development applications may require a CSBMP or site based stormwater management plan (SBMP) to be submitted with the development application to council for all developments requiring assessment against the Part 9.4.2 Healthy waters code. This will assist in assessing the impact of the development on the site.

(2) SC6.4.3.8.5 SBMP document information outlines the overall framework required for SBMPs.
The following information should also be considered:

(a) the overall potential impacts of both the construction and permanent phases, and the feasibility and cost-effectiveness of control measures on each site (given, for example, site constraints, and nature and scale of the development) need to be considered first when a change in land use is proposed, and subsequently as the development unfolds; and

(b) potentially serious land capability constraints affecting the cost-effectiveness and hence the feasibility of a development include:

flood prone areas	sediment basins are often located at the low point of a development and they may not be stable or able to be properly installed or operated if subject to flooding;
acid sulphate soils	larger treatment devices such as sediment basins, wetlands and bioretention systems are often located in low lying areas that are susceptible to the disturbance of acid sulphate soils;
steep terrain	high erosion risk, difficulty in preventing erosion, and in installing a stable and adequately sized sediment basin; and
flat terrain with high groundwater levels	difficulty in collecting and directing surface flows, coupled with difficulty of installing a sediment basin in the presence of high groundwater, which is sometimes geochemically contaminated.

Editor's note—this will include a brief description of erosion and sediment control (ESC) for these two stages of the development approval process.

(4) Operational works guidelines

(a) Operational works applications may require the submission of a preliminary erosion and sediment control plan (ESCP) as supportive information which complies with council requirements as a minimum technical standard.

(b) The preliminary ESCP will be confirmed on site during the pre-start meeting. At this stage, council can check the appropriateness of the preliminary design on site to ensure that the contractor(s) will implement what is on the design plan and will not be responsible in making any changes to suit the site condition during the construction phase.

(c) The preliminary ESCP should take into consideration change to surface levels that are reflected in the bulk earthworks plan(s) of the siteworks plan(s) accepted as part of the operational works approval. The primary ESCP submitted as part of the CSBMP may later be followed by a series of secondary ESCPs for the various stages of the project.

(d) Subsequent installation, operation, maintenance and monitoring of structural controls and their works programming and coordination requires ongoing adaptive management, and this must be carried out in compliance with the general environmental duty under the Environmental Protection Act, that is, taking all reasonable and practicable measures to protect the environmental values of receiving waters from environmental harm. Refer to information in Table SC6.4.3.8.1. Operational works applications should be accompanied by a series of detailed stormwater management drawings. The plans (ESCP) should include notes on the drawings which require contractors to follow the preferred construction and establishment methodology outlined in an approved SBMP and in accordance with the *SEQ Healthy Waterways Partnership Construction and Establishment Guidelines*: Swales, Bioretention Systems and Wetlands.

(e) Drawings should be in accordance with SC6.4.2 Development application guidelines.

(f) The extent of unnecessary soil disturbance, including disturbances outside the designated work area, must be minimised at all times.

(g) Land clearing must be limited to the current stage of works unless otherwise approved in writing possible standard condition by the assessment manager.

(h) It is recommended that land clearing is undertaken, as a minimum, necessary to provide either of the following:

(i) up to 8 weeks of site activity during those months when the expected rainfall erosivity is less than 100, 6 weeks if between 100 and 285, 4 weeks if between 285 and 1500, and 2 weeks if greater than 1500; or

(ii) up to 8 weeks of site activity during those months when the actual or average rainfall is less than 45 mm, 6 weeks if between 45 and 100 mm, 4 weeks if between 100 and 225 mm, and 2 weeks if greater than 22 mm; or

(iii) utilising local sediment export data to assess the risks of land exposure during different months of the year.

Editor's note—minimise works during the "wet season" months of 1 December to 31 March. The month of December is also critical to allow establishment of 70% groundcover prior to the expected high rainfall in the months of January and February.

These impacts need to be considered separately from the post-development or permanent settlement phase as the issues and impact assessment methodology are different.

(i) The critical impact factors are site erosion hazard (including the timing of development with respect to wet seasons) and the duration and areal extent of exposed soil until final site stabilisation after the end of major house-building activities.

Editor's note—definitions of site erosion hazard and major house-building activities to come.

(j) Avoiding exposure of disturbed areas during peak rainfall periods will significantly reduce the potential for erosion and stream hydro-modification to occur. While it is generally recommended that larger sites are

cleared and developed in manageable smaller stages, this may sometimes conflict with the need to quickly complete and stabilise a large development prior to the wet season.

Editor's note—minimise works during the "wet season" months of 01 December to 31 March. The month of December is also critical to allow establishment of 70% groundcover prior to the expected high rainfall in the months of January and February.

(k) Where larger sites are not staged, however, there should be a progressive revegetation (or other effective stabilisation measure) program implemented following commencement of clearing (not at the end) so that no part of the site is left exposed and unstable for extended periods in the high rainfall coastal regions. Refer to SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction.

Editor's note—even temporary grass vegetation or synthetic covers can reduce erosion levels to less than 1 per cent of the level expected if the site is left with soils exposed.

(5) Water quality objectives

(a) Environmental values (EVs) and water quality objectives (WQOs) need to be identified to ensure that the quality of affected receiving waters are maintained or enhanced. WQOs includes all measurable water quality goals that have been derived to protect corresponding environmental values.

(b) The EPP (Water) establishes the EVs in receiving waters.

(c) The associated WQOs form the basis for defining the required water quality of urban stormwater entering and mixing in local waterways.

(d) There are three ways to estimate the level of stormwater quality improvement necessary for a site to ensure WQOs are taken into account to help protect council infrastructure and the EVs for waterways.

For the site scale these are:

(i) monitoring – actual stormwater quality can be compared with receiving water quality to establish the level of treatment necessary to protect EVs, where sufficient monitoring data are available from the same development type in similar landscape conditions;

(ii) modelling – stormwater quality and its potential impact on receiving waters can be mathematically modelled to determine treatment requirements (design objectives). Some monitoring data are usually required to validate such models. e.g. SC6.4.3.8.6 MUSIC modelling; and

(iii) best management practices – best available data on the performance efficacy of current best practice treatment technologies can be used to establish minimum standards of performance (typically expressed as minimum average annual pollutant load reductions, or minimum average percentage reductions in pollutant loads, e.g. measures in SC6.4.3.9 Water sensitive urban design guidelines).

(e) In rapidly urbanising catchments, the wet-weather impacts of the construction phase of the land development phase need to be considered as well as the post-development (or permanent settlement phase), as the issues and impact assessment methodology are different. Critical impact factors include soil erosion hazard of the landscapes being developed, and increased rainfall run-off coefficients which occur when land is cleared and topsoil removed.

(f) The preferred method for determining the required level of treatment is described in SC6.4.3.9 Water sensitive urban design guidelines.

(g) Modelling provides an ability to predict likely changes in water quality associated with proposed urban developments. Such water quality models can be used to establish performance outcomes for stormwater systems. These are limited by the availability of local water quality data and the understanding of the biological and physical processes that influence water quality and the receiving water environment. There are often significant limits on the confidence with which predictions can be made using water quality models at the site scale. Despite the uncertainty of modelling, adopting predictive modelling techniques to quantify estimates of stormwater pollutant concentrations and loads from urban land surfaces and the pollutant removal efficacy of current best practice stormwater treatment infrastructure is an accepted method for establishing best practice stormwater management "treatment

train" design for regions where limited or no monitoring data exists.

(6) Stormwater quality risk classification
Developments are classified as either having a “low risk” or a “high risk”.

Note—a development (or development proposal) may be classified as “high risk” if it falls within one of the following categories:

(a) any development (or development proposal) within or adjoining areas of identified ecological status as indicated on council planning scheme maps; or

(b) material change of use for urban purposes that involves:

(i) greater than 2,500m2 of land; or

(ii) 6 or more additional dwellings; or

(c) reconfiguring a lot for urban purposes that:

(i) would result in 6 or more residential allotments or that provides for 6 or more dwellings; or

(ii) involves greater than 2,500m2 of land and results in an increased number of lots; or

(iii) is associated with operational work disturbing greater than 2,500m2 of land; or

(d) operational work for urban purposes that involves:

(i) disturbing greater than 2,500m2 of land.

“Low risk” is a development (or development proposal) that is not “high risk”.

Small, “low risk” developments in Townsville do not have to identify EVs and WQOs for receiving waters. Proposals for these developments need to demonstrate achievement of best management practices for the type of pollutants that are likely to be generated.

(a) Developments in Townsville considered as “high risk” in relation to impacts on stormwater quality require the identification of EVs and WQOs for receiving waters within and/or downstream of the development. Proposals for these developments need to demonstrate that stormwater draining from the site will not threaten the relevant environmental values and their corresponding water quality objectives, in affected receiving waters through the use of appropriate SBMPs.

(7) Water sensitive urban design considerations.

Note—refer to information in Table SC6.4.3.8.1.

(a) WSUD approaches to water management during development and its construction aim to minimise impacts on the natural water cycle, avoid or minimise off-site pollutant discharge, limit changes to the volume, rate, duration and frequency of stormwater discharge, and protect council infrastructure and the EVs of receiving waters.

(b) WSUD applied to the construction phase of land development is primarily concerned with surface drainage and erosion and sediment control.

(c) WSUD at the construction stage needs to take account of the final layout of permanent stormwater controls that will be constructed.

(d) Temporary erosion and sediment controls need to be incorporated into SBMPs to protect permanent stormwater controls such as wetlands, swales, and bio-retention systems proposed to be constructed.

(e) Poor erosion and sediment control planning and implementation can severely compromise the success of biological assets utilised as part of operational stormwater quality controls and increase weed infestations, decrease drainage and filtering capacities, smother landscaping and greatly reduce system reset times.

(f) WSUD principles must be incorporated into construction phase, planning and design.

(8) Detailed design

(a) A SBMP shall be submitted to council as part of the detailed engineering design documentation following

approval of the concepts from council.

(b) The documents are to be site specific and not a generalisation of erosion and sediment control or stormwater quality. The documents may also form part of the contract specifications for a contractor to comply with during construction.

(c) Where available, examples of proposed developments detailing locations of water quality structures, sediment and erosion control methodology may be obtained from council and used as a guide when preparing SBMPs.

(9) Construction

(a) No site works shall commence prior to council's approval of the detailed design documents.

(b) All works are to be undertaken in accordance with the development conditions, accepted drawings, the approved SBMP, local laws and environmental regulations.

(c) Implementation of the approved works during construction must be supervised by the nominated professional.

(d) The developer (or representative) shall constantly monitor, review and modify soil and water management practices to correct any deficiencies.

(e) Random audits may be performed by council throughout the construction phase of the project to review compliance with approved documentation.

Editor's note—where inconsistencies are noted, written advice will be sent to the developer (or representative) requiring appropriate action within 24 hours.

(f) A key reference document, *Best Practice Erosion and Sediment Control*, should be consulted for information on the main concepts for reducing pollution from construction sites.

(g) Construction activity can be divided into two phases—the land development stage and the building construction stage.

Editor's note—both of these phases are known to result in serious stormwater pollution unless appropriately managed.

(i) Land development stage
Land development involves making undeveloped vacant land suitable for urban uses through vegetation clearing, land forming and provision of services such as roads, drainage, water supply, sewers, electricity, gas and other services.

Land development usually involves major earthworks resulting in significant potential for contamination of stormwater by eroding soils.

(ii) Building stage
Building construction can result in significant soil disturbance as well as the contamination of stormwater with building wastes. Pollutants can include litter, rubble, concrete-mixer waste, paints, plaster, brick sand, cleaning products and imported soils, etc. It should be noted that conventional allotment sediment control practices for a building site are largely ineffective at turbidity control. Therefore, for greenfield developments, subdivision-scale controls may be needed.

(iii) Effective source control measures employed during construction can greatly minimise the impact of both phases of construction activity on stormwater quality. SBMPs (these may sometimes be referred to as erosion and sediment control plans or include such provisions) are an effective means of planning and implementing measures to minimise the generation of pollutants from construction activities.

(10) Maintenance plan requirements

(a) Maintenance plans are to be provided for stormwater quality improvement devices (SQIDs) that are to be handed over to council.

(b) SC6.4.3.9 Water sensitive urban design guidelines should be consulted when preparing a maintenance plan.

(c) The responsibilities for maintenance of SQIDs are to be detailed in the SBMP.

(d) The maintenance plans are to be written for use by council's maintenance and asset personnel.

Editor's note—examples of SQIDs that require maintenance plans include trash racks, constructed wetlands and ponds.

Note—trash racks, Gross Pollutants Traps and similar are not preferred.

(e) The maintenance plans are to include as a minimum:

(i) design details;

(ii) manufacturer and supplier contact details (where relevant);

(iii) inspection frequency;

(iv) maintenance frequency;

(v) data collection requirements;

(vi) clean-out procedures that address, at a minimum, public safety, maintenance techniques, wet waste disposal, equipment requirements, environmental management considerations and occupational health and safety and disposal requirements; and

(vii) permeability testing requirements and guidelines for the filter media.

(f) An on-site hand-over meeting and completion of handover documentation must occur between the developer (or representative), responsible maintenance personnel and appropriate representatives from council.

(g) In the event that the SQID is not complying with approved conditions, council is under no obligation to accept responsibility of the asset.

SC6.4.3.8.4 Lodgement of site based stormwater management plans

(1) A site based stormwater management plan (SBMP) identifies stormwater management strategies and actions to broadly address:

(a) water quality;

(b) water quantity;

(c) waterway corridor issues; and

(d) The contents of the SBMP are dependent on the stage of development (concept or detailed design) and the level of risk for the proposed development ("low" or "high").

(2) The SBMP should contain sufficient detail to determine whether the stormwater controls are acceptable to address water quality, water quantity and waterway corridor issues. All SBMP should consider if a development is staged, including the anticipated timeframes for the staged works.

(3) Where an SBMPs is required, it should be prepared in accordance with this sub-section and Table SC6.4.3.8.1 as a minimum standard.

(4) Tables SC6.4.3.8.1, SC6.4.3.8.2 and SC6.4.3.8.3 Checklist for preparation of a site based stormwater management plan has been provided as a detailed check list to outline the minimum standards for creation and preparation of an SBMP that has been requested by council, to be submitted as part of an application or as part of a development condition.

SC6.4.3.8.1 Rapid risk assessment for conceptual site based management plans

Rapid risk assessment for cSBMP	Value
Land size:	
≤5,000m²	0
>5,000m² ≤10,000m²	1
>10,000m²	2
Estimated impervious area of site (road, roofs, parking, etc)	
≤25% of developable area	0
>25% ≤75% of developable area	1
>75% of developable area	2
Lot distance from areas identified within Natural assets environmental importance overlay map OM-08 as of 'very high environmental importance'	
>100m from the proposed development	0
Within 100m of the proposed development	1
Within 50m of the proposed development	2
Within the proposed development	3
Total value – 3 scores combined	
Conceptual site based management plan required at MCU and ROL stages for scores >6	

Table SC6.4.3.8.2 Checklist for preparation of a site based stormwater management plan

Site Based Management Plan Requirements
Introduction and Site Characteristics - Both Operational and Construction Phases
Description and location of the proposed development including existing and proposed land uses
Identification and description of any waterways or wetlands on or adjacent to the site including relevant background water quality data
Related studies and or plans such as catchment management plans, waterway management plans, stormwater management plans
Description of site flora and fauna including any areas of ecological significance
Summary of hydrologic and hydraulic information
Map indicating the proposed size and location for all major stormwater treatment devices such as sediment basins, constructed wetlands and bioretention systems
Parkland contributions (if required)
Completed site risk assessment
Summary of the SBMP study team
Construction Phase Elements (ESCP)
General Plan Requirements
Plan sign off including contact details for the nominated 'Suitably Qualified Person' and 'Responsible Person'
A summary statement describing the scope and intent of the work to be performed
Proposed limits of disturbance during construction activities including fencing, non-disturbance areas, retained groundcover and vegetation
Description of the proposed works including commencement and duration
Description of site preparation and initial land clearing strategies, including ESC controls to be installed prior to disturbance
Map indicating any areas of high erosion risk and/or critical environmental values
Map indicating the existing and proposed topography and drainage (including clearly depicted overland flows)
Descriptions of stabilised construction access points
Plan indicating the locations of the site office, car park(s), sediment stockpiles and associated drainage and sediment controls
Soils
General soil description as identified from published soil maps used in the soil investigation for the site
If required by State Planning Policy 2/02 - an acid sulphate soil investigation
Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the 'Cation Exchange Capacity' values
Description of the proposed remedial actions required to treat problem soils: steep slopes, saline soils, dispersive soils, extremely acidic or alkaline soils and acid sulphate soils

Drainage, Erosion and Sediment Control Measures
Map indicating how off site water is diverted around or through the site and how stormwater is diverted away from site entry and exit points
Plan/s submitted for each stage of works that utilise standard ESC symbols and clearly indicate the proposed controls and control locations
Design and construction details for any specified ESC measures, including calculation sheets for the sizing and layout of sediment basins
Specification of the flocculent type, methodology and application rate for any and each sediment basin proposed
Description of how any soil stockpiles are to be protected
Hydraulic analysis demonstrating flow velocities and capacities on site
Implementation schedule providing specific timeframes and sequences for works to be carried out
Specifications of stabilising measures for surfaces exposed for more than 14 days
Technical notes demonstrating best practice site management including dust, chemical, oil, fuel, litter and debris control
Site Revegetation, Rehabilitation, Maintenance and Monitoring
Capital cost of proposed strategy
Description of revegetation, hydroseeding, hydromulching or mulching methods
Site maintenance plan indicating performance standards for ESC structures, establishment of ground cover and monitoring frequencies
An Inspection Test Plan (ITP) for monitoring site performance is provided clearly indicating witness points, hold points and end points
Nominated Total Suspended Solid (TSS) concentration targets for water leaving site
Weekly site inspection checklist for ESC controls in place
Completion of the Townsville City Council Erosion and Sediment Control Plan Checklist
Nomination of 'Responsible Person' accountable for maintenance of structural controls
Total Suspended Solids monitoring program identifying methodology and locations for water quality monitoring
Operational Phase Elements (WSUD)
General Plan Requirements
Plan sign off and contact details for the nominated 'Suitably Qualified Person' and 'Responsible Person'
Clear indication of proposed works including expected commencement and duration
Map indicating the existing and proposed topography and drainage (including clearly depicted flowpaths for various AEP’s)
General soil description as identified from published soil maps used in the soil investigation for the site
Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the Cation Exchange Capacities values
Proposed remedial actions required to treat problem soils: steep slopes, saline soils, dispersive soils, extremely acidic or alkaline soils and acid sulphate soils
Electronic copy of MUSIC (or similar pollution reduction modelling program) outputs for the proposed works
Description of any existing stormwater infrastructure
Stormwater Quantity (Hydrology and Hydraulics)
Description of proposed methodology
Details of model analysis
Comparison of existing and proposed hydrology and hydraulics eg. catchments, flows and flood levels for various AEP’s
Selection and assessment of controls
Description of proposed mitigation measures
Designs drawings for proposed controls
Stormwater Quality (Pollution Reduction)
Identification of environmental values, pollutions of concern and water quality objectives
Description of proposed methodology
Details of model analysis
Selection and assessment of controls
Description of proposed mitigation measures
Design drawings for proposed controls

Water quality monitoring program identifying methodology and locations for water quality monitoring
Maintenance and Asset Handover
Capital cost of proposed strategy
Map and details of maintenance access points and dewatering areas
Annual maintenance strategy including asset access, maintenance and resetting methodologies
Details of asset reset times and life cycle costings including ongoing maintenance costs
Nomination of 'Responsible Person' accountable for maintenance of structural controls
Description and timing for asset handover to council

SC6.4.3.8.3 Checklist preparation of a conceptual site based stormwater management plan

Site Based Management Plan Requirements

Introduction and Site Characteristics Both Operational and Construction Phases

Description and location of the proposed development including existing and proposed land uses

Identification and description of any waterways or wetlands on or adjacent to the site including relevant background water quality data

Description of site flora and fauna including any areas of ecological significance

Map indicating the proposed size and location for all major stormwater treatment devices such as sediment basins, constructed wetlands and bioretention systems

Parkland contributions (if required)

Completed site risk assessment

Construction Phase Elements (ESCP)

General Plan Requirements

Description of the proposed works including commencement and duration

Map indicating the existing and proposed topography and drainage (including clearly depicted overland flows)

Soils

General soil description as identified from published soil maps used in the soil investigation for the site

Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the 'Cation Exchange Capacity' values

Drainage, Erosion and Sediment Control Measures

Site Revegetation, Rehabilitation, Maintenance and Monitoring

Nominated Total Suspended Solid (TSS) concentration targets for water leaving site

Operational Phase Elements (WSUD)

General Plan Requirements

Clear indication of proposed works including expected commencement and duration

Map indicating the existing and proposed topography and drainage (including clearly depicted flowpaths for various AEP’s)

Description of any existing stormwater infrastructure

Stormwater Quality (Pollution Reduction)

Description of proposed mitigation measures

SC6.4.3.8.5 SBMP document information

The SBMP should outline information relevant to the authorship of the SBMP (ideally provided in tabular form), including document title, reference number, document ownership (including names of personnel that have issued and checked the SBMP) and name of client (and client representative, if appropriate).

The lodgement of development information should be accompanied by information including topographic, drainage, vegetation and soils details as well as the proposed development plan in addition to the following items (1) to (12) and clause SC6.4.3.8.6.

(1) Executive summary

A concise summary of the study methodology and findings should be presented along with a table outlining how the proposed methodology and findings and response to any previous information requests from council.

(2) Table of contents

The table of contents should include a table of the body of the report, a table of appendixes and a table of figures and diagrams.

(3) Introduction

The introduction should include a general description of the proposed development/ works, existing site, scope of the SBMP and the following information:

(a) submission date;

(b) developer's name;

(c) consultant's name;

(d) current and proposed land use of development site;

(e) description of site location (including street directory reference); and

(f) reference to associated documents.

(4) Locality plan

The report should include a locality plan which shows the site location in relation to major topographic features and landmarks such as waterways and major infrastructure such as roads as well as applying the principles of good mapping and drafting.

(5) Site characteristics

(a) An accurate site plan, including survey, should be presented at a smaller scale than the locality plan to show appropriate development site details; and

(b) The plan should include the baseline information used to determine the layout including existing topography catchment/drainage information and vegetation.

(c) If the development is to be constructed in stages these should also be shown on the site plan.

(d) Depending on the extent of information available and scale, it may be more appropriate to present a range of plans which show the different site characteristics. These plans can be presented in the appendixes but for ease of assessment the report should not simply refer to separate reports.

(e) Supporting text should include detailed description of the site characteristics and discussion of how proposed clearing/earthworks will influence existing drainage.

(f) A description of the opportunities and constraints (for example, steep topography preventing the application of devices like swales) should also be discussed.

(6) Proposed land uses

As well as presenting information in plan format, land uses should also be presented in tabular form as follows:

Table SC6.4.3.8.4 Proposed land-uses in tabular format

Land type	Area (ha)	Assumed impervious area
Open space/parkland		
Low density residential		
Medium density residential		
High density residential		
Industrial		
Commercial		
Other		
Total/Overall		

(7) Location conditions

The rainfall and soil category will influence treatment location, design and construction and should also be presented.

(8) Design objectives

The report is to identify the stormwater quality management objectives for both the construction phase and post-construction phase (operational-construction phase) of the proposed development.

(9) Strategy description and plan

(a) The proposed treatment strategy should be presented in plan format (with scale bar) showing sub-catchment boundaries (including any untreated areas) and flow paths.

(b) Other aspects critical in explaining the proposed strategy include:

(i) treatment area locations and indicative footprints including allowance for all relevant design;

(ii) requirements, for example, batters, maintenance access and fore bays;

(iii) description of how run-off will be conveyed to treatment systems; and

(iv) confirmation that treatment system can drain (that is, outlet can freely drain).

(c) Sub-catchments should also be presented in tabular form as follows:

Table SC6.4.3.8.5 Sub-catchment in tabular format

Sub-catchment code	Sub-catchment land use category	Treatment ID	Sub-catchment area (ha (% imp))
A			
B			
Total			

The designer should ensure that sub-catchment names (for example, sub-catchment A) and sub-catchment areas noted on the plan also match those presented in the table. Similarly the designer should ensure that the areas match the sub-catchment names and areas modelled. Confirmation that these cross checks have occurred should be noted in the report.

(10) Modelling approach
Reporting the modelling approach should be undertaken in accordance with council's music modelling requirements.

(11) Treatment plans and sections

(a) The tables should be supported by a full layout plan and sections (longitudinal and cross sections) for each stormwater treatment measure showing integration with the existing or proposed drainage system, benching levels (and, if appropriate, standing water, extended detention and peak water levels), bunding and other conceptual features such as, but not limited to, maintenance access, monitoring access (if proposed) and safety precautions (for example, fencing and/ or dense vegetation restricting public access).

(b) For sites with multiple small treatment devices, a full layout plan and a section drawing of a selected representative sample of devices must be provided.

(c) Layout plans should consider the integration of the stormwater treatment measures into the surrounding topography.

(d) These designs must be prepared as preliminary design drawings suitable for the subsequent preparation of detailed civil design drawings for construction.

(e) The design of treatment devices should be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(12) Professional preparation of site based stormwater management plans

(a) It is a requirement that all site based stormwater management plans are prepared by suitably qualified and experienced professionals.

(b) A suitably qualified and experienced professional is defined as a person with the following attributes:

(i) Site Based Stormwater Management Plans (SBMP): relevant tertiary qualifications or equivalent, including being a registered professional Engineer of Queensland (RPEQ).

SC6.4.3.8.6 MUSIC modelling requirements

(1) MUSIC modelling is the standard accepted for modelling for stormwater management for development in Townsville.

(2) The modelling, reporting and assessment methodology presented in the MUSIC Modelling Guidelines is to be applied using local data.

(3) Rainfall, evaporation and pollutant data are to be used from the following sources to ensure that parameter values within the Townsville Local Government Area are regionally relevant to the Townsville environment.

(a) Data for rainfall is to be based on Townsville records for a significant period of time (10 – 20 years) with a range of significant wet and dry periods.

(b) Parameter values for pollutant loads are to be sourced from SC6.4.3.9 Water sensitive urban design guidelines.

(4) Reporting is to specifically outline all parameters used (for example, meteorological data, time step, percentage effective impervious areas, base and stormflow concentration parameters, pollutant reduction efficiencies, treatment node dimensions), either in the body of the report or as an appendix.

(5) The report should record the version of urban stormwater model used.

(6) A digital file containing all relevant modelling files must be provided with the report to enable checking of all modelling calculations by Townsville City Council. The files should include a 'readme' text file, containing a description of the contents and details of any naming conventions used for model files. The checking will also ensure integrity of data to ensure that no parameters have been altered.

(7) Models provided should include:

(a) pre-development condition;

(b) developed site without any stormwater treatment measures; and

(c) developed site with proposed stormwater treatment strategy.

(8) The design of treatment devices should be in accordance with the SC6.4.3.9 Water sensitive urban design guidelines.

(9) Parameters used in the modelling will therefore need to be checked for consistency during design as well as assessment.

(10) A description of the selected stormwater management options should be presented.

(11) This section should include modelling results and dimensions of stormwater treatment measures.

SC6.4.3.8.7 Erosion and sediment control plans

(1) Erosion and sediment control plans (ESCPs) shall contain the following.

(a) Adequate local site data, including soil data, must be obtained to allow the preparation of an appropriate ESCP, and allow the selection, design and specification of required Erosion and sediment control (ESC) measures.

(b) Prior to development of the ESCP, the site must be assessed from a hydrological, hydro-geological, hydraulic, vegetation, soils and geological perspective to determine relevant site constraints that may affect the focus or detail of the plan.

(c) The plan(s) must include all aspects of proposed site disturbance, temporary drainage works, erosion and sediment control measures, installation sequence, and site rehabilitation for the duration of the project, including (where appropriate) the nominated maintenance period.

(d) Generally, an ESCP must address the following issues:

(i) identify the likely need for the construction of sediment basins on the site;

(ii) identify that adequate space has been made available for the construction and operation of major sediment traps and essential flow diversion systems;

(iii) demonstrate that there is a feasible means of constructing the project while still protecting key environmental values;

(iv) identify problem soil areas including, dispersive soils, acid sulfate soils, areas of potential mass movement; and

(v) identify key environmental features on the site such as protected vegetation.

(e) The level of detail supplied in the ESCP must be commensurate with the complexity of the proposal and the assessed environmental risk.

(f) Where appropriate, ESCPs (including supporting documentation) should include, but not be limited to:

(i) north point and plan scale;

(ii) site and easement boundaries and adjoining roadways;

(iii) construction access points;

(iv) site office, car park and location of material stockpiles;

(v) limits of disturbance;

(vi) retained vegetation including protected trees;

(vii) general soil information and location of problematic soils;

(viii) groundwater, and flood-affected areas (50% AEP);

(ix) location of critical environmental values (where appropriate);

(x) existing site contours (unless the provision of these contours adversely impacts the clarity of the ESCP);

(xi) final site contours including locations of cut and fill;

(xii) construction drainage plans for each stage of earthworks, including land contours for that stage of construction, sub-catchment boundaries and location of watercourses;

(xiii) existing and final overland flow drainage paths;

(xiv) location of vegetated buffer strips;

(xv) stabilised entry/exit point (rumble pad);

(xvi) location of soil and sand stockpiles;

(xvii) location of all proposed temporary drainage control measures;

(xviii) location of all proposed erosion control measures (alternatively, use notes to describe locations);

(xix) installation sequence and maintenance requirements;

(xx) permanent site stabilisation measures;

(xxi) a statement of who is responsible for establishing and maintaining all erosion and sediment control measures;

(xxii) general layout and staging of proposed works;

(xxiii) location of all drainage, erosion and sediment control measures;

(xxiv) full design and construction details (such as, cross-sections, minimum channel grades, channel linings) for all drainage and sediment control devices, including diversion channels and sediment basins;

(xxv) site revegetation requirements (if not contained on a separate plan submitted to the assessing authority);

(xxvi) site monitoring and maintenance program, including the location of proposed water quality monitoring stations (if required);

(xxvii) technical notes relating to:

(A) site preparation and land clearing;

(B) extent, timing and application of erosion control measures;

(C) temporary ESC measures installed at end of working day;

(D) temporary ESC measure in case of impending storms, or emergency situations;

(E) installation sequence for ESC measures;

(F) site revegetation and rehabilitation requirements;

(G) application rates (or at least the minimum application rates) for mulching and revegetation measures;

(H) legend of standard symbols used within the plans; and

(I) sediment basin operation and flocculent dosing.

(xxviii) calculation sheets for the sizing of ESC measures;

(xxix) completed ESCP checklist; and

(xxx) any other relevant information council may require to properly assess the ESCP.

(g) If the timing of the proposed construction activities are not known during development of the ESCP, and if rainfall erosivity varies significantly throughout the year, then the erosion control specifications placed on the ESCP must specify appropriate erosion control measures for each level of rainfall erosivity. Refer to SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction.

(h) The timing of works and the installation of control measures has a major influence on the management of stormwater. As such, the installation sequence must be considered generally as outlined below.

(i) establish a single stabilised entry/exit point (rumble pad);

(ii) install sediment fence(s) along the low side of the site;

(iii) divert up-slope water around or through the work site and appropriately stabilise any drainage channels;

(iv) clear only those areas necessary for building or construction work to occur;

(v) stockpile topsoil within the sediment-control zone;

(vi) stabilise exposed earth banks e.g. vegetation, erosion control blankets;

(vii) install on-site waste receptacles e.g. mini-skips, bins, reo cages. These should be covered to prevent waste being moved by wind;

(viii) commence building activities;

(ix) install roof downpipes as soon as practicable after the roof is laid;

(x) maintain all control measures in good working order; and

(xi) revegetate or otherwise stabilise the site.

(i) An ESCP is required to be approved by council prior to the commencement of any work or activity, including land clearing (except as allowed under for the purposes of ground survey, geotechnical investigation, or other recognised essential purposes), provided the work is:

(i) consistent with state and council vegetation protection and/or preservation requirements and/or policies; and

(ii) undertaken so that the ground surface is not disturbed and at least 150mm stubble remains on the surface (where such a stubble exists prior to clearing); or

(iii) to provide site access via the minimum practicable number of site access corridors.

(j) Erosion and sediment control management plans (ESCMP) shall be scaled drawings (no larger than 1:1000) with detailed specifications/diagrams which can be readily understood and applied on site by supervisory staff.

(k) All drawings/plans shall be prepared in accordance with SC6.4.2 Development application guidelines and good drafting principles.

(2) Professional ESCP sign-off

(a) The ESCP must clearly state that no land-disturbing activities on the site shall occur until all perimeter ESC measures, sediment basins, and associated temporary drainage controls, have been constructed in accordance with best practice erosion and sediment control.

(b) It is a requirement that all ESCPs are signed by suitably qualified and experienced professional. A suitably qualified and experienced professional is defined as a person with the following attributes:

(i) design phase (ESCP) - relevant tertiary qualification or satisfies at least one of the following 3 criteria:

(A) Statement of Attainment from a Townsville City Council 5 or 6 Day Course (Erosion and Sediment Control Planning for North Queensland); or

(B) Certified Professional in Erosion and Sediment Control (CPESC); or

(C) holds a qualification which is equivalent to either of the above and is accepted by council.

(ii) construction phase (ESCP): relevant tertiary qualifications or satisfies at least one of the following criteria:

(A) holds a Statement of Attainment from a Townsville City Council 2 Day Course (Erosion and Sediment Control for Site Supervisors); or

(B) holds a qualification which is equivalent to the above and is accepted by council; or

(iii) operational phase (WSUD):

(A) relevant tertiary qualifications or a Statement of Attainment from a Townsville City Council 2 day course (Water sensitive urban design for Site Supervisors).

(B) holds a qualification which is accepted by council.

Editor's note—Statement of Attainment from a Townsville City Council 2 Day Course (Water sensitive urban design for Site Supervisors) is a course currently being developed by TCC.

(c) When signing-off on an ESCP, the signatory is deemed to be making the following statements:

(i) the ESCP satisfies the intent and design/performance standards established by all relevant local, state and federal policies relating to erosion and sediment control;

(ii) the ESCP has been reviewed and approved by personnel suitably trained and experienced (to a degree appropriate for the given type and size of the land disturbance) in each of the following categories: construction, soil science, hydrology/hydraulics, and site revegetation/rehabilitation;

(iii) the ESCP is both reasonable and practicable; and

(iv) the ESCP contains sufficient information to allow the appropriate implementation of the plans.

(d) ESCPs that incorporate a sediment basin with a constructed earth embankment with a height greater than 1m, must be signed-off by a geotechnical specialist.

(e) The approved ESCP must be available on-site for inspection by council officers while work activities are occurring.

(3) Should the development be commenced and not completed within 12 months of approval of the ESCP, a revised ESCP must be prepared, with further revisions thereafter at half-yearly intervals. For master planned developments this requirement applies for the ESCPs for each stage.

(4) Additional erosion and sediment control measures are implemented, and a revised ESCP is submitted for approval (within five business days of any such amendments) in the event that:

(a) there is a high probability that serious or material environmental harm may occur as a result of sediment leaving the site; or

(b) the implemented works fail to achieve the local government ESC standard/code, or state environmental protection requirements; or

(c) site conditions significantly change; or

(d) site inspections indicate that the implemented works are failing to achieve the "objective" of the ESCP.

(5) In circumstances where it is considered necessary to prepare an amended ESCP, and the preparation of the amended ESCP is not imminent, then all necessary new or modified erosion and sediment control measures

must be implemented in accordance with current best practice:

(a) in circumstances where there is significant risk of environmental harm, then upon receipt of the amended ESCP, all works must be implemented in accordance with the revised plan;

(b) otherwise, only upon approval of the amended ESCP by the assessing authority shall works be implemented in accordance with the amended plan; and

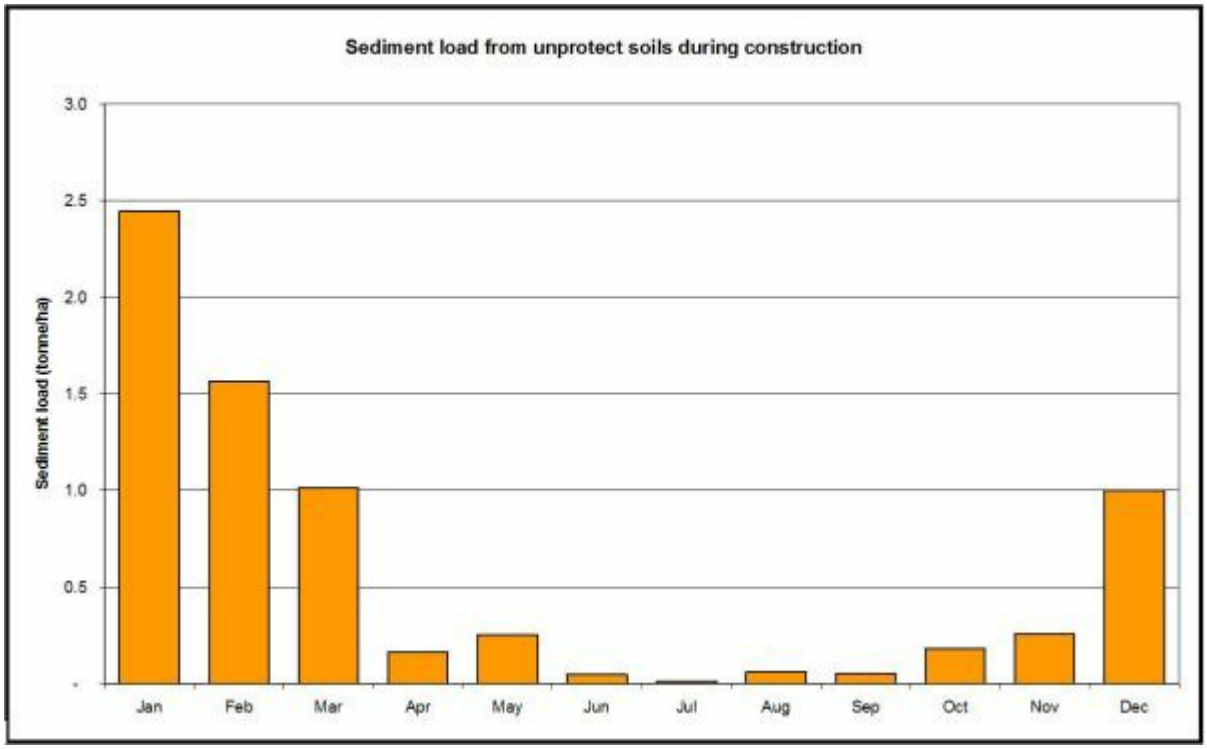
(c) a copy of the amended ESCP must be forwarded to council within 5 business days of any such amendments.

(6) The design standard of erosion and sediment control must be commensurate with the degree of environmental risk associated to the proposed works.

(7) All erosion and sediment control measures, including temporary drainage control measures, must be designed in accordance with the design standards in SC6.4.4.4 Stormwater drainage design.

(8) The ESCP must incorporate “hold points” (where appropriate) detailing critical performance indicators of the various elements of the ESCP. The development must not be allowed to proceed without adherence to designated hold points at specified times.

SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction



Month	Sediment (Tonnes/hectare)	% yearly load			
Jan	2.40	32.9			Very high risk
Feb	1.60	21.9			
Mar	1.00	13.7			
Apr	0.20	2.7			Low to moderate risk
May	0.30	4.1			
Jun	0.10	1.4			
Jul	0.00	0			
Aug	0.10	1.4			
Sep	0.10	1.4			
Oct	0.20	2.7			
Nov	0.30	4.1			
Dec	1.00	13.7			
	7.30	100			

Source: Extrapolated from *Black Ross Water Quality Improvement Plan.*

SC6.4.3.9 Water sensitive urban design guidelines

SC6.4.3.9.1 Introduction

(1) Water By Design's *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland*, Version 1, 2006 (or as amended), are adopted, with the following exclusions:

(a) Chapter 1 Introduction

(b) Chapter 6 Constructed Stormwater Wetlands.

Note—Chapter 3 Bioretention Swales, Chapter 5 Bioretention Basins, and Appendix A Plant Selection for WSUD Systems, which formed part of the original version of the Technical Design Guidelines, have been superseded by Healthy Waters' *Bioretention Technical Design Guidelines (Version 1, October 2012)*. The *Bioretention Technical Design Guidelines* are **not** being adopted.

(2) The following sections – Introducing water sensitive urban design, Bioretention swales, Bioretention basins, Constructed stormwater wetlands, and Appendix A Plant selection for water sensitive urban design systems - have been developed specifically for the coastal dry tropic conditions found in the Townsville area, and replace those equivalent sections in the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (and the superseded parts that form the *Bioretention Technical Design Guidelines*).

(3) References to chapters and sections in this sub-section refer to the chapters and sections in the *Water Sensitive Urban Design Guidelines for South East Queensland*.

SC6.4.3.9.2 Introducing water sensitive urban design

(1) Water sensitive urban design (WSUD) is an internationally recognised concept that offers an alternative to traditional development practices. WSUD is a holistic approach to the planning and design of urban development that aims to minimise negative impacts on the natural water cycle and protect the health of aquatic ecosystems. It promotes the integration of stormwater, water supply and sewage management at the development scale.

The key principles of WSUD are to:

(a) protect existing natural features and ecological processes;

(b) maintain the natural hydrologic behaviour of catchments;

(c) protect water quality of surface and ground waters;

(d) minimise demand on the reticulated water supply system;

(e) minimise sewage discharges to the natural environment; and

(f) integrate water into the landscape to enhance visual, social, cultural and ecological values.

These guidelines are not intended to limit innovation in design or construction of WSUD elements by restricting alternative approaches to those presented here. Alternative designs should be considered where potential improvements in performance, constructability or maintenance requirements can be demonstrated. However, the design procedures and recommendations given in these guidelines are based on contemporary best practice, incorporating lessons from local experience, and are regarded as appropriate for the coastal dry tropics region.

(2) Design objectives for stormwater management
The adopted design objectives for the coastal dry tropics in mean annual pollutant load leaving a development site, compared to traditional urban design where stormwater is not treated:

(a) >= 80% reduction in total suspended solids load

(b) >= 65% reduction in total phosphorus load

(c) >= 40% reduction on total nitrogen load

(d) >= 90% reduction in gross pollutant load.

Editor's note—this sub-section contains illustrations and photographs of stormwater treatment devices. These are intended as examples only and should not be regarded as acceptable solutions. Unless specifically indicated, all drawings are not to scale.

(3) Selection of appropriate stormwater management measures

(a) Not all of the stormwater management measures presented in this sub-section are suitable for any given site. Appropriate measures should be selected by matching device characteristics to target pollutants and the physical constraints of the site.

(b) These guidelines are not intended to provide detailed advice on selection of stormwater treatment devices. However, the following tables provide an indication of:

(i) the scale at which various treatment measures are typically applied (Table SC6.4.3.9.1);

Table SC6.4.3.9.1 Scale of WSUD application in urban catchments

WSUD Measure	Allotment Scale	Street Scale	Precinct or Regional Scale
Swales and buffer strips		✓	
Bioretention Swales		✓	✓
Sedimentation basins			✓
Bioretention basins	✓	✓	✓
Constructed wetlands		✓	✓
Infiltration measures	✓	✓	
Sand filters	✓	✓	
Aquifer storage and recovery			✓

(ii) the effectiveness of these treatment measures in removing pollutants, attenuating peak flow rates and reducing runoff volume (Table SC6.4.3.9.2); and

Table SC6.4.3.9.2 Effectiveness of WSUD measures for runoff quality and quantity management

WSUD Measure Water	Quality Treatment			Peak Flow Attenuation*	Reduction in Runoff Volume*
	TSS	TP	TN		
Swales and buffer strips	H	M	L	L	L
Bioretention Swales	H	H	H	M	L
Sedimentation basins	H	M	L	M	L
Bioretention basins	H	H	H	M	L
Constructed wetlands	H	H	H	H	L
Infiltration measures**	-	-	-	H	H
Sand filters	H	M	L	L	L
Aquifer storage and recovery**	-	-	-	H	H

H – High; M – Medium; L – Low * Frequent events only ** Water quality treatment is not a primary function of these devices

(iii) site conditions that may affect the suitability of different treatment measures (Table SC6.4.3.9.3).

Table SC6.4.3.9.3 Site constraints for WSUD measures

WSUD Measure	Steep site (>5%)	Shallow bedrock	Acid Sulfate Soils	Low permeability soil (eg. Clay)	High permeability soil (eg. sand)	High water table	High sediment input	Land availability
Swales and buffer strips	C	D	D	✓	✓	D	D	D
Bioretention Swales	C	C	C	✓	✓	C	D	D
Sedimentation basins	C	✓	✓	✓	✓	D	✓	D
Bioretention basins	D	D	D	✓	✓	C	C	D
Constructed wetlands	C	D	C	✓	D	D	D	D
Infiltration measures	C	C	C	C	✓	C	C	D
Sand filters	D	✓	✓	✓	✓	D	C	✓
Aquifer storage and recovery	C	C	C	C	✓	C	C	D

C – Constraint may preclude use; D – Constraint may be overcome through appropriate design; ✓ – Generally not a constraint

(4) Safety and risk management

(a) WSUD aims to protect the environmental assets of a site and enhance liveability through greater integration of built and natural features. This approach may introduce some risks to the urban environment that are greater than or different to those encountered in traditional land development practice. The more obvious of these risks relate to the presence of open water bodies and the introduction of street-scape elements that may alter lines of sight or other aspects of traffic safety.

(b) Whilst this sub-section makes occasional comment on various aspects of safety, they are not intended to provide comprehensive advice on appropriate risk management strategies. Designers are responsible for providing an appropriate level of public safety in their designs and for ensuring that risk management procedures, in accordance with relevant standards and guidelines, are followed. Further information on risk management for water-related urban infrastructure is provided in the *Queensland Urban Drainage Manual*.

SC6.4.3.9.3 Bioretention swales

(1) Bioretention swales act to disconnect impervious areas from downstream waterways and provide protection to natural receiving waterways from frequent storm events by reducing flow velocities compared with piped systems. The bioretention component is typically located at the downstream end of the overlying swale “cell” (i.e. immediately upstream of the swale overflow pit(s) as shown in Figure SC6.4.3.9.1.

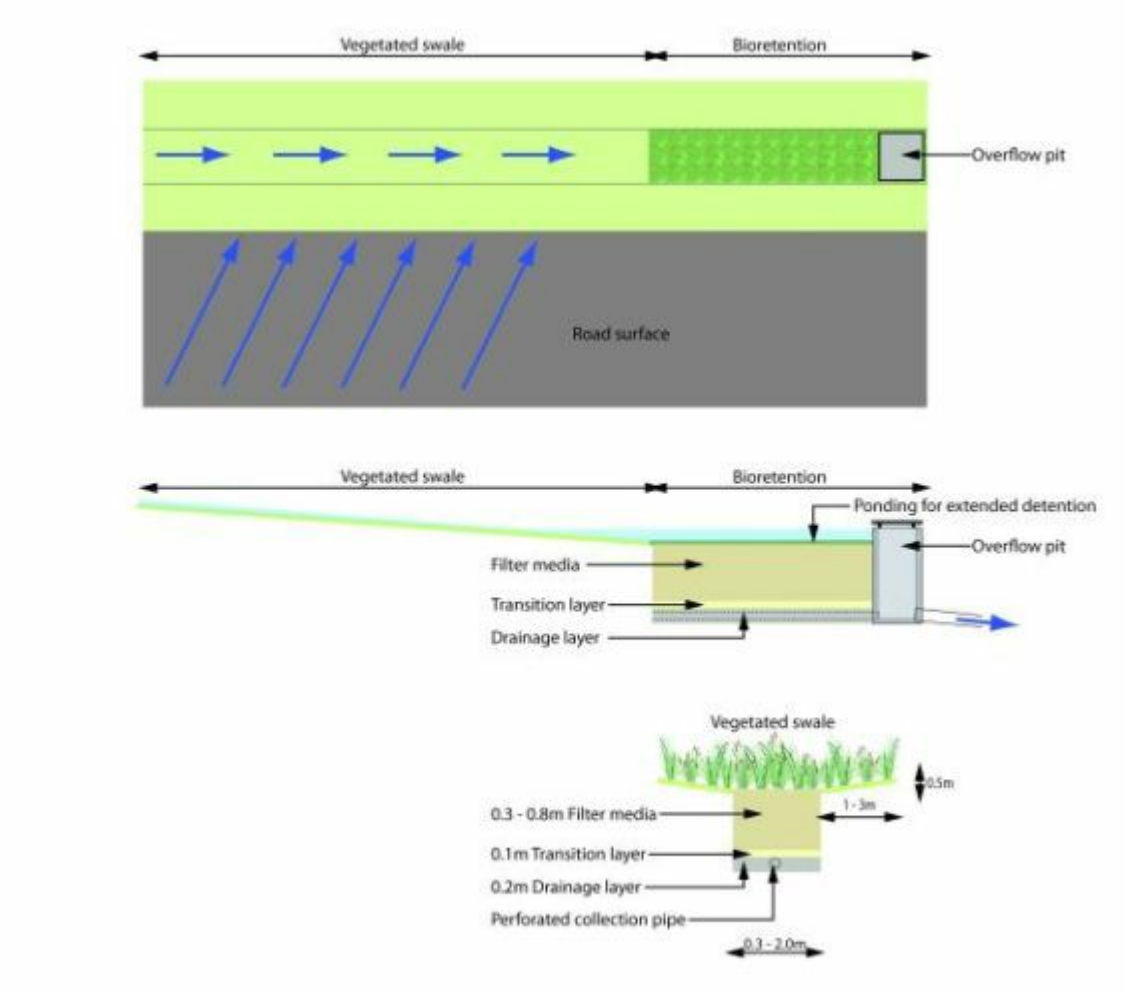


Figure SC6.4.3.9.1 Bioretention swale conceptual layout

The choice of bioretention location within the overlying swale will depend on a number of factors, including area available for the bioretention filter media and the maximum batter slopes for the overlying swale. Typically, when used as a continuous trench along the full length of a swale, the desirable maximum longitudinal grade of the swale is 4%. For other applications, the desirable grade of the bioretention zone is either horizontal or as close as possible to encourage uniform distribution of stormwater flows over the full surface area of bioretention filter media and allowing temporary storage of flows for treatment before bypass occurs.

(2) Design considerations for bioretention swales

(a) This section outlines some of the key design considerations for bioretention swales that the detailed designer should be familiar with before applying the design procedure presented later in this chapter. Standard design considerations for the swale component of bioretention swales are discussed in detail in Chapter 2 (Swales) and are not reproduced here. However, other swale design considerations that relate specifically to the interactions between the swale and bioretention components are presented in the following sections together with design considerations relating specifically to the bioretention component.

(i) Landscape design

Bioretention swales may be located within parkland areas, easements, car parks or along roadway corridors within footpaths (i.e. road verges) or centre medians. Landscape design of bioretention swales along the road edge can assist in defining the boundary of road or street corridors as well as providing landscape character and amenity. It is therefore important that the landscape design of bioretention swales addresses stormwater quality objectives whilst also being sensitive to these other important landscape functions. It is also necessary to adequately address potential aesthetics issues such as weeds and sustaining perennial plants during the dry season.

(i) Hydraulic design

A key hydraulic design consideration for bioretention swales is the delivery of stormwater runoff from the swale onto the surface of a bioretention filter media. Flow must not scour the bioretention surface and needs to be uniformly distributed over the full surface area of the filter media. In steeper areas, check dams may be required along the swale to reduce flow velocities discharged onto the bioretention filter media.

It is important to ensure that velocities in the bioretention swale from both minor (2-10 year ARI) and major (50-100 year ARI) runoff events are kept sufficiently low (preferably below 0.5 m/s and not more than 2.0 m/s for major flood) to avoid scouring. This can be achieved by ensuring the slope and hydraulic roughness of the overlying swale reduce flow velocities by creating shallow temporary ponding (i.e. extended detention) over the surface of the bioretention filter media via the use of a check dam and raised field inlet pits. This may also increase the overall volume of stormwater runoff that can be treated by the bioretention filter media.

(iii) Ex-filtration to in-situ soils

Bioretention swales can be designed to either preclude or promote ex-filtration of treated stormwater to the surrounding in-situ soils depending on the overall stormwater management objectives established for the given project.

Where the concept design specifically aims to preclude ex-filtration of treated stormwater runoff it is necessary to consider if the bioretention swale needs to be provided with an impermeable liner. The amount of water lost from bioretention trenches to surrounding in-situ soils is largely dependent on the characteristics of the local soils and the saturated hydraulic conductivity of the bioretention filter media (see SC6.4.3.9.3(2)(a)(iii)).

If the selected saturated hydraulic conductivity of the bioretention filter media is less than 10 times that of the native surrounding soils, it may be necessary to provide an impermeable liner. Flexible membranes or a concrete casting are commonly used to prevent excessive ex-filtration. This is particularly applicable for surrounding soils that are very sensitive to any ex-filtration (e.g. sodic soils and reactive clays in close proximity to significant structures such as roads).

The greatest pathway of ex-filtration is through the base of a bioretention trench, as gravity and the difference in hydraulic conductivity between the filter media and the surrounding native soil would typically act to minimise ex-filtration through the walls of the trench. If lining is required, it is likely that only the base and the sides of the drainage layer (refer to SC6.4.3.9.3(2)(a)(iii)) will need to be lined.

Where ex-filtration of treated stormwater to the surrounding in-situ soils is promoted by the bioretention swale concept design, it is necessary to ensure the saturated hydraulic conductivity of the in-situ soils is at least equivalent to that of the bioretention filter media, thus ensuring no impedance of the desired rate of flow through the bioretention filter media. Depending on the saturated hydraulic conductivity of the in-situ soils it may be necessary to provide an impermeable liner to the sides of the bioretention filter media to prevent horizontal ex-filtration and subsequent short-circuiting of the treatment provided by the filter media. Bioretention trenches promoting ex-filtration do not require perforated under-drains at the base of the filter media or a drainage layer.

A subsurface pipe is often used to prevent water intrusion into a road sub-base. This practice is to continue as a precautionary measure to collect any water seepage from bioretention swales located along roadways.

(iv) Vegetation types

Bioretention swales can use a variety of vegetation types including turf (swale component only), sedges and tufted grasses. Vegetation is required to cover the whole width of the swale and bioretention filter media surface, be capable of withstanding design flows and be of sufficient density to prevent preferred flow paths and scour of deposited sediments.

Grassed (turf) bioretention swales can be used in residential areas where a continuous bioretention

trench approach is used. The preferred vegetation for the bioretention component of bioretention swales is therefore sedges and tufted grasses (with potential occasional tree plantings) that do not require mowing.

The denser and taller the vegetation planted in the bioretention filter media, the better the treatment provided, especially during extended detention. Taller vegetation has better interaction with temporarily stored stormwater during ponding, which results in enhanced sedimentation of suspended sediments and associated pollutants. The vegetation that grows in the bioretention filter media also acts to continuously break up the surface of the media through plant root growth and wind induced agitation, which prevents surface clogging. Vegetation also provides a substrate for biofilm growth in the upper layer of the filter media which facilitates biological transformation of pollutants (particularly nitrogen).

To maintain aesthetics in highly visible areas supplemental irrigation may be required to sustain vegetation. The incorporation of saturated zones beneath the bioretention filter media can help to sustain soil moisture and is beneficial for nitrogen removal from stormwater. The ability to sustain dense perennial vegetation is important for long term weed management.

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides more specific guidance on the selection of appropriate vegetation for bioretention swales.

(v) Bioretention filter media

Selection of an appropriate bioretention filter media is a key design step involving consideration of three inter-related factors:

(A) saturated hydraulic conductivity required to optimise the treatment performance of the bioretention component given site constraints on available filter media area;

(B) depth of extended detention provided above the filter media; and

(C) suitability as a growing media to support vegetation growth (i.e. retaining sufficient soil moisture and organic content).

The area available for bioretention swales in an urban layout is often constrained by factors such as the available area within the footpaths of standard road reserves. Selecting bioretention filter media for bioretention swale applications in the coastal dry tropics will often require careful consideration of saturated hydraulic conductivity and extended detention depth to ensure the desired minimum volume of stormwater runoff receives treatment. This must also be balanced with the requirement to also ensure the saturated hydraulic conductivity does not become too high such that it can no longer sustain healthy vegetation growth. The maximum saturated hydraulic conductivity should not exceed 500 mm/hr (and preferably be between 50 - 200 mm/hr) in order to sustain vegetation growth.

The concept design stage will have established the optimal combination of filter media saturated hydraulic conductivity and extended detention depth using a continuous simulation modelling approach (such as MUSIC). Any adjustment of either of these two design parameters during the detailed design stage will require the continuous simulation modelling to be re-run to assess the impact on the overall treatment performance of the bioretention system.

As shown in Figure SC6.4.3.9.2 below, bioretention media can consist of three or four layers. In addition to the filter media required for stormwater treatment, a saturated zone can also be added to enhance nitrogen removal and to provide a source of water for vegetation over the dry season. A drainage layer is also required to convey treated water from the base of the filter media or saturated zone into the perforated under-drains. The drainage layer surrounds the perforated under-drains and can be either coarse sand (1 mm) or fine gravel (2-5 mm). If fine gravel is used, a transition layer of sand must also be installed to prevent migration of the filter or saturated zone media into the drainage layer and subsequently into the perforated under-drains.

(vi) Saturated zone

The saturated zone design involves a relatively simple modification to a conventional bioretention system. An additional layer located below the filter media is designed to retain stormwater providing a saturated zone at the base of the bioretention system. A saturated zone can be formed by using a riser pipe with the outlet level higher than the drainage layer or by incorporating a weir within the outlet pit. The saturated zone holds water and therefore provides a source of water to maintain soil moisture for plant uptake during dry periods.

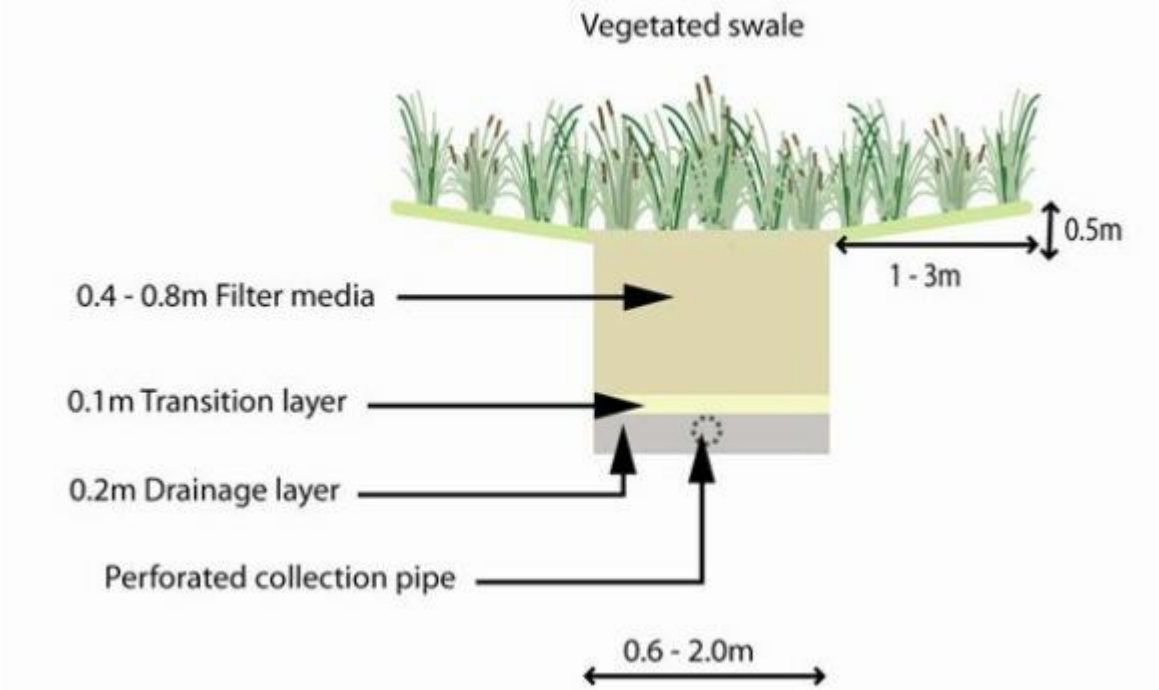


Figure SC6.4.3.9.2 Typical section of a bioretention swale

(vii) Traffic controls

Another design consideration is keeping traffic and building material deliveries off swales, particularly during the building phase of a development.

A staged construction and establishment method (SC6.4.3.9.3(5) Construction and establishment - bioretention swales) affords protection to the sub-surface elements of a bioretention swale from heavily sediment laden runoff during the subdivision construction and allotment building phases. However, to prevent vehicles driving on bioretention swales and inadvertent placement of building materials, it is necessary to consider appropriate traffic control solutions as part of the system design. These can include temporary fencing of the swale during the subdivision construction and allotment building phases with signage erected to alert builders and contractors of the purpose and function of the swales. Kerb and channel should be used at all corners, intersections, cul-de-sac heads and at traffic calming devices to ensure correct driving path is taken. For all of these applications, the kerb and channel is to extend 5 m beyond tangent points.

(viii) Roof water discharge

Roof runoff can contain a range of stormwater pollutants including nitrogen washed from the atmosphere during rainfall events. Roof water should be discharged onto the surface of the swale for subsequent conveyance and treatment by the swale (and downstream treatment measures) before being discharged to receiving aquatic environments. Depending on the depth of the roof water drainage system and the finished levels of the bioretention swale, this may require the use of a small surcharge pit located within the invert of the swale to allow the roof water to surcharge to the swale. Any residual water left in the surcharge pit can be discharged to the underlying subsoil drainage by providing perforations in the base and sides of the surcharge pit. If a surcharge pit is used then an inspection chamber along the roof water drainage line is to be provided within the property boundary. Surcharge pits are discussed further in SC6.4.3.9.3(3)(d)(ii) Concentrated inflow.

(ix) Services

Bioretention swales located within footpaths (i.e. road verges) must consider the standard location for services within the verge and ensure access for maintenance of services. Typically it is acceptable to have water and sewer services located beneath the batters of the swale with any sewers located beneath bioretention swales to be fully welded polyethylene pipes with rodding points.

(3) Bioretention swale design process

(a) Step 1: Confirm treatment performance of concept design

This design process assumes a conceptual design has been undertaken. Before commencing detailed design, the designer should first undertake a preliminary check to confirm the bioretention swale treatment area from the concept design is adequate to deliver the required level of stormwater quality improvement. This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in an appropriate quantitative modelling program. This modelling must be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows for the swale component

(i) Design flows

Two design flows are required for the design of a swale:

(A) minor flood flow (2 year ARI) to allow minor floods to be safely conveyed. For commercial and industrial areas the design flow requirement for minor flows is a 5 year ARI event.

(B) major flood flow (100 year ARI) to check flow velocities, velocity depth criteria, conveyance within road reserve, and freeboard to adjoining property.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. As the typical catchment area should be relatively small (<50 ha) the Rational Method design procedure is considered to be a suitable method for estimating design peak flows.

(c) Step 3: Dimension the swale component with consideration to site constraints

Factors to consider are:

(i) allowable width given the proposed road reserve and/ or urban layout;

(ii) how flows are delivered into a swale (e.g. cover requirements for pipes or kerb details);

(iii) vegetation height;

(iv) longitudinal slope;

(v) maximum side slopes and base width;

(vi) provision of crossings (elevated or at grade); and

(vii) requirements of QUDM and Townsville City Plan.

Depending on which of the above factors are fixed, the other variables can be adjusted to derive the optimal swale dimensions for the given site conditions. The following sections outline some considerations in relation to dimensioning a swale.

(i) Swale width and side slopes

Where the swale width is not constrained by an urban layout (e.g. when located within a large parkland area) then the width of the swale can be selected based on consideration of landscape objectives, maximum side slopes for ease of maintenance and public safety, hydraulic capacity required to convey the desired design flow, and treatment performance requirements. The maximum swale width needs to be identified early in the design process as it dictates the remaining steps in the swale design process. Selection of appropriate sideslopes for swales in parks, easements or median strips is heavily dependent on site constraints, and swale side slopes are typically between 1 in 10 and 1 in 4.

For swales located adjacent to roads, the types of driveway crossing used will typically dictate batter slopes. Where there are no driveway crossings, the maximum swale side slopes will be established for ease of maintenance and public safety considerations. Generally “at-grade”

crossings, are preferred which require the swale to have 1:9 side slopes with a nominal 0.5 m flat base to provide sufficient transitions to allow for traffic movement across the crossing. Flatter swale side slopes can be adopted but this will reduce the depth of the swale and its conveyance capacity. Where “elevated” crossings are used, swale side slopes would typically be between 1 in 6 and 1 in 4. “Elevated” crossings will require provision for drainage under the crossings with a culvert or similar.

(ii) Maximum length of a swale

The maximum length of a swale located within parkland areas and easements is calculated as the distance along the swale to the point where the flow in the swale from the contributing catchment (for the specific design flood frequency) exceeds the bank full capacity of the swale. For example, if the swale is to convey the minor flood flow (1-5 year ARI) without overflowing, then the maximum swale length would be determined as the distance along the swale to the point where the 1-5 year ARI flow from the contributing catchment is equivalent to the bank full flow capacity of the swale (bank full flow capacity is determined using Manning’s equation as discussed in SC6.4.3.9.3(3)(c) (iii) Swale capacity).

(iii) Swale capacity – Manning’s Equation and selection of Manning’s *n*

To calculate the flow capacity of a swale, use Manning’s equation. This allows the flow rate and flood levels to be determined for variations in swale dimensions, vegetation type and longitudinal grade.

$$Q = \frac{A \cdot R^{2/3} \cdot S^{1/2}}{n}$$

Where A = cross section area of swale (m^2)
R = hydraulic radius (m)
S = channel slope (m/m)
N = roughness factor (Manning’s *n*)

Figure SC6.4.3.9.3 shows a plot of Manning’s *n* versus flow depth for a grass swale with longitudinal grade of 5 %. It is reasonable to expect the shape of the Manning’s n relation with flow depth to be consistent with other swale configurations, with the vegetation height at the boundary between low flows and intermediate flows (Figure SC6.4.3.9.3) on the top axis of the diagram. The bottom axis of the plot has been modified from Barling and Moore (1993) to express flow depth as a percentage of vegetation height.

Further discussion on selecting an appropriate Manning’s n for a swale is provided in Appendix E of the MUSIC User Guide (CRCCH 2005).

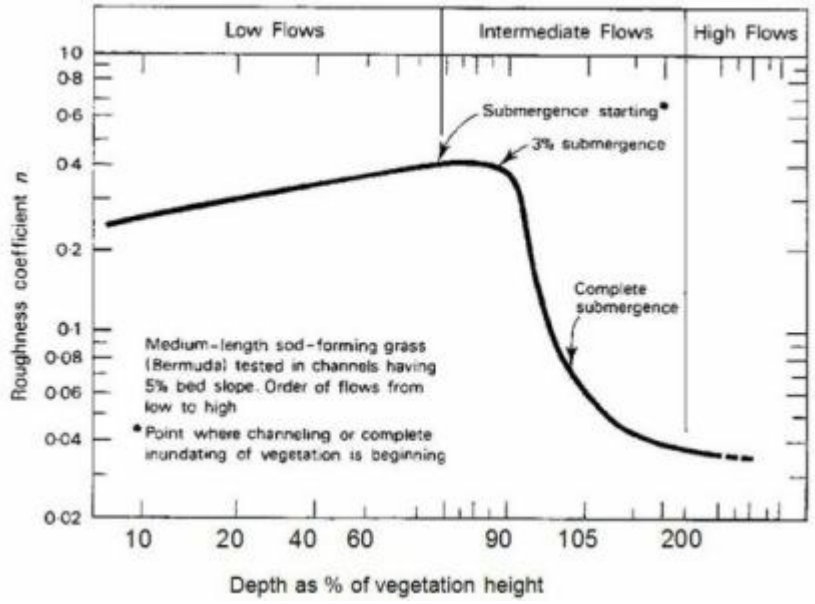


Figure SC6.4.3.9.3 Impact of flow depth on hydraulic roughness (adapted from Barling and Moore (1993))

(d) Step 4: Design inflow systems to swale and bioretention components

Inflows to bioretention swales can be via distributed runoff (e.g. from flush kerbs on a road) or point outlets such as pipe outfalls. Combinations of these inflow pathways can also be used.

(i) Distributed inflow

An advantage of flows entering a bioretention swale system in a distributed manner (i.e. entering perpendicular to the direction of the swale) is that flow depths are kept as shallow sheet flow, which maximises contact with the swale and bioretention vegetation, particularly on the batter receiving the distributed inflows. This swale and bioretention batter is often referred to as a buffer (see Figure SC6.4.3.9.4). The requirement of the buffer is to ensure there is dense vegetation growth, flow depths are shallow (below the vegetation height) and erosion is avoided. The buffer provides good pre-treatment (i.e. significant coarse sediment removal) prior to flows being conveyed along the swale.

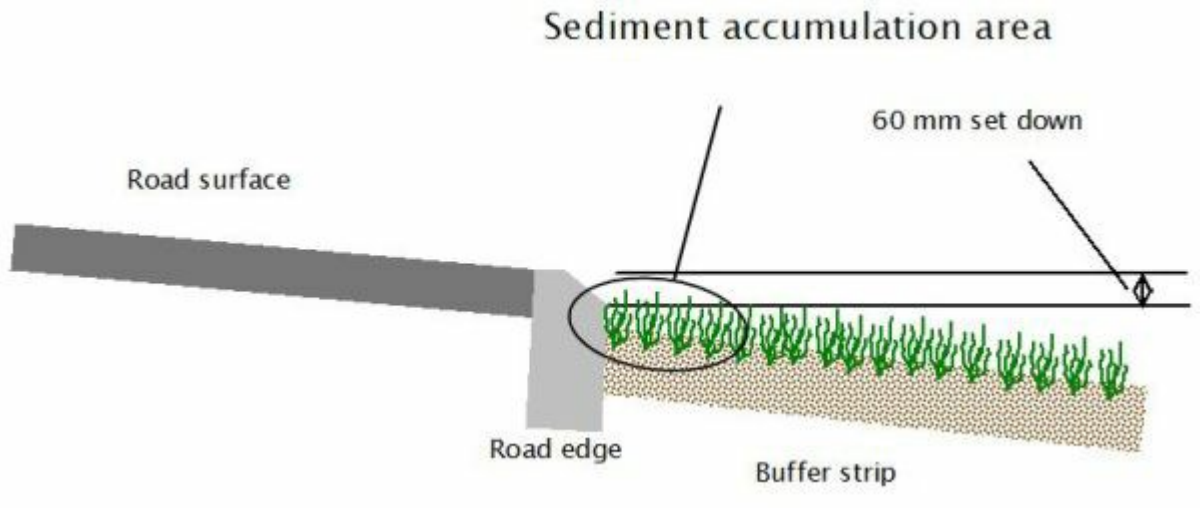


Figure SC6.4.3.9.4 Flush kerb with 60 mm setdown to allow sediment to flow into vegetated area

Distributed inflows can be achieved either by having a flush kerb or by using kerbs with regular breaks in them to allow for even flows across the buffer surface (Figure SC6.4.3.9.5).

Figure SC6.4.3.9.5 Kerb arrangements with breaks and flush kerbs to distribute inflows on to bioretention swales and prevent vehicle access

Key design parameters of buffer systems are:

(A) providing distributed flows into a buffer (potentially spreading stormwater flows to achieve this);

(B) avoiding rilling or channelised flows;

(C) maintaining flow heights lower than vegetation heights (this may require flow spreaders, or check dams); and

(D) minimising the slope of buffer, best if slopes can be kept below 5%.

Maintenance of buffers is required to remove accumulated sediment and debris therefore access is important. It is important to ensure coarse sediments accumulate off the road surface at the start

of the buffer. Figure SC6.4.3.9.6 shows sediment accumulating on a street surface where the vegetation is the same level as the road. To avoid this accumulation, a tapered flush kerb must be used that sets the top of the vegetation 60 mm which requires the top of the ground surface (before turf is placed) to be approximately 100 mm below the road surface. This allows sediments to accumulate off any trafficable surface.

Figure SC6.4.3.9.6 Flush kerb without setdown, showing sediment accumulation on road

(ii) Concentrated inflow

Concentrated inflows to a bioretention swale can be in the form of a concentrated overland flow or a discharge from a piped drainage system (e.g. allotment drainage line). For all concentrated inflows, energy dissipation at the inflow location is required to minimise any erosion potential. This can usually be achieved with rock benching and/ or dense vegetation.

The most common constraint on pipe systems discharging to bioretention swales is bringing the pipe flows to the surface of a swale. In situations where the swale geometry does not allow the pipe to achieve “free” discharge to the surface of the swale, a “surcharge” pit may be used but should be avoided where possible.

Surcharge pit systems are most frequently used when allotment runoff is required to cross a road into a swale on the opposite side of the road or for allotment runoff discharging into shallow profile swales. Where allotment runoff needs to cross under a road to discharge to a swale, it is preferable to combine the runoff from more than one allotment to reduce the number of crossings required under the road pavement. Figure SC6.4.3.9.7 illustrates a typical surcharge pit discharging into a swale.

Another important form of concentrated inflow in a bioretention swale is the discharge from the swale component into the bioretention component, particularly where the bioretention component is located at the downstream end of the overlying swale and receives flows concentrated within the swale. Depending on the grade, its top width and batter slopes, the resultant flow velocities at the transition from the swale to the bioretention filter media may require the use of energy dissipation to prevent scour of the filter media (if flow velocities > 0.5 m/sec). For most cases, this can be achieved by placing several large rocks in the flow path to reduce velocities and spread flows. Energy dissipaters located within footpaths must be designed to ensure pedestrian safety.

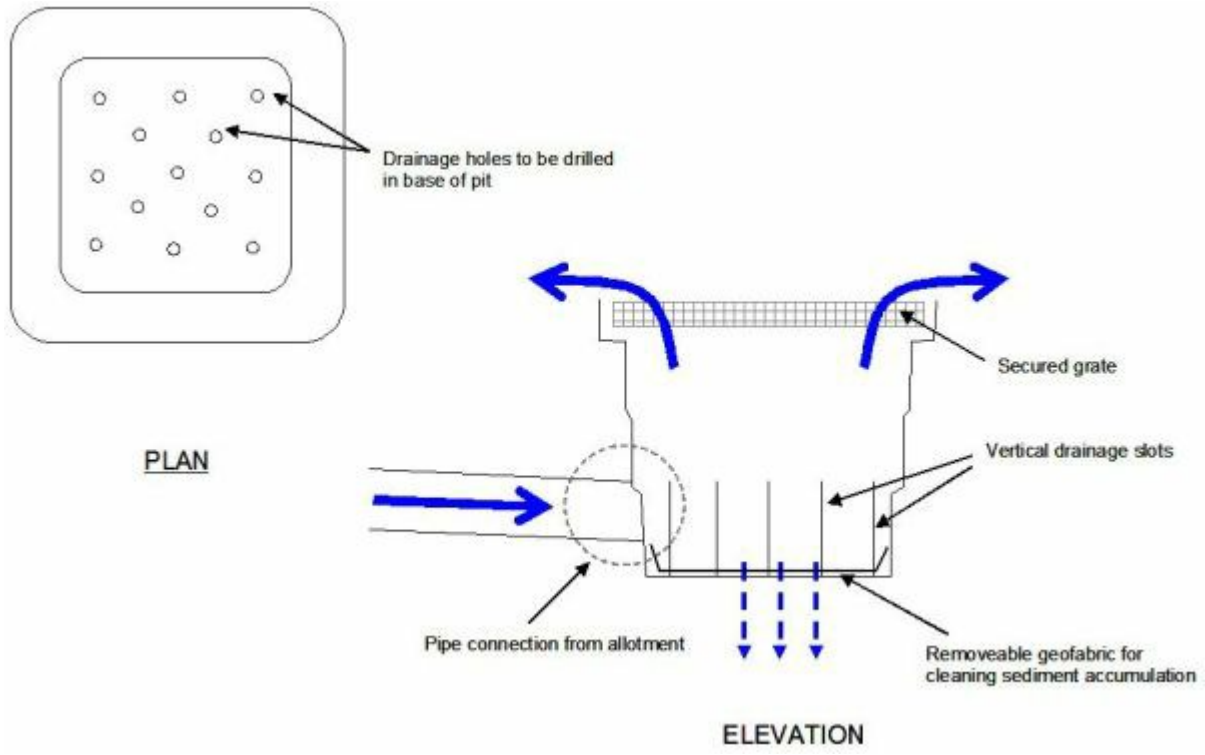


Figure SC6.4.3.9.7 Example of surcharge pit for discharging allotment runoff into a swale

(e) Step 5: Design bioretention component

(i) Select filter media saturated hydraulic conductivity and extended detention

Where design Steps 2 and 3 (SC6.4.3.9.3(3)(b) and SC6.4.3.9.3(3)(c)) reveal that the swale geometry derived during the concept design stage does not comply with the relevant local road drainage design standards and/or the standards established in QUDM for minor flood and major flood flows on adjoining road pavements and minimum freeboard requirements to adjoining properties, it is necessary to revise the swale geometry. As such, an alternative dimension for the surface area of the bioretention component may result and this may require further quantitative modelling to determine the “new” optimal combination of filter media saturated hydraulic conductivity and extended detention depth to maximise the water quality treatment function of the bioretention component.

(ii) Specify the bioretention filter media characteristics

Three to four types of media can be required in the bioretention component of bioretention swales (refer Figure SC6.4.3.9.2).

Filter media

The filter media layer provides the majority of the pollutant treatment function, through fine filtration and also by supporting vegetation. The vegetation enhances filtration, keeps the filter media porous, provides substrate for biofilm formation and provides some uptake of nutrients and other stormwater pollutants. As a minimum, the filter media is required to have sufficient depth to support vegetation. Typical depths are between 600-1000 mm with a minimum depth of 300 mm accepted in depth constrained situations. It is important to note that if deep rooted plants such as trees are to be planted in bioretention swales, the filter media must have a minimum depth of 800 mm to avoid roots interfering with the perforated under-drain system.

The saturated hydraulic conductivity of the filter media is established by optimising the treatment performance of the bioretention system given site constraints of the particular site (using a continuous simulation model). Saturated hydraulic conductivity should remain between 50-200 mm/hr (saturated hydraulic conductivity of greater than 500 mm/hr would not be accepted by most councils). Once the saturated hydraulic conductivity of the filter media has been determined for a particular bioretention swale, the following process can then be applied to derive a suitable filter media soil to match the design saturated hydraulic conductivity:

(A) identify available sources of a suitable base soil (i.e. topsoil) capable of supporting vegetation growth such as a sandy loam or sandy clay loam. In-situ topsoil should be considered first before importing a suitable base soil. Any base soil found to contain high levels of salt (see last bullet point), extremely low levels of organic carbon (< 5%), or other extremes considered retardant to plant growth and denitrification should be rejected. The base soil must also be structurally sound and not prone to structural collapse as this can result in a significant reduction in saturated hydraulic conductivity. The risk of structural collapse can be reduced by ensuring the soil has a well graded particle size distribution with a combined clay and silt fraction of < 12%;

(B) using laboratory analysis, determine the saturated hydraulic conductivity of the base soil using standard testing procedures (AS 4419-2003 Appendix H Soil Permeability). A minimum of five samples of the base soil should be tested. Any occurrence of structural collapse during laboratory testing must be noted and an alternative base soil sourced;

(C) the required content of sand or clay (by weight) to be mixed to the base soil will need to be established in the laboratory by incrementally increasing the content of sand or clay until the desired saturated hydraulic conductivity is achieved. The sand or clay content (by weight) that achieves the desired saturated hydraulic conductivity should then be adopted on-site. A minimum of five samples of the selected base soil and sand (or clay) content mix must be tested in the laboratory to ensure saturated hydraulic conductivity is consistent across all samples. If the average saturated hydraulic conductivity of the final filter media mix is within ± 20% of the design saturated hydraulic conductivity then the filter media can be adopted and installed in the bioretention system. Otherwise, further amendment of the filter media must occur through the addition of sand (or clay) and retested until the design saturated hydraulic conductivity is achieved;

(D) the base soil must have sufficient organic content to establish vegetation on the surface of the bioretention system. If the proportion of base soil in the final mix is less than 50%, it may be necessary to add organic material. This should not result in more than 10% organic content (measured in accordance with AS 1289.4.1.1-1997) and should not alter the saturated hydraulic conductivity of the final filter media mix;

(E) the pH of the final filter media is to be amended (if required) to between 6 and 7. If the filter media mix is being prepared off-site, this amendment should be undertaken before delivery to the site; and

(F) the salt content of the final filter media (as measured by EC1:5) must be less than 0.63dS/m for low clay content soils like sandy loam. (EC1:5 is the electrical conductivity of a 1:5 soil/ water suspension).

Transition layer (if required)

The purpose of the transition layer is to prevent the filter media from migrating down into the drainage layer (or saturated layer). It also acts as a buffer between the permanently saturated zone and the filter media. This buffer is necessary to ensure the filter media is not saturated for prolonged periods during rainfall events due to increases in water levels in the saturated zone. To achieve this, the transition layer depth must be greater than the head created by flows over the saturated zone outlet weir.

It is required if the particle size difference between the filter media and the drainage layer (or saturated layer) is more than one order of magnitude. If a transition layer is required then the material must be a clean, well-graded sand/coarse sand material containing little or no fines.

The transition layer is recommended to be 100 mm thick and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A recent particle size distribution for the transition layer sand will need to be obtained to ensure that it meets the required grading/"bridging" criteria outlined below. The "bridging" criteria is based on the engineering principles that rely on the largest 15% of the filter media particles "bridging" with the smallest 15% of the sand particles. This results in smaller voids, which prevent the migration of the filter media particles into the sand particles. The following equation is taken from the United

States Golf Association's recommendations for golf course construction:

Bridging Factor: **D15 (transitional layer sand) ≤ 8 x D85 (filter media)**

The addition of a transition layer increases the overall depth of the bioretention system and may be an important consideration for some sites where total depth of the bioretention system may be constrained. In such cases, the use of a sand drainage layer and/ or perforated pipes with smaller slot sizes may need to be considered (SC6.4.3.9.4(2)(e) Step 5: Design under-drain and undertake capacity checks (if required)).

Saturated layer (if required)

The saturated layer should be about 400 mm deep (but may deeper depending on the specific application) and composed of clean (i.e. free from fines) medium-coarse washed sand, gravel or small rock (50 mm diameter maximum) together with a long term carbon source. Hardwood wood chips, 5 mm to 40 mm in size, are recommended as the carbon source because they breakdown slowly to provide a long term carbon source yet have a decomposition rate that should not limit the denitrification process.

The total mass of carbon/electron donor that is required for denitrification must be calculated based on the expected stormwater influent TN mass over the desired life span of the system (e.g. 25 years). The calculation is based on the stoichiometry of the denitrification reaction (shown below).

Denitrification reaction:

$NO_3^- + 1.25\ (CH_2O) + H^+\ (10^7 M) \rightarrow 0.5N_2\ (g) + 1.75H_2O + 1.25CO_2\ (g)$

Based on a 400 mm deep saturated zone and the modelled annual TN runoff mass (for Townsville) for a bioretention system that is 2% of the contributing 1ha catchment, the saturated zone media would have the following composition:

- 76.7 m^3 washed coarse sand, gravel or small rock; and
- 3.3 m^3 hardwood wood chips, well graded 5 mm-40 mm.

This is equivalent to an organic carbon content of approximately 4-5% by volume. If the saturated zone depth changed, or the bioretention system to catchment area ratio changed, the hardwood proportion would need to be recalculated using the denitrification stoichiometry.

Calculating Carbon Source for Saturated Zone with safety factor (x2)	
Catchment Area	1 ha
Treatment Area Required	2%
Bioretention Surface Area	200 m^2
Saturated Zone Depth	400 mm
Total volume of Saturated Zone	80 m^3
TN load 1 year	12.5 kg/yr
TN load 25 years	312.5 kg/25yrs
Stoichiometry:	
N:C ratio = 1:1.25 (mol), which equates to 14:15(g) [Mw: N = 14g/mol, C = 12g/mol]	
Average total carbon content of hardwood woodchips is 50%, therefore	
N:C (woodchip) = 14:30 (g)	
N:C (woodchip) = 1:2.1	
Woodchips (312.5 x 2.1)	656 kg/carbon
Safety Factor (x 2)	1313kg/carbon
Density of wood chips	400 kg/m^3 (approx.)
Hardwood Wood Chips	**3.3 m^3**
Clean Coarse Sand	**76.7 m^3**

The saturated media must have a hydraulic conductivity of >1000 mm/hr (the ASTM F1815-06 test method is to be used to measure hydraulic conductivity).

The saturated zone should be lightly compacted (e.g. with one pass of a smooth drum lawn roller) during installation to stabilise the structure. Under no circumstances should heavy compaction or multiple-passes be made.

Drainage layer (if required)

The drainage layer is used to convey treated flows from the base of the filter media layer (or saturated zone) into the perforated under-drainage system. The composition of the drainage layer is to be considered in conjunction with the selection and design of the perforated under-drainage system (refer to SC6.4.3.9.3(e)(iii)) as the slot sizes in the perforated pipes may determine the minimum drainage layer particle size to avoid washout of the drainage layer into the perforated pipe system. Coarser material (e.g. fine gravel) is to be used for the drainage layer if the slot sizes in the perforated pipes are too large for use of a sand based drainage layer. Otherwise, sand is the preferred drainage layer media as it is likely to avoid having to provide a transition layer between the filter media and the drainage layer (if there is no saturated zone). The drainage layer is to be a minimum of 200 mm thick.

Bridging Factor:

D15 (drainage gravel/sand) ≤ 8 x D85 (filter media/saturated zone/transition layer)

Ensure drainage media is washed prior to placement in bioretention system to remove any fines.

(iii) Under-drain design and capacity checks

The maximum spacing of the perforated pipes in wide bioretention trenches is 1.5 m (centre to centre) so that the distance water needs to travel (horizontally) through the drainage layer does not hinder drainage of the filtration media.

By installing parallel pipes, the capacity of the perforated pipe under-drain system can be increased. The recommended maximum size for the perforated pipes 100 mm to minimise the required thickness of the drainage layer. Either flexible perforated pipe (e.g. ag pipe) or slotted

PVC pipes can be used, however care needs to be taken to ensure that the slots in the pipes are not so large that sediment would freely flow into the pipes from the drainage layer. This is also a consideration when specifying the drainage layer media.

To ensure the slotted pipes are of adequate size, several checks are required:

- ensure perforations are adequate to pass the maximum infiltration rate;
- ensure the pipe itself has capacity to convey the design flow/ infiltration rate; and
- ensure that the material in the drainage layer will not be washed into the perforated pipes (consider a transition layer).

The maximum infiltration rate represents the maximum rate of flow through the bioretention filter media and is calculated by applying Darcy's equation (Equation 3.2) as follows:

$$Q_{max} = K_{sat} \cdot L \cdot W_{base} \cdot \frac{h_{max} + d}{d}$$

Where Q_{max} = maximum infiltration rate (m^3/s)
K_{sat} = hydraulic conductivity of the soil filter (m/s)
W_{base} = base width of the ponded cross section above the soil filter (m)
L = length of the bioretention zone (m)
h_{max} = depth of pondage above the soil filter (m)
d = depth of filter media (m)

The capacity of the perforated under-drains need to be greater than the maximum infiltration rate to ensure the filter media drains freely and the pipe(s) do not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system rather than the perforated under-drainage system).

To ensure the perforated under-drainage system has sufficient capacity to collect and convey the maximum infiltration rate, it is necessary to determine the capacity for flows to enter the under-drainage system via perforations in the pipes. To do this, orifice flow can be assumed and the sharp edged orifice equation can be used. Firstly, the number and size of perforations needs to be determined (typically from manufacturer's specifications) and used to estimate the flow rate into the pipes using the maximum driving head (being the depth of the filtration media if no extended detention is provided or if extended detention is provided in the design then to the top of extended detention). It is conservative but reasonable to use a blockage factor to account for partial blockage of the perforations by the drainage layer media. A 50% blockage of the perforation is recommended.

$$Q_{perf} = B \cdot C_d \cdot A\sqrt{2 \cdot g \cdot h}$$

Where Q_{perf} = flow through perforations (m^3/s)
B = blockage factor (0.5)
C_d = orifice discharge coefficient (assume 0.61 for sharp edge orifice)
A = total area of the orifice (m^2)
g = gravity (9.79 m/s^2)
h = head above the perforated pipe (m)

If the capacity of the drainage system is unable to collect the maximum infiltration rate then additional under- drains will be required.

After confirming the capacity of the under-drainage system to collect the maximum infiltration rate is it then necessary to confirm the conveyance capacity of the underdrainage system is sufficient to convey the collected runoff. To do this, Manning's equation (Equation 3.1) can be used (which assumes pipe full flow (in place of channel flow) but not under pressure). The Manning's roughness used will be dependent on the type of pipe used. When a saturated zone is incorporated into the design, the underdrainage pipes are laid flat however the conveyance capacity can be calculated using the Manning's equation with an assumed friction slope of 0.5%.

The under-drains should be extended vertically to the surface of the bioretention system to allow inspection and maintenance when required. The vertical section of the under-drain should be unperforated and capped to avoid short circuiting of flows directly to the drain.

In bioretention systems with a saturated zone, the capacity of the weir or up-turned pipe (maintaining the water level within the saturated zone) must also be checked to ensure it does not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system). A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) to convey the maximum flow/filtration rate. The maximum depth of flow over the weir is to be 100 mm. This is important to limit increase in the saturated zone depth and avoid prolonged saturation of the filter media.

(iv) Check requirement for impermeable lining

The saturated hydraulic conductivity of the natural soil profile surrounding the bioretention system should be tested together with depth to groundwater, chemical composition and proximity to structures and other infrastructure. This is to establish if an impermeable liner is required at the base (only for systems designed to preclude ex-filtration to in-situ soils) and/or sides of the bioretention system (refer also to discussion in SC6.4.3.9.3(2)(a)(iii) Ex-filtration to in-situ soils). If the saturated hydraulic conductivity of the filter media in the bioretention system is more than one order of magnitude (10 times) greater than that of the surrounding in-situ soil profile, no impermeable lining is required.

(f) Step 6: Verify design

(i) Vegetation scour velocity check

Potential scour velocities are checked by applying Manning's equation (Equation 3.1) to the bioretention swale design to ensure the following criteria are met:

(A) less than 0.5 m/s for minor flood (2-10 year ARI) discharge; and

(B) less than 2.0 m/s for major flood (50-100 year ARI) discharge.

(ii) Velocity and depth check – safety

As bioretention swales are generally accessible by the public, it is important to check that depth x velocity within the bioretention swale, at any crossings and adjacent pedestrian and bicycle pathways, satisfies the following public safety criteria:

(A) depth x velocity < 0.6 m^2/s for low risk locations and 0.4 m^2/s for high risk locations as defined in QUDM; and

(B) maximum depth of flow over crossing = 0.3 m.

(iii) Confirm treatment performance

If the previous two checks are satisfactory then the bioretention swale design is satisfactory from a conveyance function perspective and it is now necessary to confirm the treatment performance of the bioretention swale by reference to the performance information presented in SC6.4.3.9.3(3)(a)).

(g) Step 7: Size overflow pit (field inlet pits)

In a bioretention swale system, an overflow pit can be provided flush with the invert of the swale and/ or bioretention system filter media (i.e. when no extended detention is provided in the design) or it can be provided with the pit crest raised above the level of the bioretention filter media to establish the design extended detention depth (if extended detention is provided for in the design).

Grated pits are typically used and the allowable head for discharges into the pits is the difference in level between the pit crest and the maximum permissible water level to satisfy the local council's minimum freeboard requirements. Depending on the location of the bioretention swale, the design flow to be used to size the overflow pit could be the maximum capacity of the swale, the minor flood flow (2-5 year ARI) or the major flood flow (50 year ARI). There should be a minimum of 100 mm head over the overflow pit crest to facilitate discharge of the design flow into the overflow pit.

To size an overflow pit, two checks should be made to test for either drowned or free flowing conditions. A broad crested weir equation can be used to determine the length of weir required (assuming free overflowing conditions) and an orifice equation used to estimate the area between openings required in the grate cover (assuming drowned outlet conditions). The larger of the two pit configurations should be adopted (as per Section 7.05 QUDM). In addition, a blockage factor is to be used, that assumes the grate is 50% blocked.

For free overfall conditions (weir equation):

$$Q_{weir} = B \cdot C_w \cdot L \cdot h^{3/2}$$

Where	Q_{weir}	=	Flow into pit (weir) under free overfall conditions (m^3/s)
	B	=	Blockage factor (= 0.5)
	C_w	=	Weir coefficient (= 1.66)
	L	=	Length of weir (perimeter of pit) (m)
	h	=	Flow depth above the weir (pit) (m)

Once the length of weir is calculated, a standard sized pit can be selected with a perimeter at least the same length of the required weir length.

For drowned outlet conditions (orifice equation):

$$Q_{orifice} = B \cdot C_d \cdot A\sqrt{2 \cdot g \cdot h}$$

Where B, g and h have the same meaning as in Equation 3.4

$Q_{orifice}$	=	flow rate into pit under drowned conditions (m^3/s)
C_d	=	discharge coefficient (drowned conditions = 0.6)
A	=	area of orifice (perforations in inlet grate) (m^2)

When designing grated field inlet pits, reference is also to be made to the procedure described in QUDM Section 7.05.4 (DNRW, IPWEA and BCC, 1998).

When a saturated zone is included in the design of a bioretention system, additional components must be incorporated into the outlet design. A saturated zone can be formed at the base of a bioretention system by using a riser pipe with the outlet level set at the top of the desired saturation depth (i.e. top of the saturated zone) or by incorporating a weir/overflow structure within the outlet pit (see Figure SC6.4.3.9.22). The saturated zone would hold water rather than draining freely, and would therefore provide a source of water to the plants during dry periods.

(h) Step 8: Make allowances to preclude traffic on swales

Refer to SC6.4.3.9.3(a)(vii) for discussion on traffic control options.

(i) Step 9: Specify plant species and planting densities

Refer to SC6.4.3.9.3(4) Landscape design notes - bioretention swales and SC6.4.3.6 Landscape policy for advice on selecting suitable plant species for bioretention swales in the coastal dry tropics. Consultation with landscape architects is recommended when selecting vegetation to ensure the treatment system compliments the landscape design of the area.

(j) Step 10: Consider maintenance requirements

Consider how maintenance is to be performed on the bioretention swale (e.g. how and where is access available, where is litter likely to collect etc.). A specific maintenance plan and schedule should be developed for the bioretention swale in accordance with SC6.4.3.9.3(6) Maintenance requirements - bioretention swales.

(k) Design calculation summary

The following design calculation table (Table SC6.4.3.9.4) can be used to summarise the design data and calculation results from the design process.

Click here to view **Table SC6.4.3.9.4 Bioretention swales design calculation summary**

(l) Typical design parameters

Table SC6.4.3.9.5 shows typical values for a number of key bioretention swale design parameters.

Table SC6.4.3.9.5 Typical design parameters for bioretention swales

Design Parameter	Typical Values
Swale longitudinal slope	1% to 4%
Swale side slope for trafficability (with “at grade” crossover)	Maximum 1 in 9
Swale side slope (with elevated driveway crossover)	1 in 4 to 1 in 10
Manning’s *n* (with flow depth lower than vegetation height)	0.15 to 0.3
Manning’s *n* (with flow depth greater than vegetation height)	0.03 to 0.05
Maximum velocity for scour in minor event (e.g. 2-10yr ARI)	0.5 m/s
Maximum velocity for 50-100yr ARI	2.0 m/s
Perforated pipe size	100 mm (maximum)
Drainage layer average material diameter (typically fine gravel or coarse sand)	1-5 mm diameter
Transition layer average material diameter typically sand to coarse sand	0.7 – 1.0 mm diameter

(4) Landscape design notes - bioretention swales

Bioretention swales are a combined solution that involves integrating a swale with the filtration function of a bioretention basin/trench. These can involve an extended detention treatment and some biological uptake through the planted bioretention component. The landscaping for both the swale and bioretention parts are essentially similar to the treatments for the stand alone components however consideration of the interface landscape between the vegetated swale and bioretention is important.

(a) Objectives

Landscape design for bioretention swales has four key objectives:

(i) ensure surface treatments and planting designs address stormwater quality objectives by incorporating appropriate plant species for stormwater treatment (biologically active root zone) whilst enhancing the overall natural landscape. This includes requirements for maintaining dense perennial vegetation throughout the dry season to maintain aesthetics and to minimise weed growth;

(ii) integrated planning and design of bioretention swales within the built and landscape environments;

(iii) incorporating crime prevention through environmental design (CPTED) principles and road, driveway and footpath visibility safety standards; and

(iv) create landscape amenity opportunities that enhance community and environmental needs, such as visual aesthetics, shade, screening, view framing, and way finding.

(b) Streetscape bioretention systems

When using bioretention swales in road reserves it is important to understand how the swale landscape can be used to define the visual road space. Creative landscape treatments may be possible given that the bioretention swale element will typically be a minimum of 4 m in width. Design responses may range from informal “natural” planting layouts to regimented avenues of trees along each external and internal edge of the bioretention swale element. Bioretention swales can be incorporated into a typical streetscape landscape using either a central splitter median or using one side of the road reserve.

Bioretention swale surface treatments are generally a vegetated swale that integrates into a densely planted bioretention component. The use of turf for the bioretention parts of the system is discouraged as mowing and public use of these areas will compact the upper filter media and limit the amount of filtration.

Vegetated bioretention swales can provide a relatively maintenance free finish if the planting and invert treatment are designed well. Key considerations when detailing are density and types of plantings, locations of trees and shrubs, type of garden (mowing) edges to turf areas that allows unimpeded movement of stormwater flow and overall alignment of swale invert within the streetscape.

(i) Centre median

Generally, the central median swale will provide a greater landscaped amenity, allowing planting and shade trees to enhance the streetscape more effectively, whilst verges remain constraint free. This swale configuration is however confined to roads requiring larger corridors for increased traffic.

This can be seen in Figure SC6.4.3.9.8 and Figure SC6.4.3.9.9.

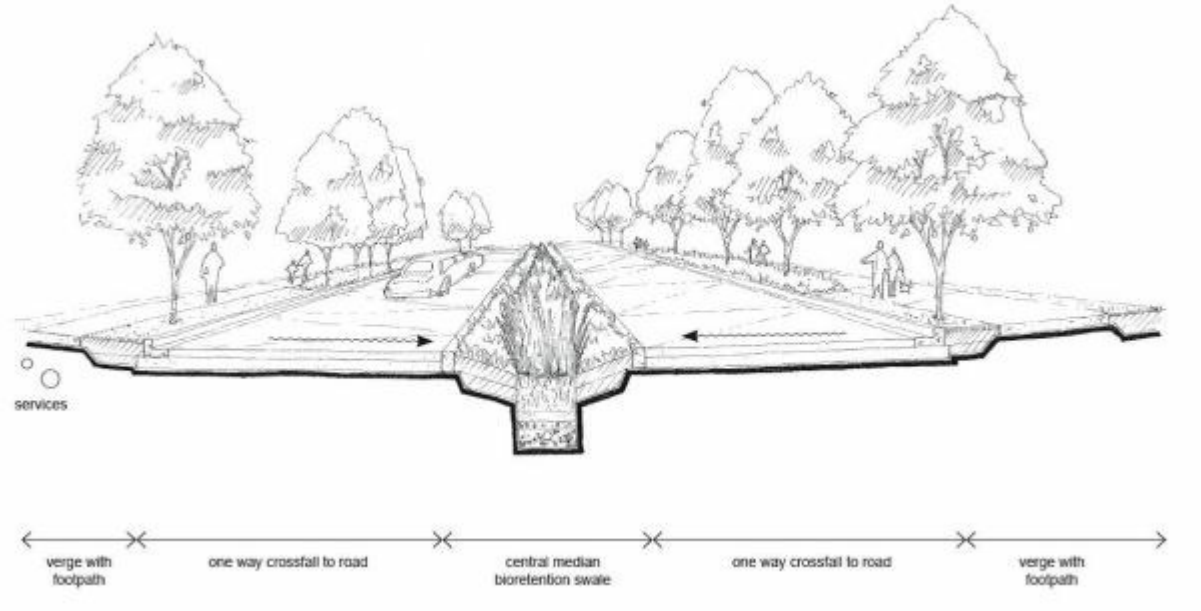


Figure SC6.4.3.9.8 Bioretention swale in centre median

Figure SC6.4.3.9.9 Median strip bioretention applications

(ii) Side of road

In smaller minor roads, one side of the road can have a swale landscape to capture stormwater runoff from road pavements and house lots. To enhance the visual road space, creative landscape treatments to driveway cross-overs, general planting and invert treatments should be used. It is important in this swale arrangement that services and footpaths that are standard for road verges have been planned and located to avoid clashes of function. This can be seen in Figure SC6.4.3.9.10.

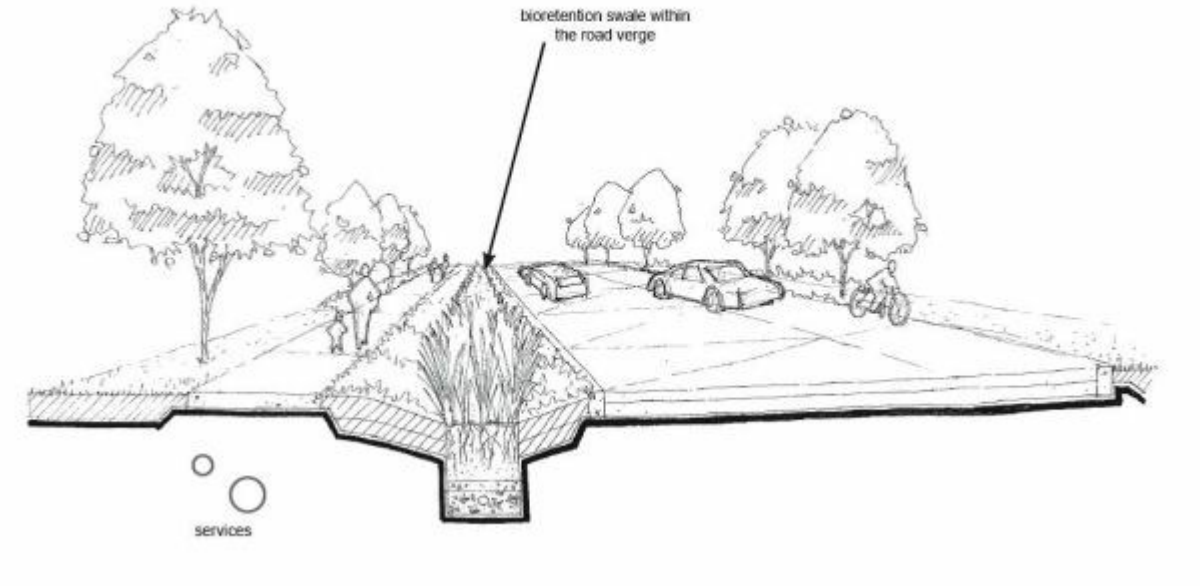


Figure SC6.4.3.9.10 Bioretention swale within road verge

(c) Civic and urban spaces

With increasing population growth in the coastal dry tropics, gentrification of urban areas is required to create more robust spaces that meet current environmental and social needs. Often constrained by existing infrastructure, landscape treatments of swales can have a dual role of providing functional stormwater quality objectives whilst creating landscapes that enhance the communities' perception of water sensitive design.

By creating hard useable edges to swales and using complimentary planting strategies, civic spaces can provide an aesthetic landscape that meets recreational uses and promotes water sensitive design to the community. Refer to Figure SC6.4.3.9.11 for an illustrative example.

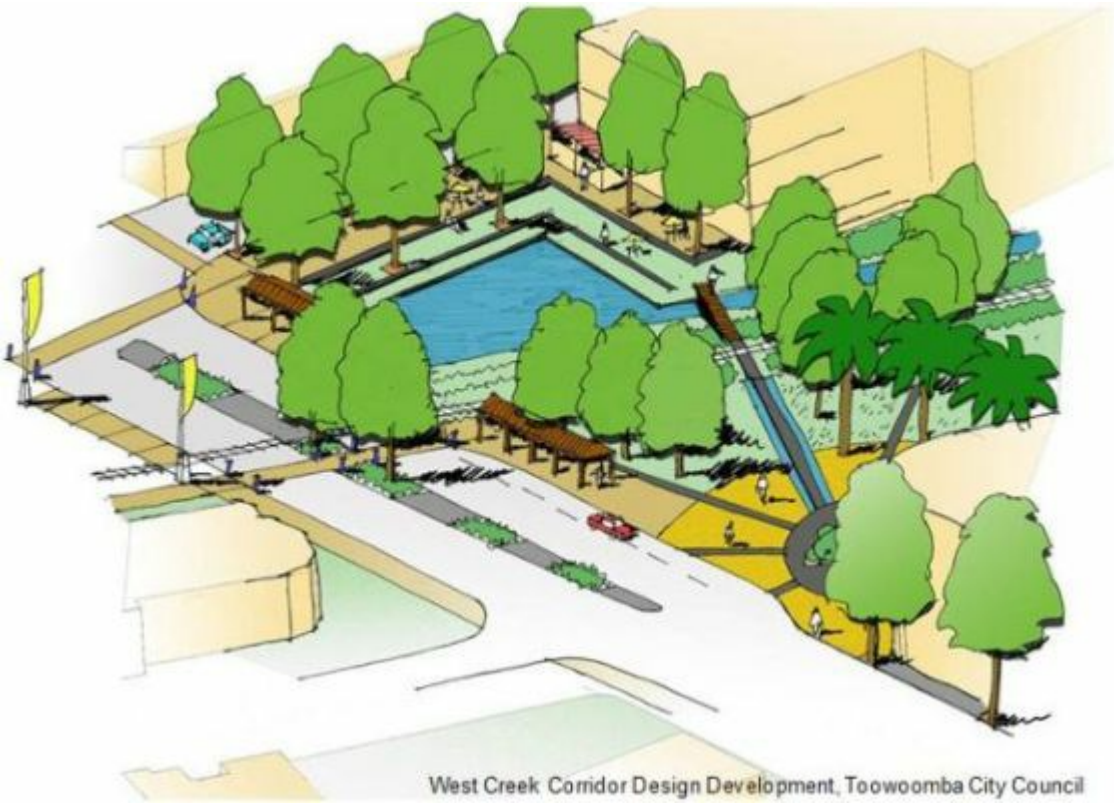


Figure SC6.4.3.9.11 Swale treatment in civic space

(d) Appropriate plant species

Planting for bioretention swale elements may consist of up to four vegetation types:

(i) groundcovers for stormwater treatment and erosion protection (required element);

(ii) shrubbery for screening, glare reduction, character, and other values;

(iii) street trees for shading, character and other landscape values; and

(iv) existing vegetation.

It is important to note that deep rooted plants such as trees are to be planted towards the top of the swale bank rather than near the bioretention trench, to avoid roots interfering with the underdrain system.

Where the landscape design includes canopy layers, more shade tolerant species should be selected for the groundcover layer. Trees and shrubbery should be managed so that the groundcover layer is not out-competed. If this does occur, replacement planting and possible thinning of the upper vegetation layers may be required.

(v) Groundcovers, shrubs and street trees

Refer to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for guidance on selecting suitable plant (including turf) species and cultivars that meet the functional requirements of bioretention swales to deliver the desired stormwater quality objectives.

(vi) Existing vegetation

Existing vegetation, such as remnant native trees, within the bioretention swale alignment may be nominated for retention. In this case, the swale will need to be diverted or piped to avoid the vegetation's critical root zone (equivalent to 0.5 m beyond the vegetation's drip line).

(e) Safety issues

Bioretention swales within streetscapes and parks need to be generally consistent with public safety requirements for new developments. These include reasonable batter profiles for edges, providing adequate barriers to median swales for vehicle/pedestrian safety and safe vertical heights from driveways to intersecting swale inverts.

(i) Crime prevention through environmental design (CPTED)

Landscape design of bioretention swales need to accommodate the standard principles of informal surveillance, exclusion of places of concealment and open visible areas. Regular clear sightlines should be provided between the roadway and footpaths/ property. Where planting may create places of concealment or hinder informal surveillance, groundcovers and shrubs should not generally exceed 1 m in height.

(ii) Traffic sightlines

The standard rules of sightline geometry apply – planting designs should allow for visibility at pedestrian crossings, intersections, rest areas, medians, driveways and roundabouts. Refer to the *Road Landscape Manual* (DMR 1997) for further guidance.

(5) Construction and establishment - bioretention swales

This section provides general advice for the construction and establishment of bioretention swales and key issues to be considered to ensure their successful establishment and operation.

(a) Staged construction and establishment method

(i) Construction and establishment challenges

There exist a number of challenges that must be appropriately considered to ensure successful construction and establishment of bioretention swales. These challenges are best described in the context of the typical phases in the development of a greenfield or infill development, namely the subdivision construction phase and the building phase (see Figure SC6.4.3.9.13).

(A) Subdivision construction - the risks to successful construction and establishment of the WSUD systems during this phase of work have generally related to the following:

- construction activities which can generate large sediment loads in runoff which can smother vegetation and clog bioretention filter media; and

- construction traffic and other works can result in damage to the bioretention swales. Importantly, all works undertaken during Subdivision Construction are normally “controlled” through the principle contractor and site manager. This means the risks described above can be readily managed through appropriate guidance and supervision.

(B) Building phase - the allotment building phase (see Figure SC6.4.3.9.12) represents the greatest risk to the successful establishment of bioretention swales.

Figure SC6.4.3.9.12 Example of building phase

(ii) Staged construction and establishment method

To overcome the challenges associated within delivering bioretention swales a staged construction and establishment method should be adopted (see Figure SC6.4.3.9.13).

(A) Stage 1: Functional installation - construction of the functional elements of the bioretention system at the end of subdivision construction (i.e. during landscape works) and the installation of temporary protective measures.

(B) Stage 2: Sediment and erosion control – during the building phase the temporary protective measures preserve the functional infrastructure of the bioretention swales against damage whilst also providing a temporary erosion and sediment control facility throughout the building phase to protect downstream aquatic ecosystems.

(C) Stage 3: Operational establishment - at the completion of the building phase, the temporary measures protecting the functional elements of the bioretention swales can be removed along with all accumulated sediment and the system planted in accordance with the design planting schedule.

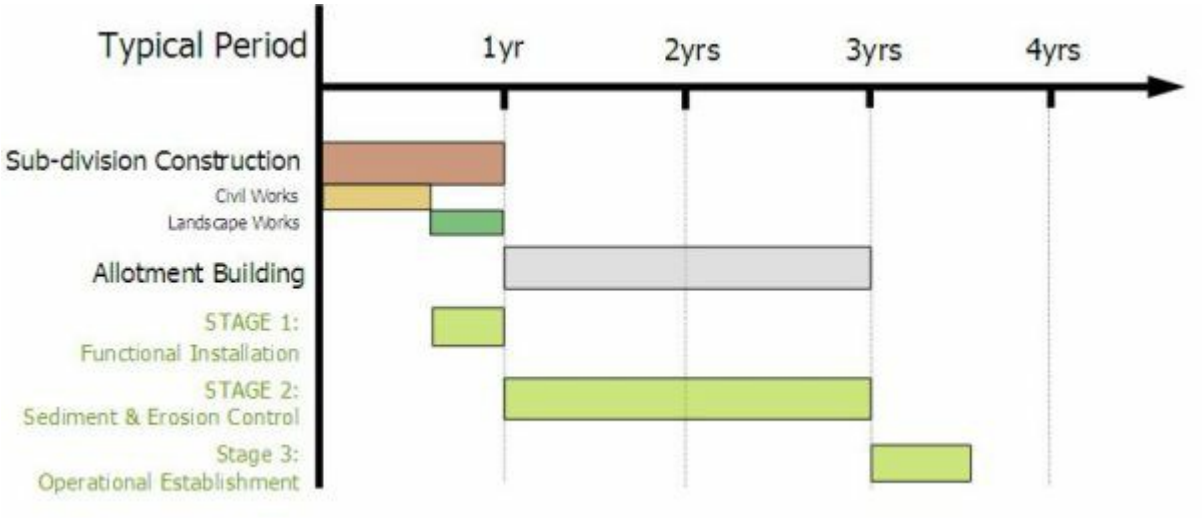


Figure SC6.4.3.9.13 Staged construction and establishment method

(iii) Functional installation

Functional installation of bioretention swales (see Figure SC6.4.3.9.14) occurs at the end of subdivision construction as part of landscape works and involves:

(A) bulking out and trimming;

(B) installation of the outlet structures;

(C) placement of liner and installation of drainage layer (i.e. under-drains and drainage layer);

(D) placement of filter media;

(E) placement of a temporary protective layer - covering the surface of filtration media with geofabric and placement of 25 mm topsoil and turf over geofabric. This temporary geofabric and turf layer will protect the bioretention system during construction (subdivision and building phases) ensuring sediment/litter laden waters do not enter the filter media causing clogging; and

(F) place silt fences around the boundary of the bioretention swale to exclude silt and restrict access.

Figure SC6.4.3.9.14 Bioretention swale functional installation

(iv) Sediment and erosion control

The temporary protective layers are left in place through the allotment building phase to ensure sediment laden waters do not clog the filtration media and allotment building traffic does not enter the bioretention swale (see Figure SC6.4.3.9.15). Importantly the configuration of the bioretention swale and the turf vegetation allow the system to function effectively as a shallow sedimentation

basin reducing the load of coarse sediment discharging to the receiving environment. Using this approach, WSUD systems can operate effectively to protect downstream ecosystems immediately after construction.

Figure SC6.4.3.9.15 Bioretention swale sediment and erosion control

(v) Operational establishment

At the completion of the allotment building phase the temporary measures are removed with all accumulated sediment and the bioretention swale re-profiled and planted in accordance with the proposed landscape design. Establishment of the vegetation to design condition can require more than two growing seasons, depending on the vegetation types, during which regular watering and removal of weeds will be required.

(b) Sourcing bioretention vegetation

The minimum recommended lead time for ordering is 3-6 months. This usually allows enough time for plants to be grown to the required size. The following pot sizes are recommended as the minimum:

(i) viro tubes 50 mm wide x 85 mm deep;

(ii) 50 mm tubes 50 mm wide x 75 mm deep; and

(iii) native tubes 50 mm wide x 125 mm deep.

(c) Vegetation establishment

The following weed control measures and watering schedule are recommended to ensure successful plant establishment. Regular general maintenance as outlined in SC6.4.3.9.3(6) Maintenance requirements - bioretention swales will also be required.

(i) Weed control

Conventional surface mulching of bioretention swales with organic material like tanbark, should not be undertaken. Most organic mulch floats and runoff typically causes this material to be washed away with the risk of blockage of drains occurring. Weed management will need to be done manually until such time that the design vegetation is established with sufficient density to effectively prevent weed propagation.

(ii) Watering

Regular watering of bioretention swale vegetation is essential for successful establishment and healthy growth and weed reduction. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. The following watering program is generally adequate but should be adjusted (increased) to suit the site conditions:

(A) Week 1-2 3 visits/ week;

(B) Week 3-6 2 visits/ week; and

(C) Week 7-12 1 visit/ week.

After this initial three month period, temporary, supplementary irrigation will be required in bioretention swales without submerged zones and may be required in bioretention swales with submerged zones (particularly during the 2 year plant establishment period). Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

(6) Maintenance requirements - bioretention swales

Bioretention swales have a flood conveyance role that needs to be maintained to ensure adequate flood protection for local properties. Vegetation plays a key role in maintaining the porosity of the soil media of the bioretention system and a strong healthy growth of vegetation is critical to its performance.

(a) Typical maintenance of bioretention swale elements will involve:

(i) routine inspection of the swale profile to identify any areas of obvious increased sediment deposition, scouring of the swale invert from storm flows, rill erosion of the swale batters from lateral inflows, damage to the swale profile from vehicles and clogging of the bioretention trench (evident by a “boggy” swale invert);

(ii) routine inspection of inlet points (if the swale does not have distributed inflows), surcharge pits and field inlet pits to identify any areas of scour, litter build up and blockages;

(iii) removal of sediment where it is impeding the conveyance of the swale and/ or smothering the swale vegetation, and if necessary, reprofiling of the swale and revegetating to original design specification;

(iv) repairing any damage to the swale profile resulting from scour, rill erosion or vehicle damage;

(v) tilling of the bioretention trench surface if there is evidence of clogging;

(vi) clearing of blockages to inlet or outlets;

(vii) regular watering/ irrigation of vegetation until plants are established and actively growing (see SC6.4.3.9.3(5)(c) Vegetation establishment);

(viii) mowing of turf or slashing of vegetation (if required) to preserve the optimal design height for the vegetation;

(ix) removal and management of invasive weeds;

(x) removal of plants that have died and replacement with plants of equivalent size and species as detailed in the plant schedule;

(xi) pruning to remove dead or diseased vegetation material and to stimulate new growth;

(xii) litter and debris removal; and

(xiii) vegetation pest monitoring and control.

(b) Additional maintenance required if a saturated zone is included in the design:

(i) check weir/up-turned pipe is clear of debris; and

(ii) check water level in the saturated zone is at the design level.

(c) Resetting (i.e. complete reconstruction) of bioretention elements will be required if the available flow area of the overlying swale is reduced by 25% (due to accumulation of sediment) or if the bioretention trench fails to drain adequately after tilling of the surface. Inspections are also recommended following large storm events to check for scour.

(d) All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure. Maintenance personnel and asset managers will use this plan to ensure the bioretention swales continue to function as designed. The maintenance plans and forms must address the following:

(i) inspection frequency;

(ii) maintenance frequency;

(iii) data collection/ storage requirements (i.e. during inspections);

(iv) detailed cleanout procedures (main element of the plans) including:

(A) equipment needs;

(B) maintenance techniques;

(C) occupational health and safety;

(D) public safety;

(E) environmental management considerations;

(F) disposal requirements (of material removed);

(G) access issues;

(H) stakeholder notification requirements; and

(I) data collection requirements (if any); and

(v) design details.
An example operation and maintenance inspection form is included in the checking tools provided in SC6.4.3.9.3(7).

(7) Checking tools - bioretention swales

A number of checking aids have been developed for designers and council development assessment officers. In addition, advice on construction techniques and lessons learnt from building bioretention swale systems are provided.

(a) Design assessment

The checklist at Table SC6.4.3.9.6 presents the key design features to be reviewed when assessing design of a bioretention swale. These considerations include configuration, safety, maintenance and operational issues that need to be addressed during the design phase. Where an item results in an “N” when reviewing the design, referral is to be made back to the design procedure to determine the impact of the omission or error.

In addition to the checklist, a proposed design is to have all necessary permits for its installations. Council development assessment officers need to ensure that all relevant permits are in place. These can include permits to clear vegetation, to dredge, create a waterbody, divert flows or disturb fish or platypus habitat.

Click here to view Table SC6.4.3.9.6 Bioretention swale design assessment checklist

(b) Construction (during and post)

The checklist at Table SC6.4.3.9.7 presents the key items to be reviewed when inspecting the bioretention swale during and at the completion of construction. The checklist is to be used by construction site supervisors and compliance inspectors to ensure all the elements of the bioretention system have been constructed in accordance with the design. If an item receives an “N” in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view Table SC6.4.3.9.7 Bioretention swale construction inspection checklist

(c) Operation and maintenance inspection

The form at Table SC6.4.3.9.8 is to be used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time.

Click here to view Table SC6.4.3.9.8 Bioretention swale maintenance checklist

(d) Asset transfer (following defects period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater

treatment device. A proposed design is to clearly identify the ultimate asset owner and who is responsible for its maintenance. Local authorities will use the asset transfer checklist at Table SC6.4.3.9.9 when the asset is to be transferred to the local authority.

Click here to view Table SC6.4.3.9.9 Bioretention swale asset transfer checklist

(8) Engineering drawings - bioretention swales

The relevant local authority should be consulted to source standard drawings applicable to bioretention swales. These drawings may provide example dimensions for a number of different road reserve configurations. Standard drawings are not intended to be prescriptive drawings which must be adhered to, rather they are intended to provide detailed examples of swales which can be incorporated into commonly used urban subdivision layouts. Designers are encouraged to develop alternative bioretention swale designs to suit site specific conditions.

In the absence of locally specific guidelines, Brisbane City Council (BCC) standard drawings applicable to swales and bioretention systems are UMS 151-158. These may also be used as reference standards for swale design. BCC Standard drawings are available online.

(9) References - bioretention swales

Barling RD & Moore ID 1993, 'The Role of Buffer Strips in the Management of Waterway Pollution', in Woodfull J et al. (eds), *The Role of Buffer Strips in the Management of Waterway Pollution from Diffuse Urban and Rural Sources*, LWRRDC Occasional Paper No. 01/93, Canberra

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DMR (Queensland Department of Main Roads) 1997, *Road Landscape Manual*, prepared by EDAW (Aust) Pty Ltd for DMR, Brisbane

Duncan HP 1995, *A Review of Urban Storm Water Quality Processes*, Cooperative Research Centre for Catchment Hydrology, Report 95/9, Melbourne, Australia

Engineers Australia 2006, *Australian Runoff Quality*, Engineers Australia, ACT, http://www.arq.org.au/

Leinster, S 2006, *Delivering the Final Product – Establishing Water Sensitive Urban Design Systems*, 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive Urban Design Book of Proceedings, Volume 2, A Deletic and T Fletcher (eds), Melbourne.

LHCCREMS (Lower Hunter and Central Coast Regional Environmental Management Strategy) 2002, *Water Sensitive Urban Design in the Sydney Region: 'Practice Note 2 – Site Planning'*, LHCCREMS, NSW.

DNRW, IPWEA and BCC (Department of Natural Resources and Water, Institute of Public Works Engineering Australia – Qld Division & Brisbane City Council) 1998, *Queensland Urban Drainage Manual (QUDM) Second Edition*, prepared by Neville Jones & Associates and Australian Water Engineering for DNRW, IPWEA & BCC, Brisbane.

Standards Australia 1997, AS 1289.4.1.1-1997: *Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the organic matter content of a soil - Normal method,* Standards Australia

Standards Australia 2003, AS 4419-2003: *Soils for landscaping and garden use*, Standards Australia

Townsville City Council, *Water sensitive urban design for the coastal dry tropics (Townsville): Technical design guidelines for stormwater management*, 2011

Weibel SR, Weidner RB, Cohen JM & Christianson AG, 1996, "Pesticides and Other Contaminants in Rainfall and Runoff", *Journal American Water Works Association*, vol. 58, no. 8, August 1966, pp. 1075-1084

SC6.4.3.9.4 Bioretention basins

(1) Bioretention basins are vegetated areas where runoff is filtered through a filter media layer (e.g. sandy loam) as it percolates downwards. It is then collected via perforated under-drains and flows to downstream waterways or to storages for reuse. Bioretention basins often use temporary ponding above the filter media surface to increase the volume of runoff treated through the filter media. They treat stormwater in the same way as bioretention swales; however, "above design" flows are conveyed through overflow pits or bypass paths rather than over the filter media. This has the advantage of protecting the filter media surface from high velocities that can dislodge collected pollutants or scour vegetation.

Bioretention basins are generally not intended to be "infiltration" systems that discharge from the filter media to surrounding in-situ soils. Rather, the typical design intent is to recover stormwater at the base of the filter media in perforated under-drains and discharge to receiving waterways or to storages for potential reuse.

Figure SC6.4.3.9.16 shows examples of a basin integrated into a local streetscape and into a car park. Figure SC6.4.3.9.16 also illustrates the key elements of bioretention basins, namely surface vegetation, extended detention, filter media, drainage layer and overflow pit.

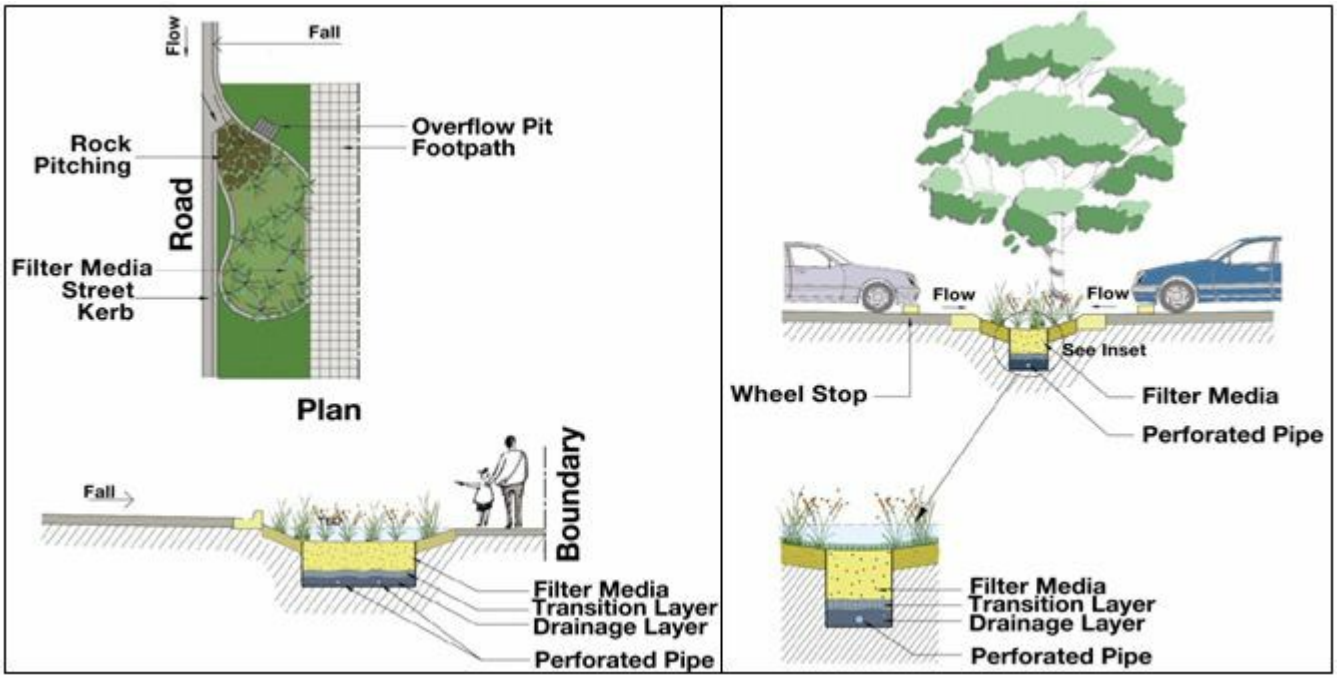


Figure SC6.4.3.9.16 Bioretention basin integrated into a local streetscape (left) and a car park (right).

(2) Design considerations – bioretention basins

This section outlines some of the key design considerations for bioretention basins that the detailed designer should be familiar with before applying the design procedure presented later in this chapter.

Rain patterns in the dry tropics mean that bioretention systems will receive large volumes of consistent rainfall during the wet season and are likely to remain dry for extended periods during the dry season. Therefore, bioretention basin design will need to be adapted to incorporate the following elements:

- controls to ensure the bioretention basin is not compromised by sediment smothering;
- a saturated zone beneath the filter media to increase soil moisture and help sustain vegetation during dry periods; or
- supplemental temporary irrigation to sustain vegetation and maintain aesthetics in highly visible areas (e.g. bioretention pods within road verges).

(a) Landscape design

Bioretention basins are predominantly located within public areas, such as open space or within streets, which provide a primary setting for people to experience their local community and environment. It is therefore necessary for bioretention basins to be given an appropriate level of landscape design consideration to compliment the surrounding landscape character and to adequately address potential aesthetics issues such as weeds and sustaining perennial plants during the dry season. The landscape design of bioretention basins must address stormwater quality objectives whilst also being sensitive to other important landscape objectives such as road visibility, public safety and community character and habitat. To achieve this, the design process requires close collaboration between landscape architects, urban designers, ecologists and WSUD engineers (see example at Figure SC6.4.3.9.17).

Figure SC6.4.3.9.17 Bioretention basin within roundabout at Kalynda Chase Development, Bohle Plains

(b) Hydraulic design

The correct hydraulic design of bioretention basins is essential to ensure effective stormwater treatment performance, minimise damage by storm flows, and to protect the hydraulic integrity and function of associated minor and major drainage systems. The following aspects are of key importance:

(i) the finished surface of the bioretention filter media must be horizontal (i.e. flat) to ensure even flow dispersion across the filter media surface (i.e. full engagement of the filter media by stormwater flows) and to prevent concentration of stormwater flows within depressions and ruts resulting in potential scour and damage to the filter media;

(ii) temporary ponding (i.e. extended detention) of up to 0.3 m depth over the surface of the bioretention filter media created through the use of raised field inlet pits (overflow pits) can assist in managing flow velocities over the surface of the filter media as well as increase the overall volume of stormwater runoff that can be treated by the bioretention filter media;

(iii) where possible, the overflow pit or bypass channel should be located near the inflow zone (refer to Figure SC6.4.3.9.16 (left)) to prevent high flows passing over the surface of the filter media. If this is not possible, then velocities during the minor (2-10 year ARI) and major (50-100 year ARI) floods should be maintained sufficiently low (preferably below values of 0.5 m/s and not more than 1.5 m/s for major flood) to avoid scouring of the filter media and vegetation;

(iv) where the field inlets in a bioretention system is required to convey the minor storm flow (i.e. is part of the minor drainage system), the inlet must be designed to avoid blockage, flow conveyance and public safety issues; and

(v) for streetscape applications, the design of the inflow to the bioretention basin must ensure the kerb and channel flow requirements are preserved as specified in the Queensland Urban Drainage Manual (QUDM) (DNRW, IPWEA and BCC 1998).

(c) Ex-filtration to in-situ soils

Bioretention basins can be designed to either preclude or promote ex-filtration of treated stormwater to the surrounding in-situ soils depending on the overall stormwater management objectives established for the given project. When considering ex-filtration to surrounding soils, the designer must consider site

terrain, hydraulic conductivity of the in-situ soil, groundwater and building setback. Where the concept design specifically aims to preclude ex-filtration of treated stormwater runoff it is necessary to consider if the bioretention basin needs to be provided with an impermeable liner. If the selected saturated hydraulic conductivity of the bioretention filter media is less than 10 times that of the native surrounding soils, it may be necessary to provide an impermeable liner. Flexible membranes or a concrete casting are commonly used to prevent excessive ex-filtration. This is particularly applicable for surrounding soils that are very sensitive to any ex-filtration (e.g. shallow groundwater or close proximity to significant structures).

Bioretention systems constructed in sodic soils without an impermeable lining are not at risk of exporting salt from in-situ soil into local streams or groundwater. Even after six months of intensive flushing under controlled, laboratory conditions, bioretention systems (constructed in sodic soils) did not leach salt from the surrounding soils (Deletic and Mudd, 2006).

The greatest pathway of ex-filtration is through the base of a bioretention basin, as gravity and the difference in hydraulic conductivity between the filter media and the surrounding native soil would typically act to minimise ex-filtration through the walls of the trench. If lining is required, it is likely that only the base and the sides of the drainage layer will need to be lined.

(d) Vegetation types

Vegetation is required to cover the whole bioretention filter media surface, be capable of withstanding minor and major design flows, and be of sufficient density to prevent preferred flow paths, scour and re-suspension of deposited sediments. Additionally, vegetation that grows in the bioretention filter media functions to continuously break up the surface of the filter media through root growth and wind induced agitation, which prevents surface clogging. The vegetation also provides a substrate for biofilm growth within the upper layer of the filter media, which facilitates biological transformation of pollutants (particularly nitrogen).

Ground cover vegetation (e.g. sedges and tufted grasses) is an essential component of bioretention basin function. Generally, the greater the density and height of vegetation planted in bioretention filter media, the better the treatment provided especially when extended detention is provided for in the design. Contact between stormwater and vegetation results in enhanced sedimentation of suspended sediments and adsorption of associated pollutants.

Plant species selected for bioretention systems must be able to tolerate free draining sandy soils and be capable of withstanding long dry periods as well as periods of inundation. To maintain aesthetics in highly visible areas (e.g. bioretention pods within road verges) temporary supplemental irrigation may be required to sustain vegetation. The incorporation of saturated zones beneath the filter media can help to sustain soil moisture and is beneficial for nitrogen removal from stormwater. The ability to sustain dense perennial vegetation is important for long term weed management.

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides more specific guidance on the selection of appropriate vegetation for bioretention basins. It should be noted that turf is not considered to be suitable vegetation for bioretention basins. The stem and root structure of turf is not suitably robust and rapid growing to ensure the surface of the bioretention filter media is continuously broken up to prevent clogging.

(e) Bioretention filter media

Selection of an appropriate bioretention filter media is a key design step that involves consideration of the following four inter-related factors:

(i) saturated hydraulic conductivity required to optimise the treatment performance of the bioretention basin given site constraints and available filter media area;

(ii) depth of extended detention provided above the filter media;

(iii) surface area of the filter media; and

(iv) suitability as a growing media to support vegetation (i.e. retains sufficient soil moisture and organic content).

The concept design stage will have established the optimal combination of filter media saturated

hydraulic conductivity and extended detention depth using a continuous simulation modelling approach (i.e. MUSIC). Any adjustment of either of these two design parameters during the detailed design stage will require the continuous simulation modelling to be re-run to assess the impact on the overall treatment performance of the bioretention basin.

As shown in Figure SC6.4.3.9.18 below, bioretention media can consist of three or four layers. In addition to the filter media required for stormwater treatment, a saturated zone can also be added to enhance nitrogen removal and to provide a source of water for vegetation over the dry season. A drainage layer is also required to convey treated water from the base of the filter media or saturated zone into the perforated under-drains. The drainage layer surrounds the perforated under-drains and can be either coarse sand (1 mm) or fine gravel (2-5 mm). If fine gravel is used, a transition layer of sand must also be installed to prevent migration of the filter or saturated zone media into the drainage layer and subsequently into the perforated under-drains.

(f) Saturated zone

The incorporation of a saturated zone into bioretention design has evolved from research demonstrating improved nitrate removal through denitrification processes (Kim et al. 2003 and Zinger et al. 2007b).

The saturated zone design involves a relatively simple modification to a conventional bioretention system. An additional layer located below the filter media is designed to retain stormwater providing a saturated zone at the base of the bioretention system. A saturated zone can be formed by using a riser pipe with the outlet level higher than the drainage layer or by incorporating a weir within the outlet pit (see Figure SC6.4.3.9.18 below). The saturated zone holds water and therefore provides a source of water to maintain soil moisture for plant uptake during dry periods.

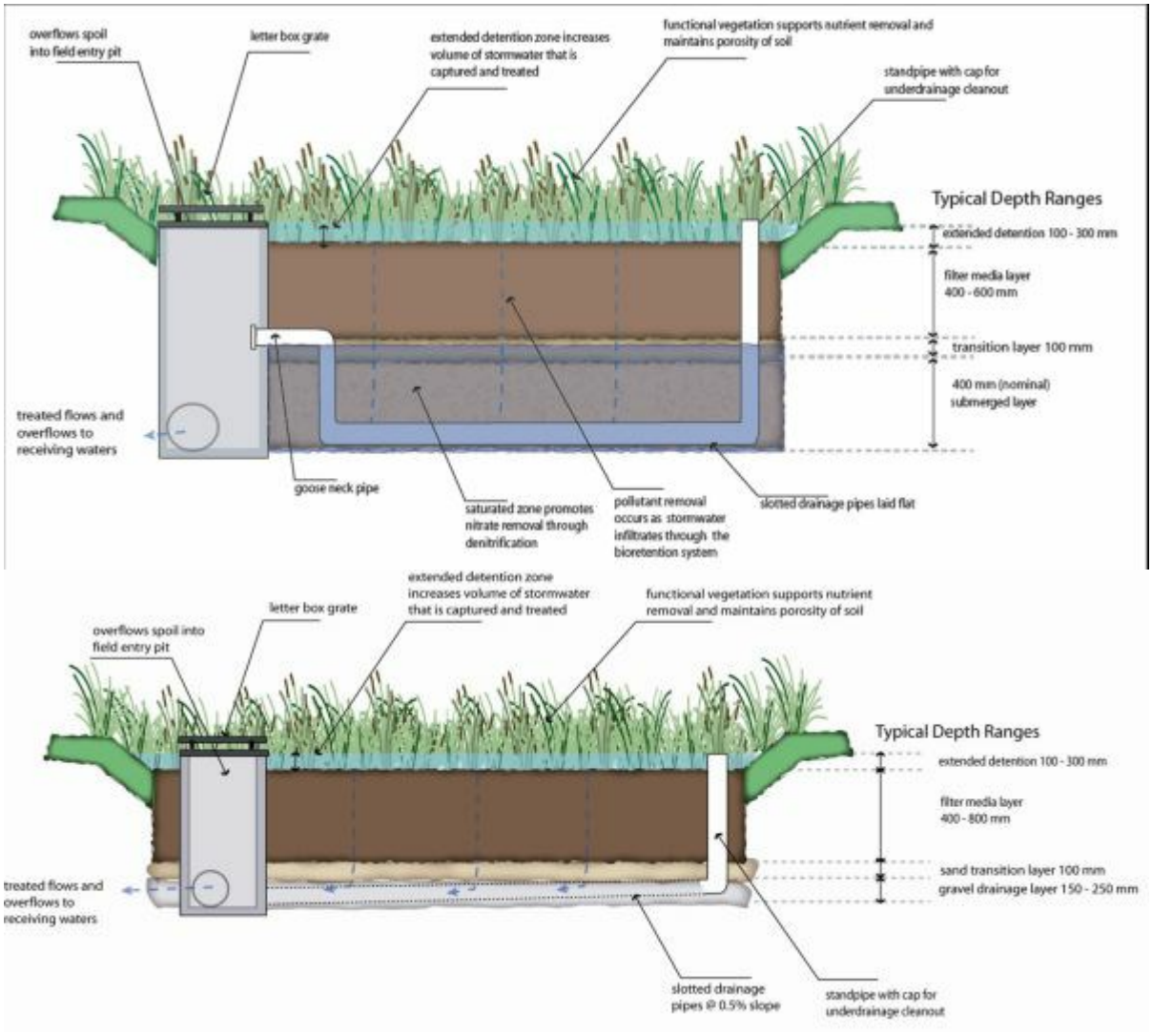


Figure SC6.4.3.9.18 Cross section of bioretention basins (top- with a saturated zone; below- without a saturated zone)

(g) Traffic controls

Another design consideration is keeping traffic and building material deliveries off bioretention basins (particularly during the construction phase of a development). If bioretention basins are driven over or used for parking, the filter media will become compacted and the vegetation damaged.

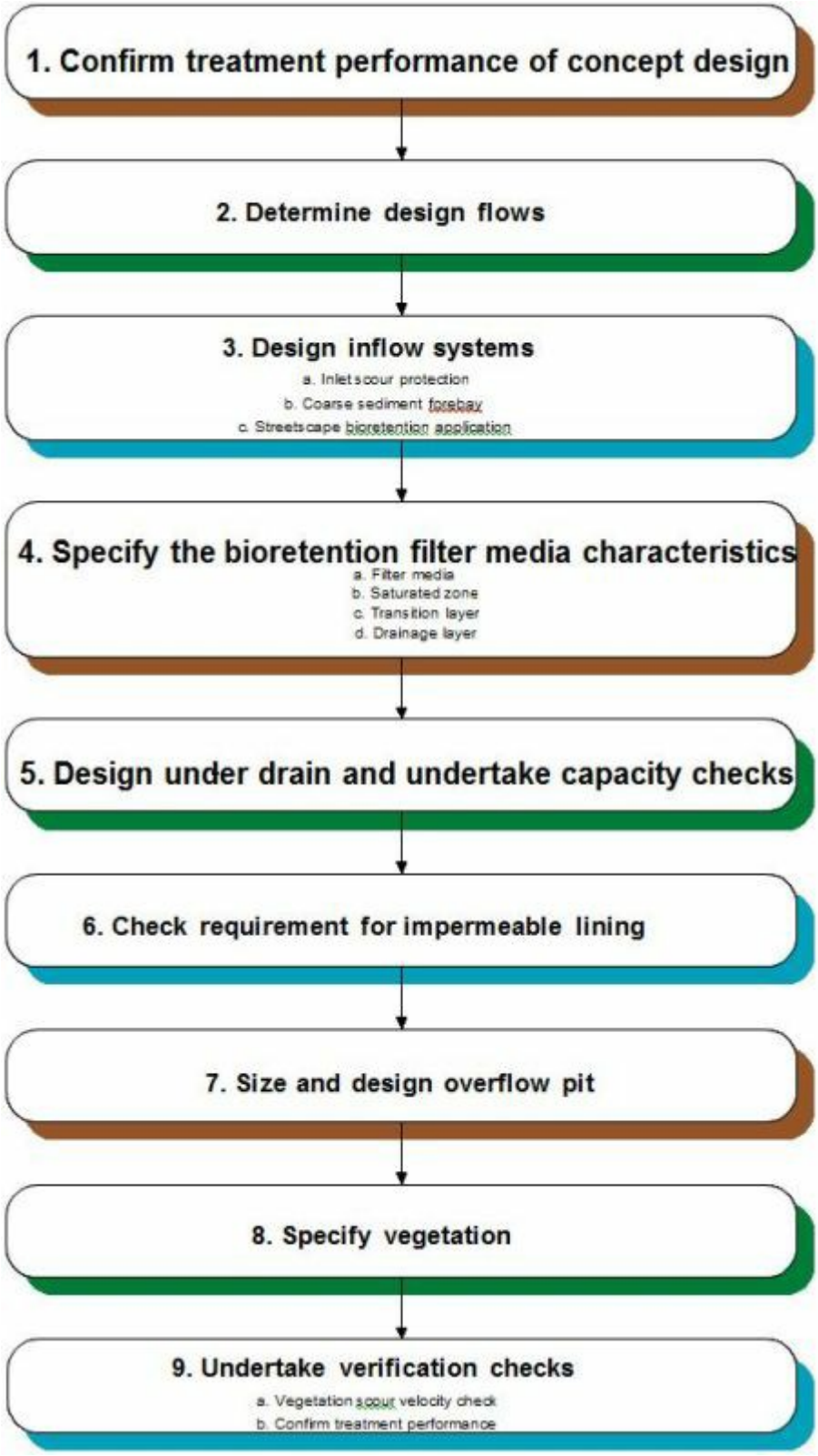
Streetscape bioretention systems must be designed to satisfy local authority requirements with respect to traffic calming devices within particular street or road reserve widths. Where bioretention is incorporated into traffic calming or control devices, or directly adjacent to mountable kerbs, consideration should be given to protection of the area immediately behind the kerb where vehicles are likely to mount the kerb.

(h) Services

Bioretention basins or cells located within road verges or within footpaths must consider the standard location for services within the verge and ensure access for maintenance of services without regular disruption or damage to the bioretention system.

(3) Design process – bioretention basins

The following sections detail the design steps required for bioretention basins. Key design steps are:



(a) Step 1: Check treatment performance of concept design

Before commencing detailed design, the designer should first undertake a preliminary check to confirm the bioretention basin treatment area (i.e. the surface area of the filter media) from the concept design is adequate to deliver the required level of stormwater quality improvement. This design process assumes a conceptual design has been undertaken.

This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in an appropriate quantitative modelling program. Where possible, this modelling should be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows

(i) Design flows

The hydraulic design of the bioretention basin should be based on the following design flows:

(A) minor flood flow (2 year ARI) to allow minor floods to be safely conveyed. For commercial and industrial areas the design flow requirement for minor flows is a 5 year ARI event; and

(B) major flood flow (100 year ARI) to check flow velocities, velocity depth criteria, conveyance within road reserve, and freeboard to adjoining property.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. If the typical catchment areas are relatively small, the Rational Method design procedure is considered to be a suitable method for estimating design flows. However, if the bioretention system is to form part of a retention basin or if the catchment area to the bioretention system is large, then a full flood routing computation method needs to be used to estimate design flows.

(c) Step 3: Design inflow systems

(i) The design of the inflow systems to bioretention basins needs to consider a number of functions:

(A) scour protection – In most bioretention applications stormwater flows will enter the bioretention basin as concentrated flow (piped, channel or open channel) and as such is it important to slow and spread flows using appropriate scour (rock) protection;

(B) coarse sediment forebay – Where stormwater runoff from the catchment is delivered directly to the bioretention basin without any coarse sediment management (through vegetated swale or buffer treatment) a coarse sediment forebay is to be included in the design. The forebay is to remove coarse sediment (1 mm +) from stormwater to minimise the risk of vegetation in the bioretention basin being smothered;

(C) constant low base flows have to be taken into account and dealt with as they can blind the filter material and promote weed growth within permanently saturated areas; and

(D) street hydraulics (streetscape applications only) – In streetscape applications, where stormwater is delivered directly from the kerb and channel to the bioretention basin, it is important to ensure the location and width of the kerb opening is designed such that flows enter the bioretention basin without adversely affecting trafficability of the road (QUDM, Table 7.04.1).

(ii) Each of these functions and the appropriate design responses are described in the following sections.

(iii) Inlet scour protection

Erosion protection should be provided for concentrated inflows to a bioretention basin. Typically, flows will enter the bioretention basin from either a surface flow system (i.e. roadside kerb, open channel) or a piped drainage system. Rock beaching is a simple method for dissipating the energy of concentrated inflow, as depicted in Figure SC6.4.3.9.19 (with the “D” representing the pipe diameter dimension). The rocks can form part of the landscape design of the bioretention component.

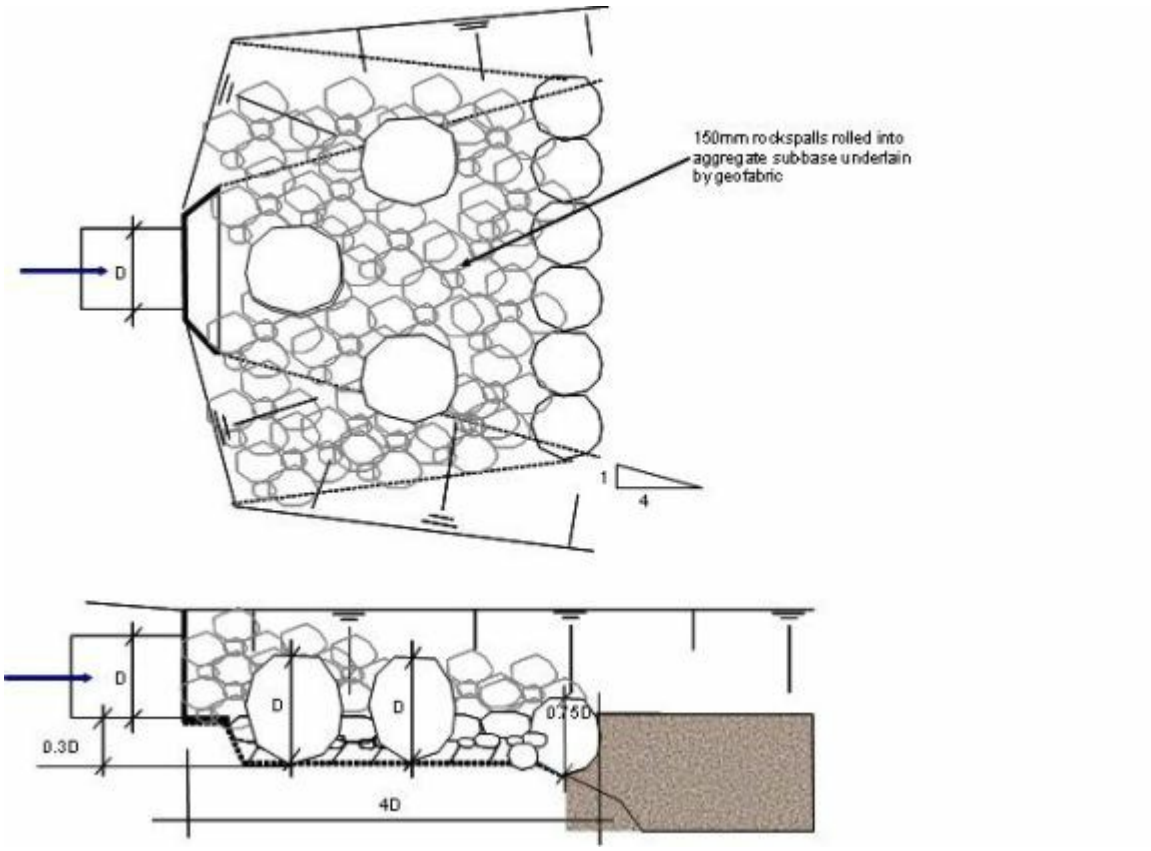


Figure SC6.4.3.9.19 Typical inlet scour protection detail for bioretention basins receiving piped flows

(iv) Coarse sediment control

Where stormwater runoff from the catchment is delivered directly to the bioretention basin without pre-treatment (through vegetated swale or buffer treatment), coarse sediment may accumulate near the basin inflow. This sediment may smother vegetation and reduce infiltration to the filter media. To mitigate these effects, either a sedimentation basin (see Chapter 4) is to be located upstream or the bioretention basin inflow system is to incorporate a coarse sediment forebay. The forebay should be designed to:

(A) remove particles that are 1 mm or greater in diameter from the 3 month ARI storm event; and

(B) provide appropriate storage for coarse sediment to ensure desilting is required no more than once per year.

The size of the sediment forebay is established using the following equation:

$$V_s = A_c \cdot R \cdot L_o \cdot F_c$$

Where
- V_s = volume of forebay sediment storage required (m^3)
- A_c = contributing catchment area (ha)
- R = capture efficiency (assume 80%)
- L_o = sediment loading rate (m^3/ha/year)
- F_c = desired cleanout frequency (years)

A catchment loading rate (L_o) of 1.6 m^3/ha/year for developed catchments can be used to estimate the sediment loads entering the basin. The area of the forebay is established by dividing the volume by the depth. The depth of the forebay should not be greater than 0.3 m below the surface of the filter media.

$$A_s = \frac{V_s}{D_s}$$

Where D = depth of sediment forebay (max 0.3 m below filter media surface).
The sediment forebay area should be checked to ensure it captures the 1 mm and greater particles using the following expression (modified version of Fair and Geyer (1954).

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A}\right]^{-n}$$

Where:

R	=	fraction of target sediment removed (80%)
v_s	=	settling velocity of target sediment (100 mm/s or 0.1 m/s for 1 mm particle)
Q/A	=	applied flow rate divided by forebay surface area ($m^3/s/m^2$)
n	=	turbulence or short-circuiting parameter (adopt 0.5)

The coarse sediment forebays will contain large rocks for energy dissipation and be underlain by filter material to promote drainage following storm events.

(v) Kerb opening configuration (streetscape applications)

In streetscape applications where stormwater is delivered directly from a kerb and channel to a bioretention basin, the following design issues must be considered:

(A) the location of the kerb opening must be designed to ensure flows in the channel do not exceed the maximum allowance widths as defined by QUDM Table 7.04.1 (DNRW, IPWEA & BCC 1998); and

(B) the width of the kerb opening is designed to allow the design flow to enter the bioretention basin.

Channel flow width at kerb opening

The width of channel flow at the kerb opening during a minor storm event (2 10 year ARI) needs to be checked to ensure it does not exceed the maximum allowable channel flow widths defined by QUDM Table 7.04.1 (DNRW, IPWEA & BCC 1998) and the local authority requirements. This check can be undertaken by applying Manning's equation or Izzard's equation and ensuring the flow depth does not exceed either the crest of the road or the top of kerb (whichever is lowest).

Design kerb opening width (where kerb and channel is used)

To determine the width of the opening in the kerb to allow flows to enter the bioretention basin, Manning's equation or Izzard's equation (QUDM Section 7.04.2) can be used with the kerb, channel and road profile to estimate the flow depth in the kerb and channel at the entry point. Once the flow depth for the minor storm (e.g. 2-10 year ARI) is known, this can then be used to calculate the required width of the opening in the kerb by applying a broad crested weir equation. The opening width is estimated by applying the flow depth in the channel (as h) and solving for L (opening width).

$$Q = C_w \cdot L \cdot h^{3/2}$$

Where

Q	=	flow (m^3/s)
Cw	=	weir coefficient (= 1.66)
L	=	length of opening (m)
h	=	depth of flow (m)

This method ensures the kerb opening does not result in an increase in the upstream channel flow depth, which in turn ensures the bioretention basin does not impact on the trafficability of the adjoining road pavement as required by the QUDM. To ensure the kerb opening width is adequate, additional width factors may be required to account for slope of the kerb and channel, and the angle at which flow meets the kerb opening. This will depend on the location and position of the bioretention system in relation to the kerb and channel. Design of the inflow system within the kerb and channel will need to consider maximising flow into the bioretention system. The kerb opening

can be made more effective by lowering the kerb opening below the channel, increasing the cross fall at the kerb opening or by providing deflectors at the kerb opening.

(d) Step 4: Specify the bioretention filter media characteristics

Up to four types of media are required in bioretention basins (refer Figure SC6.4.3.9.18 Cross section of bioretention basins (top—with a saturated zone; below—without a saturated zone)).

(i) Filter media

As a minimum, the filter media is required to have sufficient depth to support vegetation, typically between 400-600 mm (or as specified in the engineering design). It is important to note that if deep rooted plants such as trees are to be planted in bioretention basins, the filter media must have a minimum depth of 800 mm to avoid roots interfering with the perforated under-drain system.

In general, the media should be a loamy sand with an appropriately high permeability under compaction and should be free of rubbish, deleterious material, weed seeds, toxicants, and should not be hydrophobic. The filter media should contain some organic matter for increased water holding capacity but be low in nutrient content. To ensure a proposed soil is suitable as filter media, a testing regime is required. The *Guidelines for Soil Filter Media in Bioretention Systems*: Version 2.01 (FAWB, March 2008) (refer to http://www.monash.edu.au/fawb/products/index.html) provides best practice guidance on filter media selection and testing. It is recommended that soils used for bioretention filter media fulfil the requirements outlined in the FAWB Guideline. In summary, these requirements include:

(A) organic carbon levels < 5%;

(B) pH between 5.5 and 7.5;

(C) electrical conductivity < 1.2 dS/m;

(D) saturated hydraulic conductivity between 100-500 mm/hr. The saturated hydraulic conductivity of the filter media is established by optimising the treatment performance of the bioretention system given site constraints of the particular site (using a continuous simulation model such as MUSIC); and

(E) the filter media must also be structurally sound and not prone to structural collapse as this can result in a significant reduction in saturated hydraulic conductivity. The risk of structural collapse can be reduced by ensuring the soil has a well graded particle size distribution with a combined clay and silt fraction of < 3%.

(ii) Transition layer (if required)

The purpose of the transition layer is to prevent the filter media from migrating down into the drainage layer (or the saturated zone). It also acts as a buffer between the permanently saturated zone (if required) and the filter media. This buffer is necessary to ensure the filter media is not saturated for prolonged periods during rainfall events due to increases in water levels in the saturated zone. To achieve this, the transition layer depth must be greater than the head created by flows over the saturated zone outlet weir.

It is required if the particle size difference between the filter media and the drainage layer (or the saturated zone) is more than one order of magnitude. If a transition layer is required then the material must be a clean, well-graded sand/coarse sand material containing little or no fines.

The transition layer is recommended to be 100 mm thick and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A recent particle size distribution for the transition layer sand will need to be obtained to ensure that it meets the required grading/"bridging" criteria outlined below. The "bridging" criteria is based on the engineering principles that rely on the largest 15% of the filter media particles (or saturated zone particles) "bridging" with the smallest 15% of the sand particles. This results in smaller voids, which prevent the migration of the filter media particles into the sand particles. The following equation is taken from the United States Golf Association's recommendations for golf course construction:

Bridging Factor: **D15 (transitional layer sand) ≤ 8 x D85 (filter media)**

The addition of a transition layer increases the overall depth of the bioretention system and may be an important consideration for some sites where total depth of the bioretention system may be constrained. In such cases, the use of a sand drainage layer and/ or perforated pipes with smaller slot sizes may need to be considered.

(iii) Saturated layer (if required)

The saturated layer should be about 400 mm deep (but may deeper depending on the specific application) and composed of clean (i.e. free from fines) medium-coarse washed sand, gravel or small rock (50 mm diameter maximum) together with a long term carbon source. Hardwood wood chips, 5 mm to 40 mm in size, are recommended as the carbon source because they breakdown slowly to provide a long term carbon source yet have a decomposition rate that should not limit the denitrification process.

The total mass of carbon/electron donor that is required for denitrification must be calculated based on the expected stormwater influent TN mass over the desired life span of the system (e.g. 25 years). The calculation is based on the stoichiometry of the denitrification reaction (shown below).

Denitrification reaction:

$NO_3^- + 1.25\ (CH_2O) + H^+\ (10^{-7}\ M) \rightarrow 0.5N_2\ (g) + 1.75H_2O + 1.25CO_2\ (g)$

Based on a 400 mm deep saturated zone and the modelled annual TN runoff mass (for Townsville) for a bioretention system that is 2% of the contributing 1 ha catchment, the saturated zone media would have the following composition:

(A) 76.7 m^3 washed coarse sand, gravel or small rock; and

(B) 3.3 m^3 hardwood wood chips, well graded 5 mm-40 mm.

This is equivalent to an organic carbon content of approximately 4-5% by volume. If the saturated zone depth changed, or the bioretention system to catchment area ratio changed, the hardwood proportion would need to be recalculated using the denitrification stoichiometry.

Calculating carbon source for saturated zone with safety factor (x2)	
Catchment Area	1 ha
Treatment Area Required	2%
Bioretention Surface Area	200 m^2
Saturated Zone Depth	400 mm
Total volume of Saturated Zone	80 m^3
TN load 1 year	12.5 kg/yr
TN load 25 years	312.5 kg/25 yrs
Stoichiometry:	
N:C ratio = 1:1.25 (mol), which equates to 14:15 (g) [Mw: N = 14g/mol, C = 12g/mol]	
Average total carbon content of hardwood woodchips is 50%, therefore	
N:C (woodchip) = 14:30 (g)	
N:C (woodchip) = 1:2.1	
Woodchips (312.5 x 2.1)	656kg/carbon
Safety Factor (x 2)	1313kg/carbon
Density of wood chips	400kg/m^3 (approx.)
Hardwood Wood Chips	**3.3 m^3**
Clean Coarse Sand	**76.7 m^3**

The saturated media must have a hydraulic conductivity of >1000mm/hr (the ASTM F1815-06 test method is to be used to measure hydraulic conductivity).

The saturated zone should be lightly compacted (e.g. with one pass of a smooth drum lawn roller) during installation to stabilise the structure. Under no circumstances should heavy compaction or multiple-passes be made.

(iv) Drainage layer (if required)

The drainage layer is used to convey treated flows from the base of the filter media layer (or the saturated zone) into the perforated under-drainage system. The composition of the drainage layer is to be considered in conjunction with the selection and design of the perforated under-drainage pipes as the slot sizes in the perforated pipes may determine the minimum drainage layer particle size to avoid washout of the drainage layer into the perforated pipe system. Coarser material (e.g. fine gravel aggregate) is to be used for the drainage layer if the slot sizes in the perforated pipes are too large for use of a sand based drainage layer. The drainage layer is to provide a minimum of 50 mm cover above the perforated under-drainage pipes and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A particle size distribution for the gravel will need to be obtained to ensure that it meets the "bridging" criteria outlined below:

Bridging Factor:
D15 (drainage gravel/sand) ≤ 8 x D85 (filter media/saturated zone/transition layer)

Ensure drainage media is washed prior to placement in bioretention system to remove any fines.

(e) Step 5: Design under-drain and undertake capacity checks (if required)

The maximum spacing of the perforated under-drains in bioretention basins located in streetscape zones and small public zones (i.e. bioretention < 100 m^2) is 1.5 m (centre to centre). This ensures that the distance water needs to travel horizontally toward the perforated pipes through the drainage layer does not hinder drainage of the filter media. The maximum spacing of the perforated pipes in bioretention basins located in local parks and large open space areas (i.e. bioretention > 100 m^2) can be increased to 2.5 – 3 m.

In bioretention systems without saturated zones, perforated pipes are to grade at a minimum of 0.5% towards the overflow pit to ensure effective drainage. In bioretention systems with saturated zones, perforated pipes should be laid flat (i.e. at 0% grade) to avoid preferential flow paths forming vertically through the filter media closer to the outlet.

Perforated pipes should not use a geofabric wrapping, as this is a potential location for blockage and would require a complete resetting of the bioretention system. Where perforated pipes are supplied with geofabric wrapping, it is to be removed before installation.

Installing parallel pipes is a means to increase the capacity of the perforated pipe system. 100 mm diameter is recommended as the maximum size for the perforated pipes to minimise the thickness of the drainage layer. Either slotted PVC pipes or flexible perforated pipes (e.g. Ag pipe) can be used; however, care needs to be taken when selecting the type of pipe to consider the following:

(i) ensure the slots in the pipes are not so large that sediment will freely flow into the pipes from the drainage layer. This is also a consideration when specifying drainage layer media; and

(ii) minimise the potential for tree roots to enter the pipes in search of water. Generally, this is only a concern when the filter media has a low water holding capacity, or trees are planted in filter media whose depth is too shallow. In general, trees are not recommended if the filter media depth is less than 800 mm. Flexible "ribbed" pipes are more likely, than PVC pipes, to retain "beads" of moisture due to the small corrugations on the inside of the pipe. Therefore, a smooth surface perforated/slotted pipe system is recommended for use in bioretention basins exhibiting any of these characteristics.

(iii) To ensure slotted pipes are of adequate size, several checks are required:

(A) ensure the perforations are adequate to pass the maximum filtration rate;

(B) ensure the pipe itself has sufficient capacity; and

(C) ensure that the material in the drainage layer will not be washed into the perforated pipes (consider a transition layer).

The maximum filtration rate represents the maximum rate of flow through the bioretention filter media and is calculated by applying Darcy's equation as follows:

$$V_s = A_c \cdot R \cdot L_o \cdot F_c$$

Where V_s = volume of forebay sediment storage required (m^3)

A_c = contributing catchment area (ha)

R = capture efficiency (assume 80%)

L_o = sediment loading rate (m^3/ha/year)

F_c = desired cleanout frequency (years)

To ensure the perforated under-drainage system has sufficient capacity to collect and convey the maximum filtration rate, it is necessary to determine the capacity for flows to enter the under-drainage system via the perforations in the pipes. To do this, orifice flow can be assumed and the sharp edged orifice equation used. It is conservative, but reasonable to use a blockage factor to account for partial blockage of the perforations by the drainage layer media. A 50% blockage of the perforations should be used.

The flow capacity of the perforations is thus:

$$A_s = \frac{V_s}{D_s}$$

If the capacity of the drainage system is unable to collect the maximum filtration rate additional under-drains will be required.

The Manning's roughness used will be dependent on the type of pipe used (refer to QUDM Table 7.16.3 (DNRW, IPWEA & BCC 1998)). When a saturated zone is incorporated into the design, the underdrainage pipes are laid flat however the conveyance capacity can be calculated using the Manning's equation with an assumed friction slope of 0.5%.

Under-drains should be extended vertically to the surface of the bioretention system to allow inspection and maintenance when required. The vertical section of the under-drain should be unperforated and capped to avoid short-circuiting of flows directly to the drain. Reference is made to the drawings following the worked example (Section SC6.4.3.9.4(3)(i) Step 9: Undertake verification checks) for further guidance.

In bioretention basins with a saturated zone, the capacity of the weir or up-turned pipe (maintaining the water level within the saturated zone) must also be checked to ensure it does not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system). A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) to convey the maximum flow/filtration rate. The maximum depth of flow over the weir is to be 100 mm. This is important to limit increase in the saturated zone depth and avoid prolonged saturation of the filter media.

(f) Step 6: Check requirement for impermeable lining

The saturated hydraulic conductivity of the natural soil profile surrounding the bioretention system should be tested together with depth to groundwater, chemical composition and proximity to structures and other infrastructure. This is to establish if an impermeable liner is required at the base (only for systems designed to preclude ex-filtration to in-situ soils) and/or sides of the bioretention basin (refer also to discussion in SC6.4.3.9.4(2)(c) Ex-filtration to in-situ soils). If the saturated hydraulic conductivity of the filter media in the bioretention system is more than one order of magnitude (10 times) greater than that of the surrounding in-situ soil profile, no impermeable lining is required.

(g) Step 7: Size overflow pit

There should be a minimum of 50 mm head over the overflow pit crest to facilitate discharge of the design flow into the overflow pit.

In streetscape bioretention applications, a level of conservatism is built into the design of grated overflow pits by placing their inverts at least 50 mm below the invert of the street channel (and therefore setting the maximum ponding depth). The head over the overflow pit crest is the sum of the 50 mm and the maximum ponding in the street channel under the minor storm (see SC6.4.3.9.4(3)(c)(v) Kerb opening configuration). To size an overflow pit, two checks must be made to test for either drowned or free flowing conditions. A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) and an orifice equation used to estimate the area between openings required in the grate cover (assuming drowned outlet conditions). The larger of the two pit configurations should be adopted (as per Section 7.05 QUDM (DNRW, IPWEA & BCC 1998)). In addition, a blockage factor that assumes the grate is 50% blocked is to be used.

For free overfall conditions (weir equation):

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A}\right]^{-n}$$

Where:

R	=	fraction of target sediment removed (80%)
v_s	=	settling velocity of target sediment (100 mm/s or 0.1 m/s for 1 mm particle)
Q/A	=	applied flow rate divided by forebay surface area ($m^3/s/m^2$)
n	=	turbulence or short-circuiting parameter (adopt 0.5)

Once the length of weir is calculated, a standard sized pit can be selected with a perimeter at least the same length of the required weir length.

For drowned outlet conditions (orifice equation):

$$Q = C_w \cdot L \cdot h^{3/2}$$

Where

Q	=	flow (m^3/s)
Cw	=	weir coefficient (= 1.66)
L	=	length of opening (m)
h	=	depth of flow (m)

When designing grated field inlet pits, reference is also to be made to the procedure described in QUDM Section 7.05.4.

In terms of the actual grate, letter box or dome type grates must be used in bioretention basins.

When a saturated zone is included in the design of a bioretention system, additional components must be incorporated into the outlet design. A saturated zone can be formed at the base of a bioretention system by using a riser pipe with the outlet level set at the top of the desired saturation depth (i.e. top of the saturated zone) or by incorporating a weir/overflow structure within the outlet pit (see Figure SC6.4.3.9.18). The saturated zone would hold water rather than draining freely, and would therefore provide a source of water to the plants during dry periods.

(h) Step 8: Specify vegetation

Refer to SC6.4.3.9.4(4) Landscape design notes and SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for advice on selecting vegetation for bioretention basins in the coastal dry tropics.

Editor's note—applicants will also need to address 9.4.3 Landscape Code and sub-section SC6.4.3.6 Landscape policy.

(i) Step 9: Undertake verification checks

Once the detailed design is complete, a final check should be undertaken to confirm that vegetation will be protected from scour during flood events and that the final design will achieve the required treatment performance.

(i) Vegetation scour velocity check

Velocities should be kept below:

(A) 0.5 m/s for minor flood (2-5 year ARI) discharges; and

(B) 2.0 m/s for major flood (50 year ARI) discharges.

If the inlet to the bioretention basin "controls" the maximum inflow to the basin then it is appropriate to use this maximum inflow to check velocities. In this case, velocities should be maintained below 0.5 m/s.

(ii) Confirm treatment performance

If, during the course of undertaking detailed design of the bioretention basin, the basic design parameters established by the conceptual design phase have changed (e.g. area, filter media depth, etc.) then the designer should verify that the current design meets the required water quality improvement performance. This can be done by re-modelling expected treatment performance determined in the conceptual design based on the revised configuration of the system.

(j) Design calculation summary

A calculation summary sheet for the key design elements of a bioretention basin is provided in Table SC6.4.3.9.10.

Click here to obtain a copy of **Table SC6.4.3.9.10**

(4) Landscape design notes – bioretention basins

(a) Objectives

Landscape design for bioretention basins has four key objectives:

(i) addressing stormwater quality objectives by incorporating appropriate groundcover plant species for sediment removal, erosion protection, stormwater treatment (biologically active root zone) and preventing filter media blockages;

(ii) ensuring that the overall landscape design for the bioretention basin integrates with its surrounding environment. This includes requirements for maintaining dense perennial vegetation throughout the dry season to maintain aesthetics and to minimise weed growth;

(iii) incorporating crime prevention through environmental design (CPTED) principles and traffic visibility safety standards for roadside systems. This objective also needs to incorporate public safety; and

(iv) providing other landscape values such as shade, amenity, character, buffers, glare reduction, place making and habitat.

For further guidance refer to the *South East Queensland WSUD Conceptual Design Guidelines* (Healthy Waterways Partnership, 2008)

(b) Bioretention basin vegetation

Planting for bioretention basin elements may consist of up to three vegetation types:

(i) groundcovers for stormwater treatment and erosion protection;

(ii) shrubbery for screening, glare reduction and character; and

(iii) trees for shading, character, breaking up filter material and other landscape values.

The plant species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics tolerate free draining sandy soils and are capable of withstanding long dry periods as well as periods of inundation. However, because the dry periods in the coastal dry tropics can be severe, bioretention systems must have supplemental temporary irrigation or include a saturated zone. These measures ensure dense perennial vegetation can be sustained to maintain aesthetics, stormwater treatment capacity and to minimise weed growth.

(c) Parkland bioretention basins

Once the general location has been determined, it will be necessary to investigate how the elements of the bioretention system will be arranged within the open space including:

(i) opportunities and constraints presented by various siting options;

(ii) if the device is to be visually prominent (perhaps for educational value) or merged with the surrounding parkland space using a consistent planting layout in the basin, embankment and parkland; and

(iii) a formal or informal style dependent on the setting and surrounding open space and urban design.

(d) Safety issues

The standard principles of informal surveillance, exclusion of places of concealment and open visible areas apply to the landscape design of bioretention basins. Regular clear sightlines should be provided between the roadway and footpaths/ property. Safety measures in accordance with the requirements of the relevant local authority should also be installed around structural components of bioretention basins where safety hazards exist.

(i) Crime prevention through environmental design (CPTED)

Where planting may create places of concealment or hinder informal surveillance, groundcovers and shrubs should not generally exceed 1 m in height.

(ii) Traffic sightlines

The standard rules of sightline geometry apply. Planting designs should allow for visibility at pedestrian crossings, intersections, rest areas, medians and roundabouts.

(5) Construction and establishment – bioretention basins

This section provides general advice for the construction and establishment of bioretention basins and key issues to be considered to ensure their successful establishment and operation (see Figure SC6.4.3.9.20).

Figure SC6.4.3.9.20 Bioretention basin functional installation

(a) Staged construction and establishment method

(i) Sediment and erosion control

Many soils within the coastal dry tropics region are dispersive, highlighting the critical importance of appropriate sediment and erosion control. All development and land disturbance activities must employ best practice sediment and erosion control practices to minimise the impact on receiving environments (refer to the Development manual planning scheme policy SC6.4.3.8 Stormwater management plans for development).

In relation to bioretention systems, temporary protective layers must be installed and left in place throughout the allotment building phase to ensure sediment laden waters do not clog the filtration media and allotment building traffic does not enter the bioretention system (see Figure SC6.4.3.9.21). Importantly the configuration of the bioretention basin and the turf vegetation allow the system to function effectively as a shallow sedimentation basin reducing the load of sediment discharging to the receiving environment. Using this approach, WSUD systems can operate effectively to protect downstream ecosystems immediately after construction.

Figure SC6.4.3.9.21 Bioretention basin sediment and erosion control

(ii) Operational establishment

At the completion of the allotment building phase the temporary measures (i.e. geofabric and turf) are removed with all accumulated sediment and the bioretention system re-profiled and planted in accordance with the proposed landscape design. Establishment of the vegetation to design condition can require more than two growing seasons, depending on the vegetation types, during which regular watering and removal of weeds will be required.

(iii) Quality control during construction

The primary responsibility for supervision of the construction of WSUD elements lies with the site superintendent. Key milestones requiring inspection and sign off by either the superintendent or

the design team are detailed in the suggested construction sequence below.

Meetings between the design team and contractors should also take place at the commencement of each phase of works, i.e.:

- prior to commencement of civil works;
- prior to commencement of landscape works; and
- at the completion of works.

Regular site inspections by a member of the design team are also recommended to ensure the bioretention basins are constructed as per the design intent and to provide ongoing construction and establishment advice to the contractors.

The suggested construction sequence for the bioretention basins are as follows:

(A) survey bioretention basin location;

(B) undertake bulking out, including construction of bunds surrounding basin. Construct outflow headwall(s) and install section(s) of stormwater reinforced concrete pipes (RCP) that runs underneath bund. Terminate pipe at interface of bund and bioretention basin;

(C) excavate surrounding landform to design subsoil level (achieving surrounding level at this stage reduces the need for earthworks adjacent to the basins after they have been constructed);

(D) install overflow pit(s) and ensure pit crest(s) is at design level. The pit crest(s) will then be used as a datum from which other levels within the basin will be measured. The pit requires holes for pipe connections and these should be drilled at this stage;

(E) detailed excavation, trimming and profiling of sides and base of basin, ensuring base has minimum 0.5% grade (0% slope when saturated zones are included in the designs) towards pit. Ensure base of basins are free from debris. As constructed survey is required at this time and should include the base and bunds of the system and all hard structures (i.e. overflow pit, overflow weir and pipe connection punch-out holes);

(F) install silt fences around basin to prevent sediment entering system and to keep construction vehicles off the basin;

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING

(G) line basin with geofabric, ensuring geofabric extends beyond top of bioretention basin side walls, up to the sediment control fence. This ensures that exposed earth on the bunds won't wash into basins during construction;

(H) install remaining RCP stormwater pipe connecting overflow pit(s) to existing RCP stormwater pipe installed as part of Step 2;

(I) install slotted PVC under-drainage pipes and PVC collector pipes in specified layout. Ensure all pipes are laid at min 0.5% slope (0% slope when saturated zones are included in the designs) with no localized depressions verified using level or string line. Arrange slots so that they are not directly on top of the pipe (to minimise fine particles blocking the slots). Seal junctions and connections (i.e. slotted PVC pipes to PVC collector pipes; slotted PVC pipes/PVC collector pipes to overflow pits) using sealant to prevent sand/gravel/soil passing into drainage network. Connect clean out points ensuring top of clean out points will ultimately sit 200 mm below overflow pit crest;

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING

(J) install drainage, transition and saturated zones as required and as detailed in the design drawings;

(K) place prescribed bioretention filter media to design surface level of bioretention basin. Spread material using excavator bucket, hand tools, or a small "pozitrack" bobcat. Do not drive over filter media with any vehicle other than a "pozitrack" bobcat and only if agreed to by civil superintendent. In order to remove air pockets within the filter media, apply light and even compaction by making a single pass with a "pozitrack" bobcat (or similar). If required, apply additional filter media to ensure final surface level is correct. Use a spreader bar to flatten the surface of the filter media. Ultimately, the surface of the filter media must be level

(horizontal) and free from local depressions and set at 300 mm below pit crest;

(L) construct coarse sediment forebay utilising large, flat rocks to form base of forebay and interface between forebay and bioretention area;

(M) install temporary protective covering over bioretention surface. This involves covering the surface of filtration media with geofabric and placement of 50 mm topsoil and turf over the geofabric. This geofabric/turf layer is a temporary measure to protect the filter media from being clogged with construction sediment while allotment building is being undertaken. Once a majority of the allotment building is complete and the construction sediment load is minimal, this protective layer will be removed, and the system will be planted out with the vegetation as per designs;

(N) place landscaping topsoil on top of geofabric covering the bunds and around basin as per designs;

(O) flush under-drainage pipes to remove any initial ingress of material; and

(P) undertake as constructed survey of the basin surface and surrounding bunds, picking up at least one spot level per 100m² on the basin surface and at least one spot level every 10m along the top of the bunds.

FINAL SUPERINTENDENT INSPECTION AND SIGN OFF

(b) Construction tolerances

It is important to emphasise the significance of tolerances in the construction of bioretention basins (e.g. profiling of trench base and surface grades). Ensuring the surface of the bioretention filter media is free from localised depressions is particularly important to achieve even distribution of stormwater flows across the surface. In bioretention systems without saturated zones, the base of the trench should be sloped towards the outlet pit (min 0.5% longitudinal grade) to enable the perforated sub-surface drainage pipes to drain freely. Generally an earthworks tolerance of plus or minus 50 mm is considered acceptable.

(c) Sourcing bioretention vegetation

Notifying nurseries early for contract growing is essential to ensure the specified species are available in the required numbers and of adequate maturity in time for bioretention basin planting. When this is not done and the planting specification is compromised, poor vegetation establishment and increased initial maintenance costs may occur. The species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are generally available commercially from local native plant nurseries. Availability is, however, dependent upon many factors including demand, season and seed availability. To ensure planting specification can be accommodated, the minimum recommended lead time for ordering is 3-6 months. This usually allows enough time for plants to be grown to the required size. The following pot sizes are recommended as the minimum:

(i) viro tubes - 50 mm wide x 85 mm deep;

(ii) 50 mm tubes - 50 mm wide x 75 mm deep; and

(iii) native tubes - 50 mm wide x 125 mm deep.

(d) Vegetation establishment

The following weed control measures and watering schedule are recommended to ensure successful plant establishment. Regular general maintenance as outlined in SC6.4.3.9.4(5) will also be required.

(i) Weed control

Conventional surface mulching of bioretention basins with organic material like tanbark, should not be undertaken. Most organic mulch floats and runoff typically causes this material to be washed away with a risk of blocking drains. Adopting high planting densities (e.g. 8-10 plants per square metre) and if necessary, applying a suitable biodegradable erosion control matting to the basin batters will help to combat weed invasion and reduce labour intensive maintenance requirements for weed removal. A heavy application of seedless hydro-mulch or hydro-mulch seeded with a sterile annual grass (e.g. Sterile Rye Grass) to create an anchored mulch can also provide short term erosion and weed control prior to planting with nursery stock. No matting or hydro-mulch is to be applied to the surface of the bioretention basin following the construction phase (i.e. in its final design form, vegetated as per planting schedule), as this will hinder filtration of stormwater through

the filter media.

(ii) Watering

Regular watering of bioretention basin vegetation is essential for successful establishment and healthy growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. The following watering program is generally adequate but should be adjusted (increased) to suit the site conditions:

(A) week 1-2 3 visits/ week;

(B) week 3-6 2 visits/ week; and

(C) week 7-12 1 visit/ week.

After this initial 3 month period, supplementary irrigation will be required in bioretention basins without submerged zones and may be required in bioretention basins with saturated zones (particularly during the 2 year plant establishment period (see Figure SC6.4.3.9.22)). Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

Figure SC6.4.3.9.22 Plant establishment period in bioretention basin

(6) Maintenance requirements – bioretention basins

Vegetation plays a key role in maintaining the porosity of the filter media of a bioretention basin and a strong healthy growth of vegetation is critical to its performance. Therefore the most intensive period of maintenance is during the plant establishment period (first 2 years) when weed removal and replanting may be required.

Inflow systems and overflow pits require careful monitoring, as these can be prone to scour and litter build up. Debris can block inlets or outlets and can be unsightly, particularly in high visibility areas. Inspection and removal of debris should be done regularly, and debris should be removed whenever it is observed on a site. Where sediment forebays are adopted, regular inspection of the forebay is required (3 monthly) with removal of accumulated sediment undertaken as required.

For larger bioretention basins, a maintenance access track for maintenance vehicles (e.g. 4WD ute) should be provided to the full perimeter of the system for maintenance efficiency and ease.

(7) Checking tools – bioretention basins

A number of checking aids have been developed for designers and council development assessment officers. In addition, SC6.4.3.9.4(5) Construction and establishment - bioretention basins provides general advice for the construction and establishment of bioretention basins and key issues to be considered to ensure their successful establishment and operation based on observations from construction projects around Australia.

(a) Design assessment

The checklist at Table SC6.4.3.9.11 presents the key design features that are to be reviewed when assessing the design of a bioretention basin. These considerations include configuration, safety, maintenance and operational issues that need to be addressed during the design phase. If an item receives an “N” when reviewing the design, referral is made back to the design procedure to determine the impact of the omission or error. A copy of the completed design calculation summary from Table SC6.4.3.9.10 should be provided as part of the application to assist in the design assessment. In addition to the checklist, a proposed design is to have all necessary permits for its installation. Council development assessment officers will require all relevant permits to be in place prior to accepting a design.

Click here to view **Table SC6.4.3.9.11 Bioretention basin design assessment checklist**

(b) Construction (during and post)

The checklist at Table SC6.4.3.9.12 presents the key items to be reviewed when inspecting the bioretention basin during and at the completion of construction. The checklist is to be used by Construction Site Supervisors and local authority Compliance Inspectors to ensure all the elements of the bioretention basin have been constructed in accordance with the design. If an item receives an “N” in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view **Table SC6.4.3.9.12 Bioretention basin construction inspection checklist**

(c) Operation and maintenance inspection

The example form at Table SC6.4.3.9.13 should be developed and used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time. Inspections should occur every 1 - 6 months depending on the size and complexity of the system. More detailed site specific maintenance schedules should be developed for major bioretention basins and include a brief overview of the operation of the system and key aspects to be checked during each inspection.

Click here to view **Table SC6.4.3.9.13 Bioretention basin maintenance checklist**

(d) Asset transfer (following on maintenance period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater treatment device. A proposed design should clearly identify the asset owner and who is responsible for its maintenance. The proposed owner should be responsible for performing the asset transfer checklist. For details on asset transfer to specific to each council, contact the relevant local authority. Table SC6.4.3.9.14 provides an indicative asset transfer checklist.

Click here to view **Table SC6.4.3.9.14 Bioretention basin asset transfer checklist**

(8) Example engineering drawings – bioretention basins

Where council has standard drawings appropriate to a bioretention basin application, these should be used to guide the design and construction of a bioretention basin. In the absence of local standards, Brisbane City Council have developed a set of Standard Drawings (UMS 155, 156 and 337) that can be readily applied to bioretention basin applications in the coastal dry tropics. These drawings relate specifically to inlet pits and sub-surface drains for bioretention swales but may be used to guide design for bioretention basins.

Editor’s note—these are not intended to be prescriptive drawings which must be adhered too; rather they are intended to provide detailed examples of bioretention system configurations.

(9) References and additional information – bioretention basins

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SC6.4.3.9.5 Constructed stormwater wetlands

Editor's note—due to the different climatic conditions, the design of constructed wetlands in the coastal dry topics differs from the design of wetlands in south east Queensland and southern states. The following design considerations and criteria outlined below are specific to the coastal dry topics and are intended to address key requirements such as maintaining perennial wetland vegetation during the dry season; managing the potential for weed ingress and providing natural means of managing mosquito populations.

(1) Constructed wetland systems are densely vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater. Water levels rise during rainfall

events and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. In addition to treating stormwater, constructed wetlands can also provide habitat, passive recreation and improved landscape amenity.

Constructed wetlands in the coastal dry tropics will generally consist of an inlet zone (sedimentation basin to remove coarse sediments, deep pools, a deep marsh macrophyte zone (i.e. a heavily vegetated area to remove fine particulates and uptake soluble pollutants) and a high flow bypass channel (to protect the macrophyte zone from scour and vegetation damage). Figure SC6.4.3.9.23 Schematic layout of a constructed wetland system and Figure SC6.4.3.9.24 Wet and dry season conditions in a constructed freshwater wetland show the key elements of constructed stormwater wetland systems.

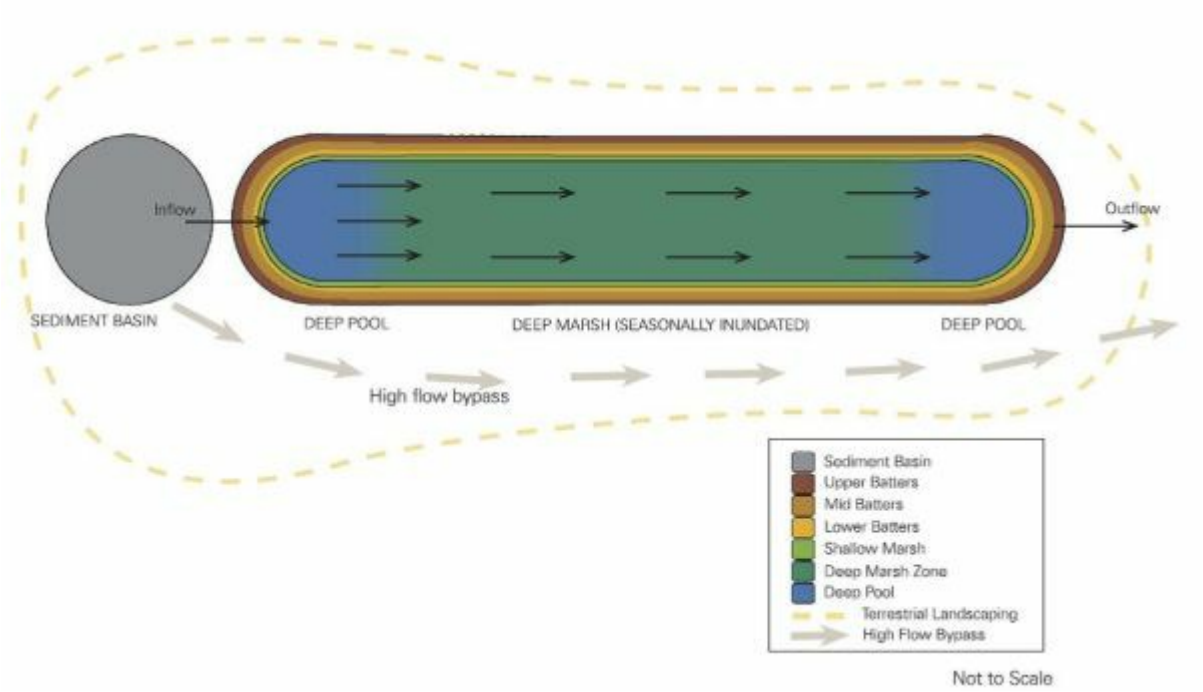


Figure SC6.4.3.9.23 Schematic layout of a constructed wetland system

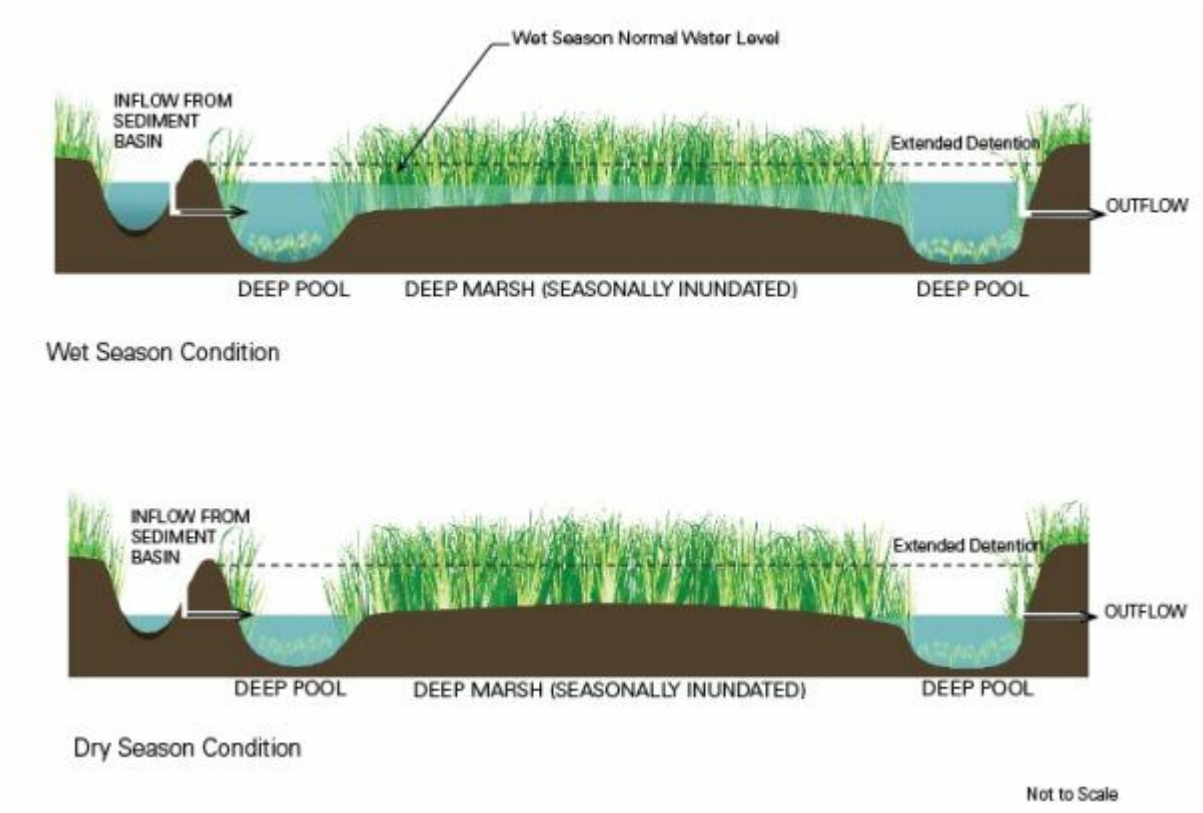


Figure SC6.4.3.9.24 Wet and dry season conditions in a constructed freshwater wetland

Constructed wetlands treat stormwater by capturing runoff and slowly passing it horizontally through a densely vegetated macrophyte zone. Soluble and colloidal (fine particles held in suspension) pollutants are mostly removed by sorption (absorption – "into" and adsorption – "onto") to biofilms on stems of wetland plants (Figure SC6.4.3.9.25). For this reason, dense vegetation is important for effective treatment and vegetation with a large stem surface area provides greatest treatment (i.e. plants with many small diameter stems are able to support more biofilms than plants with fewer, thicker stems). Emergent macrophytes are also important for:

(a) transferring oxygen to the sediments (oxygen pumps) thereby facilitating the processing and/or immobilising of pollutants captured and held within wetland sediments;

(b) aiding in the treatment of nutrient and heavy metal concentrations, either through direct uptake, or through providing a surface for biofilms and epiphytes that assist with the removal of pollutants;

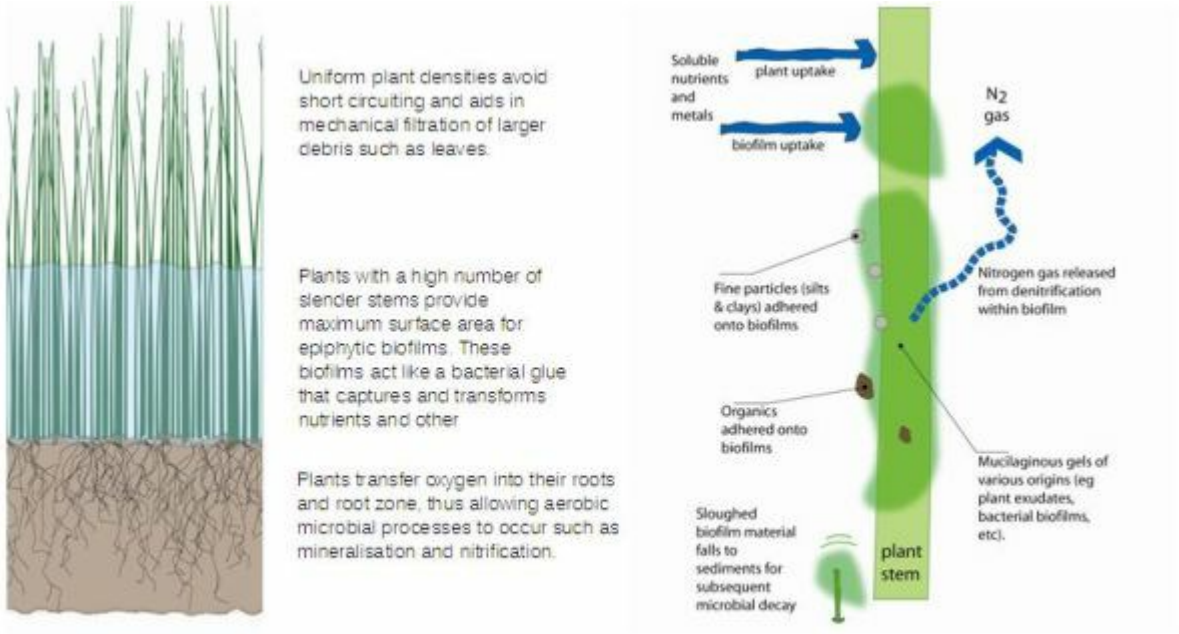
(c) influencing sediment deposition and physically filtering sediment particles from the water column;

(d) influencing hydrology and hydraulics by promoting even flow distribution through the wetland;

(e) providing shade, decreasing light availability for algal synthesis;

(f) decreasing erosion by reducing wave action and flow velocities while binding soil particles with their root systems; and

(g) providing a basis for wetland food chains and supplying shelter for mosquito predators such as macroinvertebrates and fish.



(Figure and associated text from the *Healthy Waterways WSUD Technical Design Training Notes for South East Queensland* - Version 1 June 2007)

Figure SC6.4.3.9.25 Dense emergent macrophytes and biofilms on the plant stems play an important role in nutrient removal in constructed stormwater wetlands

Source—Figure and associated text from the *Healthy Waterways WSUD Technical Design Training Notes for South East Queensland* - Version 1 June 2007.

(2) Design considerations - constructed wetlands

Due to the different climatic conditions, the design of constructed wetlands in the coastal dry topics differs from the design of wetlands in south-east Queensland and southern states. The following design considerations and criteria outlined below are specific to the coastal dry topics and are intended to address key requirements such as maintaining perennial wetland vegetation during the dry season; managing the potential for weed ingress and providing natural means of managing mosquito populations. Constructed wetlands in the form detailed below have not yet been constructed in the Townsville region. Therefore it is recommended that demonstration projects adopting the design guidelines detailed below are constructed and revisions/updates of this clause

made, where deemed appropriate, to reflect practical learnings and understanding of the performance and sustainability of constructed stormwater treatment wetlands in the coastal dry tropics.

Community acceptance of constructed wetlands will be driven by their aesthetics and landscape amenity value. Poorly designed and/or maintained wetlands are unlikely to gain community support; therefore, it is essential to address potential issues such as pests and weeds starting at conceptual design and continuing through implementation and long-term maintenance.

The operation of constructed wetlands involves the interaction between stormwater runoff, vegetation and hydraulic structures and the successful implementation of constructed wetlands requires appropriate integration into the landscape design. In this regard, the following sections provide an overview of the key design issues that must be considered when conceptualising and designing constructed wetlands.

(a) Landscape design

Constructed wetlands are often located within accessible open space areas and can become interesting community features. Landscape design aims to ensure that macrophyte planting fulfils the intended stormwater treatment function as well as integrating with their surrounds. Opportunities to enhance public amenity and safety with viewing areas, pathway links, picnic nodes and other elements should be exploited. Community education through signage and public art can also be explored. It is important that the landscape of constructed wetlands addresses stormwater quality objectives whilst being sensitive to these other important landscape aims.

Terrestrial landscaping provides a visual buffer and framework for the wetland system within the community and native habitat. Native trees can encourage recreational elements such as walking and bird watching. These recreational elements, as well as education in the form of descriptive panels and signs, can increase acceptance of these systems within the community.

Figure SC6.4.3.9.26 Boardwalk and public viewing area on the edge of a landscaped wetland

(b) Invasive weed control

To protect landscape amenity and the stormwater treatment efficiency of the wetland it is important to maintain, throughout the year, the design vegetation communities to avoid excessive colonisation of the wetland by weeds. Weed infestation is a major problem in the dry tropics, particularly within ephemeral waterways and stormwater treatment facilities. The wetland design presented in this chapter is based on an ephemeral wetland (i.e. it will dry periodically) and therefore, the design and management of the wetland to manage weed infestation takes on high importance. Management of weeds is achieved as follows:

(i) designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities;

(ii) planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season; and

(iii) during the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

(c) Detention time and hydrologic effectiveness

Detention time is the time taken for each "parcel" of water entering the wetland to travel through the macrophyte zone assuming "plug" flow conditions. In highly constrained sites, simulations using quantitative computer models, such as the Model for Urban Stormwater Improvement Conceptualisation (MUSIC, CRCCH 2005), are often required to optimise the relationship between wetland detention time1 and wetland hydrologic effectiveness to maximise treatment performance. Hydrologic effectiveness is a measure of the mean annual volume of stormwater runoff captured and treated within the wetland and is expressed as a percentage of the mean. It is recommended that a notional detention time should preferably be around 48 hours to remove nutrients effectively from urban stormwater. Optimal hydrologic effectiveness in the coastal dry tropics Region is a balance between minimising overflows in the wet season and sustaining vegetation in the dry season (i.e. sizing the wetland to treat the majority of stormwater runoff while not being too large as to result in water level drawdown and drying in excess of 60–70 days in the dry season). Further discussion on hydrologic effectiveness and sizing of wetlands in the coastal dry tropics is provided in the following sections of this clause.

Editor's note—it should be noted that detention time is rarely a constant and the term notional detention time is used throughout this chapter to provide a point of reference in modelling and determining the design criteria for riser outlet structures.

(d) Hydrodynamic design

Poor wetland hydrodynamics is often identified as a major contributor to wetland operational and management problems. A summary of desired hydrodynamic characteristics and design considerations is presented in Table SC6.4.3.9.15.

Table SC6.4.3.9.15 Desired wetland hydrodynamic characteristics and associated design considerations

Hydrodynamic Characteristics	Design Considerations	Remarks
Uniform Distribution of flow velocity	Wetland shape, inlet and outlet placement and bathymetrical design of wetland to eliminate short-circuit flow paths and poorly mixed zones.	Poor flow pattern within a wetland will lead to zones of stagnant pools which promote litter, oil and scum accumulation as well as potentially supporting mosquito breeding. Short circuit flow paths of high velocities will lead to the wetland being ineffective in water quality improvement.

Inundation depth, wetness gradient, base flow and hydrologic regime	Selection of wetland size and design of outlet control to ensure compatibility with the hydrology and size of the catchment draining into the wetland. Bathymetry layout and outlet control design to compliment the botanical design and the hydrology of the wetland.	Wetland area and outlet design is critical to achieve the WSUD Objectives (e.g. target pollutant load reduction) as well as ensuring the size is adequate to sustain wetland vegetation (i.e. not too large as to result in excessive water level drawdown and drying in excess of 60 days in the dry season). Inadequate attention to the inundation depth, wetness gradient of the wetland and the frequency of inundation at various depth ranges would lead to sparse vegetation cover and/or dominance of certain plant species (especially weed species over time). This results in a deviation from the intended botanical layout of the wetland and reduced stormwater treatment performance.
Uniform vertical velocity profile	Selection of plant species and location of inlet and outlet structures to promote uniform vertical velocity profile.	Preliminary research findings have indicated that certain plant species have a tendency to promote stratification of flow conditions within a wetland leading to ineffective water pollution control and increasing the potential for algal blooms.
Scour protection	Design of inlet structures and erosion protection of banks.	Owing to the highly dynamic nature of stormwater inflows, measures are to be taken to “protect” the wetland from erosion during periods of high inflow rates.

(e) Inlet zone design considerations

The inlet zone of a constructed stormwater wetland is designed as a sedimentation basin and has two key functional roles. The primary role is to remove coarse to medium sized sediment (i.e. 125 µm or larger) prior to flows entering the macrophyte zone. This ensures the vegetation in the macrophyte zone is not smothered by coarse sediment and allows the macrophyte zone to target finer particulates, nutrients and other pollutants.

The second role of the inlet zone is the control and regulation of flows entering the macrophyte zone and bypass of flows during “above design flow” conditions. The outlet structures from the inlet zone (i.e. sedimentation basin) are designed such that flows up to the “design flow” (typically the 1 year ARI) enter the macrophyte zone whereas “above design flows” are bypassed around the macrophyte zone. In providing this function, the sedimentation basin protects the vegetation in the macrophyte zone against scour during high flows (see Figure SC6.4.3.9.27).

When the available space for a constructed wetland is constrained, it is important to ensure that the size of the inlet zone (i.e. sedimentation basin) is not reduced. This ensures the larger sediments are effectively trapped and prevented from smothering the macrophyte zone. When the site constrains the size of the constructed wetland it is the macrophyte zone of the wetland that should be reduced accordingly.

Large wetland systems usually require a gross pollutant trap (GPT) as part of the inlet zone to protect the wetland from litter and debris. The decision of whether a GPT is required or not, depends on the presence of upstream GPT measures and catchment size. The relevant local authority should be

consulted to determine if a GPT is required.

Figure SC6.4.3.9.27 Inlet zone bypassing major design flows around wetland.

(f) Macrophyte zone design considerations

The layout of the macrophyte zone needs to be configured such that system hydraulic efficiency is optimised and healthy vegetation sustained. Design considerations include:

(i) the preferred extended detention depth is 0.5 m. Deeper extended detention depths, up to a maximum of 0.75 m, may be acceptable where the wetland has a high hydrologic effectiveness and where the botanic design uses plant species tolerant to greater depths of inundation;

(ii) the longitudinal bathymetry of the macrophyte zone should grade (min 0.5% grade) smoothly from 0.7 m in depth (based on design normal water level) up to a central crest 0.5 m in depth and then back down to a maximum of 0.7 m in depth. This ensures that isolated pools of water are not created within the macrophyte zone during the dry season when the normal water level slowly draws down due to evapotranspiration;

(iii) the macrophyte zone is to have a flat cross sectional bathymetry only grading up at the edge batters. This facilitates the even distribution of flows to avoid short circuiting, creates a uniform hydraulic conveyance and maximises stormwater contact with macrophyte stems and biofilms;

(iv) the bathymetry of the macrophyte zone should be designed so that the macrophyte zone is connected to deeper open water pools (located at the inlet and outlet of the macrophyte zone) to allow mosquito predators to seek refuge in the deeper open water zones during periods of extended dry weather;

(v) the deep open water pools should be 2 m in depth to ensure that a permanent pool of water is sustained throughout the dry season. This ensures habitat is retained for fish, macroinvertebrates (mosquito predators) and submerged macrophytes;

(vi) the surface area of deep refuge pools (excluding the sediment basin) within the wetland should be between 20% and 30% of the total macrophyte area;

(vii) the constructed wetland is required to retain water permanently and therefore the base must be of suitable material to retain water (e.g. clay). If in-situ soils are unsuitable for water retention, a clay liner (e.g. compacted 300 mm thick) must be used to ensure there will be permanent water for vegetation and habitat;

(viii) particular attention should be given to the placement of the inlet and outlet structures, the length to width ratio of the macrophyte zone and flow control features to promote a high hydraulic efficiency within the macrophyte zone;

(ix) dense littoral vegetation around the perimeter of the wetland is required to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season. During extended dry periods (e.g. in excess of 60 days) wetland macrophytes may also require irrigation to sustain dense foliage and prevent habitat opportunities for weed species;

(x) provision to drain the macrophyte zone for water level management during the plant establishment phase should also be considered; and

(xi) the macrophyte zone outlet structure needs to be designed to provide a notional detention time (usually48 hours) for a wide range of flow depths. The outlet structure should also include measures to exclude debris to prevent clogging.

(g) Wetlands constructed within retention (or detention) basins

In many urban applications, wetlands can be constructed in the base of retention basins, thus reducing the land required for stormwater treatment. In these situations, wetland systems will occasionally become inundated to greater depths than the extended detention depth; however, the inundation duration is usually relatively short (hours) and is unlikely to affect the wetland vegetation provided there is a safe pathway to drain the wetland following flood events which avoids scour of the wetland vegetation and banks.

When designing a wetland within a retention basin, the outlet control structure of the retention basin (typically culverts) should be placed at the end of the wetland bypass channel. This ensures flood flows "backwater" across the wetland thus protecting the macrophyte vegetation from scour by high velocity flows.

(h) Vegetation types

Vegetation planted in the macrophyte zone has an important functional role in treating stormwater flows, as well as adding aesthetic value. A dense cover of perennial emergent macrophytes is essential for both stormwater treatment function and for the control of weeds. It is necessary for the macrophytes to permanently occupy the wetland habitat to limit weed colonisation opportunities. Dense perennial littoral vegetation is also important to avoid the ingress of weed species into the wetland macrophyte zone. Dense planting of the littoral zone will inhibit public access to the macrophyte zone, minimising potential damage to wetland plants and reducing the safety risks posed by water bodies.

The reader is referred to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for a list of suggested plant species suitable for constructed wetland systems in the coastal dry tropics. The planting densities recommended in the list should ensure that 70 - 80% cover is achieved within two growing seasons (2 years). The distribution of the species within the wetland will relate to their structure, function, relationship and compatibility with other species. The plant species in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are listed in accordance with the wetland zone/water depth in which they should be planted. The wetland zones are: deep marsh, shallow marsh (wetland edge), lower littoral and upper littoral.

(i) Designing to avoid mosquitoes

To reduce the risk of high numbers of mosquitoes, there are a number of design features that can be considered. Not all of these will be feasible in any one situation, but they include:

(i) providing access for mosquito predators, such as fish and predatory insects, to all parts of the water body (avoid stagnant isolated areas of water);

(ii) providing a deep permanent pool (for long dry periods or for when water levels are artificially lowered) so that mosquito predators can seek refuge and maintain a presence in the wetland;

(iii) where possible, incorporating a steep slope into the water, preferably greater than 300 or 3:1 horizontal to vertical. Note that steep edges may be unacceptable for public safety reasons, and a slope of up to 8:1 horizontal to vertical is generally used;

(iv) wave action from wind over open water will discourage mosquito egg laying and disrupt the ability of larvae to breathe;

(v) providing a bathymetry such that water draws down evenly so isolated pools are avoided;

(vi) providing sufficient gross pollutant control at the inlet such that human derived litter does not accumulate and provide breeding habitat;

(vii) providing ready access for field operators to monitor and treat mosquito larvae if required;

(viii) ensuring maintenance procedures do not result in wheel rut and other localised depressions that create isolated pools when water levels fall; and

(ix) ensuring overflow channels don't have depressions that will hold water after a storm event.

(j) Designing for maintenance access

Access to all areas of a constructed wetland is required for maintenance. In particular inlet zones and

gross pollutant traps require a track suitable for heavy machinery for removal of debris and desilting as well as an area for dewatering removed sediments. If sediment removal requires earthmoving equipment to enter the basin, then a stable ramp suitable for heavy plant will be required into the base of the inlet zone (maximum slope 1:10).

To aid maintenance, it is recommended that the inlet zone is constructed with a hard (i.e. rock) bottom. This is important if maintenance is performed by driving into the basin. It also serves an important role by allowing excavator operators to detect when they have reached the base of the inlet zone during desilting operations.

Macrophyte zones require access to the areas for weeding and replanting as well as regular inspections. Commonly, these access tracks can be incorporated with walking paths around a wetland system. Maintenance access to constructed wetland needs to be considered when determining the layout of a wetland system.

(3) Technical note: saline/brackish constructed wetlands

Urban communities in the dry tropics are often located near large estuarine river systems. In some locations it may be useful to have an optional estuarine stormwater treatment system. While estuarine systems are typically lower nutrient environments than freshwater stormwater treatment systems, a modified salt marsh community would still have considerable nutrient processing capability and could potentially provide a stormwater treatment capacity in some locations. This is a new concept that has not yet been tested and therefore should only be considered if other design solutions are not possible or practical.

If an estuarine stormwater treatment system was to be trialled/ constructed as a demonstration project, it is recommended that the model would need to consider the following list of features/design elements:

(a) drain a large stormwater runoff event over several tidal cycles;

(b) during a runoff event, extended detention depth should not exceed 0.5 m, but preferably be lower;

(c) the wetland should consist of a series of cells that would progressively fill and spill during a runoff event;

(d) the initial cell would be a sedimentation pond;

(e) surrounding the sedimentation pond and throughout the subsequent cells would support salt marsh communities (ranging from herbaceous to woody);

(f) a dry weather drainage system would allow complete drainage over a single tide cycle;

(g) the wetland would be drained by a series of runnels that would be capable of completely draining the system on a low tide sequence, thus managing potential mosquito breeding habitat;

(h) high tides (exceeding mean high tide) would be allowed to penetrate the entire system;

(i) a salinity gradient would be maintained through the system for most seasons;

(j) a series of berms and chokes would be included to ensure cells progressively fill and spill and that a salinity gradient is created and maintained;

(k) in high tidal range environments particular care will be needed in the design of the hydraulic connection between the perched salt marsh treatment system and the larger and deeper estuarine drainage channels (these environments are highly susceptible to erosion particularly after catchment development); and

(l) an important element in a estuarine system will be the wetting and drying sequence in that this will heighten the capacity to process nitrogen pollutants which are critical pollutants to near shore marine ecosystems.

The illustrations on the following page (Figure SC6.4.3.9.28 Possible design features of saline/brackish constructed wetlands), demonstrate how a saline/brackish wetland may be configured to achieve the above design criteria.

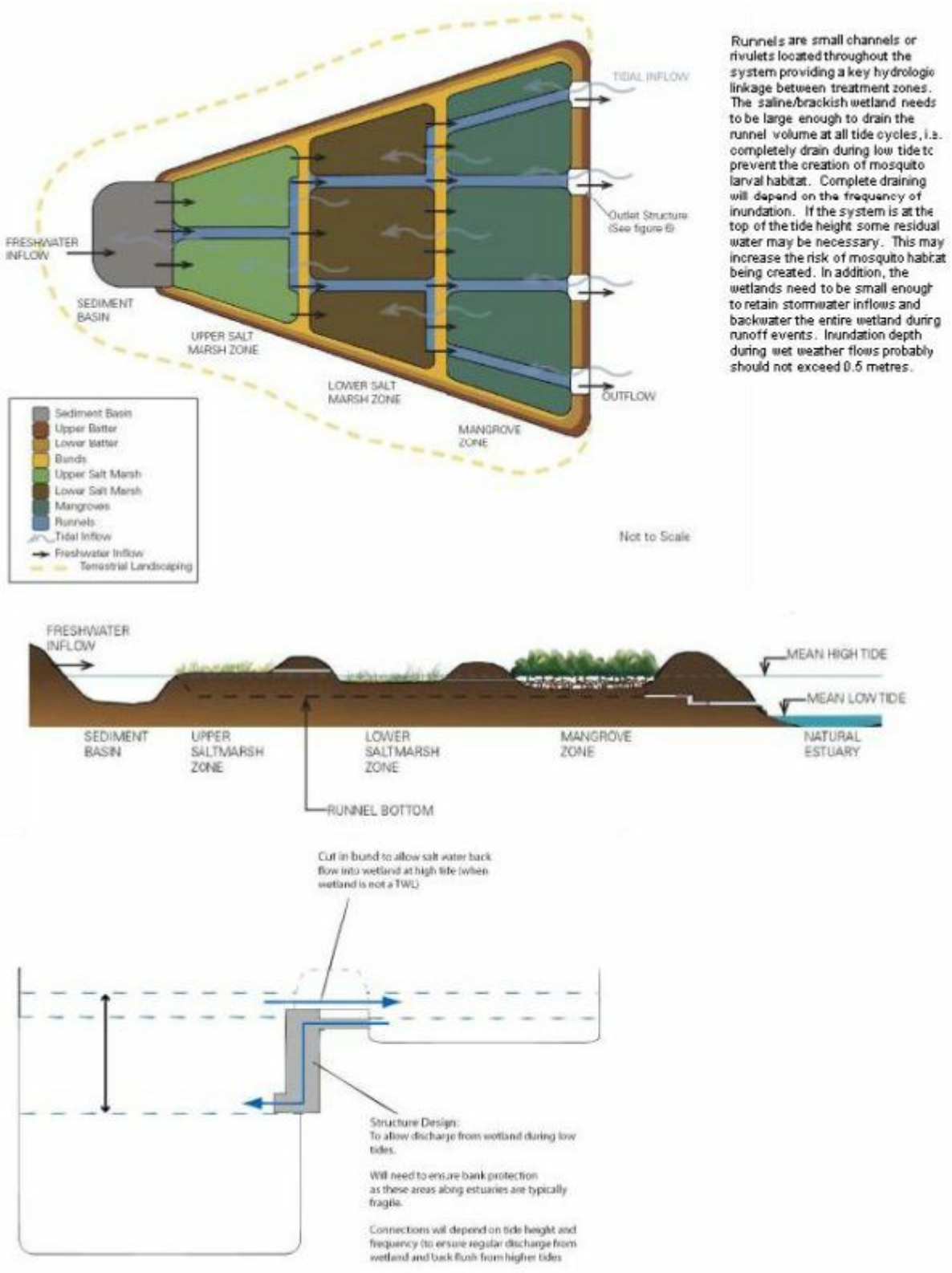
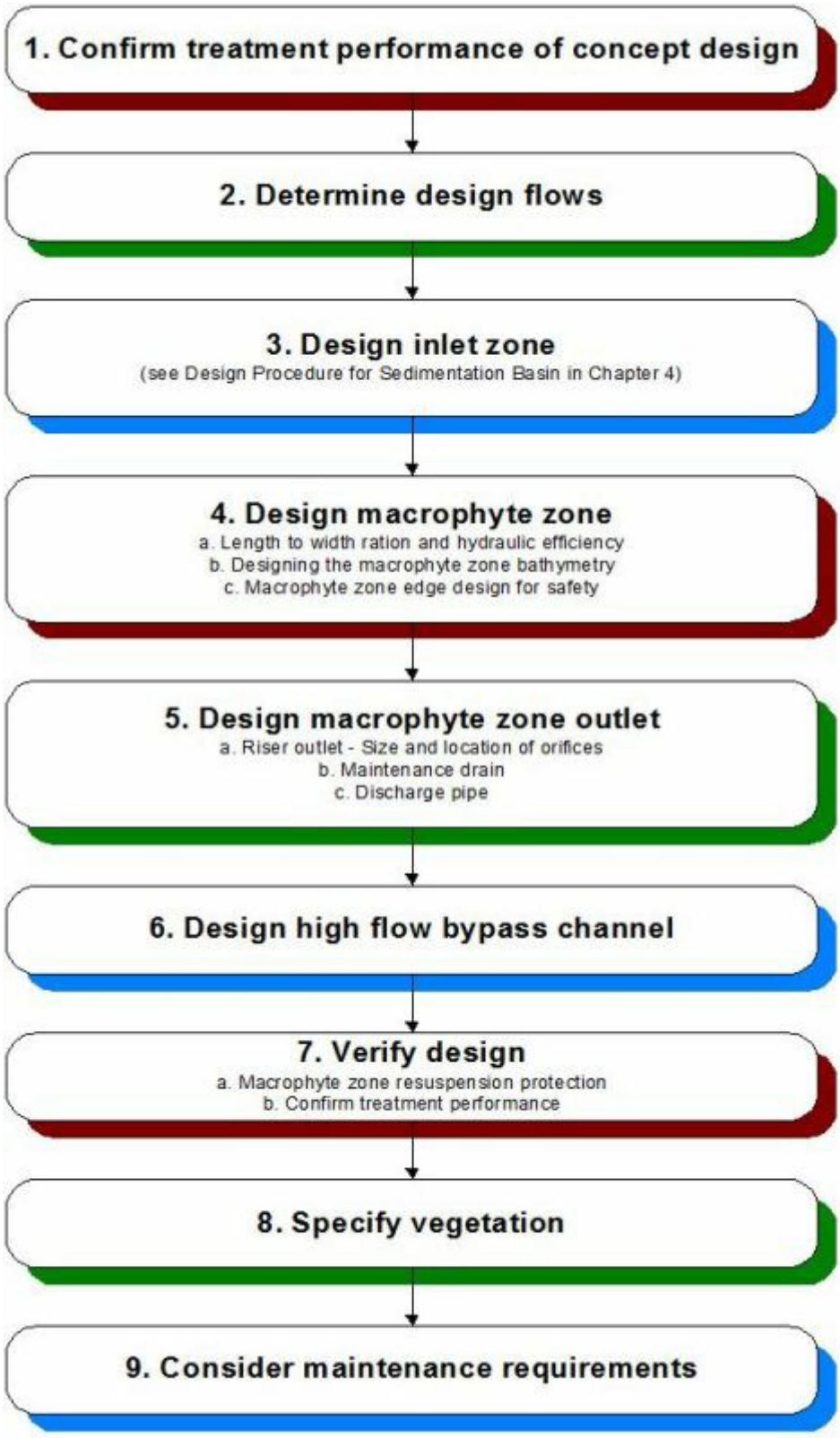


Figure SC6.4.3.9.28 Possible design features of saline/brackish constructed wetlands

(4) Wetland design process

The key design steps following the site planning and concept development stages are:



(a) Step 1: Confirm treatment performance of concept design

Before commencing detailed design, the designer should first undertake a preliminary check to confirm the constructed wetland area (i.e. the macrophyte zone surface area) from the concept design is adequate to deliver the required level of stormwater quality improvement. This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in

an appropriate quantitative modelling program. Where possible, this modelling should be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows

(i) Design discharges

To configure the inlet zone and high flow bypass elements of a constructed wetland the following design flows apply:

(A) design operation flow (1 year ARI) for sizing the inlet zone (i.e. sedimentation basin) and the "control" outlet structure (i.e. overflow pit and pipe connection) discharging to macrophyte zone; and

(B) above design flow for design of the high flow bypass around the macrophyte zone. The discharge capacity for the bypass system may vary depending on the particular situation but will typically correspond to one of the following:

- minor design flow (2 year ARI) – for situations where only the minor drainage system is directed to the inlet zone; and
- major flood flow (100 year ARI) – for situations where both the minor and major drainage system discharge into the inlet zone.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. If the typical catchment areas are relatively small, the Rational Method design procedure is considered to be a suitable method for estimating design flows. However, if the constructed wetland is to form part of a retention basin (refer to SC6.4.3.9.5(2)(g) Wetlands constructed within retention (or detention) basins) or if the catchment area to the wetland is large (> 50 ha), then a full flood routing computation method needs to be used to estimate design flows.

(c) Step 3: Design inlet zone

As outlined in SC6.4.3.9.5(2)(e) Inlet zone design considerations, the inlet zone (see example in Figure SC6.4.3.9.29 Inlet zone of a constructed wetland in Brisbane) of a constructed stormwater wetland is designed as a sedimentation basin and serves two functions: (1) pretreatment of inflow to remove coarse to medium sized sediment; and (2) the hydrologic control of inflows into the macrophyte zone and bypass of floods during "above design" operating conditions. As depicted in Figure SC6.4.3.9.30 Example of inlet zone connection to macrophyte, the inlet zone consists of the following elements:

(i) sedimentation basin "pool" to capture coarse to medium sediment (125µm or larger).

(ii) inlet zone connection to the macrophyte zone (or "control" structure as defined in normally consisting of an overflow pit within the inlet zone connected to one or more pipes through the embankment separating the inlet zone and the macrophyte zone.

(iii) high flow bypass weir (or "spillway" outlet structure to deliver "above design" flood flows to the high flow bypass channel.

Figure SC6.4.3.9.29 Inlet zone of a constructed wetland in Brisbane

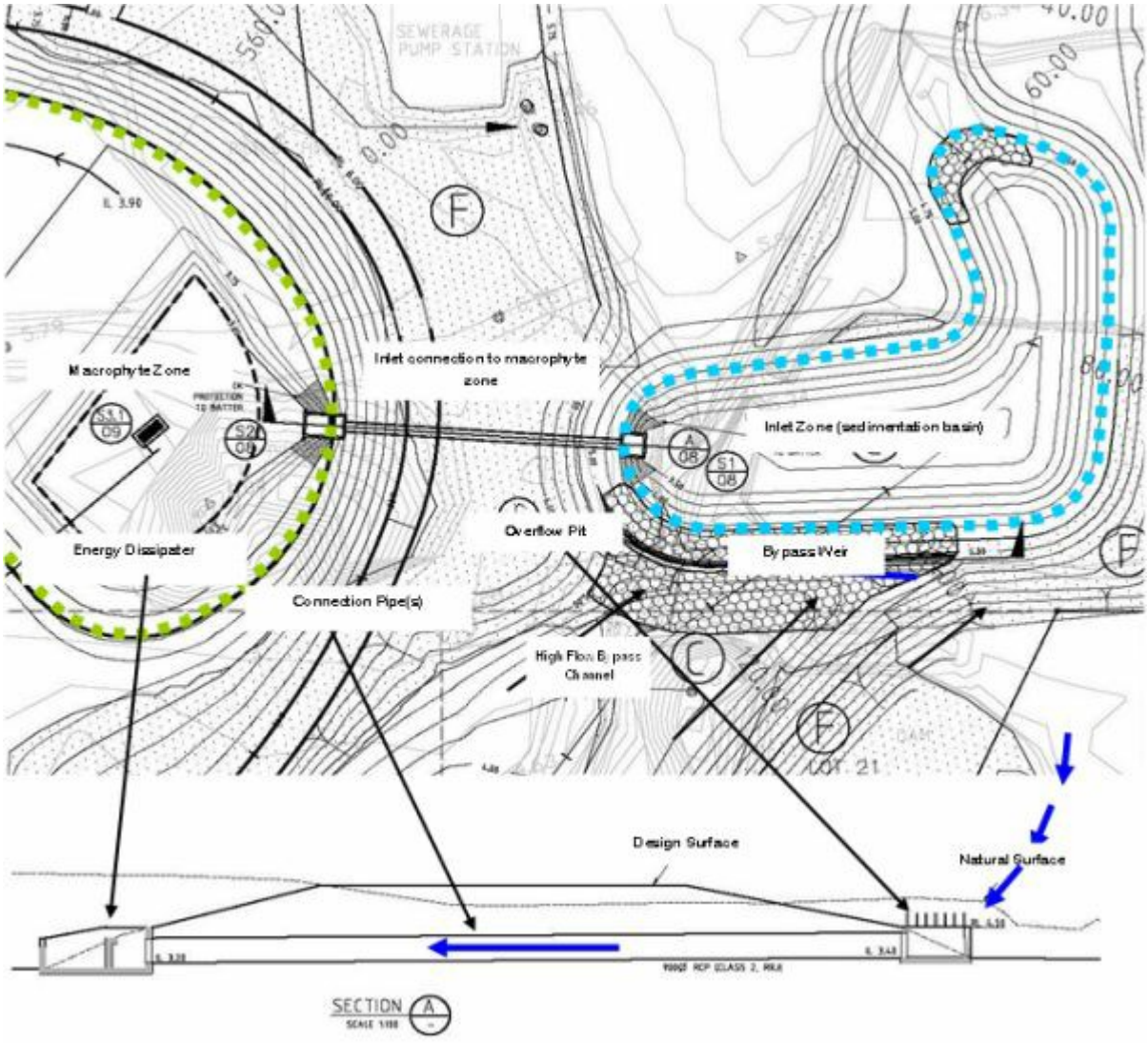


Figure SC6.4.3.9.30 Example of inlet zone connection to macrophyte zone

(iv) For more information and design guidance for each of the inlet zone elements listed above, the reader is referred to Chapter 4 Sedimentation Basins. When applying the design procedure outlined in Chapter 4, the following should be used as a guide:

(A) the inlet zone typically must comprise a deep open water body that operates essentially as a sedimentation basin designed to capture coarse to medium sized sediment (i.e. 125 µm or larger);

(B) it may be necessary for a GPT to be installed such that litter and large debris can be captured at the interface between the incoming waterway (or pipe) and the open water of the inlet zone;

(C) the crest of the overflow pit must be set at the normal water level of the inlet zone (which is typically set 0.3 m above the normal water level of the macrophyte zone);

(D) the pipe that connects the sedimentation basin to the macrophyte zone needs to have sufficient capacity to convey a 1 year ARI flow, assuming the macrophyte zone is at the normal water level and without resulting in any flow over the high flow bypass weir;

(E) the obvert of the connection pipe can be set below the normal water level of the wetland to conceal the pipe (below the normal water level) during the dry season;

(F) an energy dissipater is usually required at the end of the pipes to reduce velocities and distribute flows into the macrophyte zone;

(G) the inlet zone is to have a structural base (e.g. rock) to define the base when desilting and provide support for maintenance plant/ machinery when entering the basin for maintenance; and

(H) the high flow bypass weir ("spillway" outlet) is to be set at the same level as the top of extended detention in the macrophyte zone.

(d) Step 4: Designing the macrophyte zone

(i) Length to width ratio and hydraulic efficiency

To optimise wetland performance, it is important to avoid short circuit flow paths and poorly mixed regions within the macrophyte zone. One way to minimise this is to adopt a high length to width ratio not less than 5 to 1 for the macrophyte zone. Length to width ratios less than this can lead to poor hydrodynamic conditions and reduced water quality treatment performance.

Persson et al. (1999) used the term hydraulic efficiency (λ) to define the expected hydrodynamic characteristics for a range of configurations of stormwater detention systems (Figure SC6.4.3.9.31). Engineers Australia (2006) recommend that constructed wetland systems should not have a hydraulic efficiency (λ) less than 0.5 and preferably should be greater than 0.7.

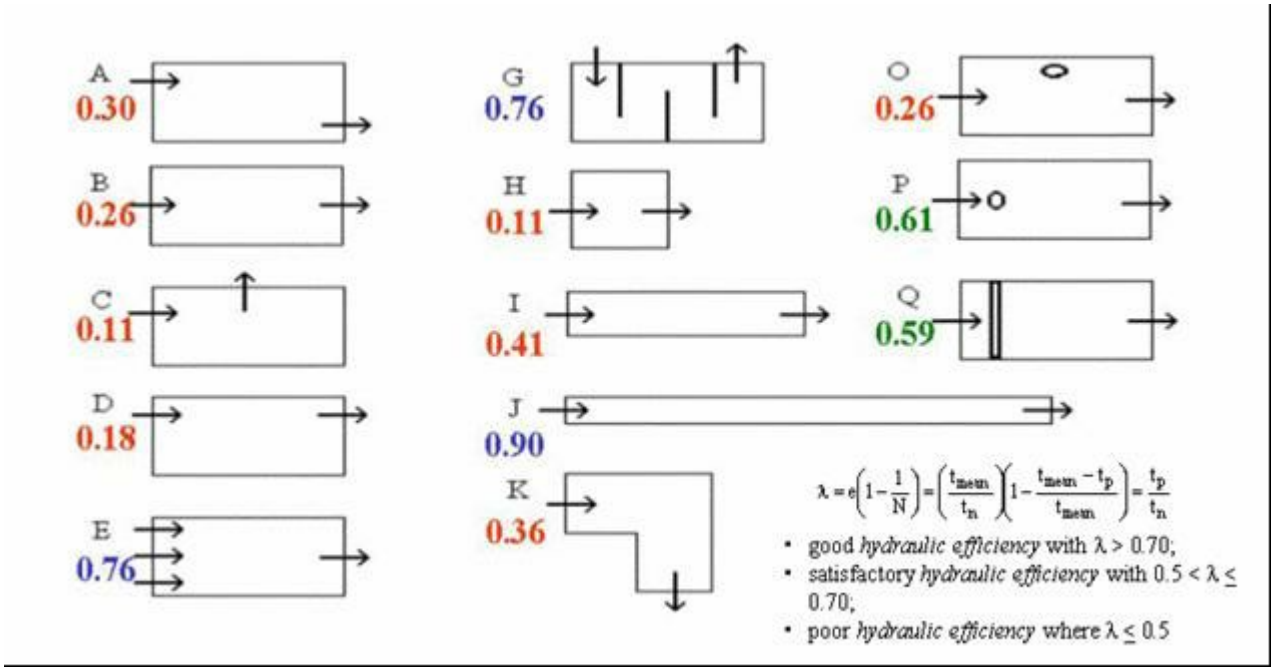


Figure SC6.4.3.9.31 Hydraulic effiency (λ) ranges

Hydraulic efficiency ranges from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment. The o in diagrams O and P represent islands in the waterbody and the double line in diagram Q represents a weir structure to distribute flows evenly (Persson et al. 1999).

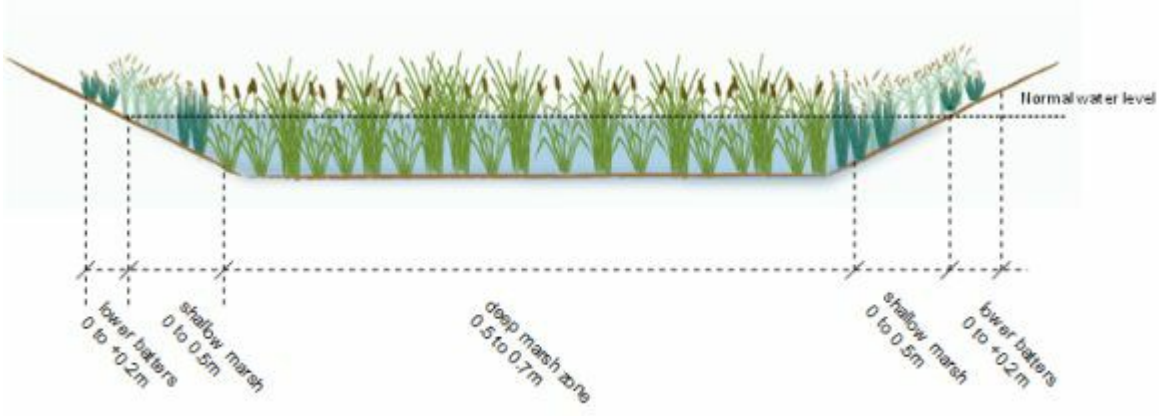
(ii) Designing the macrophyte zone bathymetry

The bathymetry of constructed wetlands in the coastal dry tropics are to be designed to ensure that macrophytes can provide adequate pollutant removal during the wet season and also be sustained during the dry season. To achieve this, the longitudinal bathymetry of the macrophyte zone should gently grade (min 0.5% grade) from 0.7 m in depth (based on design normal water level) up to a central crest 0.5 m in depth and then back down to a maximum of 0.7 m in depth. This ensures that isolated pools of water are not created during the dry season when the normal water level slowly draws down due to evapotranspiration. Smaller deep open water permanent pools at the inlet and outlet of the wetland are required to provide habitat for mosquito predators during the dry season (Refer to Figure SC6.4.3.9.23 Schematic layout of a contructed wetland system and Figure SC6.4.3.9.24 Wet and dry season conditions in a constrcted freshwater wetland). For large wetlands, this bathymetry could be repeated in series (i.e. a deep pool located between two macrophyte zones).

The macrophyte zone is to have a flat cross sectional bathymetry only grading up at the edge

batters (Figure SC6.4.3.9.32). This facilitates the even distribution of flows to avoid short circuiting, creates a uniform hydraulic conveyance and maximises stormwater contact with macrophyte stems and biofilms. This is also assisted by providing banded macrophyte planting perpendicular to the direction of flow (Figure SC6.4.3.9.33).

The deep open water pools should be 2 m in depth to ensure that a permanent pool of water is sustained throughout the dry season. This ensures habitat is retained for fish, macroinvertebrates (mosquito predators) and submerged macrophytes. Submerged macrophytes are important to provide habitat and for maintaining dissolved oxygen levels and therefore deeper pools (i.e. >2 m) should be avoided. A balance pipe connection between the deep pools is necessary to allow inflows in dry conditions to benefit and sustain the deep permanent pools. The surface area of deep refuge pool (excluding the sediment basin) within the wetland should be between 20% and 30% of the total macrophyte area. This ensures the volume of water within the pools is sufficient to maintain permanent water during the dry season but not so large that the macrophyte zone is likely to experience dry periods of greater than 60 days (due to larger inflows required to fill the pools before wetting the macrophyte zone).



Note—refer to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for more detail on planting zones and suitable macrophyte species.

Figure SC6.4.3.9.32 Typical cross section of a constructed wetland system showing preferred bathymetry and planting zones.

Figure SC6.4.3.9.33 Macrophyte zone banded planting (direction of flow is from left to right)

(iii) Macrophyte zone edge design for safety

Consideration of public safety is required when wetlands are located in parklands/public open space or any areas readily accessible. Reducing public safety risk can be achieved in a number of ways and the measures adopted should respond to the level of perceived risk given the particular

site characteristics.

One method of reducing the risk posed by water bodies is to design batter slopes on approaches and immediately under the normal water level (refer Figure SC6.4.3.9.34). It is recommended that a gentle slope to the water edge and extending below the water line be adopted before the batter slope steepens into deeper areas.

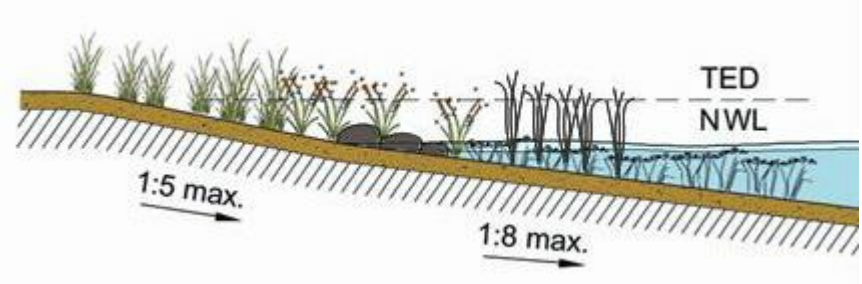


Figure SC6.4.3.9.34 Example of a wetland edge design for public safety

The safety requirements for individual wetlands will vary from site to site and requires careful consideration. The following requirements from the *Sediment Basin Design, Construction and Maintenance Guidelines* (BCC 2001) can be applied to constructed wetland systems:

- for water depths greater than 150 mm and maximum batter slope of 5:1 (H:V) or less, no fencing is required; and
- for water depths greater than 150 mm and maximum batter slope greater than 5:1 (H:V) fencing may be required.

In some cases, vertical edges are used for wetlands (refer to SC6.4.3.9.5(5) Landscape design notes). When vertical edges are used, a safety fencing/ barrier should be considered on top of concrete or stone walls where:

(A) there is a risk of serious injury in the event of a fall (over 0.5 m high and too steep to comfortably walk up/down or the lower surface has sharp or jagged edges);

(B) there is a high pedestrian or vehicular exposure (on footpaths, near bikeways, near playing/ sporting fields, near swings and playgrounds);

(C) where water ponds to a depth of greater than 300 mm on a constructed surface of concrete or stone;

(D) where the water is expected to contain concentrated pollutants; and

(E) where mowed grassed areas abut the asset.

The type of fence/ barrier to be considered should be a:

- dense vegetation at least 2 m wide and 1.2 m high (minimum) may be suitable; or
- pool fence (or similar) when there is a chance of drowning and the surrounding area is specifically intended for use by small children (swings, playgrounds, sporting fields etc.).

(iv) Macrophyte zone soil testing

Constructed wetlands are permanent water bodies and therefore the soils in the base must be capable of retaining water. Geotechnical investigations of the suitability of the in-situ soils are required to establish the water holding capacity of the soils. Where the infiltration rates are too high for permanent water retention, tilling and compaction of in-situ soils may be sufficient to create a suitable base for the wetland. Where in- situ soils are unsuitable for water retention, a compacted clay liner may be required (e.g. 300 mm thick). Specialist geotechnical testing and advice must be sought.

Wetland plants must be planted into suitable topsoil with a minimum depth of 200 mm (see SC6.4.3.9.5(6)(d) Topsoil specification and preparation). Most terrestrial topsoils provide a good substratum for wetlands, nonetheless laboratory soil testing (using Australian Standard testing procedures, e.g. AS 4419-2003: Soils for landscaping and garden use) of topsoil is necessary to ensure the topsoil will support plant and microbial growth and have a high potential for nutrient retention. Careful consideration should be given to the topsoil source and its propensity to contain weed seeds which may be viable in an ephemeral wetland habitat.

(e) Step 5: Design macrophyte zone outlet

A macrophyte zone outlet has two purposes: (1) hydrologic control of the water level and flows in the macrophyte zone to achieve the design detention time; and (2) to allow the wetland permanent pool to be drained for maintenance.

(i) Riser outlet – size and location of orifices

The riser outlet is designed to provide a uniform notional detention time in the macrophyte zone over the full range of the extended detention depths. The target maximum discharge ($Q_{max\ riser}$) may be computed as the ratio of the volume of the extended detention to the notional detention time as follows

$$Q_{max\ riser} = \frac{\text{extended detention storage volume } (m^3)}{\text{notional detention time (s)}}$$

The placement of orifices along the riser and determining their appropriate diameters is an iterative process. The orifice equation (Equation 6.2) is applied over discrete depths along the length of the riser starting at the normal water level and extending up to the riser maximum extended detention depth.

$$A_o = \frac{Q}{C_d\sqrt{2 \cdot g \cdot h}} \qquad \text{(Small orifice equation)}$$

Where

C_d	=	orifice discharge coefficient (0.67)
h	=	depth of water above the centroid of the orifice (m)
A_o	=	orifice area (m^2)
Q	=	required flow rate to achieve notional detention time (m^3/s) at the *given h*
g	=	9.79 m/s^2

As the outlet orifices can be expected to be small, it is important that they are prevented from clogging by debris. Some form of debris guard is recommended as illustrated in Figure SC6.4.3.9.35 below. An alternative to using a debris guard is to install a riser in a pit located in the embankment surrounding the wetland macrophyte zone (thus reducing any visual impact). A riser within the pit can also be configured with a weir plate (by drilling holes through the plate). An advantage of using a weir plate is that it provides an ability to drain the wetland simply by removing the weir plate entirely. Additionally, shorter weir plates may also be used during the vegetation establishment phase, thus providing more flexibility for water level manipulation.

Figure SC6.4.3.9.35 Example outlet riser assemblies with debris guards

The pit is connected to the deep pool of the macrophyte zone via a submerged pipe culvert. The connection should be adequately sized such that there is minimal water level difference between the water within the pit and the water level in the macrophyte zone. With the water entering into the outlet pit being drawn from below the normal water level (i.e. pipe obvert a minimum 0.3 m below normal water level), floating debris is generally prevented from entering the outlet pit, while heavier debris would normally settle onto the bottom of the wetland. The riser pipe should be

mounted upright on a socketed and flanged tee with the top of the pipe left open to allow overtopping of waters if any of the riser orifices become blocked. Figure SC6.4.3.9.36 and Figure SC6.4.3.9.37 show one possible configuration for a riser outlet pit.

Figure SC6.4.3.9.36 Macrophyte zone outlet arrangement

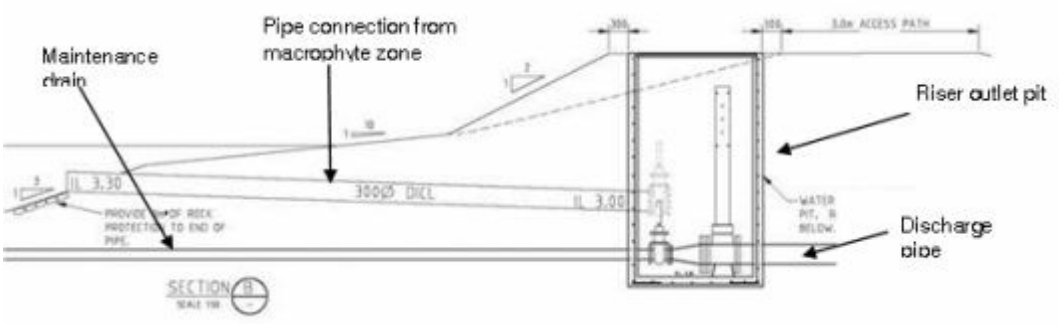


Figure SC6.4.3.9.37 Typical macrophyte zone outlet arrangement

(ii) Maintenance drains

To allow access for maintenance, the wetland should have appropriate allowance for draining. A maintenance drainage pipe should be provided that connects the low points in the macrophyte zone bathymetry to the macrophyte zone outlet. A valve is provided on the maintenance drainage pipe (typically located in the outlet pit as shown in Figure SC6.4.3.9.37), which can be operated manually. The maintenance drainage pipe should be sized to draw down the permanent pool within 12 hours (i.e. overnight). If a weir plate is used as a riser outlet, provision should be made to remove the weir plate and allow drainage for maintenance.

(iii) Discharge pipe

The discharge pipe of the wetland conveys the outflow of the macrophyte zone to the receiving waters (or existing drainage infrastructure). The conveyance capacity of the discharge pipe is to be sized to match the higher of the two discharges (i.e. maximum discharge from the riser or the maximum discharge from the maintenance drain).

(iv) Balance pipe

A balance pipe connection between the deep permanent pools in the wetland is necessary to allow inflows in dry conditions to benefit and sustain all deep pools rather than just the pool located at the inlet. The deep pools are generally 2 m in depth and may experience up to 1m of draw down during the dry season. The invert of the balance pipe should therefore be located approximately 1 m below the normal water level. A 300 mm diameter pipe is typically sufficient for a balance pipe.

(f) Step 6: Design high flow bypass channel

The bypass channel accepts “above design flow” from the inlet zone (sediment pond) of the wetland via the bypass weir (SC6.4.3.9.5(4)(c)) and conveys these flows downstream around the macrophyte zone of the wetland. The bypass channel should be designed using standard methods (i.e. Manning’s Equation) to convey the “above design flow” (SC6.4.3.9.5(4)(b)) and to avoid bed and bank erosion (see Chapter 2). Typically, a turf finish will provide appropriate protection for most bypass channel applications (but velocities need to be checked). Dense planting can be applied when appropriately designed for in terms of design roughness and management of velocities. Figure SC6.4.3.9.38 shows typical high flow bypass channel configurations.

Figure SC6.4.3.9.38 Turfed constructed wetland high flow bypass weir configuration.

(g) Step 7: Verify design

(i) Macrophyte zone resuspension protection

The principle pathway for biological uptake of soluble nutrients in wetlands is through biofilms (epiphytes) attached to the surface of the macrophyte vegetation. The biofilms, being mostly algae and bacteria, are susceptible to wash out under high flow conditions. Further, wetland surveys indicate that up to 90% of the total nutrients are stored in the sediments, therefore, the key to effective retention of pollutants is managing high velocity flows that could potentially resuspend and remobilise these stored pollutants.

A velocity check is to be conducted for design conditions, when the wetland water level is at the top of the extended detention level and the riser is operating at design capacity, to ensure velocities are less than 0.05 m/s through all zones of the wetland. The following condition must be met:

$$\frac{Q_{max\ riser}}{A_{section}} < 0.05 m/s$$

Where $Q_{max\ riser}$ = target maximum discharge (defined in Equation 6.1) (m^3/s)

Asection = minimum wetland cross-section area* (m^2) x 0.5 vegetation blockage factor**

*measured from top of extended detention

**blockage due to tall dense vegetation

(ii) Confirm treatment performance

If the basic wetland parameters established by the conceptual design phase have changed during the course of undertaking detailed design (e.g. macrophyte zone area, extended detention depth, etc.) then the designer should verify that the current design meets the required water quality improvement performance. This can be done by simulating the current design using a suitable quantitative modelling program.

(h) Step 8: Specify vegetation

Refer to SC6.4.3.9.5(5) Landscape design notes and SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for advice on selecting suitable plant species for constructed wetlands.

(i) Step 9: Consider maintenance requirements

Consider how maintenance is to be performed on the wetland (e.g. how and where is access available, where is litter likely to collect etc.). A specific maintenance plan and schedule should be developed for the wetland, either as part of a maintenance plan for the whole treatment train, or for each individual asset. Guidance on maintenance plans is provided in SC6.4.3.9.5(7) Maintenance requirements - constructed wetlands.

(j) Design calculation summary

Following is Table SC6.4.3.9.16 Constructed wetlands design calculation summary, for the key design elements.

Click here to view **Table SC6.4.3.9.16 Constructed wetlands design calculation summary**

(5) Landscape design notes - constructed wetlands

Whilst constructed wetlands play a significant role in delivering stormwater quality objectives, they can also play an important role in creating a community landscapes and urban ecology. The following sections outline some of the landscape design issues that should be considered when designing constructed wetland systems.

(a) Objectives

Landscape design of wetlands generally requires consideration of the following objectives:

(i) integrated planning and design of constructed wetlands within the built and landscape environments ensuring that the overall landscape design for the wetland integrates with its host natural and/ or built environment;

(ii) achieving dense perennial littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season;

(iii) ensuring that the wetland planting strategy is based on the wetland design depths/zones, achieves dense perennial emergent macrophyte cover and has the structural characteristics to perform particular treatment processes (e.g. well distributed flows, enhance sedimentation, maximise surface area for the adhesion of particles and provide a substratum for algal epiphytes and biofilms);

(iv) providing maintenance access to allow for the prompt removal of weeds before they spread and/or set seed;

(v) incorporating crime prevention through environmental design (CPTED) principles; and

(vi) providing other landscape values, such as shade, amenity, character and place making.

Comprehensive site analysis should inform the landscape design as well as road layouts, maintenance access points and civil works. Existing site factors such as roads, buildings, landforms, soils, plants, microclimates, services and views should be considered. For further guidance refer to the *South East Queensland WSUD Conceptual Design Guidelines* (Healthy Waterways Partnership, 2008).

(b) Wetland siting and shapes

Constructed wetlands need to be arranged to meet hydrological and stormwater quality requirements, but also to integrate effectively into the surrounding existing landscape. The arrangement of wetland, basin and high flow bypass should be designed early in the concept design phase, to ensure that amenity of open space is enhanced.

The final shape of a wetland should provide landscape opportunities to create alternate useable spaces/recreation areas (see Figure SC6.4.3.9.39). Often different shapes to wetland edges can make pathway connections through and around these recreation areas more convenient and enhances the community perception of constructed wetlands. Pathways and bridges across planted earth bunds can be the best way of getting across or around wetlands (see Figure SC6.4.3.9.40). The materials on the bridge and pathways are important to be low maintenance and do not impede hydrological flows. Ease of access to the inlet basin for sediment and trash removal is also important to consider.

The area required for the high flow bypass can be manipulated to provide open spaces that only periodically convey stormwater flows. Further discussion of high flow bypass configuration is provided in SC6.4.3.9.5(5)(c)(iii) High flow bypass channel.

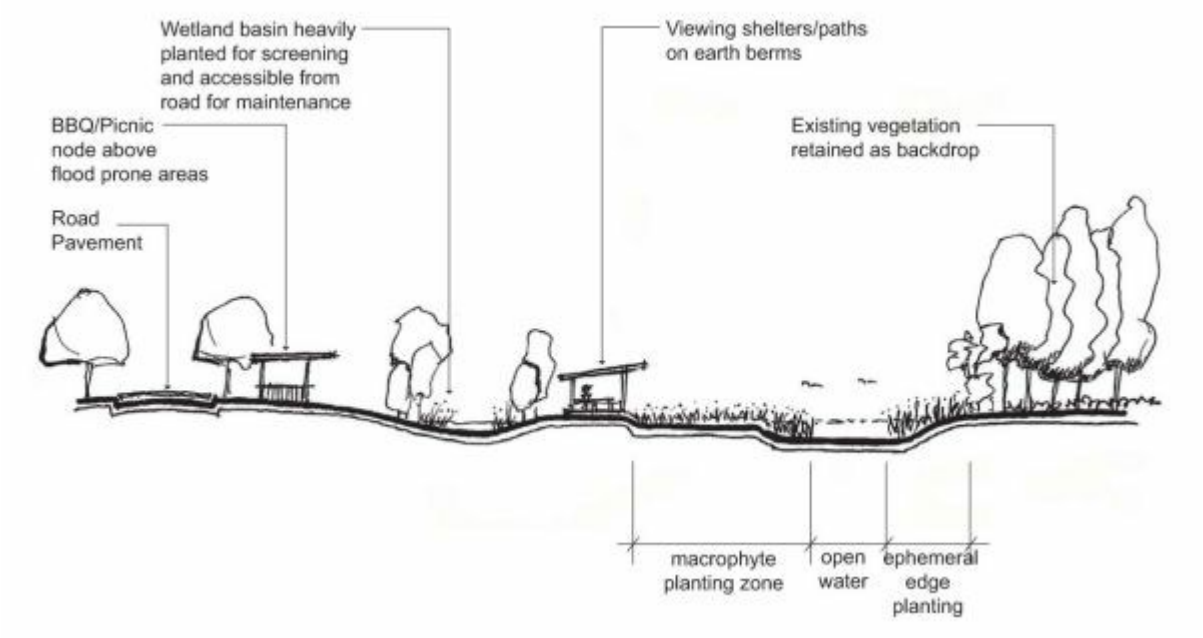


Figure SC6.4.3.9.39 Typical landscape treatments to constructed wetlands in open space areas

Figure SC6.4.3.9.40 Boardwalk treatment over wetland (left) and integration of urban art with wetland setting (right)

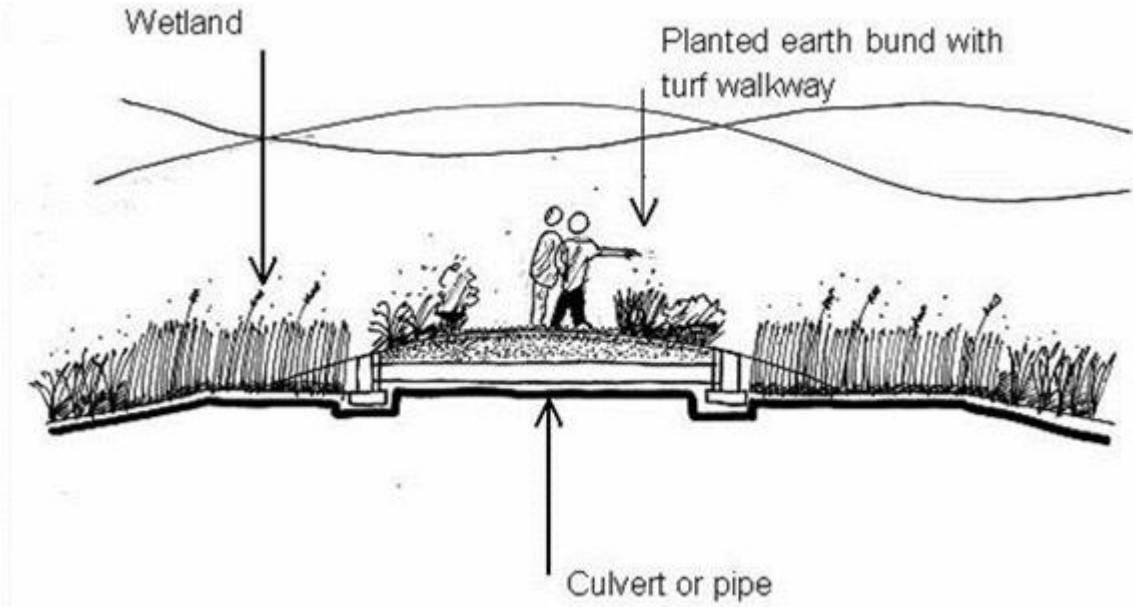


Figure SC6.4.3.9.41 Earth bund structure as wetland crossing

(c) Specific landscape considerations

Numerous opportunities are available for creative design solutions for specific elements. Close collaboration between landscape designer, hydraulic designer, civil/structural engineer and maintenance personnel is essential. In parklands and residential areas, the aim is to ensure elements are sympathetic to their surroundings and are not overly engineered or industrial in style and appearance. Additionally, landscape design to specific elements should aim to create places that local residents and visitors will come to enjoy and regard as an asset.

(i) Crossings

Given the size and location of wetland systems, it is important to consider if access is required across the wetland as part of an overall pathway network and maintenance requirement. Factors that should be considered include:

(A) the appropriateness of hardwood timber board walks given their life-cycle costs. Where walkway footings are in contact with water, council will not accept timber piers;

(B) if boardwalks are used, they should not be located near open water where they could encourage the public to feed wildlife; and

(C) earth bunds located between the sedimentation basin and macrophyte zone can be used as crossings and can be planted as a shaded walkways.

Figure SC6.4.3.9.41 illustrates a conceptual earth bund walkway.

(ii) Wetland embankments

The landscape design approach for the wetland embankments is similar to the approach taken for embankments in sedimentation basins.

(iii) High flow bypass channel

The high flow bypass channel will convey stormwater during above design flow and in some situations can form a large element in the landscape. Therefore the design of the high flow bypass needs to be carefully considered to provide recreational and landscape opportunities during times outside of above design flow events.

The key considerations for design of the high flow bypass area are as follows:

(A) no major park infrastructure including playgrounds, barbeques and amenity buildings to be located within the high flow bypass areas. Passive recreation infrastructure including seating and picnic tables are suitable provided they are of robust design;

(B) in many cases, the high flow bypass will be formed through the use of turf and in these cases the opportunity for creating more active spaces should be investigated;

(C) designers should investigate the opportunities for locating trees and other vegetation types within the bypass channel. Provided hydraulic efficiencies can be accommodated, grassed mounds and landform;

(D) grading of the embankment edge could also be explored to add variation and interest;

(E) where groundcover species other than turf are adopted, plant species should be selected to ensure appropriate response after periodic flooding;

(F) areas of large revegetation or garden beds that cut through the high flow bypass zone should use thick matting mulch types that bind well to the surface to minimise loss; and

(G) the relationship between the high flow bypass channel and the permanent water bodies should be considered in order to create interesting spaces and forms within the open space. For example, after consideration of site constraints and hydraulic parameters, designers could investigate options to separate the elements from each other or to channel both elements alongside each other. Opportunities should also be sought to achieve balanced cut and fill earthworks. Figure SC6.4.3.9.42 provides an illustration of creation of open spaces through configuration of key wetland components.

(iv) Macrophyte zone outlet structure

Landscape design approach for the macrophyte outlet zone is similar to the approach taken for overflow pits in sedimentation basins. Refer to Chapter 4, Section 4.4.3.6 for further guidance.

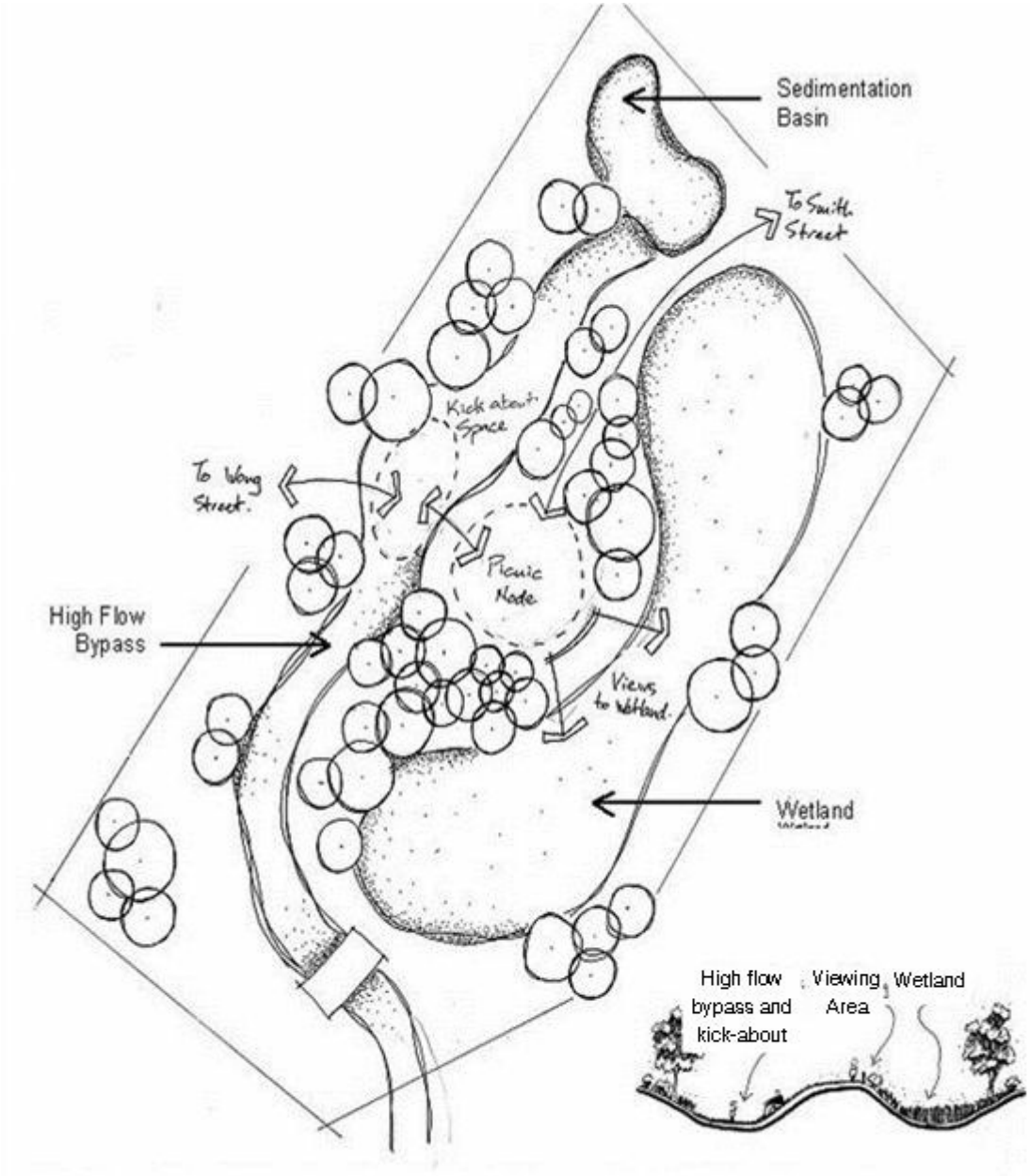
(v) Viewing areas

Refer to Chapter 4, Section 4.4.3.8 for guidance.

(vi) Fencing

Refer to Chapter 4, Section 4.4.3.9 for guidance.

Editor's note—these Chapter and Section references are to *Water Sensitive Urban Design Guidelines for South East Queensland*.



Landscape design should explore options for siting the bypass, wetland and basin and analyse the potential for enhanced amenity. This process should initially take place at the concept development phase and can be refined during the detailed design.

Figure SC6.4.3.9.42 Example relationship between high flow bypass wetland and basin and the creation of open space

(d) Constructed wetland vegetation

Planting for constructed wetlands systems may consist of up to three vegetation types:

(i) Macrophyte zone planting consisting of deep marsh (0.5 m – 0.7 m in depth at design normal water level) and shallow marsh (edges) (0.5 m – 0 m in depth at design normal water level);

Macrophyte zone planting (from 1.0 m below to 0.2 m above design water level)

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides guidance on selecting suitable plant species and cultivars that deliver the desired stormwater quality objectives for constructed wetlands. Often the most effective way to meet those objectives with the macrophyte planting is to create large bands of planting perpendicular to flow that respond to designed depth zones and local biodiversity.

In general, macrophyte vegetation should provide:

(A) well distributed flows;

(B) enhanced sedimentation;

(C) maximum surface area for the adhesion of particles;

(D) a substratum for algal epiphytes and biofilms; and

(E) habitat and refuge for fauna, both terrestrial and aquatic.

This is achieved by selecting species with many small diameter vertical leaves or stems and planting the vegetation in bands. When selecting suitable species it is important to also note the ability of some species to be highly self-sustaining. Littoral planting should provide a dense buffer between the wetland and publicly accessible open space to discourage contact with the water.

(ii) Littoral vegetation (embankment) (above design normal water level) and parkland vegetation

Between the macrophyte zone and the top of the embankment, establishment of trees, shrubs and groundcovers can occur in consideration of the following:

(A) selecting groundcovers, particularly for slopes greater than 1 in 3, with matting or rhizomatous root systems to assist in binding the soil surface during the establishment phase;

(B) achieving dense perennial littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season;

(C) preventing macrophyte zone plants and ground covers from being shaded out by minimising tree densities at the water's edge and choosing species such as Melaleuca that allow sunlight to penetrate the tree canopy;

(D) locating vegetation to allow views of the wetland and its surrounds whilst discouraging the public from accessing the water body; and

(E) parkland vegetation may be of a similar species to the embankments littoral vegetation and layout to visually integrate the wetland with its surrounds. Alternatively, vegetation of contrasting species and/ or layout may be selected to highlight the water body as a feature within the landscape. Turf may be considered to achieve this goal.

(iii) Terrestrial plants, including existing vegetation, adjacent to the upper littoral edge.

(e) Safety issues

(i) General

Constructed wetlands need to be generally consistent with public safety requirements for new developments. These include reasonable batter profiles for edges to facilitate public egress from areas with standing water and fencing where water depths and edge profile requires physical barriers to public access. Fences can be substituted where possible by using dense edge plantings to deter public access to areas of open water. Dense littoral vegetation that can grow to around 2 m high and 1.5 m wide are effective in deterring public access.

(ii) Restricting access to open water

Fences or vegetation barriers to restrict access should be incorporated into wetland areas, particularly on top of concrete or stone walls where:

(A) there is a risk of serious injury in the event of a fall (over 0.5 m high and too steep to comfortably walk up/ down or the lower surface or has sharp or jagged edges);

(B) there is a high pedestrian or vehicular exposure (on footpaths, near bikeways, near playing/ sporting fields, near swings and playgrounds etc.);

(C) where water ponds to a depth of greater than 300 mm on a constructed surface of concrete

or stone. Natural water features are exempt; and

(D) where grassed areas requiring mowing abut the asset.

Barriers that may be appropriate are:

- dense vegetation at least 2 m wide and 1.2 m high (minimum) may be suitable; and
- pool fence (or similar) when there is a chance of drowning and the surrounding area is specifically intended for use by small children (swings, playgrounds, sporting fields etc.).

Dense littoral planting around the wetland and particularly around the deeper open water pools of the sediment pond (with the exception of any maintenance access points), will deter public access to the open water and create a barrier to improve public safety. Careful selection of plant species (e.g. tall, dense or “spiky” species) and planting layouts can improve safety as well as preventing damage to the vegetation by trampling.

Dense vegetation (hedge) at least 2 m wide and 1.2 m high (minimum) may be suitable. A temporary fence may be required until the vegetation has established and becomes a deterrent to pedestrians.

An alternative to the adoption of a barrier/ fence is to provide a 2.4 m safety bench that is less than 0.2 m deep below the normal water level around the waterbody. This is discussed in Chapter 4 Section 4.3.3.3 with respect to appropriate batter slopes.

(6) Construction and establishment - constructed wetlands

This section provides general advice for the construction and establishment of constructed wetlands and key issues to be considered to ensure their successful establishment and operation. Some of the issues raised have been discussed in other sections of this chapter and are reiterated here to emphasise their importance based on observations from construction projects around Australia.

(a) Staged construction and establishment method

It is important to note that constructed wetlands, like most WSUD elements that employ soil and vegetation based treatment processes, require approximately two growing seasons (i.e. two years) before the vegetation in the systems has reached its design condition (i.e. height and density). In the context of a large development site and associated construction and building works, delivering constructed wetlands and establishing vegetation can be a challenging task. Therefore, constructed wetlands require a careful construction and establishment approach to ensure the wetland establishes in accordance with its design intent. The following sections outline a recommended staged construction and establishment methodology for constructed wetlands (Leinster, 2006).

(i) Construction and establishment challenges

There exist a number of challenges that must be appropriately considered to ensure successful construction and establishment of wetlands. These challenges are best described in the context of the typical phases in the development of a greenfield or infill development, namely the subdivision construction phase and the building phase.

(A) subdivision construction - involves the civil works required to create the landforms associated with a development and install the related services (roads, water, sewerage, power etc.) followed by the landscape works to create the softscape, streetscape and parkscape features. The risks to successful construction and establishment of the WSUD systems during this phase of work have generally related to the following:

- construction activities which can generate large sediment loads in runoff which can smother wetland vegetation; and
- construction traffic and other works can result in damage to the constructed wetlands.

Importantly, all works undertaken during subdivision construction are normally “controlled” through the principle contractor and site manager. This means the risks described above can be readily managed through appropriate guidance and supervision.

(B) building phase - once the subdivision construction works are complete and the development plans are sealed then the building phase can commence (i.e. construction of the houses or built form). This phase of development is effectively “uncontrolled” due to the number of building contractors and sub- contractors present on any given allotment. For this reason the allotment building phase represents the greatest risk to the successful establishment of constructed wetlands.

(ii) Staged construction and establishment method

To overcome the challenges associated within delivering constructed wetlands a staged construction and establishment method should be adopted (see Figure SC6.4.3.9.43):

(A) Stage 1: Functional installation - construction of the functional elements of the constructed wetland at the end of subdivision construction (i.e. during landscape works) and the installation of temporary protective measures.

(B) Stage 2: Sediment and erosion control – during the building phase the temporary protective measures preserve the functional infrastructure of the constructed wetland against damage whilst also providing a temporary erosion and sediment control facility throughout the building phase to protect downstream aquatic ecosystems.

(C) Stage 3: Operational establishment - at the completion of the building phase, the temporary measures protecting the functional elements of the constructed wetland can be removed along with all accumulated sediment.

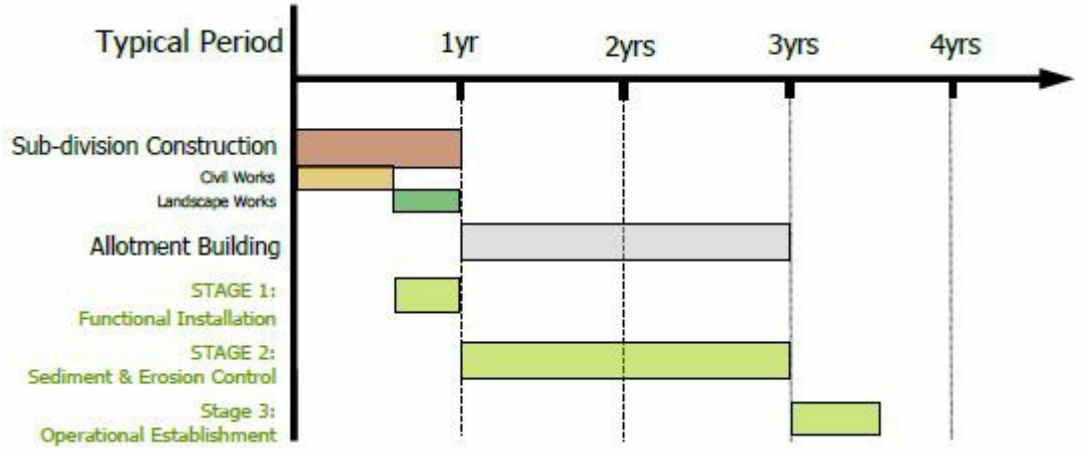


Figure SC6.4.3.9.43 Staged construction and establishment method

(iii) Functional installation

Functional installation of constructed wetlands occurs at the end of subdivision construction as part of landscape works and involves:

(A) earthworks to configure the bathymetry of the wetland;

(B) installation of the hydraulic control structures including inlet/outlet control and the high flow bypass weir;

(C) placement of topsoil, trimming and profiling;

(D) placement of turf in the High Flow Bypass channel to protect against erosion;

(E) disconnecting the Inlet Zone from Macrophyte Zone and allowing all stormwater to flow along High Flow Bypass. This effectively isolates the Macrophyte Zone from catchment flows and allows the establishment of wetland plants without the risk of being smothered with coarse sediment during the Subdivision Construction and Allotment Building Phases;

(F) planting of the Macrophyte Zone once the disconnection is in place;

(G) water level in the Macrophyte Zone can be varied as required by the rate of wetland plant maturity by opening the connection for short periods or opening the outlet control. Irrigation of edges may be required; and

(H) planting the littoral zone and providing irrigation to ensure fast establishment of dense vegetation to minimise weed growth.

Figure SC6.4.3.9.44 depicts the functional installation of a constructed wetland

(iv) Sediment and erosion control

During allotment building phases the sedimentation pond can be used to reduce the load of coarse sediment discharging to the receiving environment. The disconnection between the sediment pond and the macrophyte zone will remain in place to ensure the majority of flows from the catchment continue to bypass the macrophyte zone thus allowing the wetland plants to reach full maturity without the risk of being smothered with coarse sediment (see Figure SC6.4.3.9.45).

This means the macrophyte zone can be fully commissioned and made ready for operation once the allotment building phase is complete.

Figure SC6.4.3.9.45 Constructed wetland sediment and erosion control operation

(v) Operational establishment

At the completion of the allotment building phase the sediment pond is de-silted, the disconnection between the sediment pond and macrophyte zone is removed and the constructed wetland is allowed to operate in accordance with the design.

Figure SC6.4.3.9.46 Constructed wetland operational establishment

(b) Construction tolerances

It is important to emphasise the significance of tolerances in the construction of constructed wetland systems. Ensuring the relative levels of the control structures (inlet connection to macrophyte zone, bypass weir and macrophyte zone outlet) are correct is particularly important to achieve appropriate hydraulic functions. Generally control structure tolerance of plus or minus 5 mm is considered acceptable.

Additionally the bathymetry of the macrophyte zone must be free from localised depressions and low points resulting from earthworks. This is particularly important to achieve a well distributed flow path and to prevent isolated pools from forming (potentially creating mosquito habitat) when the wetland drains. Generally an earthworks tolerance of plus or minus 25 mm is considered acceptable.

(c) Sourcing wetland vegetation

To ensure the specified plant species are available in the required numbers and of adequate maturity in time for wetland planting, it is essential to notify nurseries early for contract growing. When early ordering is not undertaken, the planting specification may be compromised due to sourcing difficulties, resulting in poor vegetation establishment and increased initial maintenance costs. The species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are generally available commercially from local native plant nurseries but availability is dependent upon many factors including demand, season and seed availability. To ensure the planting specification can be accommodated the minimum recommended lead time for ordering is 3-6 months. This generally allows adequate time for plants to be grown to the required size. The following sizes are recommended as the minimum:

(i) viro tubes 50 mm wide x 85 mm deep;

(ii) 50 mm tubes 50 mm wide x 75 mm deep; and

(iii) native tubes 50 mm wide x 125 mm deep.

“Floral Edges”, a system of interlocking plants within one long container is recommended for wetland planting, particularly for the deep marsh zone. The series of plants (usually five) are grown together in a single “strip” container. Generally, these “floral edges” are supplied as more mature plants with developing rhizomes (for rhizomatous species) and interlocking roots. This has been used very successfully in wetland planting previously because the larger more mature plants, often with a thick rhizome system, can survive in deeper water and are more tolerant to fluctuations in water level. The

structure of this system slows the movement of water and binds the substrate, helping to reduce erosion. The weight of the interlocking plants also prevents birds from removing them, a common problem encountered during wetland plant establishment. Nurseries require a minimum lead time of 6 months for supply of these systems.

(d) Topsoil specification and preparation

The provision of suitable topsoil in wetlands is crucial to successful macrophyte establishment and to the long term functional performance of the wetland. Wetland macrophytes typically prefer medium textured silty to sandy loams that allow for easy rhizome and root penetration. Although there are a few plants that can grow in in-situ heavy clays (e.g. phragmites), growth is slow and the resulting wetland system will have low species richness, which is undesirable. The wetland must therefore have a layer of topsoil no less than 200 mm deep and preferably 300 mm in depth for improved dry season moisture retention.

During the wetland construction process, topsoil is to be stripped and stockpiled for possible wetland reuse as a plant growth medium. Most terrestrial topsoils provide a good substratum for wetlands, nonetheless laboratory soil testing (using Australian Standard testing procedures, e.g. AS 4419-2003: *Soils for landscaping and garden use*) of the in-situ topsoil is necessary to ensure the topsoil will support plant and microbial growth and have a high potential for nutrient retention. Typically, standard horticultural soil analysis, which includes major nutrients and trace elements, is suitable for topsoils intended for wetland use. The laboratory report will indicate the soils suitability as a plant growth medium and if any amendments are required.

Careful consideration should be given to the topsoil source and its propensity to contain weed seeds which may be viable in an ephemeral wetland habitat. If a problematic weed bank is likely to be present within the topsoil then importing alternative topsoil should be considered. If the in-situ topsoil is found to contain high levels of salt, extremely low levels of organic carbon (<< 5%), or any other extremes that may be considered a retardant to plant growth, it should be rejected.

If the in-situ topsoil is not suitable and soil amendment is considered impractical or not cost effective, sandy loam topsoil should be purchased from a soil supplier. If the local topsoil is suitable but very shallow, mixing with an imported soil will be necessary to reach the required volume to ensure a minimum 200 mm deep topsoil for wetland planting.

Imported topsoils are generally suitable as wetland plant growth medium, however as for in-situ soils (above), testing is required to determine the appropriate gypsum or lime dosing rate. If the local topsoil was tested and found to be suitable but then mixed with an imported soil to meet the required volume, laboratory soil testing should be repeated.

(i) Topsoil treatments

The wetland topsoil should be tested in accordance with AS 4419-2003: *Soils for landscaping and garden use* to ensure it is appropriate for growth of vegetation. If testing finds the topsoil is not appropriate then an alternative source should be found.

Topsoils for wetlands generally do not require fertiliser treatment. Imported foreign loam will contain sufficient nutrients for vegetation growth and local terrestrial topsoil will release nutrients after the wetting process. Submersion of terrestrial soils in water causes a shift from aerobic to anaerobic processes, prompting mineralisation and decomposition of organic matter contained in the soil, thus increasing available nitrogen. When soils become anaerobic, reduction processes cause iron oxides to be released from the surface of soil particles leading to increased availability of phosphorus. The addition of nutrients (fertiliser application) can facilitate the growth of algae (including cyanobacteria (blue-green) algae), particularly when the competing macrophytes and submerged plants are in the early stages of development, increasing the likelihood of algal blooms.

The topsoil within the wetland (macrophyte zones and open water zones) may need to be treated with gypsum or lime. The application of gypsum is standard on most construction sites for the purpose of securing or flocculating dispersive soils if entrained in runoff. The use of gypsum in wetland should only occur within catchments with dispersive soils and applied at a maximum rate of 0.4 kg/m^2. The application of lime may be required where the AS4419 (2003) soil testing

identifies a potential soil pH problem (pH < 5) or where acid sulfate soils (ASS) exist in the vicinity of the wetland. The rate of lime application should be guided by soil test results, an ASS Management Plan and water quality (pH) monitoring of the wetland and inflow.

Gypsum/ lime should be applied about one week prior to vegetation planting. Subsequent application may be required at intervals depending on water quality monitoring. Application of gypsum/ lime too far in advance of planting may lead to aquatic conditions that promote algal growth (i.e. clear water with no aquatic plants competing for resources).

(e) Vegetation establishment

(i) Timing for planting

Timing of vegetation planting is dependent on a suitable time of year (and potential irrigation requirements) as well as timing in relation to the phases of development. October and November are considered ideal times to plant vegetation in treatment elements. This allows for adequate establishment/ root growth before the heavy summer rainfall period but also allows the plants to go through a growth period soon after planting, resulting in quicker establishment. Planting late in the year also avoids the dry winter months, reducing maintenance costs associated with watering. Construction planning and phasing should endeavour to correspond with suitable planting months wherever possible. However, as lead times from earthworks to planting can often be long, temporary erosion controls (e.g. use of matting or sterile grasses to stabilise exposed batters) should always be used prior to planting.

(ii) Water level manipulation

To maximise the chances of successful emergent macrophyte establishment, the water level of the wetland system is to be manipulated in the early stages of vegetation growth. When first planted, vegetation in the deep marsh zone may be too small to be able to exist in their prescribed water depths (depending on the maturity of the plant stock provided). Macrophytes intended for the deep marsh sections will need to have half of their form above the water level, which may not be possible if initially planted at their intended depth. Similarly, if planted too deep, the young submerged plants will not be able to access sufficient light in the open water zones. Without adequate competition from submerged plants, phytoplankton (algae) may proliferate.

The water depth must be controlled in the early establishment phase. This can be achieved by closing off the connection between the sediment pond and the macrophyte zone (i.e. covering the overflow pit) and opening the maintenance drain. The deep marsh zones should have a water depth of approximately 0.2 m for at least the first 6 - 8 weeks. This will ensure the deep marsh zones of the wetland are inundated to shallow depth and the shallow marsh edges remain moist (muddy) providing suitable conditions for plant establishment. Seedlings planted in the littoral zones of the wetland will require ongoing watering at a similar rate as the terrestrial landscape surrounding the wetland (SC6.4.3.9.5(5)(e)(ii) Restricting access to open water). When it is evident that the plants are establishing well and growing actively, a minimum of 6 - 8 weeks following planting, the plants should be of sufficient stature to endure deeper water. At this time, the connection between the inlet pond and the macrophyte zone can be temporarily opened to allow slow filling of the wetland to the design operating water level.

(iii) Weed control

To protect landscape amenity and the stormwater treatment efficiency of the wetland it is important to maintain, throughout the year, the design vegetation communities to avoid excessive colonisation of the wetland by weeds. Weed infestation is a major problem in the dry tropics, particularly within ephemeral waterways and stormwater treatment facilities, therefore, the design and management of the wetland to manage weed infestation takes on high importance. Management of weeds is achieved as follows:

(A) designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities;

(B) planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be

required, particularly during the dry season; and maintaining dense macrophyte vegetation in the wetland during prolonged dry conditions is necessary to avoid opening up habitat opportunities for weeds. When the macrophyte zone dries (i.e. the macrophyte zone sediments are exposed) for a period in excessive of 60 days, irrigation of the macrophyte zone may be required to achieve this.

During the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

Conventional surface mulching of the wetland littoral berms with organic material like tanbark is not recommended. Most organic mulch floats and water level fluctuations and runoff typically causes this material to be washed into the wetland with a risk of causing blockages to outlet structures. Mulch can also increase the wetland organic load, potentially increasing nutrient concentrations and the risk of algal blooms. Adopting high planting density rates and if necessary applying a suitable biodegradable erosion control matting to the wetland batters (where appropriate), will help to combat weed invasion and will reduce maintenance requirements for weed removal. If the use of mulch on the littoral zones is preferred, it must be secured in place with appropriate mesh or netting (e.g. jute mesh).

(iv) Watering

Regular watering of the littoral vegetation during the plant establishment phase is essential for successful establishment and vigorous growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water level within the wetland. However, the following watering program is generally adequate but should be adjusted (i.e. increased) as required to suit site conditions:

(A) week 1-2 3 visits/ week;

(B) week 3-6 2 visits/ week; and

(C) week 7-12 1 visit/ week.

After this initial 3 month period, irrigation will still be required, particularly during the dry season. Watering requirements to sustain healthy dense vegetation should be determined during ongoing monitoring and maintenance site visits.

(v) Bird protection

During the early stages of wetland establishment, water birds can be a major nuisance due to their habit of pulling out recently planted species. Interlocking planting systems (i.e. where several plants are grown together in a single container such as “floral edges”) can be used, as water birds find it difficult to lift the interlocking plants out of the substrate unlike single plants grown in tubes.

(7) Maintenance requirements - constructed wetlands

Wetlands treat runoff by filtering it through vegetation and providing extended detention to allow sedimentation to occur. In addition, they have a flow management role that needs to be maintained to ensure adequate flood protection for local properties and protection of the wetland ecosystem.

Maintaining healthy vegetation and adequate flow conditions in a wetland are the key maintenance considerations. Weeding, planting, mowing and debris removal are the dominant tasks (but should not include use of herbicides as this affects water quality). In addition, the wetland needs to be protected from high loads of sediment and debris and the inlet zone needs to be maintained in the same way as sedimentation basins (see Chapter 4). Routine maintenance of wetlands should be carried out once a month.

(a) The most intensive period of maintenance is during plant establishment period (first two years) when weed removal and replanting may be required. It is also the time when large loads of sediments could impact on plant growth, particularly in developing catchments with poor building controls. Debris removal is an ongoing maintenance function. If not removed, debris can block inlets or outlets, and can be unsightly if in a visible location. Inspection and removal of debris should be done regularly. Typical maintenance of constructed wetlands will involve:

(i) irrigation of the littoral zone plants (especially during dry periods) to prevent the ingress of invasive weeds;

(ii) prompt removal of weeds before they spread and/or set seed is of critical importance;

(iii) desilting the inlet zone following the construction/ building period;

(iv) routine inspection of the wetland to identify any damage to vegetation, weed growth, scouring, formation of isolated pools, litter and debris build up or excessive mosquitoes;

(v) routine inspection of inlet and outlet points to identify any areas of scour, litter build up and blockages;

(vi) removal of litter and debris;

(vii) removal and management of invasive weeds;

(viii) repair to wetland profile to prevent the formation of isolated pools;

(ix) periodic (usually every 5 years) draining and desilting of the inlet pond;

(x) watering of wetland macrophytes during prolonged dry periods (in excess of 60 days);

(xi) water level control during plant establishment;

(xii) replacement of plants that have died (from any cause) with plants of equivalent size and species as detailed in the planting schedule; and

(xiii) vegetation pest monitoring and control.

Inspections are recommended following large storm events to check for scour and damage.

(b) All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure (SC6.4.3.9.5(4)(i) Step 9: Consider maintenance requirements). Maintenance personnel and asset managers will use this plan to ensure the wetlands continue to function as designed. To ensure maintenance activities are appropriate for the wetland as it develops, maintenance plans should be updated a minimum of every three years. The maintenance plans and forms must address the following:

(i) inspection frequency;

(ii) maintenance frequency;

(iii) data collection/ storage requirements (i.e. during inspections);

(iv) detailed clean-out procedures (main element of the plans) including:

(A) equipment needs;

(B) maintenance techniques;

(C) occupational health and safety;

(D) public safety;

(E) environmental management considerations;

(F) disposal requirements (of material removed);

(G) access issues;

(H) stakeholder notification requirements; and

(I) data collection requirements (if any); and

(v) design details.

An approved maintenance plan is required prior to asset transfer to the local authority. Refer to the guidelines or direction from the relevant local authority for more specific guidance on requirements for asset transfer.

An example operation and maintenance inspection form is included in the checking tools provided in SC6.4.3.9.5(8)(c) Operation and maintenance inspection form. These forms must be developed on a site specific basis as the configuration and nature of constructed wetlands varies significantly.

(8) Checking tools - constructed wetlands

A number of checking aids has been developed for designers and council development assessment officers. In

addition, SC6.4.3.9.5(6) Construction and establishment provides general advice for the construction and establishment of wetlands and key issues to be considered to ensure their successful establishment and operation, based on observations from construction projects around Australia.

(a) Design assessment

The checklist in Table SC6.4.3.9.17 presents the key design features to be reviewed when assessing a design of a wetland. These considerations include configuration, safety, maintenance and operational issues that should be addressed during the design phase. Where an item results in an "N" when reviewing the design, referral should be made back to the design procedure to determine the impact of the omission or error. In addition to the checklist, a proposed design must have all necessary permits for its installations. Council development assessment officers will require supporting evidence/ proof from the developer that all relevant permits are in place.

Click here to view **Table SC6.4.3.9.17 Wetland design assessment checklist**

(b) Construction (during and post)

The checklist in Table SC6.4.3.9.18 presents the key items to be reviewed when inspecting the bioretention basin during and at the completion of construction. The checklist is to be used by Construction Site Supervisors and local authority Compliance Inspectors to ensure all the elements of the bioretention basin have been constructed in accordance with the design. If an item receives an "N" in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view **Table SC6.4.3.9.18 Wetland construction inspection checklist**

(c) Operation and maintenance inspection

The example form in Table SC6.4.3.9.19 should be developed and used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time. Inspections should occur every 1 - 6 months depending on the size and complexity of the system. More detailed site specific maintenance schedules should be developed for major constructed wetland systems and include a brief overview of the operation of the system and key aspects to be checked during each inspection.

Click here to view **Table SC6.4.3.9.19 Wetland maintenance checklist**

(d) Asset transfer (following on maintenance period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater treatment device. A proposed design should clearly identify the asset owner and who is responsible for its maintenance. The proposed owner should be responsible for performing the asset transfer checklist. Table SC6.4.3.9.20 provides an indicative asset transfer checklist.

Click here to view **Table SC6.4.3.9.20 Asset transfer checklist**

(9) References - constructed wetlands

BCC 2000 (with revisions 2004), *Subdivision and Development Guidelines*, BCC, Brisbane

BCC 2001, *Sediment Basin Design, Construction and Maintenance: Guidelines*, BCC, Brisbane

Engineers Australia 2006, *Australian Runoff Quality, Engineers Australia*, ACT

GBLA (Graeme Bentley Landscape Architects) 2004, *Preliminary drawings for Mernda Wetland*, report for Stockland, GBLA, Victoria

Leinster, S 2006, *Delivering the Final Product – Establishing Water Sensitive Urban Design Systems, 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive*

Urban Design Book of Proceedings, Volume 2, A Deletic and T Fletcher (eds), Melbourne.

LHCCREMS (Lower Hunter and Central Coast Regional Environmental Management Strategy) 2002, *Water Sensitive Urban Design in the Sydney Region: 'Practice Note 2 – Site Planning'*, LHCCREMS, NSW

McFarlane A 1997, *Successful Gardening in Warm Climates*, Kangaroo Press, Sydney

DNRW, IPWEA & BCC (Department of Natural Resources and Water, Institute of Public Works Engineering Australia – Qld Division & Brisbane City Council) 1998, *Queensland Urban Drainage Manual* (QUDM) Second Edition, prepared by Neville Jones & Associates and Australian Water Engineering for DNRW, IPWEA & BCC, Brisbane.

Persson J, Somes NLG and Wong THF 1999, *Hydraulic efficiency and constructed wetland and ponds*, Water Science and Technology, vol. 40 no. 3, pp. 291–289

Standards Australia 2003, AS 4419-2003: *Soils for landscaping and garden use*, Standards Australia

Townsville City Council, *Water sensitive urban design for the coastal dry tropics (Townsville): Technical design guidelines for stormwater management*, 2011

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics

(1) This clause provides guidance on selecting appropriate plant species for water sensitive urban design (WSUD) systems where the plants have a functional role in stormwater treatment and/ or erosion protection. Selecting suitable plant species is critical to the long term landscape amenity, functional performance and structural integrity of WSUD systems.

Due to the strong seasonal rainfall patterns in the dry tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities. The vegetation design to manage weed infestation takes on high importance and requires special consideration to achieve the following objectives:

(a) maintain, throughout the year, a dense cover of the design vegetation to occupy habitat and avoid excessive colonisation by weeds;

(b) manage potential weed ingress from edges by sustaining perennial littoral vegetation;

(c) in bioretention systems the vegetation must be able to tolerate long dry periods, periodic inundation and free draining sandy soils;

(d) provision of irrigation to wetland littoral zones; and

(e) provision of irrigation to bioretention systems designed without saturated zones.

Careful selection of plant species and by adopting suitably high planting densities can significantly reduce costs associated with weed management.

(2) A list of recommended plant species for various WSUD systems, including appropriate planting densities, is provided in the following tables:

(a) Table SC6.4.3.9.21 A1 Groundcover plant species list for swales (incorporating buffer strips), bioretention swales and bioretention basins and Table SC6.4.3.9.22 A2 Shrub and tree plant species list for bioretention basins:

(i) swales (incorporating buffer strips);

(ii) bioretention swales; and

(iii) bioretention basins; and

(b) Table SC6.4.3.9.23 A3 Macrophyte and groundcover plant species list for wetlands and sedimentation basins and Table SC6.4.3.9.24 A4 Shrub and tree plant species list for wetlands and sedimentation basins:

(i) sedimentation basins; and

(ii) wetlands.

The plant species lists in Table SC6.4.3.9.21 A1 and Table SC6.4.3.9.22 A2 are not exhaustive and other plants may be used provided their physiological and structural characteristics match the characteristics of the plant species listed in the tables.

Non-indigenous natives and exotics should only be considered when there is a specific landscape need and the species has the appropriate growth form and habit. If non-indigenous natives and exotics are chosen, careful consideration should be given to the potential impacts on downstream receiving ecosystems. Species (including natives) that have the potential to become invasive weeds should be avoided.

(3) Swales (and buffer strips), bioretention swales and bioretention basins - plant selection

(a) Required plant characteristics

Planting for bioretention basin elements may consist of up to three vegetation types:

- groundcovers for stormwater treatment and erosion protection;
- shrubbery for screening, glare reduction and character; and
- trees for shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table SC6.4.3.9.21 A1 and Table SC6.4.3.9.22 A2 which outline plant species suitable for the coastal dry tropics. The designer should also refer to any relevant local guidelines.

(i) Groundcovers

The plant (groundcover) species listed in Table SC6.4.3.9.21 A1 have been specifically selected, based on their life histories, physiological and structural characteristics, to meet the functional requirements of swales, buffer strips and bioretention systems (i.e. bioretention swales and bioretention basins). Bioretention systems must have filter media with a minimum depth of 400 mm for groundcover plants to provide an adequate depth of aerobic soil for healthy root development.

Plant species selected for bioretention systems must be able to tolerate free draining sandy soils and be capable of withstanding long dry periods punctuated by short periods of temporary inundation. The addition of saturated zones in bioretention systems will help retain moisture during the dry season where supplemental irrigation is not provided. Suitable plants species are listed in Table SC6.4.3.9.21 A1. Where irrigation of bioretention systems is provided, a more diverse range of species may be selected to achieve the desired landscape aesthetic provided they are tolerant of the filter media conditions and have the required features to fulfil the functional roles of the WSUD element. In general, the plant species in Table SC6.4.3.9.21 A1 have the following features:

(A) they are able to tolerate short periods of inundation punctuated by longer dry periods. For bioretention systems these dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the dry tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture;

(B) they generally have spreading rather than clumped growth forms;

(C) they are perennial rather than annual;

(D) they have deep, fibrous root systems;

(E) groundcover plants can be turf, prostrate or tufted;

(F) prostrate species would typically be low mat forming stoloniferous or rhizomatous plants; and

(G) tufted species would typically be rhizomatous plants with simple vertical leaves.

Most of the groundcovers listed in Table SC6.4.3.9.21 A1 are widespread, occurring throughout the coastal dry tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area

and to compliment surrounding vegetation communities.

(ii) Shrubs and trees

Shrubs and trees are not a functional requirement within swales, bioretention swales or bioretention basins, but can be integrated to provide amenity, character and landscape value. Planting trees and shrubs in bioretention systems requires the filter media to have a minimum depth of 800 mm to avoid root interference with the perforated subsurface drainage pipes. They must also be accompanied by densely planted shade tolerant groundcover species with the characteristics outlined above. Trees and shrubs are to be managed so that the ground cover layer is not out-competed. To avoid over-shading, trees and shrubs should be planted at low densities. Periodic thinning of the upper vegetation layers may also be required. In general, tree and shrub species that can be incorporated into bioretention systems have the following general features:

(A) trees need to be able to tolerate short periods of inundation punctuated by longer dry periods. These dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the dry tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture;

(B) they need to have relatively sparse canopies to allow light penetration to support dense groundcover vegetation;

(C) have shallow root systems and root systems that are not known the be adventurous “water seekers” to reduce the risk of root intrusion into subsurface drainage pipes;

(D) trees must not be deciduous; and

(E) preferably native and occur naturally in the local area.

The shrubs and trees listed in Table SC6.4.3.9.22 A2 are recommended as they display the above features.

Most of the shrub and tree species listed in Table SC6.4.3.9.22 A2 are widespread, occurring throughout the coastal dry tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area and to compliment surrounding vegetation communities.

(b) Plant species selection

Well established uniform groundcover vegetation is crucial to the successful operation of swale and bioretention system treatment elements. As a result, plant species selection needs to consider both the aesthetic and functional requirements. The functional plant traits required for effective water treatment are different for different devices. For example:

(i) swales – require plants with vigorous growth and a spreading habit to hold soil in place against flow. They should also be suited to growth in wet clay soils. Examples include turf grasses, tufted grasses and sedges;

(ii) bioretention swales - require plants with vigorous growth and a spreading habit to hold soil in place against flow. They should be drought tolerant and suited to growth in sandy soils. Examples include turf grasses, tufted grasses and sedges;

(iii) bioretention basins – plants should be drought tolerant and suited to growth in sandy soils. Examples include grasses, shrubs and trees. A diverse mix is recommended; and

(iv) when selecting plant species from Table SC6.4.3.9.21 A1, consideration must be given to the following factors:

(A) other WSUD objectives such as landscape, aesthetics, biodiversity, conservation and ecological value;

(B) region, climate, soil type and other abiotic factors;

(C) roughness of the channel (Manning’s *n* roughness factor) (for swales); and

(D) extended detention depth (for bioretention systems).

Typical heights of each plant species and comments relating to shade and salt tolerances and soil moisture requirements are provided in Table SC6.4.3.9.21 A1 and will help with the selection process.

The low growing and lawn species are suitable for swale elements that require a low hydraulic roughness. The treatment performance of bioretention systems, in particular, requires dense vegetation to a height equal to that of the extended detention depth. Therefore, a system with a 300 mm extended detention depth should have vegetation that will grow to at least 300 mm high. Turf is not considered to be suitable vegetation for bioretention basins. The stems do not grow high enough and the root structure of turf is not suitably robust to ensure the surface of the bioretention filter media is continuously broken up to prevent clogging.

Included in Table SC6.4.3.9.21 A1 is a recommended planting density for each plant species. The groundcover planting densities should ensure that 70-80 % cover is achieved after two growing seasons (2 years) given adequate irrigation and weed control. High density planting to avoid weed ingress is particularly important in the dry tropics due to the climatic conditions which favour opportunistic (colonising) seasonal weed species. High density planting also ensures runoff does not establish preferential flow paths around the plants and erode the swale/ bioretention surface. Dense vegetation is also required to ensure a uniform root zone, which is particularly important in bioretention systems.

If prostrate shrubs that form scrambling thickets are used (in place of or in conjunction with the plant species in Table SC6.4.3.9.21 A1) they should be planted at high densities (8-10 plants/m²) and may require pruning to ensure even plant cover and to maintain an even root distribution below ground.

(c) Vegetation establishment and maintenance

Swales, buffer strips and bioretention basins are living systems and require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. In addition, specific requirements for plant stock sourcing, topsoil selection and testing and vegetation establishment, as detailed in the relevant WSUD element chapters, are necessary to maximise successful vegetation establishment and system treatment performance. Particular reference is made to the sections titled “Landscape Design Notes”, “Maintenance Requirements” and “Construction and Establishment” for guidance on vegetation establishment and maintenance procedures. The “Construction and Establishment” section also details a staged implementation approach by which the functional elements of the WSUD system are protected from building site runoff and associated sedimentation, weeds and litter during the building phase.

Table SC6.4.3.9.21 A1 Groundcover plant species list for swales (incorporating buffer strips), bioretention swales and bioretention basins

S Swale,
BS Bioretention Swale,
BB Bioretention Basin
Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density[1] (Qty/m²)	Comments
Atriplex muelleri	Salt Bush	BB	Prostrate	100	2-3	Very common low prostrate mat in saline areas, silver foliage highly ornamental
Bacopa monnieri	Bacopa	BB	Prostrate	100	6-8	Not suitable for sandy soils with low water holding capacity, Native to region prostrate herb
Bothriochloa pertusa	Indian Couch	S, BS, BB	Turf		Seeded or rolled	Tolerates prolonged dry periods
Carex fascicularis	Tassel Sedge	S	Tufted	1000	6-8	Not suitable for sandy soils with low water holding capacity,
Carex polyantha	Creek Sedge	S	Tufted	To 900	6-8	Not suitable for sandy soils with low water holding capacity,

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density[1] (Qty/m^2)	Comments
Cymbopogon refractus	Barbed Wire Grass	S	Tufted	300	8-10	Does not tolerate prolonged dry periods
Cyperus haspan	Haspan Flatsedge	S	Tufted	400	8	Suitable for, sandy soils, perennial, native to region
Cyperus javanicus		S	Tufted	1400	8	Suitable for, sandy soils, perennial, native to region
Cyperus polystachyos	Bunchy Sedge	S	Tufted	600	8	Suitable for both sand and clay soils, perennial, native to region, tolerates salinity
Cyperus scariosis#		S		900	8	Suitable for, sandy soils, perennial, native to region, tolerates salinity levels may suppress *Urochloa mutica* (para grass)
Dianella longifolia var. longifolia	Pale Flax-lily	S, BS, BB,	Tufted	300-800	8	Shade tolerant, native to region
Eragrostis elongata	Lavender Grass	S, BS, BB			8	Annual or weak perennial, best in rockeries and roadsides
Fimbristylis dichotoma		BS, BB	Tufted	750	8	Suitable for, sandy soils, perennial, native to region
Fimbristylis ferruginea	Rusty Finger Rush	BS, BB	Tufted	650 -800	8	Suitable for, sandy soils, perennial, native to region, salt tolerant
Fimbristylis tristachya		BS, BB	Tufted	600	8	Suitable for, sandy soils, perennial, native to region
Gahnia aspera	Saw Sedge	S	Tufted	1000	6	Not suitable for sandy soils, native to region, difficult to propagate
Gahnia sieberiana	Red-fruited Sword Sedge	S	Tufted	1500-3000	6	Aesthetic, difficult to propagate
Imperata cylindrical#	Blady grass	S, BS, BB	Tufted	500	8	Only use when it occurs in natural surroundings, native to region,
Juncus usitatus#	Common Rush	S, BS, BB	Tufted	500	8-10	Not suitable for sandy soils
Lomandra hystrix	Creek Matt Rush	S, BS, BB	Tufted	1000	6	Shade tolerant, native to region
Lomandra longifolia	Matt Rush	S, BS, BB	Tufted	500-1000	6	Shade tolerant, native to region
Paspalum distichum	Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Not suitable for sandy soils, native to region
Paspalum vaginatum cv 'Saltene'	Salt Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Salt tolerant, native to region
Platyzoma microphyllum	Fern	BB	Fern	150-500	8	Not suitable in areas expecting prolonged dry periods , Native to region
Eragrostis spartinoides	Love Grass	S, BS, BB	Grass	600	8	Native to region
Sporobolus virginicus	Marine Couch	S, BS, BB	Turf	To 400	Seeded or rolled	Salt tolerant, Native to region
Themeda triandra	Kangaroo Grass	S, BS, BB	Tufted	300-500	6-8	

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting

densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs. S = Swale, BS = Bioretention Swale, BB= Bioretention Basin

Table SC6.4.3.9.22 A2: Shrub and tree plant species list for bioretention basins

Note—trees not suitable for systems requiring flow conveyance (i.e. swales and bioretention swales) due to shading reducing growth of ground cover.

Scientific Name	Common Name	Form	Height (m)	Planting Density[2] (Qty/m[2])	Comments
Breynia oblongifolia	False Coffee Bush	Shrub	1-2	2-4	Native to region
Corymbia tessellaris	Moreton Bay Ash	Tree	10-20		Suitable for sandy soils, native to region
Aidia racemosa		Shrub	10-15		Native to region, tolerates high winds
Atractocarpus fitzalanii	Ivory Curl Tree	Shrub	3-10		Native to region
Eugenia reinwardtiana	Cedar Bay Cherry	Tree	1-3		Native to region
Leptospermum polygalifolium	Wild May	Shrub	1-4	2-4	Sunny position, native to region
Myoporum acuminatum	Coastal Boobialla	Shrub	0.5-6	2-4	Sun or semi-shade, salt tolerant, native to region
Albizia canescens	Townsville Siris	Tree			Native to region, rare
Buckinghamia celsissima		Tree	20-30		Native to region
Chionanthus ramiflorus	Native Olive	Tree	6-8		Native to region
Colubrina asiatica		Tree			Salt tolerant
Cupaniopsis anacaroides	Beach Tuckeroo	Tree	8-15		Suitable for sandy soils, native to region
Callistemon(Melaleuca) viminalis	Weeping Bottle Brush	Tree	5-10	<1	Requires moist soils during establishment but tolerates dry periods once established
Eucalyptus raveretiana	Black Ironbox	Tree			Tolerates high winds
Eucalyptus tereticornis	River Blue Gum	Tree	20-50m		Native to region
Ganophyllum falcatum		Tree	10-25		Native to region
Lophostemon grandiflorus		Tree	8-12		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca dealbata	Cloudy Tea Tree	Tree	5-15		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca fluviatilis		Tree			Native to region, tolerates high winds and periods of flooding, forms a root mat good for erosion cotrol
Mimusops elengi		Tree	10-15		Suitable for all soil types, native to region, tolerates high winds

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

(4) Wetlands and sedimentation basins - plant selection

Due to the strong seasonal rainfall patterns in the dry tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities such as wetlands and sediment basins. Therefore, the design and management of these systems to manage weed infestation takes on high importance. Management of weeds is achieved through the plant selection and landscape design as follows:

- planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season; and
- designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities.

During the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

(a) Required plant characteristics

Planting for wetlands and sedimentation basins may consist of two vegetation types:

- macrophytes and groundcovers for stormwater treatment, erosion protection and weed management. The macrophytes are divided further into several different zones as outlined in Table SC6.4.3.9.23 A3; and
- shrubbery and trees for screening, shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table SC6.4.3.9.23 A3 and Table SC6.4.3.9.24 A4 which outline plant species suitable for the coastal dry tropics.

(i) Macrophytes and groundcovers

The plant species listed in Table SC6.4.3.9.23 A3 have been specifically selected based on their life histories and physiological and structural characteristics, to meet the functional requirements of wetland systems. Plant species suitable for wetlands will also be suitable for edge planting around sedimentation basins. The following sections address wetlands specifically as they have very defined vegetation requirements for stormwater treatment. This includes consideration of the wetland zone/ depth range, typical extended detention time (typically 48 hrs) and extended detention depth (typically 0.5 m).

Other species can be used to supplement the core species listed in Table SC6.4.3.9.23 A3 provided they have the required features to fulfill the functional roles of the wetland zone. Careful consideration of the water depth range and wetland hydrological regime (water depth and inundation period) is also required to assess the suitability of alternate species for constructed wetlands. Wetland plants in the dry tropics must be able to tolerate large water level variations and dry periods of up to 60 days. Short growing emergent macrophytes will not be suitable for the deep marsh zone as they will become over inundated. As a guide, emergent macrophytes require 1/3 of their foliage to extend above the water level 80% of the time. However, during the plant establishment phase emergent macrophytes require 50% of their foliage above the water level.

In general, the species in Table SC6.4.3.9.23 A3 have the following features:

(A) they grow in water as either submerged or emergent macrophytes, or they grow adjacent to water and tolerate periods of inundation (typically sedge, rush or reed species);

(B) they generally have spreading rather than clumped growth forms;

(C) they are perennial rather than annual;

(D) they generally have rhizomatous growth forms;

(E) they have fibrous root systems; and

(F) they are generally erect species with simple vertical leaves (e.g. Juncus spp, Baumea spp).

(ii) Shrubs and trees

Shrubs and trees are not a required element of wetlands or sedimentation basins but can be integrated to provide amenity, character and landscape value. Shrubs and trees (generally only planted in the littoral zones) should be accompanied by dense shade tolerant groundcover species

as an understorey to occupy habitat and provide a weed ingress barrier. Table SC6.4.3.9.24 A4 provides a list of shrubs and trees that are natives to the coastal dry tropics and are suitable for planting in the littoral zone (i.e. on the batters) around wetlands and sedimentation basins.

Littoral zone vegetation is primarily for weed management (to avoid weed ingress into the macrophyte zone), batter stabilisation, aesthetics and to restrict public access, rather than for stormwater treatment. For this reason, species that do not have all of the above structural features, but fulfill the primary littoral zone requirements (e.g. weed management and erosion protection) and landscape objectives may still be acceptable for inclusion in this zone (refer to the "Landscape Design Notes" section in the relevant WSUD chapter).

(b) Plant species selection

Plant species listed in Table SC6.4.3.9.23 A3 are recommended as core species for wetland planting. These plant species have been grouped into a wetland macrophyte zone according to their preferred water depth and the hydrologic conditions of the zone. The perennial wetland plants must be able to tolerate large water level variations and periodic drying (potentially of up to 60 days duration). In general, the deep marsh emergent macrophytes must be capable of a standing water level of 0.5 m – 0.7 m punctuated with short episodes of extended detention (up to 1.2 m in total water depth) and seasonal drying.

While individual plant species can have very specific water depth requirements other species can be quite adaptive to growing across various zones over time. It is however, recommended that the suggested zones and plant groups are adhered to for planting purposes. Plant species listed against the shallow marsh and lower batters are only suited for edge planting in wetlands and sedimentation basins. Planting densities recommended should ensure that 70-80 % cover is achieved after two growing seasons (2 years). This is particularly important for weed management and therefore the recommended planting densities should not be reduced.

Suitable plant species for the littoral zone that surrounds wetlands and sedimentation basins have also been recommended in Table SC6.4.3.9.23 A3. The littoral zone relates to the berms, batters or embankments around the systems. Plants that have a drier habit should be planted towards the top of batters, whereas those that are adapted to more moist conditions should be planted closer to the water line. High density planting of the littoral zone is required to provide a barrier (by occupying habitat) to prevent weed ingress into the wetland or sediment basin.

(c) Vegetation establishment and maintenance

To maximise the success of plant establishment in wetland macrophyte zones specific procedures are required in site preparation, stock sourcing, vegetation establishment and maintenance. Reference is to be made to procedures detailed in SC6.4.3.9.5(5) Sourcing wetland vegetation as follows:

(i) sourcing plant stock (SC6.4.3.9.5(6)(c) Sourcing wetland vegetation):

(A) lead times for ordering plants; and

(B) recommended planting systems/ products;

(ii) topsoil specification and preparation SC6.4.3.9.5(6)(d) Topsoil specification and preparation):

(A) sourcing, testing and amendment; and

(B) top soil treatments (e.g. gypsum, lime, fertiliser); and

(iii) vegetation establishment (SC6.4.3.9.5(6)(e) Vegetation establishment):

(A) weed control;

(B) watering; and

(C) water level manipulation.

Constructed wetlands are living systems and they require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. Reference must also be made to the SC6.4.3.9.5(7) Maintenance requirements – constructed wetlands and SC6.4.3.9.5(6) Construction and establishment – constructed wetlands for guidance on maintenance procedures and vegetation

establishment.

Similarly, the vegetation planted in sedimentation basins require an equivalent vegetation establishment period (i.e. 2 years) and level of attention to site preparation, stock sourcing, vegetation establishment and maintenance to ensure success. Reference must be made to the sections entitled “Landscape Design Notes”, “Maintenance Requirements” and “Construction and Establishment” in Chapter 4.

(d) Vegetation selection for mosquito management

Species selected should have a stiff, thin, upright growth habit. This allows mosquito predators to access all wet areas and control mosquito larvae. Species with a spreading habit such as turf grasses or wide strappy leaves such as Typha can isolate pockets of water where mosquitoes can breed and avoid predation.

Table SC6.4.3.9.23 A3: Macrophyte and groundcover plant species list for wetlands and sedimentation basins

Key to Table SC6.4.3.9.22 A3:

Zone		Depth*(m)	Form	
P	Permanent Pool	2.0– 0.7	S	Submerged macrophyte
DM	Deep Marsh	0.7 – 0.35	E	Emergent macrophyte
SM	Shallow Marsh	0.35 – 0	Am	Amphibious
LB	Lower Batters	0 – +0.5**	A	Annual Groundcover
UB	Upper Batters	+0.5- +1.0**	Sh	Shrub
			Tr	Trees

* ‘Depth’ refers to depth below permanent pool water level

** ‘+’ denotes levels above permanent pool water level

Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal.

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m²)	Comments
Isolepis inundata	Swamp Club-rush	SM	Emergent Macrophyte		To 300	6-8	High surface area; rapid growth
Oryza australiensis	Native Rice	SM	Emergent Grass	Perennial	2500		Attracts birds, native to region
Actinoscirpus grossus		DM	Emergent	Perennial	3000	6	Suitable for clay soils
Baumea articulataarticulate#	Jointed Twig-rush	DM	Emergent	Perennial	1000-2000	6-8	Slow growth, plant solo
Eleocharis sphacelata#	Tall Spike-rush	DM	Emergent	Perennial	500-2000	6-8	Plant solo, rhizomes can restrict growth of other plants; slow establishment, flow resistant,
Leersia hexandra	Swamp Ricegrass	DM	Emergent	Perennial	2000	6	Tolerates periods of flooding, fire resistant
Lepironia articulataarticulate#	Grey Rush	DM	Emergent	Perennial	600-2300	4-6	Tall grey sedge from Hidden Valley, very ornamental, popular in wetland plantings
Phragmites australis#	Common Reed	DM	Emergent	Perennial	5000	6	Native to region, forms dense swards
Phragmites karka (vallatoria)#	Spiny MudgrassTropical Reed	DM	Emergent	Perennial	1000-2000	6	Native to region

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m[2])	Comments
Schoenoplectus litoralis	Shore Club-rush	DM	Emergent	Perennial	600-1500	4-6	Tolerates salinity
Schoenoplectus validus #	River Club-rush	DM	Emergent	Perennial	600-1600	4-6	
Scleria poiformis		DM	Emergent	Perennial	2200	6	Requires irrigation
Thoracostachyum sumatran	Sedge	DM	Emergent	Perennial	2500	6	
Eleocharis dulcis#	Water Chestnut	DM & SM	Emergent	Perennial	1000-1500	4-6	Plant solo, flow resistant
Oryza australiensis	Native Rice	DM & SM	Emergent	Perennial	2500	6	Attracts birds, native to region
Carex polyantha#	Creek Sedge	LB	Emergent Macrophyte	Perennial	To 900	6-8	
Cyperus digitatus	Sedge	LB	Amphibious Sedge	Wet Season Annual	500-1500	8	
Cyperus iria	Rice Flat Sedge	LB	Amphibious Sedge	Wet Season Annual	600	8	Tufted growth
Cyperus tenuispica		LB	Amphibious Sedge	Wet Season Annual	400	8	Suitable for sand and clay solids
Fimbristylis littoralis	Fimbry	LB	Amphibious Sedge	Wet Season Annual		8	Native to region
Juncus pristmatocarpus	Branching Rush	LB	Emergent Macrophyte	Perennial	300-600	6-8	
Phyla nodiflora		LB	Herb	Perennial	200		Native to region
Schoenoplectus lateriflorus		LB	Amphibious Sedge	Wet Season Annual	700	8	
Schoenoplectus praelongatus		LB	Amphibious Sedge	Wet Season Annual	350	8	
Ceratophyllum demersum	Hornwort	P	Submerged	Perennial	600		Native to region
Myriophyllum dicoccum	Water Milfoil	P	Submerged	Perennial or Annual	To 200	1	
Myriophyllum filiforme	Water Milfoil	P	Emergent Aquatic Herb	Dry Season Annual	150	1	
Myriophyllum verrucosum	Red Water-milfoil	P	Submerged	Perennial	100-1500	1	Native to region
Najas tenuifolia	Water Nymph	P	Submerged	Perennial	500	1	
Potamogeton crispus	Curly Pondweed	P	Submerged	Perennial	To 4500	1	Growth can be dense, native to region
Potamogeton octandrus	Pondweed	P	Submerged	Perennial	To 4500	1	
Potamogeton tricarinatus	Pondweed	P	Submerged	Perennial		1	

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m[2])	Comments
Vallisneria gigantea	Ribbonweed	P	Submerged	Perennial	To 3000	1	Rapid growth; salt tolerant (1500 ppm),
Vallisneria nana	Ribbonweed	P	Submerged	Perennial	700	1	Native to region
Ischaemum australe	Zipper Grass	SM	Amphibious Grass	Perennial	1500	6	Forms dense swards
Ischaemum rugosum		SM	Amphibious Grass	Perennial	1200	6	Native to region
Schoenoplectus mucronatus#	Club Rush	SM		Perennial	0.35-1.0m	8	Native to region
Cyperus scariosis	Sedge	SM & LB	Amphibious Sedge	Perennial	800	8	Native to region, salt tolerant
Fimbristylis dichotoma#		SM & LB	Amphibious Sedge	Perennial	1000	8	Native to region
Juncus usitatus#	Common Rush	SM & LB	Emergent Macrophyte		300-1200	8-10	Rapid growth
Dianella longifolia var. longifolia	Pale Flax-lily	UB	GrassLily	Perennial	300-800	6-8	Aesthetic; shade tolerant
Lomandra filiformis spp. filiformis	Wattle Mat-rush	UB	Tufted	Perennial	150-500	6-8	Shade tolerant when established, native to region
Lomandra longifolia #	Spiny-headed Mat Rush	UB	Tufted	Perennial	500-1000	4-6	Shade tolerant, native to region
Sorghum plumosum	Plume Sorghum	UB	Grass		To 4000	6	Growth can be dense
Themeda triandra	Kangaroo Grass	UB	Grass	Perennial	750	8	Requires local propagation, does not tolerate water logged soils
Cyperus polystachyos#	Bunchy Sedge	UB & LB	Sedge	Perennial	To 600	6-8	Suitable for sand and clay soils, Native to region, salt tolerant
Gahnia siberiana	Red-fruited Sword Sedge	UB & LB	Tufted	Perennial	1500-3000	4-6	Aesthetic. difficult to germinate

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

Table SC6.4.3.9.24 A4: Shrub and tree plant species list for wetlands and sedimentation basins

Scientific name	Common name	Zone	Form	Height (mm)	Planting Density [3] (Qty/m2)	Comments
Callistemon viminalis	Weeping Bottle Brush	UB	Tree	5.0-10.0	<1	Moist, medium to heavy soils, tolerates dry periods once established
Eucalyptus coolabah		UB	Tree		<1	
Livistona decora		UB	Tree		<1	Native to region
Lophostemon suaveolens	Swamp Box	UB	Tree	5.0-25.0	<1	Moist sandy soils
Melaleuca leucadendron	Weeping Paperbark	UB	Tree		2-4	
Melaleuca nodosa	Prickly-leafed Paperbark	UB	Tree	2.0-7.0	2-4	Deep sands and moist sandy soils
Melaleuca viridiflora		UB	Tree		2-4	Native to region
Nauclea orientalis	Leichardt Tree	UB	Tree		<1	Native to region, tolerates high winds and periods of flooding
Pandanus cookii	Screw Pine	UB	Tree		<1	Native to region, tolerates high winds, periods of flooding, fire resistant, will drop leaves
Myoporum acuminatum	Coastal Boobialla	UB	Shrub	0.5-6.0	2-4	Sun or semi-shade, salt tolerant Native to region

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

(5) References - plant selection

BCC 2005, *Growing Native Plants in Brisbane, BCC,* Brisbane, accessed 25th July 2005

BCC, DMR & PRSC (Brisbane City Council, Queensland Department of Main Roads and Pine Rivers Shire Council) 2001, *Preferred Species Manual: Green Routes Program*, prepared for the Green Routes Program by BCC, DMR and PRSC, Brisbane

SC6.4.3.10 On-site sewerage facilities

SC6.4.3.10.1 Introduction

This sub-section provides standards, advice and guidelines for applicants in the design, installation and siting of wastewater treatment and disposal systems.

The principle underpinning the use of on-site wastewater treatment and disposal is that all design, installation and construction will meet the demands of a development, whilst having full consideration of the effects to public health and ensuring that adverse impacts on environmental values are avoided.

Council will apply these guidelines when processing applications involving on-site sewerage facilities or servicing of development outside of reticulated sewerage supply areas, or applications incorporating the use of an on-site sewerage facility.

Editor's note—development within SC2.5 Natural resources overlay map-Water resource catchments (OM-09) or Natural assets environmental importance overlay map (OM-08) will need to consider additional setback requirements, including requirements for exclusions of infrastructure in some instances when applying the standards of this policy.

Editor's note—before an on-site sewerage facility can be installed on a property, the applicant is required to apply for a permit to install the treatment facility on that property. Applications to install an onsite sewerage facility are to be lodged with the Hydraulic and Building Services Unit of council as part of the plumbing/drainage application. Applicants should also refer to the On-site sewerage facilities for non-sewered properties guidelines which provides details on the application and installation stages of an on-site sewerage facility. This document may be found on council's website.

(1) Terminology

Unless noted otherwise all terms have the same meaning as given in the *Plumbing and Drainage Act* 2002 (the PD Act), the *Standard Plumbing and Drainage Regulation* 2003 and the relevant Australian/New Zealand Standard or Australian Standard. If a definition given in the relevant Australian/New Zealand Standard or Australian Standard is inconsistent with the PD Act or Regulation, the PD Act or Regulation prevails to the extent of the inconsistency.

Intermittent water course	A natural or artificial channel, identifiable by recognisable bed and banks, along which rain water or storm water usually or occasionally flows. The term does not include a closed conduit for conveying storm water.
Top bank	The same meaning as outer bank as defined in the *Water Act 2000.*

(2) Reference and source documents that are to be read and applied in conjunction with this policy sub-section are as follows:

AS/NZS 1546.1 *On-site domestic wastewater treatment units-septic tanks*
AS/NZS 1547:2000 *On-site domestic wastewater management*
AS/NZS 3500.2:2003 *Sanitary Plumbing and Drainage*
Environmental Protection Act and all subordinate legislation, in particular the *Environmental Protection (Waste Management) Regulation 2000* (Design Rules)
National Construction Code Volume 3 – Plumbing Code of Australia
Plumbing and Drainage Act 2002 (and associated Regulations)
Queensland Plumbing and Wastewater Code

Editor's note—council has specifically referred to AS/NZS 1547:2000 *On-site domestic waste water management* and is, for the purpose of this policy, the adopted standard to be read and applied in conjunction with this policy sub-section.

SC6.4.3.10.2 Application guidelines

(1) The following section details the design standards and reporting requirements for wastewater treatment systems generally, to assist applicants in demonstrating they have met the requirements of the Townsville City Plan.

(2) Development which is not connected to council's sewerage system and is not within a reticulated service area will require an on-site sewerage disposal report to demonstrate the effective and safe disposal of sewerage on-site, having particular regard to the nature of the development proposed, demands the development will place on a system, the land and surrounding environment and known hydro-geologic, public health or otherwise constrained concerns.

The report should be prepared by a professional engineer or hydraulic consultant, to document a site and soil evaluation and design of disposal facility as per procedures, reporting requirements and standards outlined AS/NZS1547:2000.

(3) As a minimum, the on-site sewerage disposal report submitted in support of an application should provide detailed information on the following; the report should:

(a) provide sufficient information for deciding whether or not a development area, subdivision, or lot is suitable for on-site system(s);

(b) provide detailed site-specific information identifying the site-and-soil characteristics to be taken into account when selecting and designing an on-site system;

(c) identify, analyse, and evaluate any risks posed by site-and-soil characteristics which might compromise the long-term effectiveness of the on-site system(s);

(d) identify, analyse, and evaluate any risks of contamination of groundwater or surface water and of associated health risks; and

(e) specify measures required to reduce and monitor such risks.

Editor's note—the flow rates should be determined using Appendix 4.2D (H in 2012 standard) *Typical Domestic Wastewater Flow Design Allowances* in AS/NZS 1547:2000.

(4) The designer's report/design, at a minimum, must comply with the requirements of the AS/NZS 1547:2000. For the purposes of reporting, Table 3.1 of AS/NZS 1547:2000 Part B; Unsewered subdivision proposals, Sections 2 (Subdivision design) and Section 3 (System Design) as well as Section 4 of AS/NZS 1547:2000 are considered relevant and should be used as a primary guide for preparing reports as it outlines the essential stages and implementation processes required. To the extent relevant, reporting should also consider the requirements of the *Queensland Plumbing and Wastewater Code.*

(5) The designer must undertake (or have undertaken) soil testing as necessary to enable an appropriate design to be completed. This may include but not be limited to the following: soil percolation tests; bore holes; test pits and soil textural analysis. The report should consider the following points when carrying out a site and soil evaluation:

(a) the determination of potential effluent disposal problems. These may include gullies, rock formations, hollows, or inconsistent soil texture, both on and off the property;

(b) the consideration of previous and current weather conditions in the determination of the site's suitability for effluent disposal;

(c) the demonstration that the disposal area is located above the 5 per cent AEP;

(d) the site plan showing the setback requirements (for buildings, pools, bores, permanent and intermittent water courses, vehicular traffic areas and drains etcetera) both on and off the property, which may influence the location of the disposal area;

(e) a proposed land application area that shall not be cut, filled or modified in any way after the site evaluation has been carried out. If this does occur the designer must be informed so that appropriate amendments can be made to the design; and

(f) the designer is to make their recommendation based on the site and soil evaluation carried out.

In addition to the above, the following must also be reported on:

(i) topography and drainage;

(ii) climate data and statistics;

(iii) groundwater information (extractive bores, uses and quality);

(iv) infrastructure (existing and proposed);

(v) potential for cumulative effects on receiving environments;

(vi) off-site impacts;

(vii) presence of any fill material;

(viii) geotechnical hazards;

(ix) setback distances;

(x) potential for environmental or public health impacts; and

(xi) site plans (individual or multiple lots).

Much of the Townsville coastal plain is derived from Quaternary alluvium which in many places has been transported and reworked as a result of changes in drainage patterns over time. This has resulted in varying soil texture types occurring in both top and sub-soil zones with a variety of geometries that cannot be assumed on a broad-scale. In recognition of this fact, site soils assessments should form part of all future reports. This approach provides for a representative assessment of the respective area's soils and enables the determination of the land capability and hydraulic loading required for the development (eg LTAR, DIR/DLR).

The soil assessment should be able to provide information on the suitability of different methods of wastewater disposal based on soil textures and hydraulic properties of the actual soils in the area of interest. In order to develop an appropriate level of confidence in the results presented, the details, locations and results of soil sampling and hydraulic property testing should accompany any report submitted.

Site specific data relating to soil properties must be utilised for any method employed as this is the media through which any potential impacts or mitigation caused by wastewater disposal must pass through. Any assessment that does not include this data collection and input carries with it an inherent risk of inaccurate prediction of effluent transport and behaviour and may even accentuate the utilisation of inappropriate system and disposal methods.

(6) Water tables in tidal areas are to be determined to the minimum accepted tidal water table in seaside areas that experience tidal influence (for example Cungulla, Magnetic Island, Cleveland Palms). The minimum water table level is taken to be the contour level of 2.25 m (Australian Height Datum). This allows for an astronomical tide of 4.1 m. Therefore, to determine vertical separation distances, this level must be taken into consideration. A site and soil evaluation may indicate the presence of a higher water table. This, along with wet weather water tables, shall be taken into consideration.

To assist applicants, the following report structure can be used in preparing an On-site sewerage disposal report, when read and applied in conjunction with relevant provisions found in AS/NZS1547:2000, including procedures outlined in sections 4.1.3.4 and 4.2.3.2 of AS/NZS1547:2000

(a) Site and soil evaluation report (all references are to AS/NZS1547:2000)

(i) Details of the site and soil evaluation personnel confirming:

- past experience of site and soil evaluation assessments;
- successful completion of an accredited training program (if applicable);
- knowledge of the regulatory assessment requirements; and
- professional liability for the interpretation of, conclusions drawn from and recommendations made as a result of the site evaluation.

(ii) desk top study as per relevant section of 4.1A2;

(iii) site and soil check as per relevant section of 4.1A3;

(iv) soil assessment items as per relevant section of 4.1A4; and

(v) evaluation of results as per relevant section of 4.1.4.

(b) Design report

(i) Details of land application facility designer confirming:

- past experience designing on-site sewerage disposal facilities;
- successful completion of an accredited training program;
- knowledge of the regulatory design requirements; and
- professional liability for the interpretation of, conclusions drawn from and recommendations made as a result of the design.

(ii) Documentation of the design process, including:

- system selection as per section 4.2A4;
- soils and LTAR/DLR values as per section 4.2A5; and
- design flows as per section 4.2A6.

(iii) Reserve area as per section 4.2.3.4,

(iv) Distribution system as per section 4.2.3.6,

(v) Nutrients as per section 4.2.3.6

(vi) Rainfall surface flow control as per section 4.2.3.7

(vii) Land use activity as per section 4.2.3.8

(viii) Site plan

- north point;
- full property description;
- name of person who evaluated the site;
- scales of 1:200 or 1:500;
- predominant wind direction;
- location, height, density and type of vegetation;
- access roads, tracks, vehicle manoeuvring areas, storage areas;
- test boreholes/pits;
- fall of land;
- setbacks;
- water supply bores, top banks of water courses, lakes, ponds, unlined stormwater drainage channels, dams;
- buildings, fences, property boundaries, pedestrian paths, walkways, recreation areas, retaining walls, in-ground swimming pools, in-ground potable water tanks; and
- primary and reserve land application areas.

It is the designer's responsibility to carry out their duties in accordance with the AS/NZS 1547:2000, the *Queensland Plumbing and Wastewater Code* (where relevant), and any other relevant legislation and supported by good engineering practice.

(7) Design flows

Any consideration of design flow should utilise guideline appendices of AS/NZS1547:2000 and incorporate allowance for peak usage and occupancy.

(8) System selection and land application design

The selection of the appropriate wastewater treatment system and disposal method should be based on the individual characteristics of the lot in question and any reporting recommendations based on investigation (as outlined in this policy sub-section). The assumption of a single type wastewater system being utilised across all lots in any subdivision application is not recommended.

Any system proposed for a lot should comply with all relevant Codes and Standards such as AS/NZS1546.1 and the *Queensland Plumbing and Wastewater Code*. Water balance and nutrient loadings need to be considered prior to the determination of appropriate lot sizes.

The assessment of soil properties (texture and hydraulic) assists in determining ideal rates of application and

also the suitability of proposed methods of disposal. The Queensland Water Recycling Guidelines (2005) provide indicative concentrations of total nitrogen (TN), total phosphorous (TP) and total dissolved solids (TDS).

It is recommended that a two stage approach be undertaken for supporting the final determination of lot sizes in a given subdivision and which is based on the suitability of the soils to certain methods of wastewater disposal, as well as any requirements of Townsville City Plan, including any applicable overlay provisions. The results of the site and soil assessment inform the selection of an appropriate system and subsequent land application design

SC6.4.3.10.3 Design considerations

(1) Set back distances

Set back distances are to comply with the requirements of the Queensland Plumbing and Wastewater Code and AS/NZS1547:2000.

Council may consider viral die off and nutrient decay calculations as a means of justifying a reduced set back distance from the following features:

(a) top bank of an intermittent water course; or

(b) easement boundary of an unlined open stormwater drainage channel or drain.

The consideration of reduced setback distances are subject to the requirements of the Townsville City Plan, which may require increased setback distances to watercourses or in some instances, development to be placed outside of riparian or wetland buffer areas as detailed in the Water resources catchment overlay code or the Natural assets overlay code. Furthermore, it will be necessary for applications to demonstrate that there will be no adverse environmental impacts, taking into consideration cumulative impacts from other development, to place infrastructure near a watercourse, wetland or open stormwater drainage channel/drain.

SC6.4.3.11 On-site water supply

SC6.4.3.11.1 Introduction

(1) Objectives

(a) The objective of this sub-section is to outline the requirements for the design and supply of potable water and non-potable water where development is located outside of a reticulated water supply area.

(b) Specifically, the following overall objectives are sought to be achieved as identified by the Townsville City Plan:

(i) to ensure adequate water supplies are available for people and fire-fighters to defend buildings from bushfires and to suppress other property fire;

(ii) ensure that development is provided with a reliable and safe supply of on-site water supply when located outside of a reticulated water supply area;

(iii) ensure that on-site water supply facilities are efficient;

(iv) ensure that on-site water supply facilities do not compromise environmental values;

(v) ensure that on-site water supply facilities are not subject to sources of contamination; and

(vi) ensure the safety and wellbeing of residents and the protection of water quality and other environmental values.

(2) Scope

(a) This sub-section sets out the requirements for development located outside of reticulated water supply area for the provision of potable and non-potable water supply facilities.

(b) This sub-section contains guidelines and statements for the design of potable water supply facilities and non-potable supply, including for fire protection.

(c) This sub-section may be applied to areas where a reticulated water supply exists and an alternative supply is sought to supplement the reticulated supply.

(3) Applicability

(a) This sub-section is to be used for assessment against the following codes where development is required to provide water supply outside of a reticulated water supply area:

(i) 6.6.1 Rural zone code (Cungulla Precinct);

(ii) 8.2.2 Bushfire hazard overlay code;

(iii) 8.2.9 Water resource catchment overlay code;

(iv) 9.2.3 Reconfiguring a lot (subdividing one lot into two lots) and associated operational work code;

(v) 9.4.4 Reconfiguring a lot code;

(vi) 9.4.5 Self-assessable works requirements code; and

(vii) 9.4.7 Works code.

(4) Terminology

Available roof area	means the whole of the roof area of every building on the lot included in a development application
Blackwater	is defined as: - the waste discharged from the human body into a toilet; and - the waste used for discharge.

Drinking water or potable water	water of a quality suitable for drinking, cooking and personal bathing. The standards that define potable water are described in the Australian Drinking Water Guidelines.
Drinking water supply system (water supply system)	all aspects from the point of collection of water to the consumer (can include catchments, groundwater systems, source waters, storage reservoirs and intakes, treatment systems, services reservoirs and distribution systems, and consumers).
Greywater	means wastewater from a bath, basin, kitchen, laundry or shower), whether or not that wastewater is contaminated with human waste.
Greywater treatment plant	a treatment plant, approved and installed under the *Plumbing and Drainage Act 2002.*
Hazard	a biological, chemical, physical or radiological agent that has the potential to cause harm.
Non-potable water	water that is not of drinking water quality, but which may still be used for other purposes, depending on its quality.
On-site water supply	is defined as a private, non-mains supply, such as water that is not provided as a reticulated council supply.
Required fire-fighting capacity	the volume of water required to comply with Part E of the *Building Code of Australia*.
Service reservoir/tank	a storage for drinking water, generally within the distribution system, used to meet fluctuating demands, accommodate emergency requirements and/or equalise operating pressures.

(5) Reference and source documents

(a) Legislation
Food Act 2006
Plumbing and Drainage Act 2002 (and associated Regulations)
Public Health Act 2005
Water Act 2000
Water Supply (Safety and Reliability) Act 2008
Public Health Regulation 2005
Standard Plumbing and Drainage Regulation 2003

(b) National codes and standards
Australia New Zealand Food Standards Code
Building Code of Australia
National Construction Code Volume 3 – Plumbing Code of Australia

(c) Queensland government
Queensland Development Code
Queensland Plumbing and Wastewater Code
Department of Health - Guidance on use of Rainwater tanks
Department of Housing and Public Works – *Rainwater tanks. A Guide to keeping your tank safe*

(d) Standards
AS/NZS 5667.1:1998: *Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.*
AS/NZS 3500:2003: *Plumbing and drainage (Set)*
AS/NZS 4766:2006: *Polyethylene storage tanks for water and chemicals*
AS/NZS 3735:2001: *Concrete structures retaining liquids*

(e) Standard Australia
NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council,* National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
Water made clear: A consumer guide to accompany the Australian Drinking Water Guidelines 2004. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra
HB230-2008 *Rainwater tank design and installation handbook, S*tandards Australia

SC6.4.3.11.2 On-site water supply general requirements

(1) This section outlines the on-site water supply systems suitable for use in the Townsville local government area.

(2) The on-site systems may be used in combination with one another to deliver a reliable supply of potable and non-potable water.

(3) Any on-site water supply should use water efficiently and minimise the whole of lifecycle cost for that infrastructure.

(4) Any on-site water supply should not adversely affect environmental values.

(5) Unless water is known to be of potable quality (e.g. from a drinking water supply system) it should be regarded as non-potable and used appropriately (fire fighting, irrigation of landscaping).

(6) On-site water supplies must not be subject to hazards and hazards must be managed appropriately to ensure a safe supply is available at all times for potable use in addition to fire-fighting requirements.

(7) Water supplied to the public must not constitute a public health risk

(a) Under the *Food Act 2006*, food businesses must ensure water used in their business (which may include roof harvested rainwater) complies with the requirements of the *Australia New Zealand Food Standards Code*, Standard 3.2.3.

(b) The *Australia New Zealand Food Standards Code*, Food Safety Standard 3.2.3 – *Food Premises and Equipment*, requires food businesses to use potable water for activities conducted on the premises. Where businesses do not have access to a potable water source, they must be able to demonstrate that the water is safe to use. Non potable water may only be used when it will not affect food safety i.e. the washing of non-food contact surfaces such as floors.

(c) The water must be of a potable quality unless the food business can demonstrate that the non-potable water will not adversely affect the safety of the food handled by the business.

(d) Food businesses must ensure the water they use for food related activities conducted at their premises is potable (safe for human consumption).

These activities include:

(i) washing food or ingredients;

(ii) cooking;

(iii) adding to food and drinks;

(iv) making ice;

(v) cleaning of food contact surfaces;

(vi) cleaning of food containers and utensils; and

(vii) personal hygiene.

(8) Council may set conditions of approval dealing with the following matters (but not limited to):

(a) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;

(b) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;

(c) maintenance of safe access to bores for inspections by council staff; and

(d) on-going monitoring, including:

(i) provision of a report recording ground water levels each month for 6 months; and

(ii) regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

(9) The following on-site water supplies are permitted (SC6.4.3.11.12 Water resource catchment overlay):

(a) rainwater harvesting (tanks);

(b) groundwater (bore water);

(c) surface water;

(d) carted drinking water;

(e) recycled water (reclaimed water); and

(f) greywater (non-potable from manual supply service).

(10) The following on-site water supplies are not considered appropriate for supply:

(a) recycled carted water; and

(b) greywater – (potable supply from permanent structure).

SC6.4.3.11.3 Water quality for on-site supplies generally

(1) The *Australian Drinking Water Guidelines* (ADWG) are the standards for potable water for use in the Townsville area. SC6.4.3.11 Attachment A sets out the potable drinking water requirements to be achieved.

Editor's note—the current *Australian Drinking Water Guidelines* cover a range of topics, including management of water supply systems, water quality (microbiological, physical, chemical and radiological) and monitoring.

(2) The following information should be used in undertaking testing of water quality.
References:

(a) AS 5667.1:1998.

Editor's note—physical and chemical samples:
Use a bottle supplied by the laboratory or thoroughly clean a plastic bottle about one litre in volume (ie. Soft drink bottle), then rinse several times with the sample before filling.

Transport the sample directly to the laboratory on the day of sampling if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's note—microbiological samples
Collect sample in sterile bottle provided by the laboratory, or in a 250 ml sterile container which can be bought from a Pharmacy. Do not rinse out the bottle with sample.

Remove cap, fill bottle leaving a small air space, then replace cap without touching the insides of the cap or bottle.
Transport the sample directly to the laboratory on the day of sampling if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's note—pumped supply:
Pump for four hours to remove stagnant water from the bore hole and pipes before sampling.

If the bore runs dry before four hours are up, let it stand until it can be pumped again, then pump again until dry, repeat this process once more, then sample.

Note pumping time, type of pump, type of casing, depth, age of bore, etc. (this information can be useful to the laboratory for

interpretation of results).

SC6.4.3.11.4 Rainwater harvesting (tanks)

Editor's note—HB 230:2008 Rainwater tank design and installation handbook—provides practical information for the collection, use and storage of rainwater.

(1) A tank installed for a building must have sufficient collection and storage capacity to provide an acceptable contribution for its external and/or internal connections and their associated water use, having regard to the following:

(a) the local rainfall pattern;

(b) the roof catchment area; and

(c) the area available for the location of the rainwater tank.

(2) Installed tanks must ensure they comply with the requirements of the *Public Health Regulation 2005*. The legislation stipulates a "relevant tank"— a tank or other receptacle that is used or intended to be used for holding or storing water — must have at every opening:

(a) mosquito-proof screens that:

(i) are made of brass, copper, aluminium or stainless steel gauze;

(ii) have a mesh size of not more than 1 mm;

(iii) are installed in a way that does not cause or accelerate corrosion; and

(iv) stop mosquitos passing through the openings; or

(b) flap valves that, when closed, stop mosquitoes passing through the openings.

(3) A tank must have suitable measures to prevent:

(a) insects (mosquitoes) and other fauna from breeding inside the tank;

(b) if a wet system supplies the tank— insect (mosquito) and fauna-proofing for each pipe opening that supplies the tank, with screen mesh with an aperture of no greater than 1 mm; and

(c) vermin from entering the tank.
The following are acceptable:

(i) screen mesh with an aperture of no greater than 1 mm, made of brass, copper, aluminium or stainless steel gauze to prevent the intrusion and breeding of insects (mosquitoes) and other fauna;

(ii) flap valves at each opening of the tank; and

(iii) a vermin trap.

(4) A tank must have suitable measures to prevent contaminants from entering the tank especially having regard to the potential nature and level of contaminants within the locality and on-site uses.

A tank must have a minimum of 20 litres of first flush from the roof catchment area so that potentially contaminated rainwater is diverted and discarded before entering the tank where the tank is connected to:

(a) a shower or wash basin; or

(b) a swimming pool; or

(c) kitchen or hot water service; or

(d) another fixture required by a local government in a local planning instrument.

Editor's note—for those with a rainwater supply, it is important to check regularly to ensure that first-flush devices are working properly. It is also important to keep the roof catchment clean — bird droppings, peeling paint and dirt on the roof are the biggest sources of contamination. Guttering should be cleared regularly and overhanging branches should be kept to a minimum, because they can be a source of debris and allow birds and small animals access to the roof.

Editor's note—HB 230:2008 *Rainwater tank design and installation handbook*—provides practical information for the collection, use

and storage of rainwater.

(5) The occupier of a place where a rainwater tank is installed (or if there is no occupier, the owner of the premises) must ensure that the tank is maintained at all times to ensure a reliable supply.

(6) Where in a reticulated water supply area, water from a tank must not contaminate the potable water within a reticulated town water supply system. Where tank/s are installed, the reticulated town water supply system is protected from the potential of back-flow by the installation of:

(a) a back-flow prevention device that complies with AS/NZS 3500:2003; or

(b) for a tank, a dual-check valve with an atmospheric port.

(7) A tank stand and the support base of a tank must be capable of withstanding loads likely to be imposed. The base of the tank is well supported by a ground treatment in accordance with the manufacturer's specifications and standard drawings for that tank.

(8) Where a premises is providing tank water supply and required to also install a static water supply for fire fighting purposes, applicants will need to also comply with SC6.4.3.11.11 Requirements for fire fighting.

(9) Where a tank is installed to supply water to the plumbing fixtures, the tank must have appropriate and clear signage to warn that the water in the tank is suitable for drinking.

(10) All water tank overflows are to be connected to or able to discharge to a lawful point of discharge.

(11) Development proposing to utilise a rainwater tank must determine that adequate rainwater volume can be collected to meet the annual water demand.

Editor's note—calculating the maximum amount of rainwater that can be collected from the available roof area can be completed using the following formula.

run-off (litres) = A x (Rainfall – B) x roof area

"A" is the efficiency of collection and values of 0.80-0.85 (that is, 80-85% efficiency).

"B" is the loss associated with absorption and wetting of surfaces and a typical value of 2 mm per month (24 mm per year) can been used.

"Rainfall" should be expressed in mm and "roof area" in square metres (m^2).

For example, the run off from a 200 m^2 roof which receives 750 mm of rain per year, with an efficiency of collection of 80% (A = 0.80) and loss of 2 mm per month (B = 24) would be: Run-off = 0.8 x (750-24) x 200 = 116,160 Litres (or 116.2 kL).

(12) If the maximum volumes are less than the annual water demand, then either the catchment area will need to be increased or water demand will need to be reduced or an alternative and supplementary source will need to be nominated.

SC6.4.3.11.5 Groundwater (bore water)

(1) In Queensland, the Department of Natural Resources and Mines (DNRM) manages access to and use of underground water.

The right to take underground water is either established under the *Water Act 2000* (the *Water Act*) or granted under a "licence" or "water allocation". The drillers' licensing arrangements under the *Water Act* ensure all water bore drillers are properly skilled and that their work meets minimum standards.

Editor's note—information on water bore drillers and bore drilling requirements can be found on the DNRM website.

(2) Each lot created or use proposed is to be provided with a proven and available long term sustainable resource of potable groundwater, properly licensed as required, supplemented where practical, with an alternative supply such as rainwater.

Editor's note—water from a deep, encased and well maintained bore and/or from a confined aquifer will generally not need treatment after addition to a rainwater tank, but the chemical quality of some groundwater is not suitable for drinking.

(3) Only groundwater that is compliant with values cited in the *Australian Drinking Water Guidelines* (ADWG) should be used.

Editor's note—key health parameters for groundwater are arsenic, nitrate, fluoride and health-related heavy metals. Salinity is an important aesthetic parameter.

Editor's note—groundwater from shallow or unconfined aquifers is readily contaminated by agricultural, industrial or urban activities and generally should not be used as a source of drinking water unless it has been recently tested for microbial and chemical quality and is compliant with guideline values cited in the ADWG.

(4) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all ground water achieves the guideline values cited in the ADWG. Methods used to treat groundwater must be certified by a registered professional in the field of ground water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with fire fighting water).

(5) Any proposed ground water extraction, when combined with existing levels of extraction in the area, is to be sustainable on both a local and regional level. The average annual demand for ground water must not exceed the average long term recharge in the area.

To demonstrate compliance with the above criteria, council may request that a Groundwater resource assessment be undertaken by a qualified hydro-geologist.

A Groundwater resource assessment should include, at a minimum:

(a) consideration of information available from previous studies and new information collected as part of the investigation;

(b) consideration of the maximum ground water extraction rate attainable, proposed pumping rates, land slope, flooding, drainage, geology, ground water recharge potential, local experience, proximity to and protection from potential contaminants, soil characteristics (colour, texture, structure, permeability and presence of rock), percolation testing, direction of ground water flow, seasonal fluctuation in ground water levels, and the current degree of district and local extraction;

(c) a comparison between the average annual ground water demand and the average annual ground water recharge, on a local and a district level;

(d) the results of drilling and testing of an adequate number of bores, supplemented with ground water modelling where necessary, to ensure a thorough and accurate investigation of the ground water resources available. Bores are required for two purposes, namely, for interference testing and for regional ground water level observation;

(e) results of independent and simultaneous pumping of test bores, and measurement of water levels to check for localised pumping interference with any existing and proposed neighbouring bores. Pumping tests should be undertaken for a minimum of 8 hours duration and pumped at the rate the pump is intended to be operated in the proposed development. The available draw down in neighbouring bores during the test must not be reduced by greater than 20% when compared to available draw down in these bores prior to pumping;

(f) if bore interference is found to be greater than 20% of the available draw down, supplementary pumping tests must be undertaken to measure the effect of reducing either the pumping rate, the duration of pumping, or both, until the resulting interference is within this level;

(g) water quality testing to determine whether extracted water will be of a potable quality, including where relevant, written advice from a registered professional in the field of ground water quality. Appendix A outlines appropriate standards for bore water testing (potable uses);

(h) investigation of previous land uses and the possibility of contamination of aquifers to determine the quality of ground water;

(i) details of the pump type, capacity and pumping curve for bores; and

(j) preparation of a report detailing all the studies and works undertaken, the resource assessment findings and assumptions made.

(6) Methods used to treat groundwater to meet health and aesthetic guidelines must be certified by a registered professional in the field of ground water quality.

(7) For licensing and construction requirements for underground water the local DNRM office should be consulted.

Editor's note—before considering sinking a water bore refer to fact sheet Drilling for water on the DNRM website.

(8) The bore shall be constructed to ensure that contamination of the groundwater source does not occur, either during construction or operation.

(9) The bore head shall be mounded to prevent ponding and stagnation of water around the bore to eliminate the possibility of mosquitoes breeding and problems caused by flies or odour.

(10) All drainage shall be directed away from the bore.

(11) Bores nominated to supply potable water supply are to be appropriately site away from sources of contamination, including on-site sewerage facilities. For further details relating to on-site sewerage facilities, refer to the sub-section SC6.4.3.10 On-site sewerage facilities for non-sewered properties.

(a) On-site sewerage treatment facilities shall be placed as far away as possible from ground water bores used for potable groundwater supply. Minimum allowable distances are to be in accordance with the *Plumbing and Drainage Act 2002* and relevant codes and regulations established pursuant to the *Plumbing and Drainage Act,* which are applicable at the time of making application for development approval.

(b) New land parcels or existing land within non-sewered areas must provide evidence prior to the sealing of the plan of survey or the commencement of the use that an appropriate on-site sewerage treatment facility can be designed and accommodated within each proposed lot in addition to the potable supply of ground water.

SC6.4.3.11.6 Surface water

(1) Surface water includes water derived from dams, creeks, rivers and streams.

(2) The use of surface water is generally considered permissible only when in a non-urban zone (excluding rural residential).

(3) Surface water supplies are more prone to contamination from sources such as animal and human waste and algal blooms.

(4) Due to the potential for contamination, surface water is not recommended as a source of drinking water unless additional treatment processes such as filtration and disinfection are in place.

(5) Unless drinking water quality can be assured through disinfection and routine testing, surface water should be utilised for purposes other than drinking such as irrigation and toilet flushing and fire fighting. Treatment may still be necessary for non-drinking uses.

(6) Water subject to potential contamination from human or livestock waste, such as dams, rivers and creeks, can contain a wide range of pathogenic organisms including chlorine-resistant Cryptosporidium. Water of this type may not be suitable for drinking even after disinfection.

(7) Surface water that is protected from human and livestock waste can be used and should be demonstrated.

(8) Surface water must be able to provide a reliable year round supply of water for both potable and fire-fighting purposes and should be demonstrated.

(9) Potable water quality:

(a) When used, pumped or captured surface water should be added to a storage tank in one action, then treated and allowed to stand for at least one hour before use.

(b) Where surface water is to be the primary source of a potable water supply, the quality of water extracted is to be of a potable quality and meet aesthetic, chemical and microbial requirements.

(c) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all surface water achieves the guideline values cited in the ADWG.

(d) Methods used to treat surface water must be certified by a registered professional in the field of water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with fire fighting water).

(10) Each surface water pump point must be metered (or where there are multiple, collectively recorded), with the meter maintained, read and the volume pumped recorded on a quarterly basis.

(11) Any proposed surface water use is to be sustainable on both a local and regional level. The average annual demand for surface water must not exceed the average long term recharge in the area to ensure ground water supplies are maintained.

(12) To demonstrate compliance with the above criteria, council may request that a groundwater resource assessment be undertaken by a qualified hydro-geologist.

SC6.4.3.11.7 Carted drinking water

(1) The use of carted drinking water supply is only used as a supplementary/secondary supply measure to ensure a long term and sustainable supply of water to a premises.

(2) Water cartage is necessary in some instances to supplement existing rainwater supplies.

Editor's note—if rainwater collection is limited by the size of storage tanks or roof catchment areas or a lack of rain, drinking water supplies may need to be augmented with carted water.

(3) Carted water is not be used as a sole source of supply except as a temporary use.

(4) Carted water is to be stored in water tanks as outlined in SC6.4.3.11.8 Rainwater harvesting tanks.

(5) Drinking water is recognised as a food. Water carters/carriers may need to be registered as a food business if the supply of additional potable water is needed.

(6) When using carted water, it is advisable to ensure the water carter can provide evidence that water supplied will be safe to drink. This evidence could include: any authorisations issued for the purpose of supplying drinking water; the identity and quality of the source water; proof that tankers used are suitable for the purpose of carrying drinking water (for example, not likely to have carried other materials that would contaminate drinking water).

(7) Ensure that carted water supplied for drinking is disinfected at the point of supply (such as the rainwater tank) as this provides protection against contamination introduced during filling of the water tanker and during transport to the point of supply.

SC6.4.3.11.8 Recycled water

(1) Recycled water is any water that has been used at least once and then supplied for reuse, either treated or untreated. Without appropriate treatment, recycled water may contain a range of contaminants.

Editor's note—for example, water used for the final rinse in a commercial laundry is only lightly contaminated and thus may be used again, untreated, for the first wash cycle. On the other hand, sewage must be treated at a sewerage treatment plant before it can be recycled for any purpose.

Recycled water from sewerage treatment plants is put into different classes depending on its microbiological quality. These classes range from Class A+ (the highest) to Class D (the lowest).

(2) The use of recycled water can reduce the demand on alternative supplies that are potable.

(3) Recycled water can be used where it is demonstrated that it is safe to do so and does not adversely affect the environment, adjoining properties or constitute a public health risk.

(4) Recycled water is not to be used for potable water, food preparation or topping up of pools or spas, but may be appropriate for private and commercial purposes such as irrigation and possibly toilet flushing, car washing and dust suppression (or similar), including for fire-fighting.

(5) Recycled water when used for watering plants and lawns (source of irrigation) can be an effective means of saving water provided some sensible precautions are undertaken, including watering several locations to

prevent salts and other contaminants from accumulating in the soil and rotation of irrigation using mains or rainwater to help flush salts from the soil.

(6) Signage must be erected at sources of recycled water use to advise that the water is not suitable for drinking.

(7) The static storage of recycled water must be separately stored from other sources of potable water.

(8) The quality of the water will determine the permitted uses and businesses using recycled water are required to obtain approval and adhere to any specified conditions.

(9) The storage of untreated water for more than 24 hours (bacteria and organic contaminants in water will cause it to turn septic and produce strong and offensive odours).

(10) Recycled or untreated water is not allowed to pool or run-off onto other properties, into watercourses, public space or the stormwater system.

SC6.4.3.11.9 Non-restricted water supply risks

(1) Selecting an alternative supply, consideration must be given to the potential health concerns, sensible practices and disinfection options available as well as the location, rainfall patterns, supply required and overall cost (initial and maintenance).

Editor's note—advice on the use of on-site water supply:

- ensure water is collected from the most suitable and safest source available;
- determine what microbial or chemical contaminants are in the surrounding environments and what effects they may have on the water used;
- treat water if necessary to make it safe. This could involve the removal of solids, chemicals and microorganisms;
- ensure collection sources for rain water such as roofs and gutters are kept free of extraneous matter such as leaves and bird droppings;
- ensure a first flush system is used for all rain water collection to ensure that the first water collected during a rain fall event is discarded thereby reducing the amount of microorganisms entering the tank;
- ensure tanks which are used to store water are cleaned out regularly to remove any build up of sludge or debris. This reduces the potential risks of chemical or microbiological contamination of the water;
- where water is supplied by a water carrier, it should be sourced from a potable water supply. The carrier should have hoses which are in good operating condition and are capable of being effectively cleaned and sanitised. The water carriers should only used for the purpose of carrying potable water, the operator should be able to provide documentation showing this;
- ensure all equipment that is used to collect and store the water is suitable and well maintained;
- ensure all equipment used in the collection and storage of water is well positioned to minimise the risk of contamination;
- ensure all water storage equipment is vermin proof; and
- monitor the water regularly to ensure that the conditions of the water have not changed and any treatments being undertaken are appropriate to ensure its safety. It is important to remember that some water sources such as bore water may have a very high mineral load. While this may not affect the safety of the water, it may affect the quality, flavour and hardness and have an undesirable effect on the equipment that is used. It is recommended that water is tested by an accredited laboratory on a regular basis to ensure the steps that have been put in place are still adequate to maintain the safety of the water.

  For advice on what constitutes good quality water see the *Australian Drinking Water Guidelines 2011* available from the National Health and Medical Reserch Council's website.

SC6.4.3.11.10 Requirements for non-potable water supply

(1) The *Plumbing Code of Australia* requires that a non-drinking water supply:

  (a) must only be connected to outlets clearly identified for non-drinking use and must be limited to the uses specified in the Code; and

  (b) is not to have a cross connection with a drinking water service.

Editors note—if non-potable water is adequately treated, its quality will improve and it can be used for a wider range of purposes. Some examples of non-potable water used are:

- class A recycled water from a sewage treatment plant used for dust suppression, car washing, landscape irrigation or irrigation of sporting ovals;
- quarry water used for dust suppression and landscape irrigation;
- swimming pool backwash water used for toilet flushing;

- agricultural waste water used for crop irrigation; and
- creek, dam, and river water used for dust suppression.

SC6.4.3.11.11 Requirements for fire-fighting supply

Editor's note–fire fighting uses large amounts of water. If fire fighters need to leave a site to obtain more water, that site will be undefended and may be damaged or lost. If fire fighters don't have access to adequate water supplies at a site they may not even attempt to defend the site because it will be unsafe.

Editor's note - Where the building Code of Australia and applicable Queensland Building Codes provide standards for the installation of fire fighting appliances, the provisions of those standards shall prevail.

The purpose of this section is to outline adequate and accessible water supplies required for fire-fighting purpose and to ensure that they are available for people and fire-fighters to defend from fires. Suitable water supplies and appliances shall be provided and easily accessible at all times.

(1) The minimum dedicated amount of water for fire-fighting purposes is 10,000L of stored (static water) for a property less than 2500 square metres in area and at least 20,000L of stored (static water) for property greater than 2500 square metres. The amount of stored static water must be available and accessible at all times.

Editor's note—some development may require more water to comply with the Building Code of Australia or to ensure that an adequate supply to available to service a particular development where that development is likely to require increased fire fighting capacity.

(2) Fire-fighting water supply needs to be provided and easily accessible at all times, although it does not need to be drinkable (potable).

(3) A dedicated water tank for the storage of fire-fighting water is the accepted standard. Where alternatives are provided, it should be demonstrated that the water supply will be available and accessible at all times.

(4) Where not using a dedicated fire fighting storage tank, the outlet for the internal fixtures is located above the point at which the tank will contains the dedicated amount for fire-fighting purposes.

(5) Fire-fighting water supplies (including pipelines, hydrants, fittings and storages) are:

- (a) provided before building construction commences;
- (b) designed, located and fitted to ensure reliablity during a fire (eg: polypipes are buried or shielded - refer to the National Plumbing and Drainage Code AS3500);
- (c) properly maintained and accessible at all times by emergency vehicles;
- (d) tanks must be located so that a vertical clearance of 4m to overhanging obstructions is achieved (vegetation, power lines);
- (e) a cleared area on either side of the tanks, a minimum of 6m, to allow fire-fighting vehicles and crews access to the tanks; and
- (f) tanks should avoid be located on slopes, including access to, greater than 12 per cent.

Editor's note: A fire truck has to be within about 3 metres from a water supply to be able to pump from it.

Editor's note: Plastic tanks dedicated for fighting purposes are not recommended, however if they are submerged, they may be acceptable.

(6) At least one tank is within 100m of the building which has fire brigade tank fittings. If the tank is underground, it has an access hole of 200mm (minimum) to allow access for suction lines.

(7) A water supply for fire fighting purposes must be clearly marked and identified by emergency services and others. Where a dedicated tank for storage of fire fighting water is used, the tank must have appropriate signage to warn that the water in the tank is not suitable for drinking.

Editor's note—The following is applicable for development within the Water resource catchment overlay map OM-09 (Schedule 2 of Townsville City Plan) and where development is to address the assessment criteria of the Water resource catchment overlay code found in Part 8.2.9 of the Townsville City Plan.

SC6.4.3.11.12 Water resource catchment overlay

(1) To demonstrate the protection of water quality, ecological values and other environmental values, applicants may be asked to provide groundwater resource assessment where the proposed development is to use any ground resource as outlined in SC6.4.3.11.5(5).

(2) No on-site water supply infrastructure, including underground pipe, is to be located such that it will not change the physical integrity of waterways, wetlands, lakes, springs and riparian areas.

(3) On-site water supplies may only be from harvested rainwater (tanks) or ground water (where undertaken and demonstrated sustainable by a ground water assessment) and may be supplemented by carted water.

(4) Recycled water or greywater is not to be used to protect the water catchment from potential contamination.

(5) The capture of ground surface water is not permitted.

(6) A ground water level observation bore is to be installed adjacent to the site. The observation bore must be installed remote from all production bores to ensure there is no local interference to ground water levels at the observation bore.

(7) Council may set conditions of approval dealing with the following matters:

- (a) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;
- (b) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;
- (c) maintenance of safe access to bores for inspections by council staff; and
- (d) on-going monitoring, including:
  - (i) provision of a report recording ground water levels each month for 6 months; and
  - (ii) regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

(Source) NHMRC *Australian Drinking Water Guidelines 2011*

Physical and chemical tests	Health	Aesthetic
PH	n/a	6.5 - 8.5
TDS (mg/L)	n/a	<600
Hardness (mg/LCCO3) (incl Ca and Mg)	n/a	200
Aluminium (mg/L)	0.1 (dialysis patients)	0.2
Cadmium (mg/L)	0.002	n/a
Copper (mg/L)	2.0	1.0
Iron (mg/L)	n/a	0.3
Lead (mg/L)	0.01	n/a
Manganese (mg/L)	0.5	0.1
Zinc (mg/L)	n/a	3.0
Sodium (mg/L)	n/a	180
Chloride (mg/L)	n/a	250
Fluoride (mg/L)	1.5	n/a
Nitrate (mg/L)	50	n/a
Sulphate (mg/L)	500	250

SC6.4.3.12 Constructed lakes

SC6.4.3.12.1 Introduction

(1) Purpose

The purpose of the policy sub-section is to provide standards, advice and guidelines for the design, construction and maintenance of constructed lakes in the Townsville area.

Well designed and maintained lakes can add considerable value to the urban environment including improved visual amenity, recreational opportunities, and wildlife habitat.

Lakes built in the dry tropics region of Townsville operate under a range of challenging climatic conditions, and maintaining a healthy water body can be difficult to achieve. The extended dry season combined with high rainfall events during the wet season mean that lakes often undergo rapid changes in state. A healthy water body can very quickly develop poor water quality and algal blooms that are unsightly and a potential threat to public health.

A number of constructed lakes have been built in and around the Townsville area and are experiencing numerous problems. These include:

(a) weed infestations (terrestrial and aquatic);

(b) excessive siltation;

(c) highly turbid waters;

(d) poor water quality;

(e) stratification;

(f) frequent algal blooms;

(g) fish kills; and

(h) limited maintenance access to remove built up silt, debris and weeds.

The burden of rectifying these lakes and satisfying community expectations has been incurred by council. As a consequence, council has identified a need to regulate the construction of lakes within the Townsville area.

Editor's note—Part 9.4.2 Healthy waters code of the Townsville City Plan provides assessment matters for applications involving lakes to specifically consider, in addition to other relevant sections of the Townsville City Plan.

(2) Objectives

This sub-section outlines the information that should be lodged with a particular development application if that development includes a lake.

Note—this sub-section is intended to provide the necessary guidance to design a sustainable healthy lake in the Townsville area. However, due to the challenging climatic conditions experienced in Townsville and the low number of examples of constructed lakes, this sub-section does not guarantee performance, and proponents should be aware that lake designs in accordance with this sub-section do not exempt the proponent from any necessary post construction maintenance and rehabilitation prior to handover.

(3) Principles

(a) Lake designs should aim to enhance biodiversity through revegetation, establish linkages with existing vegetation communities, and be supportive of public interaction and education. Lakes designs should provide enhanced landscape aesthetic and amenity for surrounding residents through the installation of improved passive recreation facilities i.e. paths and trails.

(b) The primary intent and range of uses for the lake is to be clearly defined by the proponent. The design intent must be accompanied by concept plans showing location and layout with respect to the development. Council will consider applications that are sustainable for their intended use, have no negative impact on surrounding environments and have been designed to minimise on-going maintenance.

(c) Uses preferred by council:

(i) The preferred lake with regards to long term sustainability, weed and water level management is a saline lake. Although less diverse than fresh water lakes, the operation of saline lakes are considered more robust for Townsville conditions.

(ii) Where fresh water lakes are proposed, the proponent should consider other alternatives such as heavily vegetated constructed wetlands which can provide open water views and water treatment benefits (refer to SC6.4.3.9 Water sensitive urban design guidelines). The proponent must clearly indicate how water level variations will be managed and proposed alternative sources of water to maintain lake water levels within acceptable variations.

(iii) The following are not encouraged by council:

(A) brackish lakes, including saline lakes that receive large freshwater inflows;

(B) lakes that receive untreated stormwater (i.e. stormwater that has not been treated to achieve the requirements of the SC6.4.3.9 Water sensitive urban design guidelines, or untreated overflows);

(C) lakes that are greater than 3 m in depth from wet season normal water level to finished bed level;

(D) lakes that impact on the sustainability and health of local aquifers or adjacent waterways;

(E) lakes that promote primary and secondary human contact activities such as boating, swimming, fishing and skiing;

(F) lakes that are used for flood management purposes;

(G) lakes for stormwater harvesting;

(H) lakes that result in the removal of existing significant vegetation;

(I) lakes that disturb natural waterways i.e. are located within the natural waterway alignment; and

(J) lakes that are primarily designed as a source of fill for development (i.e. to raise the level of the development site).

(d) Lakes should be constructed off-line to minimise any disturbance to the passage of aquatic fauna. Off-line systems facilitate lake draining and maintenance, if necessary. Should in-line diversion structures be proposed to supply constructed lakes (e.g. diversion weirs) suitable arrangements must be made to maintain connectivity (i.e. fish passage) and stream base flows or environmental flows.

(4) Terminology

Aquifer	A geological formation saturated with water that contains and transmits water.
Brackish lake	A lake that is permanently or temporarily in a state between fresh and saline. For the purposes of this policy salinity levels range between 1,000 – 15,000 mg/L. Brackish lakes include fresh water lakes with saline intrusions, groundwater dominated brackish lakes or saline lakes with freshwater input. Brackish lakes are not encouraged Townsville.
Constructed lake	An artificial body of permanent open water with recreational values with either an edge fringed with emergent macrophytes or a hard edge. While submerged macrophytes may occur throughout the water column, the dominant feature is open water. For the purposes of comparing with a constructed wetland, a lake is a water body that has greater than 30% of its area as open water (i.e. less than 70% as emergent macrophytes). For the purposes of this document, a constructed lake is considered to be a receiving water body, and does not contribute to the mandatory water quality improvements outlined by the State Planning Policy.

Constructed wetland	An artificial, shallow body of water that consists of heavily vegetated macrophyte zones and deep pools that support a range of aquatic vegetation across the majority of the waterbody area. A constructed wetland has less than 30% of its area as open water (i.e. more than 70% as emergent macrophytes). The inlet zone and deep pools of a constructed wetland may, for instance, resemble a pond, but the dominant feature of the system is the macrophyte zone, containing emergent marsh, rush and reed vegetation that can withstand wetting and drying cycles. The structure and function of constructed wetland systems means they can remove pollutants from stormwater runoff through enhanced sedimentation, fine filtration and biological uptake (refer to SC6.4.3.9 Water sensitive urban design guidelines).
Dam	An artificial body of permanent open water provided as a source of water. In the context of this policy a dam can be used as a storage mechanism to provide lake top-up water.
Environmental value	Values or uses of water that support healthy ecosystems and contribute to public benefit, safety and health. Environmental values are typically determined through a transparent process involving government, industry groups and the community. Environmental values require protection from the effects of pollution and discharges.
Fresh water lake	A lake that receives treated stormwater runoff inflows only and is not influenced by tidal inundations or saline groundwater intrusions. Typically salinity levels are less than 1,000 mg/L
Lake catchment	The area from which all stormwater runoff flows into a lake.
Macrophytes	Large, submerged or emergent aquatic plants.
Normal water level (NWL)	The normal operating water level of the lake system, as defined by the lake outlet.
Primary contact	With regards to constructed lakes includes recreational activities that result in the immersion of the body in the water. These include swimming, skiing, diving and wading.
Receiving water body	A water body that receives stormwater runoff from the catchment under consideration. For the purposes of this policy constructed lakes and natural wetlands are included in the definition of receiving waters, but constructed wetlands that have been built primarily for the purpose of stormwater (or wastewater) treatment, are not. Saline lake - A lake that is permanently in a saline state, whether tidally influenced or as a result of groundwater intrusions. Salinity levels are at or above 15,000 mg/L permanently.
Secondary contact	With regards to constructed lakes includes recreational activities that result in some contact with the water but not the immersion of the body in the water. These include boating and fishing.
Sediment	Solids (typically sand, silt and clay) that are transported by water and deposited from suspension. Considered to be a "contaminant" as defined in the *Environmental Protection Act* (1994) or any latest version of this act / legislation / documents.
Stormwater	Surface water that runs off land or structures on land following a rain event (including piped flows).

Stormwater quality improvement devices (SQIDs)	Devices used to improve the health of the receiving waters by reducing the amounts of pollutants that enter waterways from stormwater runoff. Types of SQIDs include trash racks, gross pollutant traps, sediment basins, constructed wetlands, bio-retention devices and swales.
Water body	A water body, whether constructed or natural, that has defined bed and banks. A water body can be fresh or saline and can be tidally influenced.
Waterway	Means any of the following (whether or not temporarily dry: river, creek, stream, gully or drainage channel, including the bed and bank, whether modified or not. This term includes waterways indicated on the Townsville City Plan maps.
Water quality indicators	A water quality indicator is a physical, chemical and biological property of water that can be measured in a quantitative way (e.g. pH, temperature). The resulting water quality data enables trends or changes in water quality to be determined over time.
Water quality objectives (WQOs)	Measurable values for the quality of receiving waters to ensure that Environmental Values of those waters are safeguarded.
Water sensitive urban design (WSUD)	WSUD is an approach to water management in urban areas with the "interactions between the urban built form (including urban landscapes) and the urban water cycle as defined by the three urban water streams being potable water, wastewater and stormwater" (Engineers Australia 2003).

(5) Reference and source documents

(a) Queensland state legislation

Editor's note—design of a constructed lake may also need to consider relevant Queensland state legislative requirements as listed below or any latest version of these acts/legislation/documents.

Coastal Protection and Management Act 1995
Coastal Protection and Management Regulation 2003
Environmental Protection Act 1994
Environmental Protection Regulation 2008
Environmental Protection (Water) Policy 2009
Fisheries Act 1994
Local Government Act 2009
Soil Conservation Act 1986
State Planning Policy
Planning Act 2016
Vegetation Management Act 1999
Water Act 2000

(b) Queensland state authorities

Department of Environment and Heritage Protection, *Queensland Water Quality Guidelines 2009*
Department of Environment and Heritage Protection, *Urban Stormwater Quality Planning Guidelines*, 2010
Department of Environment and Heritage Protection,. Urban Stormwater *Quality Planning Guidelines, December* 2010.
Department of Energy and Water Supply, *Queensland Urban Drainage Manual*
Department of Transport and Main Roads, Road Drainage Manual: *A Guide to Planning, Design, Operation and Maintenance of Road Drainage Infrastructure*, 2010

(c) Australian Standards

AS/NZS ISO 31000 *Risk management - Principles and guidelines*
AS 1289 *Methods of testing soils for engineering purposes*

AS 1547 *On-site domestic wastewater management*
AS 4419 *Soils for landscaping and garden use*

(d) Other

ANZECC, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand,
Brisbane City Council (BCC), *Sediment Basin Design Guidelines* 2001
Brisbane City Council (BCC), *Stormwater Outlets in Parks and Waterways, Guidelines*, 2002
Brisbane City Council (BCC), *Natural Channel Design Guidelines*, 2000
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Institution of Engineers Australia, Queensland Division (IEAQ), *Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites*, 1996
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Mackay City Council, *Engineering Design Guidelines Constructed Lakes Planning Scheme Policy No. 15.15*, 2008
Melbourne Water, *Constructed Shallow Lake Systems, Design Guidelines for Developers*, Version 2, November 2005
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QDOT, 1998. *Tide Tables for Queensland*. Queensland Department of Transport
Scheffer, M., Rinaldi,S. Gragnani, A. Muir, L.R. and Van Nees, E.H. 1997. *On the dominance of filamentous Cyanobacteria in shallow, turbid lakes*. Ecology, 78: 272-282.
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Scheffer, M., 2001. *Alternative attractors of Shallow Lakes*. The Scientific World 1: 254-263.
Townsville City Council, *Water sensitive urban design for the coastal dry tropics (Townsville): technical*

design guidelines for stormwater management, 2011
Wagner-Lotkowska, I., Izydorczyk, K., Jurczak, T., Tarczńska, M., Frankiewicz, P., and Jorgensen, S.E., 2004. Chapter 12 – *Management: Reservoirs and Lakes*. In: Integrated Watershed Management: Ecohydrology and Phytotechnology – Manual (Eds: M. Zalewski, R.D. Robarts, V. Santiago-Fandino and P. Pypaert) United Nations Environment Programme, Osaka.
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Witheridge G, *Erosion and Sediment Control – A Field Guide for Construction Site Managers*, 2010

SC6.4.3.12.2 Minimum requirements

(1) The proponent must clearly demonstrate through design, investigation and monitoring that the proposed lake will:

(a) be sustainable for its intended use;

(b) have no negative impact on surrounding environments;

(c) provide a high level of amenity to surrounding land uses;

(d) have no adverse impacts on flood capacity;

(e) be safe due to minimisation of hazards; and

(f) be designed to minimise on-going maintenance.

(2) General requirements

A suitably qualified and Registered Professional Engineer of Queensland (RPEQ), with specific water sensitive urban design and lake design experience, must undertake or oversee all aspects of the constructed lake design. As constructed lakes will often involve significant landscape input, a suitably qualified landscape architect registered with the Australian Institute of Landscape Architects (AILA) should also work with the RPEQ.

The design must comply with all relevant requirements of:

(a) the requirements of the Townsville City Plan and, specifically, Part 9.4.2 Healthy waters code and any other applicable development codes;

(b) this sub-section;

(c) reference and source documents listed in SC6.4.3.12.1(5), in general;

(d) any development approval conditions relevant to the design; and

(e) any specific relevant and reasonable request, sought by council in writing.

The RPEQ shall sign all plans associated with the lake, certifying that the design, subsequent construction and performance criteria complies with this section.
Regardless of final ownership of the proposed lake, the proponent is to follow the requirements of this sub-section.

(3) Minimum functional requirements

The following are considered minimum requirements for the sustainable healthy operation of a lake:

(a) lake depths of 1.5 m to 3 m to finished bed level at the wet season normal water level (preferably 2-2.5 m). A minimum lake depth of 1.5 m is considered necessary to allow maintenance equipment such as floating weed harvesters to access lakes;

(b) sufficient inflow to sustain lake water levels within acceptable variations;

(c) upstream water quality treatment devices (SQIDS) to ensure inflows to the lake meet the requirements of the State Planning Policy and SC6.4.3.9 Water sensitive urban design guidelines. Untreated overflows must by-pass constructed lakes;

(d) floating aquatic vegetation minimised within the lake to reduce potential organic carbon loads;

(e) shaped and oriented to minimise dead spots. Where possible lake shapes should be orientated in the direction of the prevailing wind to improve mixing;

(f) suitable outlet configuration to manage lake water levels to facilitate plant and lake establishment, and on-going management actions (i.e. lower lake level by gravity);

(g) measures to pass high flows (i.e. untreated over flows) around the lake;

(h) sufficient liner (e.g. clay) at the lake floor to ensure the system minimises seepage losses, and in some cases to stabilise the lake bed (i.e. cover marine clays);

(i) integration of the lake within the site constraints;

(j) sufficiently strong embankments and overflow structures to manage peak flows and erosion;

(k) suitable access for heavy machinery in various locations to enable management actions (i.e.de-silting, weed and debris removal);

(l) edge treatments that minimise potential weed ingress;

(m) consideration of public safety issues and hazards (i.e. edge treatments, access to water, CPTED principles, flood capacity);

(n) sufficient measures to minimise algal bloom development (e.g. sufficient lake turnover and/or other strategies for managing algal growth such as mechanical aerators and mixers, ultrasonic treatments etc.);

(o) protection and appreciation of existing natural assets such as significant trees, marine plants, billabongs and wetlands;

Editor's note—applicants should also refer to Part 8.2.5 Natural assets overlay code and SC6.9 Natural assets planning scheme policy for additional information.

(p) sufficient measures to control pests (including bird population control) and mosquitoes including providing a habitat for predators;

(q) enhanced biodiversity through revegetation; and

(r) enhanced landscape aesthetic and amenity for surrounding residents through installation of improved passive recreation facilities i.e. paths and trails.

SC6.4.3.12.3 Development application requirements for constructed lakes

(1) Information for development applications

All drawings and documents submitted to council for approval shall be prepared by a suitably qualified person.

(a) MCU/ROL applications

The proponent will be required to submit a constructed lake concept design report with comprehensive management plans to support a development application for reconfiguring a lot (ROL) or material change of use (MCU) or operational works, where the proposed development includes a lake.

A separate stormwater quality management plan will be required to support the concept design report where a fresh water lake is proposed.

Table SC6.4.3.12.1 provides a checklist of items for submission at the MCU/ROL stage.
Additional plans/reports may be required to meet necessary state legislation requirements due to the proposed works, or other requirements of the Townsville City Plan.

(b) Operational works applications

Following approval from council and other relevant government agencies of concepts submitted as part of the ROL/MCU application, detailed design documents will be required for operational works approval. Detailed design documents shall be in both graphic and written form and contain sufficient information to enable council to assess compliance with the applicable codes.

The detailed design submission for operational works approval must include:

(i) constructed lake detail design report (updated from the ROL/MCU submission);

(ii) construction drawings – civil/landscape;

(iii) constructed lake technical specifications;

(iv) soil erosion sediment control plan;

(v) constructed lake monitoring plan (updated from the ROL/MCU submission);

(vi) constructed lake maintenance plan (updated from the ROL/MCU submission);

(vii) groundwater assessment and management plan (updated from the ROL/MCU submission); and

(viii) acid sulfate soils management plan, where required, and generally in accordance with the relevant State Planning Policy and its referenced documents.

Editor's note—additional reports/plans may be required to meet necessary regulatory and/or Townsville City Plan requirements due to the proposed works.

(2) Construction

Construction can only commence following operational works approval. Works are to be carried out in accordance with the approved drawings and specifications and any associated management plans as a result of the development assessment process.

(3) Constructed lake landscape plan

A constructed lake landscape plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council.

Constructed lakes will most likely be included in developments to provide a high amenity focal point for residents. The lake designs should aim to enhance biodiversity through re-vegetation and establishing linkages with existing vegetation communities, public interaction and education.

Landscape plans are to be provided and prepared by a suitably qualified landscape architect/designer, registered with AILA.

The landscape plan should demonstrate that the lake blends into surrounding environment (built and natural) and protects and enhances natural features such as significant trees and existing aquatic habitats (i.e. streams, billabongs, freshwater wetlands, saltmarshes). Landscape designs are to consider the principles of crime prevention through environmental design (CPTED).

At the ROL/MCU stage plans are to be developed that show:

(a) existing ground levels;

(b) the proposed lake footprint with respect to the development;

(c) road and lot layout;

(d) existing and retained vegetation;

(e) natural features and receiving environments;

(f) edge batter treatments including provision for irrigation where applicable;

(g) proposed lake operating levels (dry, normal and wet) and base levels;

(h) topsoiling and lining;

(i) adjacent levels including roads, property boundaries and floor levels;

(j) setbacks, buffers and landscaping;

(k) accesses;

(l) inlets and outlets including treatments to minimise visual impact;

(m) activities to be carried out in the area adjacent to the lakes e.g. parks and car parks;

(n) photographs showing examples of design intent and character;

(o) educational opportunities such as signage and public art; and

(p) highest astronomical tide and 50 year flood levels.

Figure SC6.4.3.12.1 Example of a lake landscape plan

Constructed lake landscape plans are to be updated as part of the operational works submission, including planting details (refer to SC6.4.3.12.5(12) Step 12), landscape surface treatment plans, landscape details and specifications. The use of endemic plant species is to be encouraged.

Landscape design can play an important role in overcoming negative community perceptions to certain lake treatments such as tree plantings where residents in the past have deliberately removed trees and shrubs due to concerns with pests. Signage explaining the function of each element in the overall design can help educate local residents.

(4) Constructed lake recreation plan

A constructed lake recreation plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council.

A recreational management plan is to be developed by a suitable qualified landscape architect/designer registered with AILA in association with a recreational consultant and must include details on proposed activities including pedestrian movement and signage.

Lakes designs should provide enhanced landscape aesthetic and amenity for surrounding residents through the installation of improved passive recreation facilities such as paths, trails, viewing platforms, picnic and playground nodes. Lake recreational areas are to be designed so that they are available to all groups of the population, i.e. it should consider all abilities. The lake design and associated parklands must be:

(a) consistent with the area's social and recreational master plans; and

(b) cognisant with local planning and other issues.

Designs should also be mindful of the amount of space a proposed lake will take and how this will impact on other recreational activities to ensure a balance land use outcome. Consideration should also be made to other amenity values such as shade, character and multi-use.

Linkages between the lake and recreational master plans are also to be provided (e.g. footpaths, cycleways, etc.).

(5) Constructed lake monitoring plan

A constructed lake monitoring plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission. The monitoring plan is to set out the testing schedule and frequency for monitoring lake health. Water quality monitoring will be critical in assessing the on-going performance of the lake and provide the basis for remedial and adaptive management activities. Costs associated with monitoring must be included in the life cycle costing (SC6.4.3.12.5(18) Step 18) and must be separated from other costs.

The proponent will be required to develop a water quality strategy including water quality objectives to maintain environmental values of the lake, receiving waters and ground water, where applicable. Water quality objectives will be required to be derived for local conditions in accordance with the *Queensland Water Quality Guidelines 2009.* When deriving suitable values for the water quality strategy the proponent must take into consideration local water quality values of source and receiving waters, together with local aquifer water quality, if applicable.

A summary of all water quality results will also be required for handover purposes. Council will not consider handover until all monitoring results and reports are received.

Minimum monitoring requirements

(a) weekly in-situ testing using a multi-probe for pH, turbidity, DO, temperature and EC at 0.5 m depth intervals from surface to lake bed at the lake inlet and outlet;

(b) weekly laboratory testing (NATA approved) for algal counts, TN and TP. Surface samples at the inlet and outlet are required;

(c) weekly measurements of lake water level;

(d) monthly laboratory testing (NATA approved) for E.coli, TSS, turbidity, NH3, TKN, Nitrate/Nitrite, TN, TP, FRP, Al (soluble). Surface samples at the inlet and outlet are required;

(e) trapping of adult mosquitoes at the lake site (weekly during the wet season from the on-set of the first wet season rains, fortnightly to monthly other times);

(f) larval surveys from shallow flooded vegetated areas around the lake (weekly during the wet season from the on-set of the first wet season rains, fortnightly to monthly other times);

(g) fortnightly water level and EC measurements of groundwater from installed monitoring wells (where shallow groundwater is observed); and

(h) annual bathymetry of lake bed to determine sediment accumulation.

Reporting

Quarterly reports are to be submitted to council summarising the water quality monitoring results. The reports shall also include summaries of local climatic conditions, including daily rainfall and shall also include any observations made during the period (e.g. visual water quality, odours, algal biomass, fish kills etc.). Copies of lab testing results are to be included in an appendix to the report. Water quality exceedences (considering trigger values derived to maintain environmental values of the lake, receiving water body and groundwater, if applicable) are to be clearly identified. The reports shall also detail any corrective measures that may have been taken.

Quarterly reports are to be submitted within 1 month of the last monitoring event in the quarter.

An annual report will be required to assess the overall performance of the lake based on the monitored and observed data throughout the monitoring period. The report should detail performance with respect to the intended design and actions taken to meet the intended performance.

Corrective actions and adaptive management

Table SC6.4.3.12.2 provides indicative target values for lake health relevant for Townsville for the range of physico-chemical indicators to be tested on a weekly basis. The values have been derived from the *Queensland Water Quality Guidelines* and are provided for guidance only.

The proponent must derive local water quality objectives in accordance with the procedures outlined in the

Queensland Water Quality Guidelines (DERM, 2009). This will involve definition of the water type, selection of indicators, selection of reference sites, collection of reference data and derivation of guideline values based on the reference data.

Parameter	Freshwater	Mid-Upper Estuarine
pH	6.5 - 8.0	7.0 - 8.4
DO	>6 mg/L	>6 mg/L
TDS	<1,000 mg/L	>15,000 mg/L
TN	0.35 mg/L	0.3 – 0.4 mg/L
TP	0.01 mg/L	0.025 – 0.04 mg/L
Turbidity	1 - 20 NTU	8 - 25 NTU
Chl-a	5 ug/L	4- 10 ug/L

Table SC6.4.3.12.2 Suggested target values for physico-chemical indicators.

Table SC6.4.3.12.3 provides target values for the management of cyanobacteria (blue green algae) and mosquitoes. The presence of cyanobacteria can present a significant hazard to lake users. The values for cyanobacteria have been derived from the *Guidelines for Managing Risks in Recreational Water.*

Parameter	Freshwater lake	Saline lake
Cyanobacteria	≤500 cells/mL *Microcystis aeruginosa* or biovolume equivalent ≤0.04 mm^3/mL combined total of all cyanobacteria	Refer to guidance provided in the 'Guidelines for Managing Risks in Recreational Water' (National Health and Medical Research Council, 2008)
Mosquito larvae	1 larvae per 2 ladle dips (300mL ladle)	1 larvae per 2 ladle dips (300mL ladle)

Table SC6.4.3.12.3 Suggested target values for cyanobacteria and mosquito populations.

Where weekly testing indicates values above derived water quality objectives or biological indicators, corrective actions are to be taken as soon as possible. Exceedance or other lake health issues such as fish kills and odour problems shall be reported immediately to council and the Department of Environment and Heritage Protection (EHP). The source of the exceedance should be identified as soon as possible.
Typical corrective actions include:

- contacting council and EHP as soon as an exceedance is identified;
- identifying the cause of the water quality or biological indicator problem. This includes reviewing monitoring and operational data, climatic data, upstream sources, internal lake processes etc. Discussions with designers, council/EHP may be required to gain a better understanding of the problem and determine possible actions;
- increasing the frequency of monitoring of parameters of concern;
- minimising potential impacts to downstream receiving environments e.g. temporarily block outlets; and
- undertaking remedial action on items identified as potential sources e.g. upstream water quality improvement devices.

An important component of the monitoring plan will be the adaptive management strategies to be developed for algal blooms and mosquito outbreaks. The following provides guidance on suitable adaptive management strategies for a adaptive management of algal blooms and adaptive management of mosquito outbreaks.

Adaptive management of algal blooms
Design of lakes in Townsville must include an algal management strategy as defined in SC6.4.2.12.5(8) Step 8. The algal management strategy is intended as a proactive response and not a reactive response to cyanobacterial blooms.

When a cyanobacterial bloom occurs in a freshwater lake, it will be necessary to follow the recommended actions detailed in the *Queensland Water Quality Guidelines*. For algal blooms in saline lakes, refer to the algal guidelines for coastal and estuarine waters in the *Guidelines for Managing Risks in Recreational Waters.*

Adaptive management of mosquito outbreaks
Larval counts of 1 per 2 ladles (300 mL ladle) are indicative of possible mosquito problems for adjacent residents (Warchot and Whelan, 2008), however resident complaints or significant numbers of mosquitoes in adult trapping may also be cause for mosquito control.

Where mosquito problems are encountered a number of actions can be followed:
- identifying the source and cause of the breeding;
- rectification of surface depressions that may lead to isolated pools;
- clearing collected debris that may be in and around the lake;
- draining areas identified with large mosquito breeding;
- ensuring suitable native fish species are present in the lake; and
- use of a suitable insecticide/larvicides.

Use of insecticides can quickly control mosquito breeding, but is not recommended as a long term strategy due to potential issues with insecticide resistance, long term cost of maintaining a mosquito control program and the possibility of the insecticide applications not being able to target all areas of breeding (Warchot and Whelan, 2008).

Ecologically friendly insecticides include (Whelan and Warchot, 2008):
- Bacillus thuringiensis var. Israelensis;
- Bacillus sphaericus; and
- Methoprene.

(6) Constructed lake maintenance plans

A constructed lake maintenance plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council. A final approved constructed lake maintenance plan will be required prior to asset handover.

The constructed lake maintenance plan shall be a living document that can be updated should there be any changes during construction. The plan must include all expected maintenance associated with the constructed lake and associated infrastructure such as pumps, recirculating wetland and landscape treatments.

The maintenance plan is intended to ensure that the lake functions as intended and is not prone to weed

infestations or decreased amenity values. The maintenance plan must clearly set out:

(a) expected maintenance activities;

(b) frequencies;

(c) roles and responsibilities;

(d) maintenance procedures;

(e) equipment requirements;

(f) product specifications;

(g) occupational health and safety;

(h) public safety;

(i) environmental protection;

(j) disposal;

(k) accesses;

(l) emergency responses; and

(m) notification requirements.

Maintenance forms must be developed as part of the plan and filled in and stored during inspections and maintenance.

The costs of expected maintenance activities must be included in life cycle costing (SC6.4.2.12.5(18) Step18), and must be separated from other costs. The maintenance plan will need to consider lake monitoring and adaptive management to ensure maintenance responses to monitoring exceedences.

The maintenance plan must clearly describe activities required during establishment, defects liability period and those following asset handover. Intensive maintenance will most likely be required during the first few years during lake and plant establishment. This is also the time when the lake is most vulnerable to sediment loads from construction activities. Design drawings are to be included as part of the maintenance plan.

The maintenance plan must consider lake accesses as detailed in SC6.4.2.12.5(14) Step 14, and maintenance draining as outlined in SC6.4.2.12.5(10) Step 10.

Typical maintenance actions include:

- routine inspections of the lake for vegetation health, weed infestations, scour, litter and debris and mosquitoes;
- routine inspection of inlets and outlets for sediment build up, scour, litter and blockages;
- removal of litter and debris;
- removal and management of invasive weeds;
- periodic de-silting;
- replacement of plants that are damaged or have died with equivalent plants;
- regular irrigation of plants during establishment;
- repairs due to vandalism; and
- mosquito control including repair to lake edges to prevent the formation of isolated pools.

Inspections for removal of debris should be done regularly and removed whenever observed. Scour around the inlets and outlets should be checked following large storm events.

Construction drawings

All drawings submitted to council for approval shall be prepared by a suitably qualified person and shall conform to the standards detailed in SC6.4.2.5 Details on drawings.

Annual lake bathymetry surveys are to be provided to council with estimates of sediment accumulation from the original constructed levels.

As constructed plans are to be provided following handover to council either as an annotated set of the original plans (where variations to the original design are minor) or otherwise as a new site survey.

(7) Constructed lake technical specification

The technical specification shall clearly set out the scope of the works, roles and responsibilities, certification and sign-off and construction hold points. The specifications shall be in accordance with the construction plans and provide flexibility to allow additional field investigation and design modification due to unexpected conditions encountered during construction

(8) Soil erosion management plan

A soil erosion management plan shall clearly identify measures to manage erosion and sediment control during construction and be guided by principles set out in:

- *Best Practice Erosion and Sediment Control*; and
- *Erosion and Sediment Control – A Field Guide for Construction Site Managers*.

The soil erosion management plan shall include:

(a) project and site description (topography, drainage, soils, rainfall);

(b) potential impacts from construction activities including a risk assessment;

(c) soil management measures including a plan showing proposed measures; and

(d) responsibilities, monitoring and maintenance.

The plan must also detail contingencies in the event of unplanned discharges including remediation.

The plan should be a living document that can be modified if site conditions change or if the adopted measures fail to perform as expected.

(9) Soil and groundwater assessment and management plan

A soil and groundwater assessment management plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission. This will be an update from the concept design phase in consultation with council and shall include assessment of any additional soil and groundwater information gained since the concept design stage. Refer to SC6.4.3.12.5(3) Step 3. The soil and groundwater assessment plan should include:

(a) site description including local soil and groundwater characteristics;

(b) field investigation work including any test pitting, monitoring well installation etc.;

(c) laboratory testing and interpretation;

(d) monitoring data and interpretation;

(e) assessment of acid sulfate potential;

(f) identification of problematic soils e.g. sodicity, dispersive soils, peats etc.;

(g) assessment of the shallow groundwater regime, if present; and

(h) groundwater risks and management options

(10) Acid sulfate management plan

When an acid sulfate management plan is deemed necessary, the plan should clearly identify the risk of contamination to the environment and measures to manage the risk. The plan must detail:

(a) construction sequences;

(b) impacts of dewatering;

(c) liming requirements;

(d) exposure of materials;

(e) monitoring requirements;

(f) action plans for unplanned acidification of ground or surface waters; and

(g) responsibilities, reporting and auditing.

(11) Maintenance and handover

(a) Necessary maintenance will be defined in the maintenance plans provided during the ROL/MCU submission and updated during the operational works approval stage. Updates may be required should the designs change during construction and may require the approval of council.

For the purposes of maintenance and the handover, a constructed lake is deemed to include the lake open water body and edge treatments. The limits of each are defined below:

(i) lake water body: all areas to wet season normal water level; and

(ii) edge treatments: all areas from lake wet season normal water level to the edge of the buffer zone (see below).

The lake buffer zone is considered necessary to provide sufficient width to allow maintenance activities (including access by machinery) to be undertaken to all areas of the lake, provide a passage for fauna and provide water quality buffering for untreated overflows entering the lake. A minimum width of 25 m is suggested. Where the proponent proposes a reduced width they must clearly demonstrate that the width is sufficient to maintain the aforementioned functional requirements of this edge treatment.

The proponent is also responsible for any rectification works on areas outside of the constructed lake should the operation of the lake negatively impact on outside areas.

(b) Defects liability period

The defects liability period for the lake water body and edge treatments will commence following practical completion and continue for at least:

(i) 5 years after 90% of all houses are constructed within the lake stormwater catchment, provided the lake is constructed, established and functioning at plan sealing; or

(ii) 5 years after the lake is constructed, established and functioning where the lake is not directly fed from stormwater runoff.

Prior to establishing the lake system, the lake shall be drained and de-silted, where necessary, to establish the lake system as per the detail design.

(c) Handover

At the completion of the defects liability period, a handover meeting will be scheduled between the developer (or representative), maintenance personnel and council.

The council may engage an independent auditor to assess handover and is under no obligation to accept the asset if it does not meet the performance requirements as described in the constructed lake conceptual design report, detailed design report and this sub-section.

Council will only accept the lake once the lake is demonstrated to meet the performance requirements as detailed in the design reports and monitoring plans. The council will require demonstration through a minimum of 5 years of continuous monitoring data (as defined in the monitoring plan) on the performance of the lake system.

Council will require a final survey of the lake floor prior to handover. Where sediment accumulation is in excess of that anticipated the proponent will be required to drain and de-silt the lake and re-establish the lake as per the design. Handover cannot occur until the re-established lake performance is demonstrated over a continuous 5 year period.

As constructed plans are to be provided following handover to council either as an annotated set of the original plans (where variations to the original design are minor) or otherwise as a new site survey.

SC6.4.3.12.4 Lake health considerations

(1) A constructed lake is an artificial body of permanent water with either an edge fringed with emergent macrophytes or a hard edge. While submerged macrophytes may occur throughout the water column, the dominant feature is open water (typically at least 30% of the total area).

Urban runoff entering a constructed lake must have sufficient treatment.

For the Townsville region this includes load reduction from the urban runoff component of:

- 80% reduction in total suspended solids;
- 65% reduction in total phosphorous;
- 40% reduction in total nitrogen; and
- 90% reduction in gross pollutants.

The design of constructed lakes needs to consider the complex behaviour, in particular, the alternate states that lakes can operate under depending on a number of influences and stressors.

Key factors affecting lake health:

(a) nutrients;

(b) light and turbidity;

(c) organic carbon loads;

(d) lake detention time;

(e) salinity;

(f) water level and depth;

(g) mixing; and

(h) temperature.

The designer must also be aware that constructed lakes are community assets and issues such as pest and weed control and integration into the overall landscape design should be considered at the concept design and planning stage.

(2) Lake conceptual model – alternate states

The conceptual model of how lakes transition between alternate states is presented in Figure SC6.4.3.12.2.

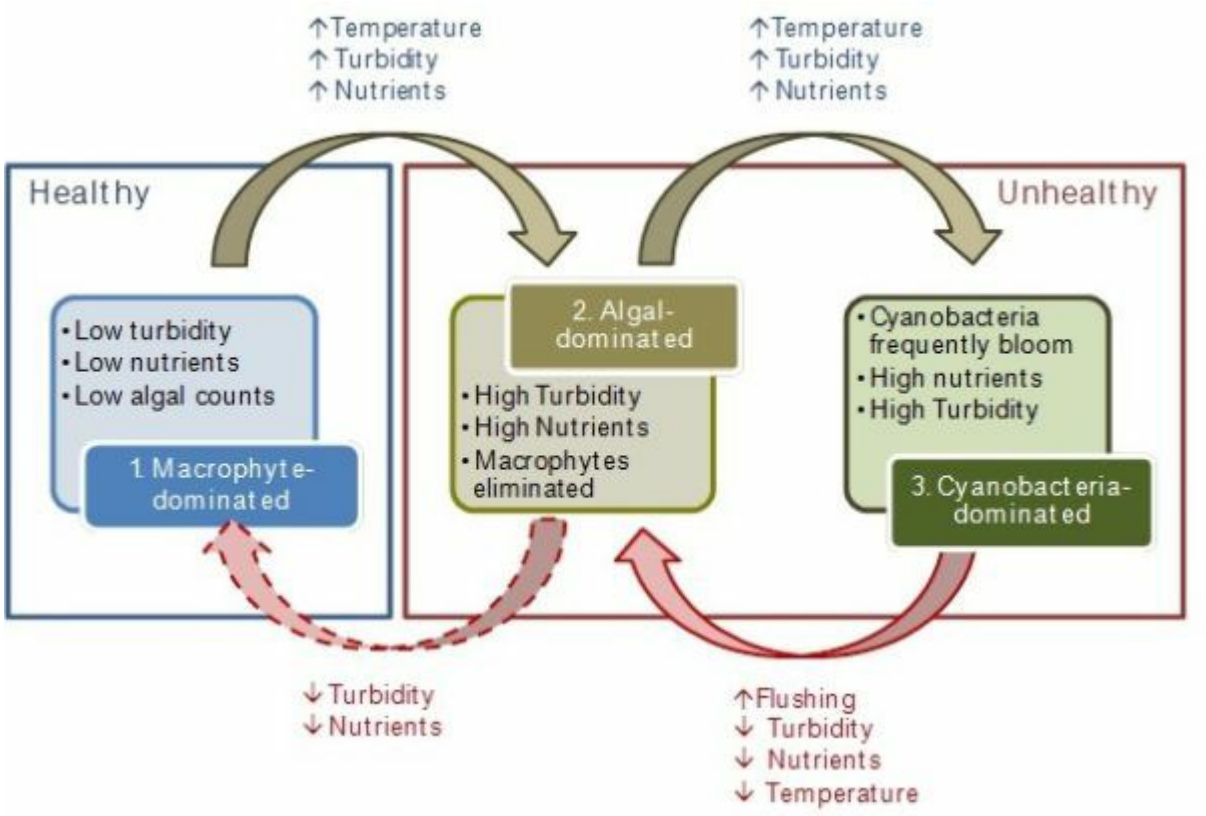


Figure SC6.4.3.12.2 Conceptual model of the alternative states observed in shallow lakes

The alternate states model considers that freshwater shallow lakes may exist as (after Moss, 1998):

- a macrophyte dominated state with clear water; or
- a turbid state dominated by phytoplankton; or
- a cynobacterial (blue-green algae) dominated state

The key driving mechanisms between each of the alternative states are nutrient levels and turbidity. The switch between the alternative states is typically triggered by the exceedance of a critical turbidity threshold. The critical turbidity thresholds required to trigger a switch from one state to another are likely to differ between lake systems and are also influenced by other environmental factors, such as lake detention times and temperature (Scheffer, 1998). Figure SC6.4.3.12.3 (below) illustrates the switch between alternative states.

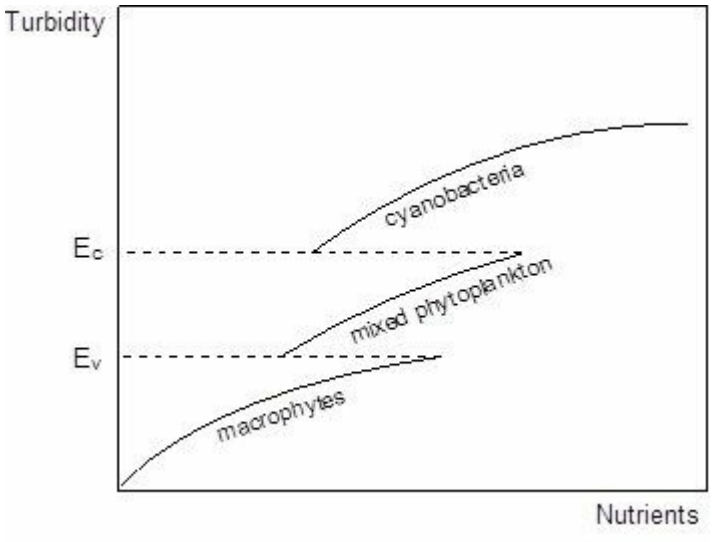


Figure SC6.4.3.12.3 Switch between alternative states

(a) Macrophyte dominated lake

A healthy lake is typically dominated by macrophytes (emergent and submerged water plants).

Macrophyte dominated lakes help maintain low turbidity via the uptake of nutrients, prevention of re-suspension of sediments and provision of refugia for zooplankton against predators (Scheffer, 2001).

Macrophyte dominated lakes are reasonably robust to increased nutrient loads, which allows the macrophyte biomass to increase and thereby maintain low turbidity (Scheffer et al., 2001) i.e. the macrophyte dominated system provides positive feedback to increases in nutrients, enhancing their own growing conditions (Scheffer et al, 2001).

(b) Macrophyte to Phytoplankton state

High nutrient concentrations can lead to an increase in phytoplankton biomass and biofilm growth on the macrophytes, leading to increased turbidity and decreased light penetration which can cause a rapid collapse of the macrophyte community (Scheffer, 2001).

The switch to a phytoplankton state is considered problematic with regards to lake heath as this state inhibits the growth of macrophytes (mainly due to low light penetration) and maintains high turbidity levels. Once a lake has switched to a phytoplankton dominated state, restorative efforts to reduce turbidity and re-establish macrophyte communities are extremely difficult.

(c) Phytoplankton to Cynobacteria state

The switch from a phytoplankton dominated state to a Cynobacterial dominated state is generally triggered in response to increased turbidity and water temperatures (Scheffer, 1998). Whilst both Cyanobacterial and phytoplankton (non-Cyanobacterial) communities may dominate over a range of nutrient concentrations, a critical turbidity level exists above which the Cynobacteria will become dominant (refer to Figure SC6.4.3.12.4).

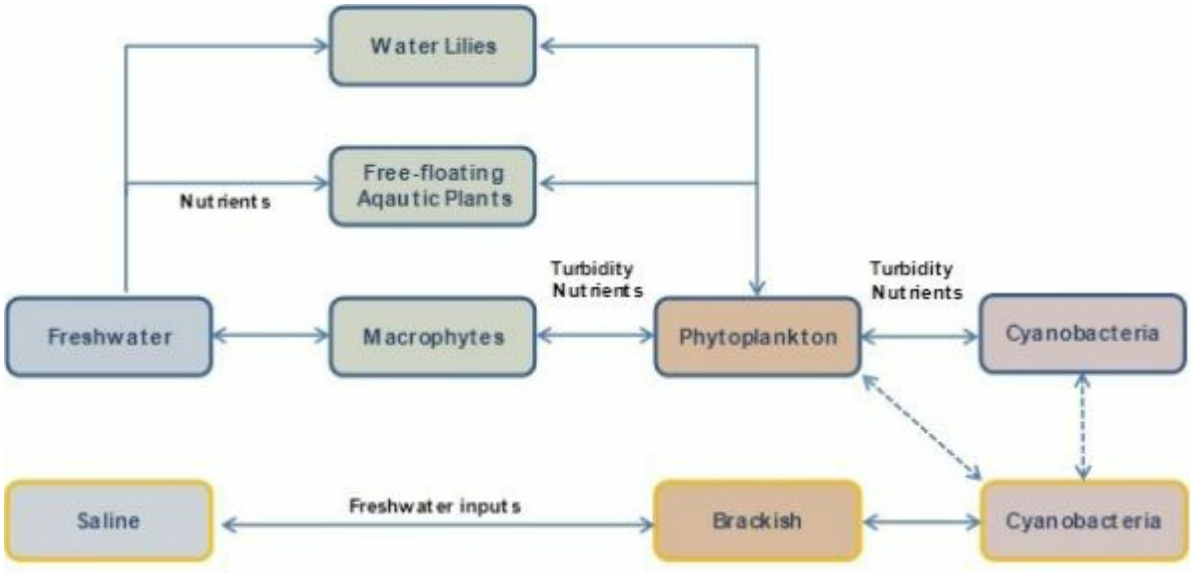


Figure SC6.4.3.12.4 Fresh and saline lakes alternate states

In saline lakes, alternate states are triggered by freshwater inputs, which result in brackish lakes that are highly susceptible to Cyanobacteria blooms. Brackish lakes do not tend to develop a phytoplankton state in response to freshwater inputs, unless salinity levels are reduced to fresh water levels (i.e. 1,000 mg/L TDS salinity or less).

(3) Factors affecting lake health

The following section relates to freshwater lakes, where algal management can be difficult to achieve in Townsville.

Saline lakes are generally less susceptible to algal blooms, although marine species of algae do exist. Saline lakes are less likely to experience aquatic weed infestations and seasonal water level variations are less problematic to manage.

(a) Nutrients

Nutrients of concern for urban lake health include nitrogen, phosphorous and trace metals. Nutrients (particulate and soluble) are typically delivered to lakes through stormwater runoff. Nutrients may also be delivered to lakes via in-situ soils, breakdown of organic matter and groundwater processes. Other site conditions such as perched water tables and waterlogged areas (e.g. where anaerobic condition exists) can also promote the formation of nutrients into bio-available forms.

Particulate nutrients associated with suspended solids will typically settle to the bottom of lakes and provide a reservoir of nutrients, which can be released back to the water column under appropriate conditions, whereas soluble inorganic nutrients are readily bio-available to phytoplankton.

High nutrient levels also favour growth of aquatic weeds such as Salvinia (Salvinia molesta), Water hyacinth (Eichhornia crassipes) and Water lettuce (Pistia stratiotes) and other floating species such as native and introduced water lillies. These floating species provide a continual source of organic matter (carbon) to lake sediments. The decomposition of organic matter can deplete oxygen within the lake water column and sediments, resulting in the release of soluble nutrients back to the water column which is then available for phytoplantkton and Cyanobacterial growth. Depletion of oxygen and/or the development of Cyanobacterial blooms can also lead to fish kills, animal death and a risk to public health.

Many Cyanobacteria species are able to obtain nitrogen from the atmosphere, thus nutrient management in lakes typically focuses on phosphorous.

Note—guidance on suitable treatments is included in SC6.4.3.9 Water sensitive urban design guidelines. Areas close to the coast or water draining to the coast can be more susceptible to nutrient hazards. Regional hazard maps can be used to identify potential areas of concern where more detailed mapping and investigation (e.g. soil and groundwater analysis) can occur.

(b) Light and turbidity

Light penetration and turbidity are important factors that trigger switches between alternate states, as described earlier. Recent studies (Scheffer et al., 1997) have shown that the abundance of Cyanobacteria is more highly correlated to underwater light conditions than to phosphorous concentrations. In shallow lakes, the probability that Cyanobacteria will dominate the algal community will depend strongly upon diminishing light levels attributed to increases in turbidity (Scheffer, 1998). Increases in Cyanobacterial biomass therefore provides a positive feedback, further favouring the development of Cyanobacterial blooms.

Note—macrophyte dominated lakes help to maintain low turbidity, as well as providing a mechanism for nutrient uptake. This reduces the opportunity for phytoplankton or Cyanobacterial dominated states which are characterised by high turbidity. Submerged and emergent macrophytes should be encouraged, and floating aquatic plants which contribute to shading and organic carbon loads discouraged. In Townsville, constructed lake depths are limited to 3 m below wet season normal water level, which should encourage light penetration and establishment of submerged plants.

(c) Organic carbon loads

The primary source of organic carbon in urban lakes is typically from leaf litter in stormwater runoff, floating aquatic plants and emergent and submerged macrophytes when within the lake when they decompose. Floating aquatic plants provide a highly bio-available carbon source as they tend to have soft and non-fibrous tissues. Aerobic decomposition of accumulated organic loads at lake beds result in a depletion of oxygen and can cause anaerobic conditions (depending on the amount of organic load available). In situations where organic material is still available under anaerobic conditions, anaerobic bacterial activity can lead to the release of highly bio-available nutrients back to the water column (Lawrence and Breen, 1998). This can result in subsequent algal blooms and poor water quality.

Note—minimise the input of leaf litter into urban lakes through upstream treatment measures. Avoid floating aquatic plants where possible. Creating lake edges that encourage emergent macrophytes will inhibit the establishment of floating attached plants such as water lilies, which tend to grow from lake edges to the centre.

Floating aquatic weeds such as Salvinia molesta are more difficult to manage. Maintaining low lake nutrient levels will minimise proliferation. This includes the provision of submerged macrophytes, which maintain oxygen to lake sediments, reducing opportunities for nutrients to be available for floating plants and phytoplankton.

The lake design should provide suitable access to the lake water body for removal of floating aquatic weeds by mechanical harvesters. A minimum water depth of 1.5 m should be provided for harvesting equipment. Suitable access must also be provided heavy machinery to manoeuvre when collecting the weed and debris.

(d) Lake detention times

Lake detention time plays an important role in managing lake algal biomass and thus reducing the risk of Cyanobacterial growth. Lake detention time, simply put, is the time it takes for the entire lake volume to be displaced via inflows to the lake. Generally there are two ways in which lake water is displaced, either via episodic events that displace the entire lake volume (washout) or from constant inflows (flushing).

Algal growth rates are dependent on nutrients, light, temperature and hydrologic conditions. Algal population growth can occur rapidly, and algal bloom concentrations may develop within weeks. It is possible to manage the formation of algal blooms by removing algal biomass from lake systems via the manipulation of lake detention times.

In Townsville, urban lakes that rely on catchment inflows will typically experience long detention times (>100 days) during the dry season, significantly longer than the time required for algal populations to reach bloom concentrations. Probabilistic approaches, such as those used in Brisbane and Mackay (20 percentile detention time for a constructed lake should not exceed 20 days), are not particularly relevant for Townsville conditions, as these conditions cannot be demonstrated to be achieved on average, regardless of catchment to lake size, unless alternative sources of top up water are available.

Algal management is thus a key design consideration for urban lakes reliant on catchment inflows in Townsville. A number of options are available to the designer including a flushing and/or recirculation strategy. These are discussed in more detail in SC6.4.3.12.15(8) Step 8 – Algal management and SC6.4.3.12 Attachment A Alternative Strategies for Managing Cyanobacterial Growth.

During the short wet season, lake detention times are significantly shorter and the risk of algal blooms are less, although the potential still exists during summer drought conditions.

Note—where possible the designer should consider saline lakes with tidal flushes or consider alternative options to freshwater lakes such as constructed wetlands. Where freshwater lakes are proposed, a suitable algal management strategy will be a key design consideration. Lake depths should also be minimised where possible (preferably between 1.5 and 2.5 m) to reduce any necessary pumping requirements for recirculation.

(e) Salinity

Cyanobacteria dominance is highly sensitive to changes in salinity (Paerl, 1988). Brackish lakes are often dominated by Cyanobacteria due to the tolerance of many Cyanobacterial species to low salinity. Saline lakes subject to freshwater inflows, particularly during the wet season, are thus highly susceptible to Cyanobacteria blooms. In Townsville, brackish lakes (1,000 to 15,000 mg/L TDS), or saline lakes with freshwater inputs should be avoided.

Note—avoid brackish lakes or brackish conditions that may occur in lakes (e.g. saline lakes subjected to large freshwater inflows). Preference is for lakes to permanently operate as either saline (>15,000 mg/L TDS) or fresh (<1,000 mg/L TDS) at all times.

(f) Water level and depth

Lake water level variation and depth play an important role in maintaining macrophyte dominance, and thus resistance to algal blooms. Shallow lakes (<3 m) are more favourable to macrophyte growth, where light penetration is higher and conditions suitable for macrophyte reproduction and establishment. Shallow lakes will typically have a higher threshold turbidity level before switching to a phytoplankton

state (Scheffer, 1998), and therefore have more resistance to increased turbidity and nutrient levels.

Shallow lake depths (<3 m) are also less prone to stratification and subsequent problems associated with the release of nutrients from anaerobic sediments.

Water level variation due to evaporation in Townsville can be greater than 1 m in lakes reliant on catchment inflows. This has direct implications for the health and survival of edge treatments such as emergent macrophytes, which help to reduce the proliferation of floating aquatic plants and ingress of weeds, and thus play an important role in managing the health of urban lakes.

Alternately, saline lake edge treatments such as salt couch are highly sensitive to water level variations and do not survive well when exposed to extended periods of inundation.

Note—lake depths from normal wet season operating levels to finished bed level are limited to 3 m in Townsville, but preferably in the range of 2.0 to 2.5 m. A suitable impervious base (e.g. compacted clay liner) should be provided to minimise seepage losses for lakes reliant on catchment inflows. Lake edge treatments should be such that the width of the exposed batter due to water level variations is minimised. Within the zone of water level variation edge batters at 1V:3H are preferred.

For saline lakes water level variations should be minimised as far as possible, preferable to less than 0.3 m. Salt couch edge treatments are particularly sensitive to long periods of inundation.

(g) Mixing

Mixing and turbulence within lake systems limits the formation and accumulation of Cyanobacterial blooms (Wagner-Lotkowska, 2004). Well mixed conditions can be achieved by ensuring good hydraulic efficiency, shallow lakes (<3 m), maximising wind induced turbulence and providing lake flushing. Mixing can also be accomplished by mechanical means including aerators, mechanical mixers and internal recirculation.

Note—lake configurations should provide length to width rations of 3L:1W or greater. Inlets and outlets should be at opposite ends of the lake. Dead end zones or square edges are to be avoided.

Where possible, align lakes in the direction of the prevailing winds to maximise wind induced turbulence. The prevailing wind for Townsville during the critical winter dry season is south easterly. The base of the lake should be flat to promote even wind mixing. Isolated deep pockets should be avoided.

(h) Weed control

Weed infestation is a major problem in the dry tropics and has been observed to be a significant maintenance burden for existing lakes in the Townsville area. To maintain amenity and minimise on-going maintenance the proponent must detail specific actions (design and management) to address potential weed ingress, both terrestrial and aquatic. Aquatic weed problems are mainly associated with fresh water lakes in the Townsville region and the following design notes are primarily related to weed control in fresh water lakes.

Note—provide a densely vegetated perennial lake edge to create a barrier for weed ingress. This vegetative barrier must be designed so as to be capable of surviving expected water level variations. This may include the provision of irrigation during the dry season.

Include submerged macrophytes to fresh water lakes, to maintain oxygen to lake sediments, thus minimising the opportunities for highly bio-available nutrients to be released and available for floating plants.

Minimise nutrient and organic loads to the lake.

Avoid the inclusion of floating aquatic vegetation (e.g. water lilies) that can contribute to organic loads to the lake, thus supporting weed infestations such as Salvinia, Water hyancinth and Water lettuce.

Provide suitable access for prompt removal of terrestrial and aquatic weeds.

Figure SC6.4.3.12.5 Examples of aquatic weeds - Salvinia (L) and Water Lettuce (R)

Figure SC6.4.3.12.6 Example of water lilies (L) and weed infestation at a lake edge (R)

SC6.4.3.12.5 Constructed lakes design steps

These guidelines are a step by step outline to support development applications where involving reconfiguring a lot (ROL) or material change of use (MCU), where a proposed development includes a lake, and subsequent Operational Works requirements. Council will require considerable detail at the ROL/MCU stage to fully assess the merits of proposed lake. This includes field investigations to characterise the soils and groundwater at the proposed site.

(1) Step 1: Design intent

The primary intent for the lake is to be clearly defined. The design intent must be accompanied by concept plans showing location and layout with respect to the development as well as existing vegetation and receiving environments. The principles in SC6.4.3.12.1(3) include constructed lake uses preferred by council.

(2) Step 2: Determine lake type

(a) Saline lake

In Townsville, due to the extended dry season, the preferred constructed lake with regards to long term sustainability, weed and water level management is a saline lake, where possible. Although less diverse than fresh water lakes, the operation of saline lakes are considered more robust for Townsville conditions. Saline lakes should not be configured to receive fresh water inflows as this can result in brackish conditions which are highly susceptible to the development of Cyanobacterial blooms. This can include stormwater runoff or pumped fresher inputs during the wet season where the source water is from estuaries. The proposed method of inflow, control and water level management must also be stated. Refer to SC6.4.3.12.5(4) Step 4 (e.g. pumped or gravity control).

(b) Fresh water lake

Where fresh water lakes are proposed, the proponent should consider other alternatives such as heavily vegetated constructed wetland systems which can provide open water views and water treatment benefits (refer to SC6.4.3.9 Water sensitive urban design guidelines).

In the case that a fresh water lake is decided upon, the proponent must demonstrate that the lake is configured to receive treated stormwater inflows only (as per the requirements of SC6.4.3.9 Water

sensitive urban design guidelines). Untreated overflows should by-pass constructed fresh water lakes. A separate Stormwater quality management plan (SQMP) must be submitted detailing upstream water quality devices and expected improvements via MUSIC modelling.

Editor's note—SC6.4.3.8 Stormwater quality management plans for development provides guidance to applicants on the preparation of SQMPs, including the use of MUSIC modelling.

The proponent must also clearly demonstrate how water level variations will be managed and proposed alternative sources of water to maintain lake water levels within acceptable variations (refer to SC6.4.2.12.15(7) Step 7).

(c) Brackish lakes
Brackish lakes should be avoided in Townsville. Freshwater Cyanobacteria are particularly responsive to changes in salinity, often resulting in dramatic alterations in dominance (Paerl, 1988). Brackish lakes are often dominated by Cyanobacteria due to the tolerance of many Cyanobacterial species to low salinity.

(3) Step 3 – Site soil and groundwater assessment
A soil and groundwater assessment will be required to characterise local soil and groundwater and demonstrate that the proposed lake will not negatively impact on the local groundwater (considering seasonal fluctuations) and avoids problematic soil areas (e.g. high organic contents, peats, sodic soils).

Where contaminated sites are identified, thorough soil and groundwater assessments will be required and remediation plans developed. Groundwater modelling will also be required to demonstrate that proposed lakes do not or are not negatively impacted by adjacent contaminated sites. Specialist geotechnical/hydrogeological advice will be required to assess risks and develop remediation plans.

A site and soil evaluation must be undertaken in accordance with AS/NZS 1547. Field investigations and laboratory testing are required to sufficiently classify soils, determine the requirements for lining, identify possible PASS and sodicity issues and seasonal groundwater fluctuations. More detailed investigations such as Acid sulfate soils testing will be required in the detailed design stage, if deemed necessary.

Editor's note—Part 9.4.2 Healthy waters code sets out requirements for acid sulfate soils, including the reporting and management requirements to be achieved.

Installation of a series of shallow groundwater wells will be required to sufficiently characterise the shallow groundwater regime (if this occurs) and possible groundwater related impacts and risks due to the proposed lake. Monitoring of water levels at fortnightly intervals over a continuous full dry and wet season will be required as a minimum to support the lake design. The monitoring wells will be required to be available following the lake construction for monitoring purposes, and should be provided with lockable standpipes. A typical shallow monitoring well is indicated in Figure SC6.4.3.12.7 below.

Soil and groundwater investigations must identify potential risks and possible management options and further testing and monitoring required. This also includes assessments on nutrient hazard, which will require soil and groundwater nutrient characterisation. Other site conditions such as perched water tables, waterlogged areas where anaerobic condition exists are to be identified as these can promote the formation of nutrients into bio-available forms.

Additional design and investigation may be required during the detail design stage to manage identified risks.

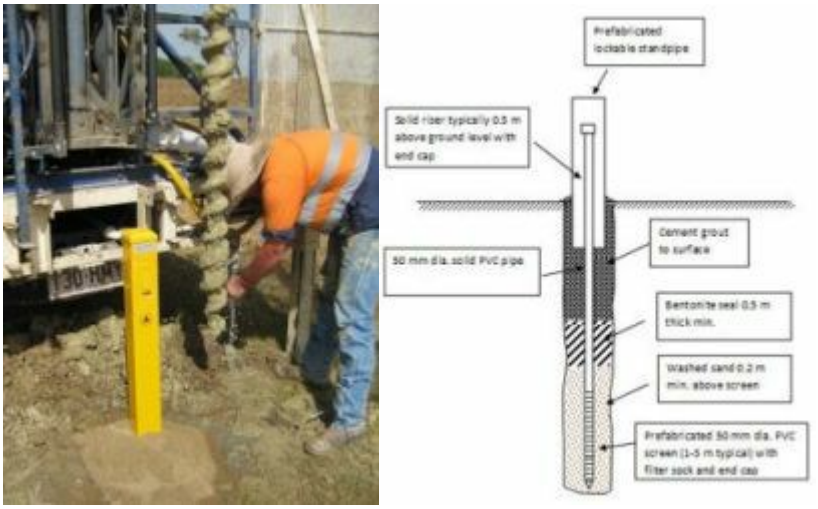


Figure SC6.4.3.12.7 Typical monitoring well installation

(4) Step 4 – Lake inflows and outflows

(a) Lake inflows will depend on the type of lake proposed. Inflows to fresh water lakes will be governed by catchment dependent stormwater runoff. As the source of inflow is typically limited to urban runoff entering the lake, water level variations of one metre or more could be expected throughout the year.

Saline lakes typically have a constant source of water available, and as such water level variations will depend on the configuration of inlets and outlets in such cases. For example water level fluctuations can be maintained constant throughout the year with pumped delivery.

Whether designing saline or fresh water lakes, inlets and outlets must be configured to maintain the intended operation of the lake as either a saline or fresh water system, this includes preventing tidal influences to fresh water lakes, and large fresh water inputs to saline lakes (e.g. stormwater inflows or pumped fresh water during the wet season where the source of water is from estuaries).

Maintaining the intended type of lake (i.e. fresh or saline) will minimise possible detrimental impacts to the aquatic flora and fauna that establishes within the lake.

Lake outflows are typically associated with evaporation and seepage losses as well as overflows controlled by the lake outlet.

Depending on the lake system proposed sufficient information must be provided to council to define both inflow and outflow. Typical details that should be defined (where relevant) include:

(i) catchment area draining to the lake, including characteristics (land use, per cent impervious);

(ii) drainage network connecting to the lake (existing and proposed);

(iii) upstream water quality improvements (applicable to freshwater lakes only);

(iv) source of water, quality and sustainability;

(v) pump or gravity diversions to the lake including required rates and necessary controls; and

(vi) outflow type including provision for water level manipulation and maintenance draining.

(b) Freshwater lake considerations

(i) Water quality improvements

Catchment inflows contributing to freshwater lakes must be demonstrated to achieve the minimum water quality improvement targets. A separate Stormwater quality management plan is required detailing upstream stormwater quality improvement devices and demonstrates through MUSIC modelling expected water quality improvements.

Editor's note: SC6.4.3.8 Stormwater quality management plans for development provides guidance to applicants on the preparation of SQMPs, including the use of MUSIC modelling.

Target pollutant load reductions for new developments relevant to Townsville are:

(A) 80% reduction in Total Suspended Solid;

(B) 65% reduction in Total Phosphorous;

(C) 40% reduction in Total Nitrogen; and

(D) 0% reduction in gross pollutants (>5 mm particles).

Modelling is to consider 6 minute rainfall data for Townsville for the period 1970-1983 (mean rainfall 1,165 mm). Upstream stormwater quality improvement devices must be designed in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(i) Modelled catchment inflows

The expected inflow volume and seasonal variation is to be modelled, considering catchment characteristics and upstream treatment devices. Modelled inflows must only account for treated flows entering the lake, overflows are not to be included. Modelling of catchment inflows must be undertaken at a suitable time step to accurately model diversions to treatment devices. Typically this is at 6 minute intervals for urban catchments. Modelled inflows can be transformed to daily aggregates for further interrogation such as water balance modelling to review lake water level variation. MUSIC modelling used to demonstrate upstream water quality improvements can be adapted to provide catchment inflow series at daily time steps.

(5) Step 5 – Determine a preliminary lake layout

Develop a preliminary layout within the site constraints. The preliminary layout should consider:

(a) soils and groundwater;

(b) topography;

(c) waterways and flood plains;

(d) existing vegetation;

(e) surrounding environments;

(f) flora and fauna;

(g) natural features such as significant trees, exiting aquatic environments (billabongs, wetlands, marine plants);

(h) coastal management and erosion prone zones;

(i) buffer distances; and

(j) easements and service corridors.

Baseline surveys are critical at this stage to fully understand site constraints and opportunities. These include topographic, drainage, vegetation and flora and fauna surveys. Soils and groundwater assessments must be presented in a separate report as detailed in SC6.4.3.12.5(2) Step 2. Delineation of the highest astronomical tide (HAT) level and mean high water spring tide level (MHWS) will also inform the potential impact on erosion prone zones. For Townsville these levels correspond to:

- HAT = 2.254m AHD; and
- MHWS = 1.254m AHD.

Site reconnaissance and review of aerial photographs must be undertaken at this stage to fully understand the site constraints and opportunities.

Based on climatic conditions for Townsville, the maximum fresh water lake area (at wet season normal water level) is considered at 2.5% of the contributory catchment (considering 50% impervious fraction). Refer to SC6.4.3.12.5(7) Step 7. Smaller areas may be necessary for algal management (refer to SC6.4.3.12.5(8) Step 8).

The lake configuration should consider shapes that avoid dead end zones or result in poorly mixed waters.

Minimum length to width ratios of 3L:1W are recommended to ensure good hydraulic efficiency.

Where possible the orientation of lakes should be in a north west/south east alignment corresponding with the dry season prevailing wind. Lakes should not include islands as these can create poor water circulation and provide a refuge for birds that can contribute to nutrient loads to the lake.

Preliminary layouts should make provision for batters, edge treatments and buffers (refer to SC6.4.3.12.5(11) Step 11). These can add considerably to the overall lake area above the normal lake water level and can impact on the final layout.

Lakes should avoid areas where poorly structured soils (e.g. high organic content, peats, sodic soils), high acid sulfate potential and/or high nutrient hazard is identified.

Lake layouts must also demonstrate that the lake blends into surrounding environments and enhances natural features. Consideration must also be given to linking with recreational and landscape master plans for the area as well as public interaction and education opportunities.

Lakes should also avoid constricted flood ways where flow velocities can be high during flood events.

Editor's note: Applicants should refer to Part 8.2.6 Flood hazard overlay code for details of flood across the Townsville region.

(6) Step 6 –Lake bathymetry

A lake stage/storage/area curve must be developed for council review, including allowance for lake batters (refer to to SC6.4.3.12.5(11) Step 11 for typical acceptable edge treatments). The bathymetry should consider the proposed shape within the site constraints. The depth of the lake must be between 1.5 and 3 m, preferably in the range of 2-2.5 m. Lake depth is considered from wet season normal water level to finished lake bed level.

Depths greater than 3 m are more prone to stratification, which can potentially lead to the release of nutrients to upper waters when they de-stratify, potentially increasing the risk of phytoplankton blooms, particularly Cyanobacteria (toxic blue green algae). A minimum depth of 1.5 m must be provided to allow maintenance equipment such as floating weed harvesters to access lakes.

(7) Step 7 – Undertake water balance modelling

Water balance modelling is required to review the seasonal water level variation of lakes. The proponent must demonstrate to council the expected water level variation over a minimum 10 year continuous modelling period.

The general form of the water balance equation is given by:

$S=I-O$

where

S=storage, I=inflow, O-outflow

(a) Inflows:

(i) catchment runoff entering the wetland (see SC6.4.3.12.5(4) Step 4); and

(ii) direct precipitation over the lake.

Other inflows such as groundwater and base flow are difficult to quantify and can only be considered where sufficient data supports their use. As a conservative approach these can be ignored.

(b) Outflows:

(i) evaporation losses (determined from the stage/storage/area curve, as derived from SC6.4.3.12.5(6) Step 6 and typical daily evaporation rates for Townsville);

(ii) lake outflows/overflows; and

(iii) seepage losses.

(c) Water level variation

Water balance modelling must demonstrate that lake water level drawdown from wet season normal water level does not exceed 1 m once every 10 years on average and less than 0.7 m on a more frequent

basis (on average once every 2 years or less).

Based on climatic conditions for Townsville, the maximum fresh water lake area (at wet season normal water level) is considered at 2.5% of the contributory catchment (considering 50% impervious fraction).

(d) The overall size of the lake will also need to consider algal management issues, as described in SC6.4.3.12.5(8) Step 8. Where algal management options consider recirculation through a wetland, water balance modelling must also include the impacts from inclusion of the recirculation wetland. Refer to SC6.4.3.12.5(8) Step 8.

Designers must be aware of the implications of water level variations with respect to edge treatment survival and visual amenity. Design steps should be taken to limit water level variation to no more than 1 m once every 10 years and 0.7 m once every 2 years, and this may require the inclusion of:

(i) a lake liner to minimise seepage losses; or

(ii) provision for lake top-up.

Designers may need to consider hard edge treatments to minimise visual impact in high amenity areas or supplementary irrigation to maintain lake edge vegetation. SC6.4.3.12.5(11) Step 11.

Photos: Shaun Leinster

Figure SC6.4.3.12.8 Examples of impacts due water level variations

(e) Lake top-up

Where designers consider lake top-up to maintain lake water levels, suitable sustainable sources are to be considered. These may include the use of harvested stormwater and groundwater for fresh water lakes. Where groundwater is proposed the proponent must undertake necessary hydrogeological investigations to demonstrate that the proposed pumping does not detrimentally impact on the local groundwater resource. The quality of the groundwater must also be demonstrated to not negatively impact on the health of the lake.

Lake top-up for saline lakes must maintain the salinity of the lake at greater than 15,000 mg/L. This may require the provision for salinity control on pumped delivery to lakes from estuaries to ensure wet season fresh water pulses are not delivered to the lake.

Potable mains supply is not considered an acceptable source for lake top-up.

Where harvested stormwater is considered for lake top-up for fresh water lakes sufficient storage must be available. The volume of storage required can be estimated from the water balance modelling, but as a general guide is in the order of 15 ML per hectare of lake per annum to maintain constant water levels throughout the year, where the lake area is taken at the wet season normal operating level.

Storages can be constructed storages or use of natural underground aquifers. Constructed storages to provide sufficient top up for Townsville fresh water lakes are typically not considered practical due to the significant volumes that would be required (typically in the order of the total lake volume), although dedicated storage dams may be considered.

When considering aquifer storage opportunities, hydrogeological investigations will be required to determine the feasibility, which will include assessing the capacity of the aquifer to store water and the potential impact on the native groundwater and other users. Storage of water in shallow aquifers is not recommended due to the possible impact on adjacent structures and possible water logging. Design guidance on aquifer storage and recovery (ASR) is outside the scope of this guideline. Specialist hydrogeological advice must be sought should this option be pursued.

(8) Step 8 - Algal management

A key design consideration for algal management in lakes is the management of trigger mechanisms such as nutrients and turbidity, and the removal of algal biomass from the lake water body before bloom concentrations occur. Algal biomass removal rates should be at least equal to the in-situ algal growth rate. Algal biomass removal can be facilitated via a number of methods including lake flushing or removal through a recirculating wetland. Other methods are available and are included in SC6.4.3.12 Attachment A: Alternative strategies for managing Cyanobacterial growth.

Photos: Shaun Leinster

Figure SC6.4.3.12.9 Examples of blue-green algae

A probabilistic approach based on lake residence time has been adopted in Queensland, such as the Brisbane City Council's *WSUD guidelines for Pond and Lake Design* and also *Mackay Planning Scheme Policy 15.15* – Constructed lakes for minimising the risk of Cyanobacterial growth in constructed lakes. These recommend a 20th percentile residence time for lakes not exceeding 20 days.

The Mackay Planning Scheme Policy 15.15 – Constructed lakes also stipulates that where the lake residence time criteria is exceeded, then water can be recirculated through a wetland at a rate that ensures lake turnover every 20 days. A minimum wetland residence time of 5 days is also stipulated to provide sufficient contact time (two growing cycles) for algal biomass removal.

The effectiveness of a recirculation strategy using surface wetlands for algal management in Townsville is still largely unknown and the required recirculation rates for Townsville conditions are also currently unknown. However recirculating lake water through surface flow wetlands is considered a sound approach with respect to removal of suspended solids (and thus turbidity) and nutrients in lake water, two key triggers for changes in state for shallow lakes.

Whichever algal management method is proposed, the proponent must clearly demonstrate that the strategy is effective in removing algal biomass to minimise the opportunities for algal blooms.

In the absence of further information, proponents proposing constructed lakes in Townsville must demonstrate that the entire lake volume is "flushed" through the lake within a 20 day period for the control of algal biomass. As rainfall dependent catchment inflows in Townsville will result in extended periods where full lake volume turnover is not achieved (e.g. >100 days during the dry season), other sources such as diverted surface water and groundwater will be required. The rate of diversion can be estimated simply as follows:

Required lake inflow rate (m3/d) = lake volume (m3)/20 days

Where flushing is adopted, the source of water used must have a nutrient, turbidity, algal bio-mass less than or equal to the lake water and salinity ranges should be maintained for the intended lake type (refer to Table SC6.4.3.12.2 Suggested target values for physico-chemical indicators).

(a) Recirculating wetlands

Where no external flushing supply is available, provision for a recirculating wetland for algal management should be made. The following design criteria are considered:

(i) recirculation of the full volume of lake water through the wetland every 20 days;

(ii) minimum wetland contact time of 5 days;

(iii) treated water re-entering the lake must have turbidity, nutrient and algal biomass levels less than or equal to the lake water; and

(iv) water re-entering the lake must be at opposite ends from where water is abstracted from the lake to avoid short circuiting of treated flows.

This strategy does not guarantee that no algal blooms will occur and proponents must also develop an adaptive management plan for algal blooms.

For the above design considerations, the approximate size of the recirculating wetland is 1.5 times the area of the lake based on an average wetland depth of 0.3 m. Smaller recirculating wetlands can be considered where the proponent can demonstrate that algal biomass removal rates are greater rates than those assumed in the above derivation. For example, ultrasonic treatments of recirculated lake flows can potentially reduce algal biomass concentrations, thus reducing the recirculating wetland size. A further alternative may be the use of floating macrophyte beds, which can remove bio-available nutrients from the water column, and can be used within the lake or as part of the recirculation strategy. This option will require regular harvesting of the floating macrophytes to reduce nutrient loads from the lake.

Design of the recirculating wetland must consider maintaining the health of the wetland and associated vegetation. This requires the recirculating wetland to be operated continuously throughout the dry season to maintain a permanent pool of water over the majority of the wetland area. To minimise recirculation rates the recirculating wetland is considered as a shallow planted system, without deep pool areas. This differs from stormwater treatment wetlands where deep pool zones are included, and typically cover up to 20% of the total area in the dry tropics (refer to SC6.4.3.9 Water sensitive urban design guidelines).

An average wetland depth of 0.3 m is considered sufficient for recirculating wetlands and will include shallow to deeper zones supporting a range of emergent macrophytes from shallow marsh (0-0.2 m), marsh (0.2-0.35 m) and deep marsh (0.35-0.5 m). The wetland area needs to be sized to provide a 5 day treatment time, considering the minimum recirculation rate determined for the lake volume (refer to above). In this case the wetland area can be estimated as follows:

Recirculating wetland area = 5 days x recirculating pump rate (m3/d)/ave wetland depth (0.3 m)

The overall configuration of the recirculating wetland must consider inlets and outlets at opposite ends and minimum length the width ratios of 5L:1W to maintain good hydraulic efficiency and thus mixing throughout the wetland. Wetland shapes must avoid dead end zones and possible short circuiting. Designers are directed to SC6.4.3.9 Water sensitive urban design guidelines for further advice on the design of constructed wetlands.

(9) Step 9 – Select final lake layout

Following approval of concepts presented to council, the final lake area must be selected considering the soil and site constraints from SC6.4.3.12.5(3) Step 3 and SC6.4.3.12.5(5) Step 5, depth ranges within those indicated SC6.4.3.12.5 (6) Step 6, acceptable water level variations derived from SC6.4.3.12.15(7) Step 7 and additional allowances where recirculating wetlands are proposed for algal management SC6.4.3.12.5(8) (Step 8).

The final lake configuration must consider shapes that avoid dead end zones or result in poorly mixed waters. Minimum length to width ratios of 3L:1W are to be provided to ensure good hydraulic efficiency.

The final lake layout will need to integrate with the approved landscape and amenity plans for the development, development road layouts, accesses and required civil works.

(10) Step 10 –Design of inlets, outlets and other hydraulic structures

Lake inlets and outlets should be located at opposite ends of the lake to promote uniform movement of water through the lake and avoid short circuiting of flow. The design of inlet and outlet structures will depend on the type of lake proposed. Inlets and outlets must be designed for minimum maintenance and must make provision for scour control at pipe outlets.

Inlets and outlets must not be subject to blockage through excessive silt and debris build up and/or excessive vegetation. Design actions may include:

- provision of stone pitching at inlets and outlets to prevent vegetation growth; or
- suitable screens to minimise debris ingress.

Inlets and outlets structures are to result in minimal visual impact and may be hidden under boardwalks or amongst rocks, for example.

The proponent is to provide engineering calculations for the design of lake hydraulic structures, the design of which will differ depending on whether a fresh water or saline lake is proposed. The designer is directed to other parts of SC6.4 Development manual planning scheme policy as relevant, the *Queensland Urban Drainage Manual*, and the *Road Drainage Manual* for more design guidance on specific hydraulic design of pipes and pits and erosion protection at pipe outfalls.

The influence of tidal variation including storm surge, wave setup and impacts of climate change must be detailed to council. For the purposes of design the following tide levels are noted for the Townsville region (Townsville Harbour, QDOT, 1998):

Tidal plane	mAHD
Highest Astronomical Tide (HAT)	2.254
Mean High Water Springs (MHWS)	1.254
Mean Sea Level (MSL)	0.1
Mean Low Water Springs (MLWS)	-1.13
Lowest Astronomical Tide (LAT)	-1.86

The designer must consider the potential impacts of sea level rises due to climate change and make provisions in the design for such increases.

In the case of saline lakes proponents must clearly indicate how lake flushing will be achieved and any necessary pumping equipment, control and telemetry systems that may be required to facilitate operation.

(a) Inlets

Inlets to lakes may be gravity diversion of treated stormwater runoff or pumped delivery from adjacent water bodies (e.g. from estuarine river systems).

Stormwater inflows

In the case of piped stormwater flows to lakes, pipe inverts from upstream catchments should be set no lower than lake wet season normal operating level. This will avoid permanent water within the pipe drainage system and maintain hydraulic capacity of the connecting pipe drainage. Suitable erosion protection at the pipe outfall must be provided to prevent scour. Refer to QUDM, 2007.

Photos: Shaun Leinster

Figure SC6.4.3.12.10 Examples of concealed inlets to lakes

Provision for a gross pollutant trap may also be required to capture litter and leaf matter prior to discharge to the lake.

Where a separate inlet sedimentation zone is proposed, the designer is directed to the SC6.4.3.9 Water sensitive urban design guidelines for further advice.

Pumped inflows

Pipe outfalls to lakes for pumped delivery may be submerged, however suitable backflow prevention devices must be installed to prevent possible draining of the lake.

Photos: Ralph Williams

Figure SC6.4.3.12.11 Pump intake from Ross River – note blocked screen (L), and pumping infrastructure including sump and control equipment (R)

Pumped delivery systems must consider aspects such as the control of delivery to the lake. This may include the control of the pumping regime through tidal cycles and preventing fresh water being pumped to the lake. The expected pumped volumes with respect to the lake volume should be demonstrated to allow sufficient flushing. A flow meter on the discharge side of the pump is recommended. Suitable arrangements must be made in case of pump failure to ensure minimum flushing rates are maintained. This may include a standby pump. Provision for internal lake recirculation may also be required where extended periods of fresh water during the wet season at the source of pumping prevent delivery to the lake.

(b) Outlets

Lake outlets can be configured in a number of ways and will determine the normal wet season operating level. Lakes for flood mitigation purposes are not encouraged in Townsville region and should by-pass high flows, thus the design of lake outlets will only need to consider design inflows (e.g. connecting pipe capacity or pumped diversion rate) and any incidental rain over the lake.

Impacts of possible tailwater effects at pipe outlets must be considered when sizing outlet pipes. Refer to QUDM, 2007 for further guidance.

In the case of fresh water lakes, ingress of tidal waters to the lakes must be prevented. Water levels to HAT (2.15 m AHD) must be considered in this case. Allowances for tidal surges should also be made.

Outlets must be designed to minimise potential blockage. An overflow path (e.g. weir) should be provided in case of outlet structure blockage. This will minimise potential damage to vegetated edge treatments.

Overflow pit and discharge pipe
Overflow pits can be located within the lake water body, with the crest of the pit defining the normal lake wet season operating level.
The design should consider:

(i) pit dimensions such that pit capacity is greater than the connecting culvert capacity;

(ii) suitable pit grate to protect against clogging by debris;

(iii) minimal visual impact;

(iv) prevent local fauna such as ducks from entering the pit; and

(v) capacity to drain the lake for maintenance.

Additional guidance is provided in the SC6.4.3.9 Water sensitive urban design guidelines.

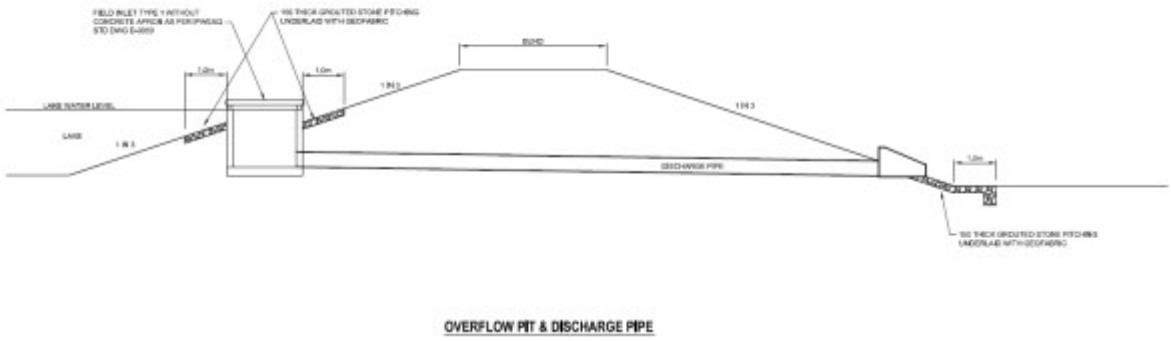


Figure SC6.4.3.12.12 Typical overflow pit and discharge pipe details

Outlet pit and discharge pipe
Outlets may also consider submerged pipes connecting the lake to an outlet pit with a discharge pipe. The lake normal water level may be set via an open ended riser pipe or a weir plate in the outlet pit. Either can be configured to be easily removed to facilitate maintenance draining.

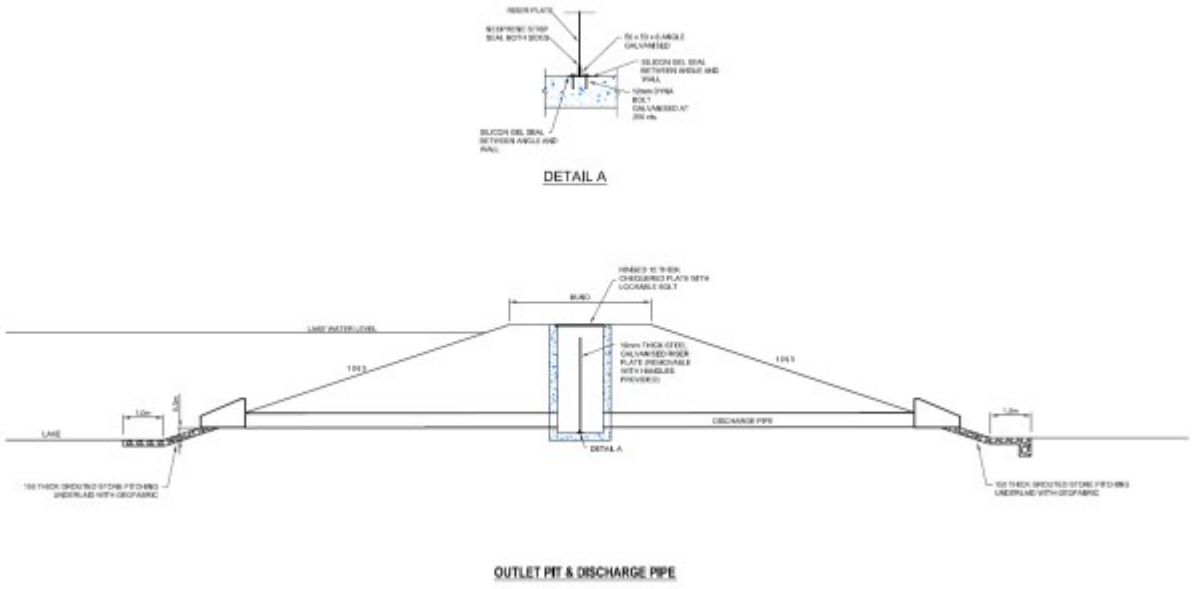


Figure SC6.4.3.12.13 Typical outlet pit and discharge pipe details

Overflow weir

Lake outlets may also be controlled via an overflow weir with weir levels set at the normal wet season operating level. This may also include outlet culverts that effectively operate similar to a weir i.e. the culvert invert defines the normal wet season operating level.

Suitable erosion protection such as rock pitching must be provided at lake outlets and overflows.

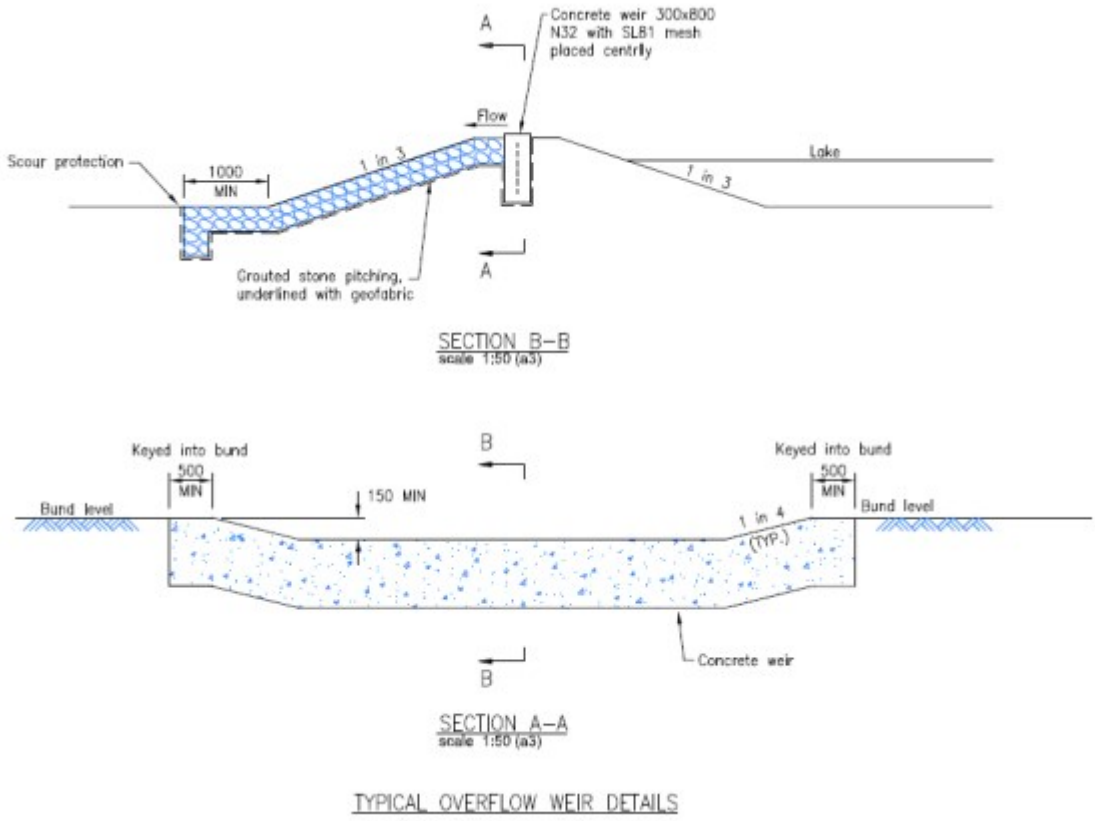


Figure SC6.4.3.12.14 Typical overflow weir detail

(c) Interconnections between lakes

Where separate interconnected lakes are proposed, suitable connections between lake water bodies must be provided. This may include open channel/weir connections or culvert connections. The design

must consider:

(i) maintaining good hydraulic efficiency and mixing between water bodies;

(ii) minimising head losses between water bodies during operation;

(iii) maintaining access between the lake water bodies; and

(iv) provision for lake drawdown during maintenance.

Where open channel/weir connections are proposed, the designer must consider the potential impact of any necessary recirculation strategy. In such instances, preference is for submerged pipe connections, to maintain hydraulic interconnection between lake water bodies during the dry season when lake operating levels are below wet season normal water levels. As lake water level variations of up to 1 m are considered, submerged pipes obverts should be at least 1 m below normal wet season operating levels.

Where gravity drainage is proposed for lake maintenance, interconnecting pipes will need to consider inverts that facilitate adequate drawdown of all connected water bodies.

(d) Maintenance drain

Provision for a maintenance drain must be made to allow the lake to be drained for periodic maintenance. This drain can be a manually driven gravity drain or where gravity drainage is not possible provision for pumping must be made. The proponent must state the proposed method of draining and where pumping is proposed suitable access must be allowed for pump maintenance. The cost of pumping must also be considered in any life cycle costing (refer to SC6.4.3.12.5(18) Step 18).

The operation of the maintenance drain should ideally allow lake drawdown within seven days, although for large lakes this may not be possible.

The proponent must considered impacts of lake draining on potential acid generating conditions that may occur as well as the potential impacts on downstream receiving bodies due to the draining.

The maintenance drain must also facilitate water level management during establishment, particularly for establishing lake edge vegetation.

(11) Step 11 - Design of lake edges and batters

Lake edges play an important role in weed management for lakes. Edge treatments must also consider large water level variations (up to 1 m are allowed on an infrequent basis and 0.7 m on a more frequent basis, refer to SC6.4.3.12.5(7) Step 7), including visual amenity aspects and survival of edge vegetation. Edge treatments must consider public safety (refer to SC6.4.3.12.5(17) Step 17).

To minimise exposed edge width due to water level variations, batters slopes at a minimum 3H:1V are preferred. Flatter slopes above wet season normal water level are permitted depending on the final treatment. Where turf areas are proposed batter slopes of no more than 5H:1V must be provided to allow mowing. Typical edge treatments for both fresh and saline lakes are indicated in Figure SC6.4.3.12.15.

At the ROL/MCU stage the proponent must indicate the type of edge treatments proposed, including the structure and mix of edge treatment (refer to SC6.4.3.12.5(12) Step 12).

At the operational works stage, lake edges must be considered based on an updated water balance based on the final lake layout to confirm expected water level variations established from preliminary layouts.

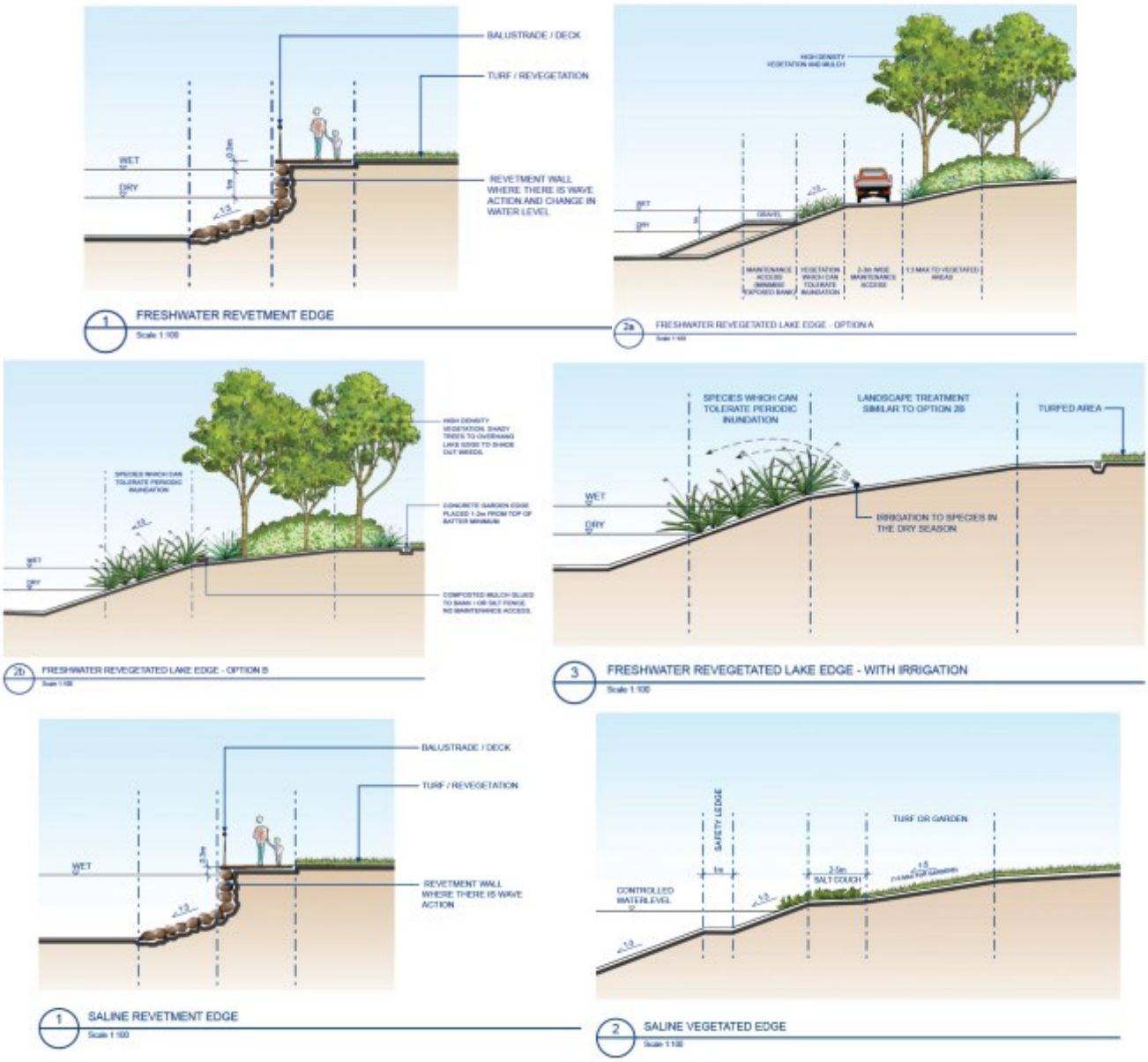


Figure SC6.4.3.12.15 Typical examples of edge treatments for fresh and saline lakes

(12) Step 12 –Vegetated lake edge treatments

Editor's note—applicants should also refer to 9.4.3 Landscape Code and Development manual planning scheme policy sub section SC6.4.3.6 Landscape policy.

The structure and mixture of vegetation of the proposed lake edge will be a key design consideration for a well performing edge treatment. Lake edge treatments should aim to re-establish a mix of local indigenous species including trees, shrubs, groundcovers and grasses that complement and enhance the amenity of the area. Adjacent parkland vegetation may consider similar species to lake edges to integrate the lake with the surrounds, or alternatively different species may be used to provide a contrast to highlight the lake as a feature within the landscape.

At the ROL/MCU stage the proponent should indicate the proposed structure and mix of vegetation for the proposed lake, together with the proposed methods for establishing and maintaining healthy vegetation. The expected lake water level variations are also required.

Editor's note—guidance on typical options for varying lake edge conditions are presented previously in SC6.4.2.12.5(11) Step 11, and can be adapted to suit specific requirements of the proposed lake.

For operational works approval the proponent should clearly detail proposed treatments including:

- plant species;
- location with respect to lake water level;
- planting density and layout; and
- planting methods.

Planting details should be indicated in plan and section in the detail design drawings. Guidance on plant species suitable for the Townsville region is provided in SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.3.6 Landscape policy.

Various types of treatments can be used and the type and density will be a key design consideration for the effective performance of the treatments. Broadly edge treatments can include:

- perennial sedges and rushes (emergent macrophytes);
- ground covers;
- shrubs;
- turf;
- trees; and
- mulches.

A minimum planting of 1 m vertically above wet season normal water level is considered necessary to provide stable edge treatments.

Successful establishment of vegetated lake edges will include:
Good soil preparation including a minimum 200 mm topsoil. Soils are to be amended where necessary to be considered as agronomically acceptable. Topsoils are to be laboratory tested to AS4419-2003 *Soils for landscaping and garden use* to ensure topsoil suitability for plant growth. Topsoils must not contain weeds or susceptible to acid generation which may kill off plants. Amendments such as lime and gypsum may be required.

- selection of an appropriate planting time. Planting toward the end of the dry season is preferred to take advantage of early wet season rains.

- maintaining good moisture for plant growth during establishment. This may include; supplementary irrigation and mulching;
- protection from disturbance during establishment;
- replacing damaged or dead plants; and
- removing weeds both prior to and during establishment.

(a) Perennial sedges and rushes (1.0 m below to 0.2 m above wet season NWL)
Sedges and rushes provide a soft natural edge to lakes. The use of sedges and rushes are important in minimising weed ingress and provide a dense barrier to the lake edge minimising human contact with water and thus reducing safety risks. It is important that sedges and rushes are planted in high densities (20 plants/m^2) and permanently occupy the edge to limit the opportunities for weed establishment. Typically dense vegetation at least 1.2 m high and 2-3 m wide will be suitable.

Photos: Shaun Leinster

Figure SC6.4.3.12.16 Examples of edges treatments with sedges and rushes

Plant selection must be able to survive the expected water level variations and may require supplementary irrigation to ensure survivability during the dry season. Tall, small diameter stemmed, self-sustaining plants that distribute themselves by producing large quantity of seed are preferred.

Where possible, shade should be provided over sedges and rushes to minimise the potential ingress of weed species such as Para grass. Shade can be provided through planting of trees species adjacent to the lake edge. Aspect also plays an important role for shade considerations, with south facing banks providing good shade opportunities to lake edges.

(b) Ground covers and shrubs (greater than 0.2 m above wet season NWL)
Groundcovers and shrubs can be provided above the lake normal water level to help stabilise lake batters and provide aesthetic/landscape feature. Groundcovers and shrubs should be less than 1 m in height to maintain open visible areas. Groundcovers and shrubs are particularly useful where batter slopes greater than 3H:1V are proposed. For slopes greater than 3H:1V, ground covers with matting and rhizomatous root systems can assist binding the soil surface during establishment.

Photos: Shaun Leinster

Figure SC6.4.3.12.17 Examples of edge treatments using ground covers

(c) Turf
Turf treatments can be used to highlight the water body as a feature within the landscape and encourage recreational use adjacent to the lake. For maintenance purposes, batter slopes for turf treatments must be not greater than 5H:1V. Supplementary irrigation will most likely be required to maintain turf health.

For saline lakes, salt couch is a typical suitable edge treatment. Salt couch is particularly sensitive to extended periods of inundation and should be above the normal wet season water level. Salt couch extending 2-5 m from the water edge over a wide flat (10H:1V) area is preferred.

Photos: Shaun Leinster

Figure SC6.4.3.12.18 Example of a turf and salt couch edge treatment

(d) Trees

Trees provide an important function in the overall performance of lake edges where perennial sedges, rushes and shrubs are proposed. Trees provide shade which helps minimise ingress of weeds such as Para grass. In such cases, the tree location must be within close proximity to the edge such that shading is achieved. Tree densities of 1 2 per m^2 are recommended.

When selecting tree species, preference is for deep rooted species. Careful consideration must be made when grass and tree species are mixed together as grasses can kill off trees when establishing. Use of ground covers around trees are preferred. Ground cover legume species are preferred with trees, however legume tree species should be avoided (e.g. acacias).

It is likely that suitable education signage will be required around areas with tree planting to describe the function of trees with respect to the lake. Past experience with lakes in residential areas around Townsville has seen residents removing trees due to the desire for increased lake views and the perception that the native vegetation encourages snakes.

(e) Mulches

A variety of mulches are available to provide erosion protection and aid vegetation establishment at lake edges. The suitability of mulches will depend on the vegetation proposed and batter slopes. Typically, mulches should be bio-degradable and are usually 50-100 mm thick. Typical mulches include:

(i) straw/sugar cane mulches: are particularly useful for grass establishment where water for irrigation is limited. They are also useful where dispersive clay soils exist. Typically used in flat slope areas (less than 10H:1V), but can be used on steeper;

(ii) slopes with the use of tackifiers or with biodegradable mesh anchoring;

(iii) hydromulching: typically used for grass establishment, but will usually require greater watering requirements than straw mulch treatments. Adhesive binders and fertilizers are typically incorporated into hydromulch mixtures, together with fibrous matrix of wood or paper pulp and grass seed. Hydromulching is particularly suited to steeply sloping sites or areas with difficult access;

(iv) bush mulches: includes mulches such as bush mulch, bark and wood chip and are most suited to shrub and tree areas. They are not suited to areas where grasses are proposed and should only be used where tube stock planting is planned;

(v) compost blankets: particularly suited to revegetation of steep slopes with grasses and plants. Also useful when topsoil placement is difficult or insufficient topsoil is available;

(vi) bonded fibre matrix: a fibrous glued type mulch, highly suitable for vegetating steep slopes, particularly in wet environments. This form of mulch treatment can be moulded to form effective erosion control barriers, and may be suitable in lieu of silt fences near lake edges; and

(vii) rock mulching: mostly applicable to areas where plants establishment is difficult or in high amenity areas. Rock mulches are prone to siltation and should only be used when absolutely necessary.

Photos: Shaun Leinster

Figure SC6.4.3.12.19 Examples of the use of mulches at or near lake edges

(13) Step 13 – Maintaining flood capacity

The proponent must demonstrate to council that the operation of the lake must have no adverse impact on flood capacity, this includes the capacity of upstream catchments contributing to the lake and regional flooding where lakes are located on floodplain areas. Specialist hydraulic advice will need to be sought to confirm flood capacity.

Lakes in Townsville are not intended for flood management purposes. High flow by-pass provisions will be required where applicable. Standard design procedures such as Manning's equation can be used to size the high flow channels. Suitable stabilisation such as turfing must be provided and must be suitable for the expected velocity ranges.

Lakes must also make provision for an emergency overflow in the case outlets become blocked. This may include an overflow spillway (refer toSC6.4.3.12.5(10) Step 10) or demonstration that embankments are sufficiently strong to withstand overtopping. Erosion protection must be provided at overflow points.

(14) Step 14 - Lake maintenance access

The proponent must clearly indicate the location of accesses for lake maintenance. The minimum access requirements for lakes include:

(a) de-silting including dewatering pads at specified locations;

(b) debris removal;

(c) weed removal (floating and terrestrial);

(d) inlets and outlets and other hydraulic structures; and

(e) pumps and switch gear, where applicable.

Accesses should be blended into the general landscape of the lake so as to soften the impact. This may include incorporating perimeter access track as walking trails, screening of high impact accesses or incorporating into viewing areas.

Accesses must be sized to provide sufficient space to undertake the work, including sufficient turnaround areas.

Accesses for heavy machinery (e.g. excavator) must be designed for a 20 tonne capacity and of sufficient width to allow turnaround. Access provisions must also consider the maximum reach of heavy machinery (e.g. 10 m for an excavator). Access ramp slopes are to be no greater than 5H:1V. Public access to heavy machinery access points must be restricted.

The location of accesses for debris removal will need to consider prevailing wind conditions during both the wet and dry season together with lake orientation. This will determine likely collection zones for debris. Prevailing wind directions for Townsville are:

- April to November: South easterly; and
- December to March: North easterly.

Note—dewatering pads must be of sufficient distance from residential dwellings and commercial premises so that odours are unlikely to cause offense.

Provision for access to the main lake water body must be made to allow access for mechanical weed harvesters for removal of floating or submerged weed. A boat ramp type access is considered acceptable.

Photos: Jason Lange, and Sunshine Coast Regional Council and Ecologoical Engineering

Figure SC6.4.3.12.20 Examples of aquatic weed removal methods

Provision for de-silting must be made at lake inlet zones. This includes a suitable ramp to the base on the inlet zone. Provision of a hard base to the inlet bay must be made to indicate when the floor of inlet zone is reached by machinery operators. A hardstand dewatering pad at the inlet zone must be provided and graded to drain back to the inlet zone. Other de-silting accesses may be necessary should sediment accumulation be anticipated at other areas of the lake.

Suitable access must be available at all inlet and outlet structures. Where inlets and outlets are concealed under decks, amongst rocks and plantings, the proponent must demonstrate how access will be achieved at these points.

Vehicle access around the lake perimeter is to be provided for incidental monitoring and maintenance such as mowing, weed removal, mosquito larvae monitoring and removal. This can be incorporated as part of pedestrian trails around the lake.

Access to all pump and switch gear installations must be made and must allow for provision for pump replacement (i.e. crane access).

Where lake fountains are proposed pumping equipment should be located at the shoreline and not within the lake to allow easier access for maintenance.

Sufficient accesses must be provided to minimise vehicles driving on lake edges where wheel ruts can form. These can potentially provide a habitat for mosquito breeding.

(15) Step 15 - Vector control

A mosquito baseline survey/audit must be completed for all proposed lakes to establish the existing mosquito populations prior to construction. This baseline information should consider seasonal variations in mosquito populations and would likely require regular monitoring for an entire wet and dry season period prior to lake construction.

The proponent must detail design actions that minimise the occurrence of mosquitoes due to the proposed lake and associated installations such as any necessary recirculating wetlands and pump sumps. Standard design practices to minimise mosquito breeding include (adapted fromSC6.4.3.9.5(2)(i) Designing to avoid mosquitoes):

(a) providing access for mosquito predators, such as fish and predatory insects, to all parts of the water body (avoid stagnant isolated areas of water). Native fish species must be used;

(b) where possible, incorporating a steep slope into the water, preferably greater than 3H:1V;

(c) wave action from wind over open water will discourage mosquito egg laying and disrupt the ability of larvae to breathe;

(d) providing a bathymetry such that water draws down evenly so isolated pools are avoided;

(e) providing sufficient gross pollutant control at the inlet such that human delivered litter does not accumulate and provide a breeding habitat;

(f) providing suitable access to likely debris collection points (refer to SC6.4.3.12.5(14) Step 14) for removal of any accumulated debris;

(g) providing ready access for field operators to monitor and treat mosquito larvae, if required;

(h) ensuring maintenance procedures do not result in wheel rut and other localised depressions that create isolated pools when water levels fall;

(i) ensuring pits and sumps are provided with lockable galvanised lids that prevent access to mosquito adults;

(j) ensuring overflow channels do not have depressions that will hold water after a storm event;

(k) aquatic plants such as Water Hyacinth, Salvinia and water lilies can provide a breeding medium for some mosquito species whose larvae attach to these plants under water. These plants should be removed immediately if encountered. Suitable access must be provided to facilitate floating weed removal (refer to SC6.4.3.12.5(14) Step 14);

(l) appropriate landscaping in areas surrounding lakes to ensure proper drainage. Surrounding areas with poor drainage (e.g. flat lake edge batters) can become mosquito breeding grounds; and

(m) limit water level variations where possible.

Further advice on suitable native fish species for mosquito control is available from the Department of Primary Industries. Permits for stocking lakes with native fish local to the area are not required. Care must be taken with the suitable fish selection to ensure no environmental harm from fish stocked in lakes, which can easily make their way into downstream rivers and creeks etc.

A mosquito monitoring program must be established for the proposed lake. Monitoring is to include adult trapping, at the lake site and larval surveys for areas that include water retained in shallow flooded vegetated areas. Typically monitoring frequencies will be intensive (weekly) during the wet season (December to March), and less frequent during other times (fortnightly to monthly).

Larval surveys can be undertaken by sampling water with a 300 mL ladle. As a general guide a larval density of 1 larvae per 2 ladle dips or higher is likely to indicate a potential mosquito problem for adjacent residents (Warchot and Whelan, 2008). Mosquito problems may also be identified from adult trapping indicating significant pest numbers or resident complaints.

An adaptive management strategy must also be developed for control of mosquitoes.

(16) Step 16 - Bird control

Lake designs must consider actions that discourage the establishment of large waterbird populations. Large bird populations can cause lake water quality issues due to additional nutrient and faecal contamination, and reduce local biodiversity by damaging native vegetation. Large bird populations in urban residential areas also can create nuisance issues such as noise and faecal droppings.

A number of design actions are available to control bird populations. These include:

(a) densely vegetating lake edges with sedges and rushes to inhibit access to shallow water for feeding;

(b) selecting non-roosting trees such as eucalyptus;

(c) avoiding ground covers and shrubs that support roosting or breeding of species such as ibis (e.g. some melaleuca species);

(d) discouraging opportunities for feeding including educational signage; and

(e) providing suitable refuse collection around picnic areas.

Note—islands in lakes should not be provided in lakes as these can attract and create a refuge for birds, for example Ibis.

(17) Step 17 - Public safety

Lake designs must consider public safety and be designed in accordance with the crime prevention through environmental design (CPTED) principles. The proponent must demonstrate how the lake will achieve and manage these outcomes.

Lake edge treatments play an important role in public safety. Various suitable lake edge treatments are provided in SC6.4.3.12.5(11) Step 11 and SC6.4.3.12.5(12) Step 12. Lake edge treatments can be formed to create a barrier to open water access through dense edge plantings or balustrades where revetment edges are planned.

Where vegetated edges are proposed, the designer must consider the requirement for steeper batter slopes (3H:1V) below normal operating levels to minimise exposed edge width. Suitable vegetation selection will be important where a vegetated barrier is provided. Safety ledges can also be provided just below normal operating level where access to the water body is available. Refer to SC6.4.3.12.5(11) Step 11.

Lake designs must minimise areas of concealment and ground covers should be chosen to maintain an open visible aspect.

Lake boardwalks and viewing platforms must be demonstrated to be safe for public use, including suitable barriers for children.

Adequate signage must be provided to indicate suitability for recreation activities (e.g. no swimming), and potential threats from local fauna (e.g. beware of crocodiles).

Passive recreation facilities such as paths and trials must not create a trip hazard and designed so that they are available to all groups of the population i.e. it should consider all abilities. Safe distances from paths to lake edges should be considered.

(18) Step 18 –Life cycle costing

Life cycle costs for the proposed lake must be determined over a life span of 30 years. The life cycle costs must include acquisition, construction, establishment, operation, monitoring, maintenance, replacement and disposal costs. The costs must also clearly indicate “who pays,” i.e. developer costs and council costs. This includes costs associated with pumping infrastructure, including power and carbon offsetting costs and those associated with monitoring (e.g. water quality, mosquito monitoring).

Comparisons of lake life cycle costs with a similar parkland area not containing a lake are to be provided to council.

The life cycle cost plan is to include an extended dry season and a longer than normal wet season every 5 years.

This information will be used by council to assess the financial sustainability of the lake system, to make design refinements with the proponent and to identify whether additional funds will be sought from proponents to manage the lake following handover to council ownership.

SC6.4.3.12 Appendix A - Alternative strategies for managing Cyanobacterial growth

The following is taken from DesignFlow, 2010. *“Constructed Water Bodies in Urban Areas of SEQ – Critical Analysis of Recirculation Strategy”*. Prepared for Water by Design.

Mechanical removal

Cyanobacterial surface scums may be mechanically removed using booms dragged behind boats and the concentrated Cyanobacterial scum on the surface pumped off. This technique is not widely used for the management of Cyanobacterial blooms as Cyanobacterial biomass will be present throughout the water column, and therefore only a small proportion of the algal biomass will be removed.

Atkins *et al.* (2001) reported the use of flocculation and mechanical removal techniques to manage a *Microcystis aeruginosa* bloom in the Swan River, Perth. A mixture of bentonite clay and polyaluminium chloride was used to flocculate and sink the *Microcystis cells* prior to mechanical removal using oil spill equipment.

The mechanical removal of Cyanobacterial biomass offers the advantage of also removing nutrient loads from the water body, however the disposal of the odorous and often toxic biomass may be problematic.

Ultrasonic treatment

Ultrasonic irradiation of Cyanobacterial cells is a relatively new strategy that has been proposed for managing Cyanobacterial growth in lakes. Many of the common bloom forming Cyanobacteria are characterised by the presence of gas vacuoles which enable the Cyanobacterial cells to regulate their position within the water column. The presence of gas vacuoles provides a competitive advantage to Cyanobacteria over the majority of other algal groups, as it enables the Cyanobacteria to scavenge nutrients from the hypolimnion (lower strata of the water column) and to optimise their exposure to light within the epilimnion (upper strata of the water column).

Lee *et al.*, (2001) investigated the use of ultrasonic irradiation as an alternative strategy for controlling Cyanobacteria, and found that the gas vacuoles of Cyanobacteria (*Microcystis viridis* and *M. aeruginosa*) were disrupted following brief exposure to ultrasonic irradiation, resulting in about 80% of the Cyanobacterial cells settling out. Decreased photosynthetic activity was observed following irradiation, suggesting that the ultrasonic treatment also inflicted damage to the photosynthetic apparatus of the Cyanobacteria.

A potential risk associated by exposing Cyanobacterial cells to ultrasonic irradiation is that the cell membranes may rupture, potentially releasing cyanotoxins into the water column. Interestingly, Lee *et al*., (2001) observed that ultrasonication of the *Microcystis* cells did not increase the concentration of cyanotoxins in the water column. More recent research has shown that ultrasonication of Cyanobacterial cells (for periods less than 5 mins) does not increase cyanotoxins (in this case Microcystins) but cyanotoxins may also degrade in the ultrasonic fields (Ma et al., 2005). The effects of ultrasonic irradiation upon other cyanotoxins such as cylindrospermopsin (*Cylindrospermopsis* and *Aphanizomenon*) and saxitoxins (Anabaena) have not been tested.

The evaluation of ultrasonic irradiation to control Cyanobacterial growth in lakes thus far has resulted in mixed outcomes. Nakano, et al. (2001) trialled the use of ultrasonic irradiation coupled with flushing in a large shallow hyper-eutrophic lake (1 m depth, 33 Ha) that was plagued by Cyanobacterial blooms. Whilst the use of the ultrasonic irradiation of reduced peak concentrations for chl-a from 200 ug/L to 130 ug/L (Lee, et al. 2002), the study was unable to conclusively demonstrate the effectiveness of the ultrasonic treatment upon Cyanobacterial growth.

Ahn, *et al.* (2007) used ultrasonic irradiation to control Cyanobacteria in a small eutrophic lake (2 m depth, 0.9 Ha). During the period of the year when Cyanobacterial blooms dominated the lake, chl-a concentrations remained low at approximately 10 ug/L compared to an adjacent control lake where chl-a concentrations varied between 20-87 ug/L.

The potential impacts of utilising ultrasonic irradiation to control Cyanobacteria upon other aquatic organisms are hitherto largely unknown. Ahn et al. (2007) reported that larger organisms (fishes and aquatic insects) did not seem to be affected by ultrasonication. Kotopoulis *et al.* (2009) found that acoustic pressures produced during ultrasonication surpassed the Nato Undersea Research Centre rules and proceedures (NURC) by 35 dB, and cautioned the use of ultrasonication in aquatic environments.

The use of ultrasonic irradiation of Cyanobacterial cells appears to offer a potential strategy to control of Cyanobacterial growth in small lakes where lake water can be readily recirculated through an ultrasonic unit. Further research is required to determine how this strategy might best be applied to small lakes, and to the effects of ultrasonication on aquatic ecosystems and cyanotoxin release and decay.

Sediment removal

The removal of the upper sediment layers from the lake bottom is a commonly used strategy for removing phosphorus loads from highly eutrophic lakes. One of the advantages in removing the upper sediment layer is that any Cyanobacterial resting cells (e.g. akinetes) will be also be removed.

Sediment removal should be considered a "last resort" option for reducing the risk of Cyanobacterial growth in constructed lakes. The removal of sediments from a lake may have a profound influence upon benthic organisms,

including the removal of macrophytes and fauna from the lake. In addition, sediment removal is generally confined to small lakes due to the costs associated with the removal and disposal of the contaminated sediments.

The removal of upper sediment layers may not be an effective strategy for managing Cyanobacteria in constructed lakes, particularly where stormwater inputs contribute nutrient loads sufficient for Cyanobacterial growth to occur. Lake systems with high submerged macrophyte cover are particularly susceptible to sediment removal, as the ensuing turbidity following the sediment removal may inhibit macrophyte recolonisation, which results in the reversion of the lake to an algal/CyanobacteriaCyanobacterial-dominated state.

Sediment capping
Sediment capping of in situ sediments involves the placement of a cover over the sediment to seal it off, thereby minimising the release of contaminants (nutrients) to the water column (Hart et al., 2003). Sediment capping may involve placing a physical barrier over the sediment (e.g sand or gravel) or providing an active barrier (Hart et al., 2003).

Active barrier systems are generally pervious geochemical materials that are capable of actively demobilising contaminants in the sediment pore water by adsorption or precipitation processes. A number of active barrier systems have been tested in lakes including calcium carbonate, zeolites, modified clays and kaolin amorphous derivatives (Jacobs and Forstner, 1999; Hart et al., 2003).

Both sediment capping methods offer effective strategies for reducing phosphorus release from sediments. Generally, physical barriers need to be placed during construction or following drawdown of lake water levels. Active barrier systems can be very expensive to use, and there is little information available detailing the long term effectiveness of these systems. The use of sediment capping in constructed urban lakes is unlikely to be a successful long-term strategy for managing Cyanobacterial growth due to the influence of stormwater pollutant loads upon in like water quality.

Phosphorus precipitation and inactivation
The strategy involves the use coagulants to reduce the overall available load of phosphorus available for Cyanobacterial growth. The coagulants are added to the lake water, where the coagulant binds to the bio-available phosphorus, then precipitates out of the water column as "flocs". The flocs settle down to the sediments where the phosphorus is effectively removed from the water column and locked up in a form that is unavailable for phytoplankton growth.

Coagulants commonly used to precipitate phosphorus within lakes include aluminium-sulphate, zirconium, iron and calcium salts, and some clay materials (Cooke, *et al*., 2005; Scheffer, 1998),

The effectiveness of coagulants in shallow lakes is generally low where macrophytes are present, or when the external loading of phosphorus (via stormwater) exceeds the phosphorus binding capacity of the coagulate (Welch and Cooke, 1999). The constant re-suspension of sediments due to wind action in shallow lakes also renders the use of coagulants ineffective.

Artificial destratification
Artificial destratification refers to the mixing of the hypolimnetic and epilimnetic layers within stratified lakes. Stratification generally occurs within deep lakes >5 m, although diurnal stratification will often occur in much shallower lakes.

Stratification occurs when a density gradient develops within the water column between the warmer upper layer (epilimnion) and the colder and denser bottom layer (hypolimnion). When lakes are stratified, the hypolimnion becomes depleted of oxygen and reducing conditions develop, releasing nutrients such as ammonia and phosphorus from the sediments. Under stratified conditions, Cyanobacterial species that are able to regulate their buoyancy are able to access both nutrients in the nutrient-rich hypolimnion and sunlight for photosynthesis in the epilimnion.

Aerators are commonly used in stratified lakes continually mix the water column, thus eliminating the competitive advantage of Cyanobacterial buoyancy over other non-buoyant algae (Reynolds et al., 1984). Whilst artificial destratification has been used successfully in Australia for controlling the release of nutrients from lake sediments, only limited success has been achieved controlling Cyanobacteria (McAuliffe and Rosich, 1990). It is expected that

improvements in destratification technology (e.g. mixer design) will increase mixing efficiency and improve the control of Cyanobacterial growth (Brookes et al., 2002).

Hypolimnetic withdrawal

Hypolimnetic withdrawal involves the removal of nutrient rich hypolimnetic water from stratified lakes (Nurnberg, 1987). The removal of hypolimnetic water effectively decreases phosphorus concentrations in the epilimnetic layers of stratified lake systems, thereby limiting the potential for excessive Cyanobacterial growth to occur (Nurnberg, 1987).

Hypolimnetic withdrawal is a widely used strategy for managing water quality (risk of Cyanobacterial growth) in a range lakes, varying in depth from 4.5 – 25 m (Cooke *et al*., 2005). Hypolimnetic withdrawl is only applicable to lake systems where the amount of discharged water can be replaced with sufficient inflow, so that the water level remains constant (Cooke et al., 2005).

Whilst hypolimnetic withdrawal is a relatively simple and cost effective strategy, it is unlikely that this technique could be used to effectively manage water quality within constructed urban lakes. Most urban lakes have a shallow depth profile and are relatively well mixed (in some cases shallow lakes may also exhibit diurnal stratification). Furthermore, hydraulic retention times in urban lakes are usually high, and sufficient inflow is unlikely to be available in order to maintain constant water levels.

Constructed urban lakes which regularly exhibit stratification may benefit from hypolimnetic withdrawal, however due consideration would also need to be given to the disposal of the poor quality hypolimnetic water downstream.

Algicides

Chemical control of algal and Cyanobacterial growth within reservoirs has been a widespread water quality management practice for over 100 years (Burch et al., 2002).

The most common algicides used to control Cyanobacteria in reservoirs are copper sulfate or chelated forms of copper. These are extremely effective as they act rapidly and are toxic phytoplankton (and Cyanobacteria) at concentrations that do not represent a health risk to humans (Steffensen *et al*., 1999). The chemical composition of the receiving water, particularly pH, alkalinity and dissolved organic carbon influence copper speciation and complexation, thus greatly influencing copper toxicity. Copper algicides are economical, easy to apply and are generally considered to not to cause extensive environmental damage (Burch et al., 2002).

Recent studies have shown however, that sediment bound copper and other heavy metals may impact benthic communities, zooplankton, fish and invertebrates. Copper is not biodegradable, and once it has entered the environment, its potential toxicity is controlled by its speciation or physico-chemical form (Burch et al., 2002). One of the major problems associated with the use of copper-based algicides to control Cyanobacterial growth is that copper lyses the algal cells, resulting in the release of intracellular toxins and other odorous compounds into the surrounding water (if present). This can exacerbate health risks to humans and other animals. Currently, there is little information on the minimum withholding period in relation to toxin degradation (Burch et al., 2002).

Other algicides used to control Cyanobacterial growth in lakes include potassium permanganate, simazine compounds, chlorine, lime and barley straw (Burch et al., 2002; House and Burch, 2002). Potassium permanganate, simazine and chlorine are lethal to algal cells and may result in the release of cyanotoxins. Lime is used as an algicide to coagulate and precipitate algal cells from the water column, and does not appear to cause cell lysis and toxin release (Burch et al., 2002). Recent studies have shown that the use of lime is most effective in hard water lakes (Murphy and Prepas, 1990), however dosing rates are quite high and this technique has not been extensively tested within Australian waters (considered soft waters) (Burch et al., 2002).

Considering the potential environmental and human health risks, the use of algicides is not recommended for the sustainable long-term management of Cyanobacterial growth in constructed lakes.

Biomanipulation

The biomanipulation method is often referred to as “top-down control”, and refers to the management of higher trophic organisms to maximise grazing of algae, and therefore a reduction in Cyanobacterial biomass in the lake system. There is no information on the use of biomanipulation to manage Cyanobacteria in constructed lakes.

In a review of 33 whole-lake biomanipulation experiments, Reynolds (1994) concluded that top-down effects on the lower trophic levels (phytoplankton) were inconclusive. Reynolds (2006) postulated that the manipulable linkages between phytoplankton, zooplankton, planktivorous fish and piscivores apply only to truly pelagic systems.

Boon et al. (1994) reviewed the potential use of top-down control of Cyanobacteria and concluded that zooplankton assemblages in Australian waters are quite different in composition from those of the Northern Hemisphere, and therefore unlikely to respond to manipulations of trophic structure in a similar way. The study concluded that the manipulation of trophic structure in Australian fresh waters to control Cyanobacterial blooms is therefore unlikely to be effective.

Floating macrophyte beds

Floating macrophyte beds have been increasingly used to manage water quality in lakes where other methods of water quality treatment may be constrained. This is particularly the case in many golf courses, where high nutrient concentrations in the stormwater runoff often stimulates excessive algal growth in the waterways.

The use of floating macrophytes has been widely used within the United States for well over 20 years to treat wastewater and stormwater runoff (Reddy and DeBusk, 1987). Floating macrophyte beds can be effective for managing algal growth in lakes as they remove bioavailable nutrients from the water column, thereby reducing nutrient availability to Cyanobacteria or other algae. Floating macrophyte beds are relatively simple and cost effective, and regular harvesting of the macrophytes serves to further reduce nutrient loads from the lake system.

Basil, tomato and silver beet plants growing in aquaponic units (floating plant beds) were recently trialled at Rio Tinto's Kestal Mine (Central Queensland) in order to control blue-green algal growth in a number of lake systems (Fabbro and Duivenvoorden, 2004; L. Fabbro pers. comm.). The research showed that the basil, tomato and silver beet plants were particularly effective at removing phosphorus and molybdenum from the water, essential elements that are required for Cyanobacterial growth (L. Fabbro pers. comm.).

The use of floating macrophyte beds offers a range of potential options for managing water quality in constructed urban lakes. Floating macrophyte beds could be used in situ (within the lake) or within dedicated bays as part of a lake recirculation system.

Sub-surface wetlands

Recirculating lake water through sub-surface flow wetlands may be an alternative option for removing Cyanobacterial biomass from lake systems. Sub-surface wetlands are most commonly used to treat municipal sewage, and also wastewaters from agriculture, industry and landfill, and less commonly to treat stormwater runoff.

Sub-surface wetlands remove a wide range of pollutants including nutrients, suspended solids and organic matter from the water by fine filtration, adsorption and biological processes (uptake, aerobic/anaerobic degradation, nitrification/denitrification) (Vymazal, 2005).

SC6.4.3.13 Townsville road hierarchy

SC6.4.3.13.1 Introduction

The Townsville road hierarchy is a planning tool to guide good-practice transport planning and management, with the aim of balancing the needs of both the land use and the roadway system. A road hierarchy establishes each roadway function such that appropriate objectives for that roadway and design criteria, can be developed and implemented. These objectives and design criteria are aimed at achieving an efficient road system whereby conflicts between the roadway and the adjacent land use are minimised, and the appropriate level of interaction between the roadway and land use is permitted. The road hierarchy also forms the basis of ongoing planning and system management aimed at reducing the conflict between existing incompatible functions.

The use of road hierarchy categories as part of the land use and transport network planning process enables optimisation of the relationships and key roles associated with accessibility, connectivity, amenity, and safety for all road/land users, including vehicles, bicycles, pedestrians, and public transport. The road hierarchy categories and sub-categories contained herein are pertinent and appropriate with the current transport environment in the Townsville area. As time passes, and the transport system and its relationship with land uses changes, these road hierarchy principles will require further development and refinement.

Editor's note—this sub-section deals mainly with issues relating to "Roads". Issues relating to 'Streets" are dealt with in more detail in other parts of the Development manual planning scheme policy.

(1) Integrated Regional Transport Planning Framework

Integrated land use and transport planning must be embedded and applied in a wide range of circumstances – from strategic planning to detailed design for one mode or across all modes. This road hierarchy sub-section contains specific information for managing the interface between land use and roadway systems. This sub-section is to be used with regard for the overarching planning framework. The Integrated Regional Transport Planning (IRTP) Framework for Queensland (Queensland Government, 2003) is a preliminary transport planning guide that can provide the more general guidance not covered by this road hierarchy sub-section and has been adopted by Townsville City Council.

The IRTP Framework, applies to all facets of transport planning, including:

(a) public transport, walking and cycling networks;

(b) road upgrades;

(c) new road, rail or multi-modal corridors;

(d) heavy-vehicle safety and efficiency;

(e) policy positions; and

(f) entire local government areas or regions.

The IRTP Framework aims to:

(a) reduce the need to travel and the length of trips;

(b) provide a choice of travel options for people and goods, and promote sustainable choices;

(c) make it safe and easy for people to access goods, services and destinations, particularly by public transport, walking and cycling;

(d) increase the share of trips by public transport, walking and cycling;

(e) provide for the safe and efficient delivery of freight;

(f) minimise the need for new transport infrastructure; and

(g) achieve desired outcomes using the most cost-effective package of measures.

(2) Structure of the road hierarchy

Based on the desired outcomes, directions and principles contained in the IRTP Framework, this sub-section establishes a four level road hierarchy that manages the interface between land use and roadway system and

guides system planning and management in urban and rural areas. Figure SC6.4.3.13.1 shows the basic structure of the four level road hierarchy, and the four levels are explored in more detail in SC6.4.3.13.3, and in SC6.4.3.13 Attachment A: Urban and rural traffic environments map, SC6.4.3.13 Attachment B.1: Road hierarchy elements and their objectives in urban areas, B.2: Road hierarchy elements and their objectives in rural areas, C.1: Townsville road hierarchy map (existing), C.2: Townsville road hierarchy map (future), D.1: Road hierarchy desirable performance criteria in urban areas and D.2: Road hierarchy desirable performance criteria in rural areas.

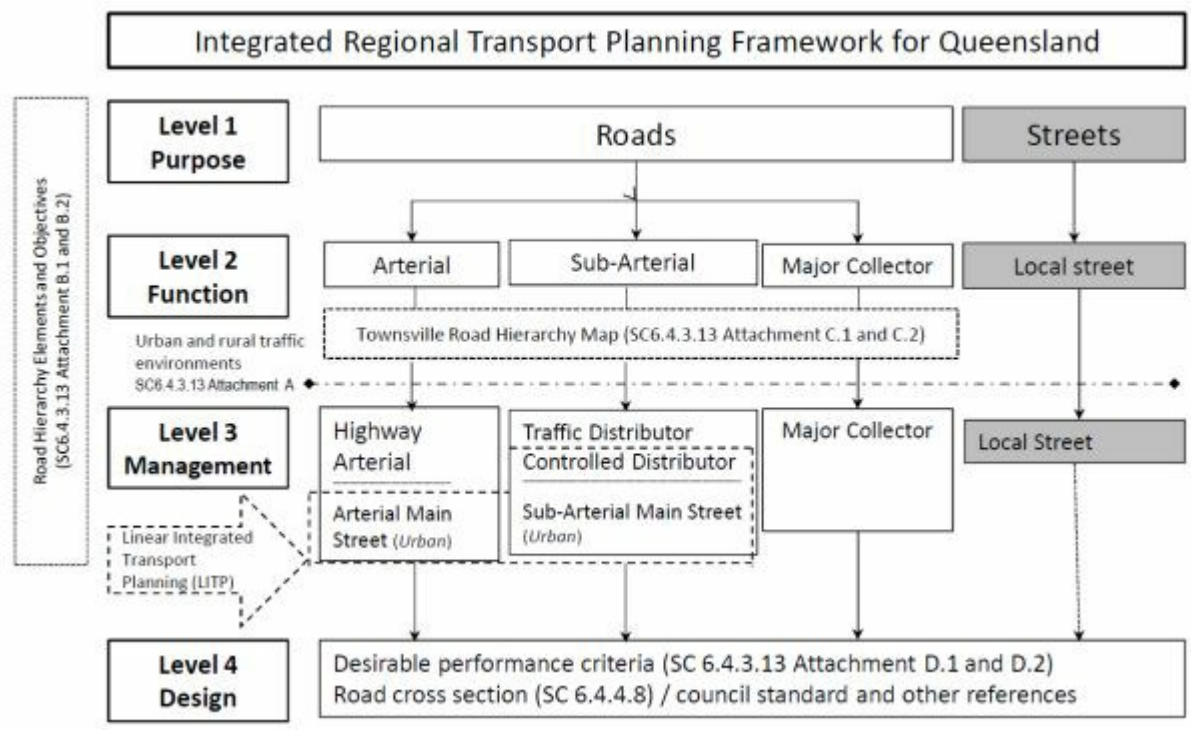


Figure SC6.4.3.13.1 Structure of the four level road hierarchy

(3) Road hierarchy objectives

The four level road hierarchy aims to meet the following objectives, and will assist council and the state government with meeting appropriate standards for roadway construction:

(a) to systematically classify roads into a framework around which council and the state government can plan and implement various land use, infrastructure construction, maintenance, and management schemes and projects such as:

(i) identifying the effects of development decisions in and on surrounding areas and roadways within the hierarchy; and

(ii) developing design that facilitates urban design principles such as accessibility, connectivity, efficiency, amenity and safety;

(b) to guide network planning and management for all modes (private, passenger and commercial/industrial transport) and users (motorised and non-motorised); and

(c) to clarify policies and decisions in designing new networks and in managing existing road systems in order to provide a rational basis for management of the network under the current or future planning schemes, for example:

(i) enabling investment and traffic management efforts to be concentrated on those links able to cope efficiently with transport needs;

(ii) enabling council and the state government to adopt appropriate standards of construction on traffic routes; and

(iii) enabling the network to be optimised to accommodate access and non-transport functions.

(d) The ways in which these objectives may be implemented within a well-formed road hierarchy include:

(i) concentrating longer distance flow onto routes in less sensitive locations;

(ii) ensuring land uses and activities that are incompatible with traffic flow are restricted from routes where traffic movement should predominate;

(iii) preserving areas where through traffic is discouraged;

(iv) identifying treatments such as barriers, buffers, and landscaping to preserve amenity for adjacent land uses;

(v) ensuring activities most closely related to frontage development, including social interaction and parking, can be given more space when environmental and access functions are allowed to predominate;

(vi) ensuring safe traffic operation by controlling access onto roads, and separating different types of traffic in higher order road corridors;

(vii) ensuring efficient traffic operation for through traffic whilst designing new roads as part of a safe system approach;

(viii) enabling the orderly planning of heavy vehicle and dangerous goods routes;

(ix) planning for and providing public transport routes;

(x) planning for and providing pedestrian and bicycle routes; and

(xi) identifying facilities for pedestrians, cycles and public transport.

(4) Scope

This document is a planning tool for all road agencies and authorities involved in land use and transport planning/management processes in Townsville. The road hierarchy elements can be applied in areas such as:

(a) planning – in designating a Strategic Transport Network for a region, consisting of roadways and other facilities for the movement of goods and people;

(b) management - in designating and programming improvements to achieve the desirable performance criteria over time for each element of the road network;

(c) environment – in managing the road network to facilitate efficient operation, which will assist in achieving environmental sustainability and improve amenity to the region's inhabitants;

(d) safety – in managing the road network by controlling access onto traffic carrying roads, providing appropriate design standards, and proper use of the network by the vehicle fleet to facilitate safe movement of all road users; and

(e) congestion management – in planning and managing the road network to ensure traffic volumes carried are appropriate to roadway functional and management attributes.

(5) Definition of urban and rural

The application of the road hierarchy requires the terms urban and rural to be defined for the purpose of this policy.

Urban	developed area which may comprise densely developed uses such as residential, commercial, industrial, education, recreation or a mix of these. In general, this is characterised by evenly spaced street lighting, kerbed streets, frequent closely spaced driveways (preferably none on traffic carrying roads). This will also include land designated for future urban development.
Rural	sparsely developed area which may comprise rural development, rural residential development, isolated pocket of urban development and environmental area. In general this is characterised by unkerbed streets, both sealed and unsealed roads, infrequent driveways and large tracts of undeveloped land. Street lighting may only be at intersections and points of safety concerns.

These terms do not necessarily align with definitions within legislation but relate to the character of the land for the purpose of providing access and thoroughfare. For the specific purpose of showing urban and rural traffic

environments for the Townsville road hierarchy, a map has been provided in SC6.4.3.13 Attachment A.

If a rural development is located in the adjacent urban fringe area or adjoined/contained a part of continuous existing network connection, it may be required to be designed similar to the adjacent road network environment, e.g. urban road cross section.

(6) Terminology

Category	Those elements of the road hierarchy defined at Level 2 of the road hierarchy.
DTMR	Department of Transport and Main Roads.
Environmental cell	Contains local streets with a slow speed and pedestrian priority environment, and generally bounded by major collector roads.
LITP	Linear Integrated Transport Plans: a means of planning between the roadway and the adjacent environment in an integrated manner.
MUTCD	*Manual of Uniform Traffic Control Devices.*
RPT	Regular public transport.
Specific cell	A part of the urban fabric that is contained within a block bordered by traffic carrying roads or other physical boundaries.
Sub-category	Those elements of the road hierarchy defined at Level 3 of the road hierarchy.
VPD	Vehicles per day.

SC6.4.3.13.2 General principles

(1) Network Linkage
Ideally, only roadway elements with the same place in the hierarchy, or one position higher or lower in Level 2 of the hierarchy, should intersect.

For example:

(a) arterial roads should only intersect with sub arterial roads and other arterials;

(b) sub-arterial roads should only intersect with arterials, other sub-arterials, or major collectors;

(c) major collectors should only intersect with sub-arterials, other major collectors, or local streets; and

(d) local streets should only intersect with collectors or other local streets.

However, road networks have evolved out of step with this linkage principle in practice.

In certain situations it may be acceptable for roadway categories separated by two positions within Level 2 of the hierarchy to intersect. For instance, a local street may intersect with a sub arterial road, or a collector with an arterial, without significant adverse ramifications. In other cases, a permeable grid local network creates too many street-road intersections, and some of these have to be blocked off to limit points of access for vehicles (creating cul-de-sacs). Paved footpath access into the local area for pedestrians and cyclists could be maintained, providing the desired pedestrian and cyclist access onto the arterial roads, without adverse impact on traffic flow, safety and local amenity.

It may even be acceptable for roadway categories separated by three positions in Level 2 of the hierarchy to intersect in certain cases. That is, a local street may intersect with an arterial road, provided it is not an uninterrupted flow facility, without significant adverse effects. This may be the case, for example, where a service road provides access directly to a two or four lane arterial road in an urban area, or two lane highway in a rural area.

Despite their development history and desired function in the road hierarchy, local streets may need to be compromised to provide connectivity for the public transport network.

(2) Size of precincts free from unwanted traffic

The spacing of arterials or traffic routes has the effect of defining the size of development areas that are penetrated only by streets. The size of these "cells" has a direct influence on issues such as the local traffic environment, whether or not "difficult traffic routes" can be avoided, the feasibility of sustaining low vehicle speeds in the local area, the number and frequency of connections to surrounding arterials, and access to bus routes around and through the area. Traffic should be distributed appropriately amongst the local streets to ensure that amenity levels are not exceeded and adequate connectivity is maintained.

The specific area and environmental cell concepts can be accommodated with relative ease as part of a new subdivision plan but it is often more difficult to impose the specific area concept onto an existing system. However, it is important to have a target in mind when assessing the requirements of the road systems in a particular area.

(a) Urban areas

While the size and shape of a specific area is commonly constrained by fixed elements such as existing infrastructure, topography and property boundaries, the idealised form is of the order of 1 km × 1 km for an urban specific area. This size would typically encompass four environmental cells, each 0.5 km × 0.5 km. The boundaries of the specific areas will be partially defined by the existing major road system, which in turn has generally been developed to a large extent as a result of historical events rather than recent planning initiatives. Other features may also be used as boundaries.

The aim is to define specific areas which:

(i) are relatively homogeneous in land use;

(ii) have only that traffic necessary for the functioning of the area, i.e. they are free of non-essential or through traffic; and

(iii) have a balance between the volume of essential traffic and the nature of the area. For example, higher volumes may be more acceptable in industrial areas than in residential areas.

(b) Rural areas

While the specific area concept is most relevant to an urban area, it also applies to rural areas, although in a slightly different context. Specific areas in rural areas should be linked by a system of through traffic carrying roads. The dimensions and form of a specific area will vary in rural areas due to the reduced development densities. As a result, specific area sizes in rural areas will be significantly larger than in urban areas.

(3) Abutting development and access to it

Restriction of access points to abutting land uses is one of the key parameters in the road hierarchy. Decisions on access points to new developments are linked to the strategic function of the road and the types of traffic and trips that it serves, as well as the type of environment intended to result. The allocation of accesses as part of a management regime is not identical to a "road classification" system, but may supplement it.

Decisions on network types, especially at the local level, will have long-term effects on the traffic character of an area, and inevitably the quality of service on the surrounding traffic routes. The road hierarchy provides a means of classifying and designing a roadway according to its purpose, function and management. It is intended that this process be carried out within the constraints of the network, as it is imperative that corridor continuity be considered. Notwithstanding past decisions that have resulted in existing constraints, this may mean that corridor continuity may need to be targeted as a long term goal.

In addition to corridor continuity, future development potential should also be addressed in the road hierarchy. The planning scheme earmarks a considerable quantity of land for future urban development, industrial, commercial or residential. Classification of existing roadways in these areas should support future amendments to the hierarchy and the associated changes in performance criteria. For example, an existing road may currently serve a collector function, but as the area is subdivided into urban development in the future, the potential future function of the road may require allowances to be conformed at an earlier time so that the

performance criteria of its future function can be met.

It is important to note that some non-residential land uses such as schools, parks and local shops have to be located within or near the specific areas they serve. These may be accessed by a sub-arterial road, or, if this is not possible, it is desirable that they are accessed via a major collector road rather than the local street environment. The conflicting land use requirements in these circumstances mean that network considerations must be carefully examined in terms of connectivity, network efficiency and compatibility between private vehicle, public transport, non-motorised and freight networks. Integrated land use and hierarchical transport planning can overcome this shortcoming to a large extent.

(4) Relationships between networks

"Cells" may be sized and have access limited to manage entry of unwanted traffic. However, different networks will have different entry criteria. As mentioned in SC6.4.3.13.2(1) above, network linkage principles may vary between motorised vehicles and active transport modes such as public transport, pedestrian and bicycle. For example, passenger transport networks are often focused on middle order roads to balance point to point travel times, network reach, connectivity and passenger safety. Similarly, freight networks will be based on specific freight criteria and result in different networks for freight when compared to other traffic networks. In some areas, freight networks may enter into small industrial cells and utilise low order roads to access depots. The overlay of modal networks is a key consideration in establishing the functional category for a specific link in the road network.

SC6.4.3.13.3 Four level road hierarchy

A four level road hierarchy has been developed, based on the functional objectives of each category or sub-category within the hierarchy. Level 1 begins with a broad distinction between roads and streets, and the following three levels listed with an increasing degree of detail with respect to functional objectives. The Levels are defined as follows:

Level 1. Purpose relates to the primary objective of the element, whether to carry through traffic or provide direct property access.

Level 2. Function relates to the relationship between the roadway and land use it serves (i.e. how the roadway serves the land use). This level of the hierarchy is common to traditional road hierarchy concepts.

Level 3. Management relates to the implementation of policies to achieve the envisaged function based upon the attributes of the element and of the adjacent land uses.

Level 4. Design relates to specification of the form of the element in order to achieve its functional objectives.

Note—the relevant standard drawings include SD-002 Typical Road Cross Sections – Collector Roads , SD-003 Typical Road Cross Sections – Sub Arterial Roads and SD-004 Typical Road Cross Sections – Arterial Roads.

(1) Hierarchy Level 1 - Purpose

Level 1 of the hierarchy defines roadways as either:

(a) roads to carry through traffic; or

(b) streets for access to property and collection of local traffic.

This classification applies to both rural and urban areas.

The definition of a roadway in one particular category serves to indicate a planning intent in relation to the functions that will be permitted on that roadway. Thus, measures are likely to be adopted on streets that relate to amenity and environmental capacity, for example, by removal of through traffic, or direction of local traffic to a particular collector road. At the other end of the scale, treatments on arterial roads will principally be related to increasing traffic carrying capacity. This would tend to be by removal of some incompatible lower order functions, such as limiting access to properties, disallowing any further new accesses, or reducing the number of intersecting roads.

Figure SC6.4.3.13.2 below illustrates the relationship between traffic mobility and land access in a functionally

classified roadway system.

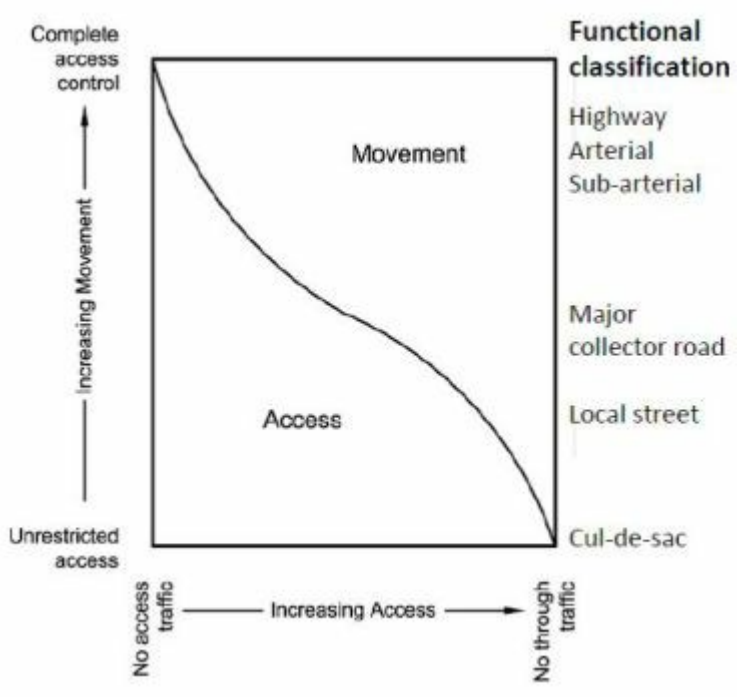


Figure SC6.4.3.13.2 Relationship between traffic mobility and accessibility

Source: Adapted from a figure in NCHRP Report 348, Access management Policies and Guidelines for Activity Centres, Transportation Research Board, Washington DC, 1993.

Note—the functional classification has been modified to suit the Townsville context.

(2) Hierarchy Level 2 - Function

Within the two broad groups of roads and streets in the first level of the hierarchy, four functional roadway categories have been identified, reflecting the different ways in which they serve land use and carry traffic.

The functional classification indicates the relative importance of the traffic mobility function as opposed to the amenity/access functions, and how these conflicting aims are to be prioritised and managed.

The four functional categories in Level 2 of the hierarchy are:

- arterial road – to carry long distance through traffic external to specific areas;
- sub arterial road – to carry through traffic between specific areas and arterial roads in a supporting role to the latter;
- collector road – to provide connectivity between the environmental cells and the traffic carrying road and to provide grouped property access; and
- local street – to provide direct property access and immediate local movements.

Based on the current and future land use zoning in the Townsville City Plan, the Townsville road hierarchy map (see SC6.4.3.13 Attachment C.1 Townsville road hierarchy map (existing) and SC6.4.3.13 Attachment C.2 Townsville road hierarchy map (future)) has been developed all Level 2 categories. To enable easier application of the road hierarchy, the same overarching objectives and category names have been applied for both urban and rural areas. It should be noted that some links are identified as a conceptual location with respect to spacing, hierarchical connectivity and continuation of links between start and end points. Therefore, if significant development is planned to occur in a large or multiple parcels of undeveloped land in either an urban or rural area, then it may be necessary to reassess that area road hierarchy plan within a whole network.

(a) Arterial road

The primary objective of arterial roads is to provide major through routes for traffic. All longer distance traffic movements should be directed onto the arterial roads. Arterial roads should form a principal

connection between major regional centres and towns. It can also serve a line haul function for public transport. Arterial roads will often be elements of the various networks with high order functions. For instance, the network of over dimension freight routes is likely to be primarily on arterial roads.

These corridors should provide for regional cycle movements, but travel speed, volume and composition is such that cycle movements should desirably be kept separate from general traffic. In general, arterial roads have high design standards for efficiency and no direct frontage access.

In rural areas it is recognised that many arterial roads have direct property access. This results from the large size of properties, the reality of limited road infrastructure and the infrequent number of vehicles with direct access. On such roadways the main goal is to provide a highly efficient traffic flow (increased speed and increased capacity), balanced with safe access.

For all arterial roads it is desirable that, over time, no new accesses are permitted and that existing accesses be removed, or at least consolidated, or turning movement restricted.

(b) Sub-arterial road

Sub-arterial roads carry through traffic and should be more convenient than using the "streets" network; therefore a high level of efficiency and safety should be provided. In general, sub-arterials do not serve the longer distance regional movements and do not provide continuity across arterials. However, they do serve to provide connections between arterial roads and may be used to provide such additional connections for through movements.

In urban areas, sub-arterial roads typically provide connection between residential, commercial or industrial areas and arterial roads. They will normally be the lowest order of road to be traversed by scheduled public transport in performing a line haul function. They may also serve to provide access to public transport at stops. These corridors may provide for cycle and pedestrian connections between local areas and the regional cycle system (if such exists). These connections would preferably be bicycle lanes on the shoulder or outer lane of sub-arterial roads rather than on the roadway with general traffic. These roads can provide consolidated access to commercial and retail developments and as a result can also cater for pedestrian movements, especially in the vicinity of such developments. The provision of consolidated access allows for turning movements to be focussed at specific, controlled locations rather than at high frequency along the roadway, thus minimising interruptions to through traffic.

In rural areas, sub-arterial roads in particular provide connections between adjacent suburbs and/or between arterials. Access may also occur, and be necessary, but these will be more widely spaced due to the larger lots.

(c) Major collector road

The objective of collector roads is to provide for the connection between the local area (local streets) and the traffic carrying roads. The form of linkage provided should predicate against the usage of collector roads within a particular area by longer distance traffic unless the trip is relevant to the area. In residential areas particularly, amenity and safety should be the most important consideration, as these roads are also intended to provide direct access to grouped properties, commercial premises, schools or community facilities.

These roads will carry public transport operating in a sweeper role, and these are likely to be school bus routes. It is necessary to ensure that the connectivity to achieve an efficient bus route does not encourage penetration by through traffic. Typically, scheduled bus routes would begin a service on collector roads, as a sweeper service, and then move to higher order links in the bus network to run as limited stop or express services.

As these roads serve as access to adjacent grouped properties, whether in residential or commercial/industrial areas, pedestrian movements need to be accommodated off the roadway. Traffic volumes should be balanced to accommodate local cycle movements on the road, and road design should create a safe environment for these vulnerable road users.

(d) Local street

The objective of local streets is to provide access to properties. In residential areas, these should be in a form to encourage a liveable and safe street environment where the motor vehicle is secondary to the pedestrian and cyclist. Through traffic should be discouraged on these streets and a lower speed environment is desirable for safety. Given the low traffic volume and potentially lower speed environment, it is appropriate for cyclists and pedestrians to share the road space. Similarly, specific facilities for pedestrians (crossings or concrete footpaths) are generally not required due to low traffic volumes and speeds. However, depending on the degree of abutting land use activity or pathway network planning, concrete pathways would provide for safety and a continuation of the pathway network.

The role of collector and local streets is complicated further as all freight, and motorised and non-motorised passenger networks can ultimately operate on these roadways, often without specific treatments.

(3) Hierarchy Level 3 - Management

Ideally, all roadways within the same category of Level 2 would be treated in the same manner. This may be achievable in a new development but existing situations or other constraints often dictate that a variety of treatments need to be available. These situations may arise for a number of reasons, not the least of which is the mixture of access and traffic functions already prevalent on many roadways.

Level 3 manages these issues through splitting the Level 2 categories into sub categories, which relate to more particular attributes of the roadway. Each sub category has objectives that are more specific than the category objectives for Level 2. The management sub categories are described broadly as follows (listed under each Level 2 category):

Arterial road

- Highway - serves longer distance movements as well as regionally and nationally significant movements. (A motorway is a highway that provides for a very high standard of travel by restricting non-motorised traffic and using only grade separated intersections.).
- Arterial - caters for longer distance movements, for example, connections between major centres.
- Arterial Main Street - caters for through traffic and, due to past land use decisions, serves adjacent retail/commercial land uses. This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions.

Sub-arterial road

- Traffic distributor - connects traffic generated in specific areas to the arterial roads and provides access to major developments.
- Controlled distributor - serves a similar function to traffic distributors but needs to be controlled for a particular reason, for example, it may provide frequent access for existing individual residential properties.
- Sub-arterial main street - connects traffic generated in specific areas to the arterial roads and, due to past land use decisions, serves adjacent retail/commercial land uses. This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions.

Major collector road

- Major collector - provides a connection between the other streets in a specific area and the traffic carrying roads, and provides access to large sites with restricted or controlled access (for example, schools, shops and multi-unit residential developments).

Local street

- Provides a connection between the other streets in a specific area and the low traffic carrying streets, i.e. less than 3,000 vpd. As it has low traffic volumes, a lower speed or a shorter length, it is better suited to

providing access to individual properties. It also provides pedestrian and recreation use service with a local traffic or pedestrian priority.

It should be noted that the arterial main street and sub arterial main street sub categories have been excluded from rural areas on the basis that these are characterised by adjacent land use/activities that are associated with urban development.

(a) Performance criteria

The preceding sections and SC6.4.3.13 Attachment B.1 and SC6.4.3.13 B.2 identify individual road hierarchy categories and their functional objectives. For the hierarchy to be an effective planning tool, means of achieving these objectives need to be identified. This has been done by specifying desirable performance criteria for each classification in Level 3 of the road hierarchy framework. It is apparent that for some management categories, a distinction needs to be drawn, with respect to performance criteria, between roadways in an urban or rural environment. Accordingly, the thresholds of the performance criteria differ between the urban and rural areas for Level 4 of the road hierarchy.
The desirable performance criteria are subdivided into three groups and described below.

(i) Functional Characteristics specify the functions or functional aspects of a roadway element.

(A) dominant linkage – what type of areas should the roadway provide service to/from;

(B) traffic carrying function – whilst volumes are not intended to define the category into which the roadway falls, this criterion provides some guidance as to the maximum volumes anticipated. These maximum volumes may not be met in non-urban areas due to the low density of development;

(C) residential, commercial, industrial access – what degree of access to each of the land use types is appropriate;

(D) desirable traffic speed environment – the desirable speed anticipated. This is not intended to define the maximum speed limit, which should be done in accordance with the MUTCD;

(E) heavy vehicle movement – whether the roadway is appropriate for heavy vehicles, other than for local access. Note that heavy vehicle volume will be important in defining road pavement and design form;

(F) dangerous goods movement – whether the roadway is appropriate for the passage of dangerous goods vehicles, other than for local access;

(G) public transport facilities – what role should the roadway serve for public transport (consistent with any public transport network planning);

(H) cycle facilities – what type of cycle facilities should be provided in the roadway corridor (consistent with any bikeway network planning). Cycle facilities would only be provided where sufficient demand is proven; and

(I) paved footpath – what type of paved footpaths (not for crossing the roadway) should be provided along the roadway. These should only be provided to satisfy a proven demand.

Note—the term paved footpath refers to a paved concrete footpath as per council standard.

The desirable performance criteria for these functional characteristics have been set to ensure the network operates effectively, efficiently and safely for its users.

(ii) Frictional Characteristics relate to the way roadside activity affects traffic use.

(A) access control – constraints imposed on direct access to adjacent development sites;

(B) parking provision – what provision for parking within the road reserve is appropriate;

(C) bus stopping provision – what provision for bus stops within the road reserve should be made

Note—indented bays also refer to bays which are clear of the through lanes as per council standard.

(D) pedestrian crossings – what type of facilities should be provided to allow pedestrians and

cyclists to cross the roadway, for example, signalised crossings, zebra crossings or pedestrian refuge islands;

Note—crossings must meet council standards and MUTCD guidelines.

(E) typical intersection spacing – the typical distance between successive intersections along that roadway;

Note—generally, 300m intersection spacing is not favourable for a corridor signal coordination plan.

(F) preferred intersection treatments – what form of intersection control is appropriate where the roadway intersects another of equal or higher classification; and

(G) number of traffic lanes – what function of road hierarchy and ultimate traffic demand should be considered.

Note—a road cross section is identified in terms of a type of kerb and channel, divided or undivided carriageways, parking, bike lanes and verge in Level 4 of the hierarchy (see SC6.4.3.13 Attachment D.1 and SC6.4.3.13 D.2).

The desirable performance criteria for these frictional characteristics are set with the intent of improving the efficiency of traffic flow and thus reducing its environmental consequences, in balance with access needs.

(iii) Impact characteristics relate to the relationship between a roadway element and amenity for adjacent land use:

(A) abutting land use types – in general, what type of land use would be appropriate or compatible with the roadway function; and

(B) land use impact amelioration – in general, what type of measures are appropriate on this roadway to reduce the immediate social and environmental impacts of traffic. Such treatments include barriers (fences, walls), buffers (vegetation), setbacks (distance to property lines and/or building fascias), streetscaping and environmental street design.

To achieve the desired traffic levels and conditions, a combination of actions will often be necessary to reduce traffic flows on some elements of the network and to increase traffic flows on other elements of the network. In order to minimise the use of lower order roads, such as local residential streets, it will be necessary to manage arterial roads in a way that makes their use more attractive than the lower order roads. Lower order roads must then be managed in a way that discourages traffic through environmental street design, such as street closures, street element length and design speed. If reactivity treatments are applied in existing areas, they must be undertaken on an area-wide basis to ensure that problems are not simply shifted from one street to another.

The desirable performance criteria for these impact characteristics are set with the intent of reducing negative social and environmental impacts of traffic flow on adjacent land uses.

The impact characteristics are important in making the adjacent land use areas more liveable and to address issues associated with the social interaction between transport and land use. Level 3 management principles for urban and rural roads are reflected in the design principles in Level 4 of the road hierarchy.

(b) Linear integrated transport plans (LITP)

There may be cases where a roadway does not readily fit into any category within the road hierarchy, due to incompatibility with the performance criteria. Under these cases, it is recommended that an LITP be developed specifically for the roadway under consideration. For example, with a key public transport corridor such as Ross River Road and Charters Towers Road, there is a need to satisfy both the traffic carrying roadway objectives, as well as the access and amenity to adjacent properties objectives. Each LITP will need to assess the roadway under consideration on an individual basis, and will therefore have

to satisfy individually tailored criteria. Figure SC6.4.3.13.3 below describes a general methodology for developing an LITP.

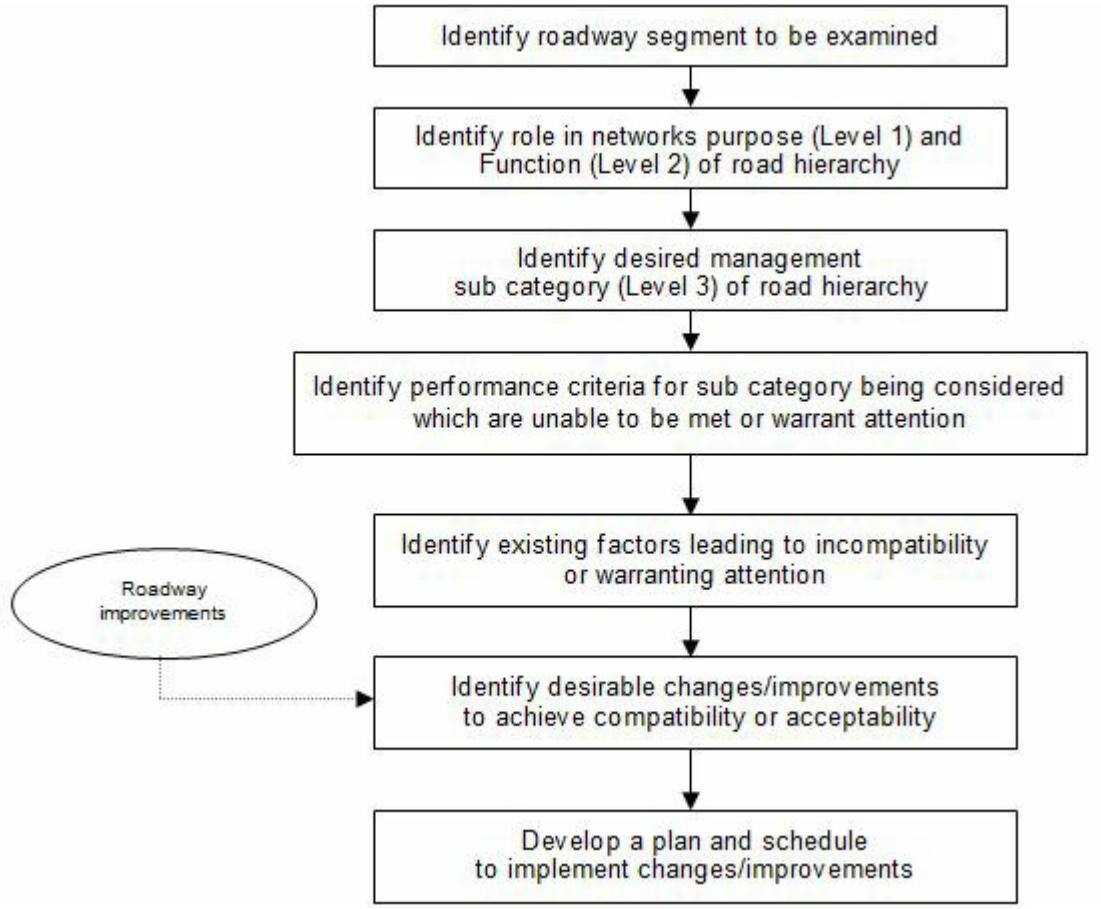


Figure SC6.4.3.13.3 Linear integrated transport planning (LITP) process

(4) Hierarchy Level 4 - Design

The fourth level of the road hierarchy framework relates to specific design criteria that are applicable to each sub category in Level 3. Level 4 aims to provide the tools with which to specify the form required of individual road hierarchy elements in order that they achieve their functional objectives. The roadway design should meet safety objectives as well as capacity and amenity objectives, where relevant. In conjunction with Level 3 objectives, it should also dictate the type of facility and design form for pedestrians, cyclists and public transport.

For each roadway, there are design elements that combine to produce a cross section or form for the roadway. SC6.4.3.13 Attachment D.1 and SC6.4.3.13 Attachment D.2 provide a set of desirable performance criteria for urban and rural areas and SC6.4.4.8 Standard drawings also includes a set of road cross sections. The design elements identified are those applicable to the road cross section away from intersections (i.e. mid-block cross section). Intersection requirements will dictate other specifications. For example, widening at intersections and future planning are an important part of defining these overall requirements. These design element details and the cross sections have been prepared for new roadways; council recognises that there will need to be variations to this to suit existing roadways (i.e. existing road forms and existing road reserve widths) in the process of network design.

It is important to note that the Level 4 specifications represent preferable specifications. There will be other constraints (e.g. topography, role in the range of networks, existing land uses, road reserve, and physical elements), which mean that the specifications may be varied from time to time. Whilst this flexibility needs to exist, it is important to keep an appropriate balance between mandatory standards, desirable objectives and constraints in order to develop an appropriate road form for each individual situation whilst still maintaining some consistency in the overall road network. The objectives and performance criteria should be maintained wherever possible.

In any case, all design criteria should be considered in line with relevant documents and proper guidelines, for example, other parts of the Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, Australian Standards, Queensland Streets, and Complete Streets for the local street level.

Note—posted speed limits are to be designated in accordance with the MUTCD-Part 4, and are required to be approved by council.

(a) **Arterial**

Administrative responsibility for roads is based on historical and political decisions as well as function within the hierarchy. Highways are administered by DTMR. The need to combine local activity planning with road planning could lead to greater local government involvement in the management of Arterial main streets. Arterials span these areas and responsibility may lie with either the state or local government.

Highway/motorway in urban/rural areas

These roads serve regionally and nationally significant movements and longer distance movements. To provide for a high standard of travel, speed environments of 100km/h or more are desirable, together with no frontage access. If frontage access does occur, then elimination of direct access from the abutting land use should be pursued.

These roads should also provide the primary freight routes and dangerous goods routes, and carry coach traffic between centres and regular public transport (RPT) bus traffic under a line haul mode. Any pedestrian and cycle facilities in urban areas should be located separately from the carriageways and protected accordingly. Crossing provisions should be grade separated. Grade separated intersections are desirable for all facilities in this category, although this will essentially be driven by volume demand or safety issues rather than hierarchy.

The road reserve width will often be dictated by the need for adjacent service roads, buffer zones and ancillary uses in the road corridor (e.g. cycle facilities, bus lanes). Divided carriageways are desirable to optimise safety and driver comfort. However, a two lane undivided cross section may be appropriate for low traffic volumes on a rural highway, provided there are sufficient overtaking opportunities. Whilst cycle facilities, pedestrian paths and bus lanes may be provided in the overall corridor, these facilities should desirably be separated from the through roadway and therefore represent an additional carriageway within the overall corridor. In rural areas, it is recognised that the demand for these adjacent facilities will generally be low.

Abutting land use types should be non-sensitive to vehicular traffic and generally not have frontage or direct access to the roadway. Uses associated with traffic such as highway service centres with amenities may be deemed appropriate in some locations based upon a needs assessment. In such cases, these would be provided with high quality direct access. Design standards for highways will primarily be set according to a high design speed and to maximise road user safety. In particular, the provision of wider shoulders is important in high speed locations.

In urban areas, grade separated intersections on urban roadways should be spaced at least 2 km apart. Intersections at grade on existing highways should be spaced no less than 1 km apart and are generally found to be between 1 km and 2 km apart.

In rural areas, if some land use provides for frontage access due to historic events, then any works undertaken to reduce this frontage access will enhance the traffic carrying capability of the highway in terms of both volume and speed. Whilst volumes may be low, the high traffic speeds mean that safety issues are important at access locations and reductions in the frequency of accesses will reduce the crash rate. Provision of pedestrian and cycle facilities will generally be related to demand and the need for a link associated with network planning. Grade separated intersections should be spaced between 4 km and 8 km, with a maximum spacing of 12 km.

Arterial in urban/rural

Arterials cater for external or intra-regional traffic and traffic between suburbs or major centres. These facilities should preferably have no direct access for all land uses. However, they often do have direct

accesses due to past land use decisions, so longer term access limitations and land use amalgamation should be pursued so that the traffic carrying role can be progressively enhanced.

The design standards are set to achieve a balance between safety and efficiency. In this case, spacing of intersections will often control the design speed and hence other design elements. There will be many existing situations where the road design is constrained by elements such as the road reserve, property access and road width. In such situations, an individual design form will need to be developed to suit the constraints, whilst still achieving the arterial road objectives.

The policy is to pursue no direct access from individual properties to arterial roads. Examples of alternative treatments include:

(i) side street entry to corner blocks; and/or

(ii) combining driveways; and/or

(iii) creating rear lane access; and/or

(iv) creating easements to service multiple properties.

To facilitate efficient traffic movement, a higher speed environment is desirable. Limits of 80 km/h for new arterial roads and 70 km/h for existing arterial roads and where physical constraints exist in urban areas, and up to 100 km/h in rural areas are recommended. Speeds in excess of the above stated speed are generally not appropriate with intersections at grade and high traffic volumes.

These roads may provide the primary freight routes and often provide secondary freight routes. Selected routes may be appropriate for dangerous goods movement. They accommodate inter urban and inter centre coach traffic and RPT bus traffic under a line haul mode with priority treatment. Any bus stops should be separate from the through traffic lanes.

Pedestrians should preferably be located separately from the carriageways, and pedestrian crossings provided at signalised points. Cycle facilities can be provided in exclusive bike lanes or on the road shoulder on roads with a speed limit less than 80 km/h, provided AUSTROADS guidelines are met. In locations where the speed limit is higher than 80 km/h, and where a high percentage of school cyclists are likely, or where there is a cycle accident history or identified potential, consideration should be given to locating these facilities separate from the carriageway.

A number of traffic lanes have to be acquired, with a minimum of a four to six lane carriageway for ultimate traffic growth, and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping or turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

The abutting land use should preferably be less noise sensitive, or alternatively should include building and site designs that minimise impacts from adjacent traffic flows.

In urban areas, intersections are generally configured at grade for this sub-category. Signalised or roundabout control is generally appropriate although high volumes may necessitate grade separation. Intersections should be spaced a minimum of 500 m apart.

In rural areas, direct access can be tolerated due to low volumes and limited frequency. However, appropriate safety levels must be achieved and the aim should be to remove such accesses over time. Intersections are generally configured at grade for this sub-category. Priority control is generally appropriate and intersections should be spaced a minimum of 1km apart due to the higher speed environments. However, a proper intersection type has to be assessed and determined using traffic analysis.

Arterial main street in urban areas

This category is directed at existing situations in urban areas, including villages, where a group of commercial land uses exists, generally on both sides of an arterial road. In these situations a decision

needs to be made, dependent on the value of these uses, whether the traffic carrying and access functions should coexist, or whether a bypass or parallel route upgrade is warranted. If it is decided that these functions should coexist, whether in the short or long term, measures will need to be developed as part of an LITP to address this mix.

These design standards are primarily aimed at safety and ensuring pedestrian mobility in conjunction with parking and vehicle access. Traffic volumes may be so high that amenity to roadside activities is limited. However, as these are arterial roads, traffic volumes should not be moderated except by bypassing where feasible.

Speeds on these facilities should be kept sufficiently low to provide for safe pedestrian crossing at controlled points and to maintain environmental amenity for adjacent land uses, but still allow for efficient traffic movement. These roads should provide for pedestrian movement on both sides with crossing at controlled points, and with bicycle lanes on the road to avoid mixing with denser pedestrian traffic.

Limiting the frequency of property access is important for the traffic carrying capacity and also for the amenity levels associated with significant pedestrian traffic in the 'main street precinct'. Streetscaping would assist in ameliorating visual and audible land use impacts.

A number of traffic lanes will have to be acquired to enable four lane or six lane carriageways (if a corridor is likely to take a key public transport route associated with the adjacent land use, e.g. potential exclusive PT lane) for ultimate traffic growth and provision made for proper width to cater for kerb and channel, medians, indented bus bays to reduce delay to through traffic and bike lanes. Opportunities should be sought to bypass freight movements. This category is generally inappropriate as a dangerous goods route.

Intersections may be closely spaced along these facilities due to past planning and land use decisions. Desirably, to avoid queue interaction, intersections should be spaced a minimum of 150m apart.

This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions. Within the rural road hierarchy, "Arterial Main Street" is not considered appropriate.

(b) **Sub arterial road design standards**

(i) **Traffic distributor in urban/rural**

These traffic carrying roads are the key supplement to the arterial road network. They should connect between arterials and specific areas and should be more convenient than using the internal streets. Consequently, a higher level of efficiency and safety should be provided. Volumes are carrying preferably up to 25,000 vpd for amenity, as abutting land uses should be non-sensitive.

To make these roadways more attractive than internal streets, a higher speed environment is desirable. Speed environments of between 70 km/h~80 km/h in urban and up to 100 km/h in rural areas are recommended. The policy is to pursue no direct access to individual properties. Examples of treatments include:

(A) side street entry to corner blocks;

(B) combining driveways;

(C) creating rear lane access;

(D) creating easements to service multiple properties.

In the preferred design form, access should be restricted and be managed through treatments such as amalgamated entry points or side streets as discussed above. This would be the treatment pursued as part of any new development. Access for major developments, multi-unit

dwellings, schools, child care centres, and/or commercial uses may be provided along these routes, provided it is controlled through channelisation or signals.

These roads may serve as secondary freight routes. Nominated routes may be appropriate for dangerous goods movement. They could accommodate RPT traffic under a sweeper mode. Any bus stops should be located separately from the through traffic lanes.

In most circumstances, specific provision for control of pedestrian movements should be provided and roadside parking will be discouraged. Usually, the prime concern will be the movement of traffic, so traffic management techniques could be applied (such as access minimised by consolidation of development accesses or side road access to sites). Noise and visual amenity impacts on surrounding uses should be managed through site considerations and/or road treatents.

Cycle facilities can be provided in exclusive bike lanes or on the road shoulder on roads with a speed limit less than 80 km/h, provided AUSTROADS guidelines are met. In locations where the speed limit is higher than 80 km/h, where a high percentage of school cyclists are likely or where there is a cycle accident history or identified potential, consideration should be given to locating these facilities separate from the carriageway.

A number of traffic lanes have to be acquired, with a four lane carriageway for ultimate traffic growth, and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two-lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping or turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

In urban areas, paved footpaths are required on one or both sides depending on the demand of pathway usage to abutting land use and traffic facilities (e.g. bus stops) with pedestrian crossings at controlled points. Intersections at grade are appropriate for this management type. Signalised or roundabout control is generally appropriate although priority controlled intersections may be acceptable; this will be determined by a traffic analysis study. Intersections are typically spaced 250~400m apart.

In non-urban areas, although access is restricted in the preferred design form, individual lot accesses are acceptable, particularly if the access points are widely spaced and properties are well set back. Pathways are only required where the road serves an identified pedestrian linkage, with pedestrian crossings at controlled points. Roundabouts or priority control are generally appropriate, although this will be determined by a traffic analysis study.

(ii) **Controlled distributor in urban/rural**

The hierarchical objective of this sub-category is to maintain the traffic carrying function as a primary role but also to allow frontage and parking (with appropriate conditions) to achieve an environment whereby "overlooking" can enhance personal safety. The controlled distributor should be used where adjacent frontage development exists, or is planned. It can be expected to be used where residences are within reasonable walking and cycling distance of regularly accessed community destinations, e.g. schools, shops.

A number of traffic lanes have to be acquired, with a four lane carriageway for ultimate traffic growth and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping and turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

To satisfy the competing demands of traffic carrying efficiency and property access/on street parking, it is important to separate parked cars and turning vehicles from the through traffic lanes.

This will require carriageway widths greater than a traffic distributor. The verge widths need to include landscaping, pathways and separation. This will be an important factor in subdivision planning when determining the lot layout and road reserve needs.

These design standards are primarily aimed at safety and ensuring pedestrian mobility in conjunction with parking and vehicle access.

In the conventional sub-arterial design case it is desirable to have no direct access to individual properties; however, consolidated access along the controlled distributor would be acceptable if the appropriate form of traffic control can be provided at these points.

This category of road is a response to relatively unique situations and often evolves as a result of previous planning decisions. By definition, these are roads where an aspect such as speed or vehicle composition up to 20,000 vpd is controlled. Such control may be:

(A) limiting speed to 60 km/h where frequent direct residential or commercial frontage exists;

(B) limiting volumes to avoid excessive pressure on abutting land uses;

(C) limiting heavy vehicle usage to protect the amenity of abutting uses; and

(D) limiting speed and/or usage of particular vehicle types where alignment constraints exist.

On roads where frequent access to adjacent land uses exists and cannot be removed or consolidated, measures should seek to achieve safe access while retaining the convenience and efficiency of the route for through traffic. This may include a lower speed environment, but it should not be so low as to cause rat running elsewhere, for example, 60 km/hr in urban areas and 60~80 km/h in rural areas. Other measures could include the protection of adjacent parking by indented bays, bicycle paths, and landscaping. A longer term aim should be to reduce access if opportunities arise.

Access for individual lots should be controlled using one or more of the following measures:

- central median (no right turns) ;
- turning lane separate from through traffic lane;
- large lot frontage;
- lot layout to avoid on street visitor parking (large lots); and
- adjacent properties having adjacent driveways.

When a road is designated as a controlled distributor, an LITP should be prepared to identify the need to control any aspect(s) of this road, and the most appropriate form(s) of control.

(iii) **Sub arterial main street in urban areas**

This category is directed at situations where a group of commercial land uses exists, generally on both sides of a sub arterial road. On these stretches of road a decision needs to be made, dependent on the value of these uses, whether the traffic carrying and access functions should coexist, or whether a bypass or parallel route upgrade is warranted.

If the traffic carrying and access functions need to, or should coexist, whether in the shorter or longer term, management measures will need to be developed as part of an LITP to address the coexistence of these two functions.

In contrast to the arterial sub-category, the traffic environment on sub arterial roads may be restricted to improve the amenity for pedestrians and users of the adjacent developments. Measures may be taken to reduce some traffic use of the road, for example, during peak periods, and opportunities should be sought to bypass freight movements.

This category is generally appropriate as a bus route, and indented bays should be provided to reduce delay to through traffic. This category is generally inappropriate as a dangerous goods route.

Speeds should be kept low to improve amenity to pedestrians and abutting land uses, and should be no greater than 60 km/h. Volumes should be no greater than 15,000 vpd in order to maintain amenity to abutting land uses. These roads required a balance between accessibility and mobility, using environmental street design or streetscaping.

In special cases, a number of traffic lanes will have to be acquired to enable four lane or six lane carriageways for ultimate traffic growth (if a corridor is likely to take a key public transport route associated with the adjacent land use, e.g. potential exclusive PT lane), and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment, whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping and turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

This category should provide for pedestrian movement on both sides with crossings at controlled points, and with bicycle lanes on the road to avoid mixing with denser pedestrian traffic. Intersections should be controlled by way of signalisation or roundabouts, although priority intersections may be appropriate. Spacing of intersections is site specific, based on past planning and land use decisions, although a minimum spacing of 150m is desirable to avoid queue interaction. Within the non-urban road hierarchy the ‘Sub-Arterial Main Street’ is not considered appropriate.

(c) **Major collector road**

Major collector roads provide a connection between the local streets and the traffic carrying roads and mark a shift in the environment between roads and streets. The design standards place a greater emphasis on travel time efficiency and strict guidelines for safety and environmental amenity should be adhered to on these roads.

Traffic flow levels commonly accepted range from 3,000 vpd up to 12,000 vpd. Access to multi-unit residential developments, schools or shopping centres may well be via major collectors. Individual residential lot access to these roads should be restricted, and generally a speed environment of 60 km/h to provide for safety and amenity while ensuring travel times are reasonable. Heavy vehicle and dangerous goods movement should be restricted in residential areas, with the exception of service vehicle movement. Buses will generally operate in a sweeper role and indented bays may be required to maintain safety at some locations.

Pathways and bicycle lanes should be provided on one or both sides of the road. However, in non-urban areas, pathways are generally not required unless network planning deems it appropriate. Some controlled pedestrian crossing points may be required in urban areas, particularly where traffic volumes are higher. Kerbside parking could be provided for in urban areas.

Intersections are typically spaced 80m to 100m in urban areas and up to a maximum 200m in non-urban areas. Intersection control would generally be either by roundabout or priority control. These roads should have two or four lane carriageways, depending on the degree of frictional and impact characteristics criteria that apply.

Environmental street design may be required in urban areas to moderate speeds and minimise through traffic penetration. Streetscaping would also assist in ameliorating visual and noise impacts to abutting land uses.

(d) **Local streets**

Level 3 sub categories mainly relate to managing and providing treatments for residential streets in the road hierarchy. However, consideration must also be given to non-residential local streets, e.g. in industrial and commercial areas. It should be noted that this document will not deal specifically with

"streets" (as per Level 1), but the following principles may be appropriate for general application across various council standards and requirements.

Streets have as their function to facilitate public interaction and movement through a place or neighbourhood. Local Streets must allow for the safe and efficient movement of all users, provision for parked vehicles, the provision of public utilities, access to allotments and streetscaping.

The management of these streets is less restrictive due to low traffic volumes, property access and parking. Volumes should be limited to below 3,000 vpd and the speed environment to 30~50 km/h in urban areas to ensure amenity for abutting land uses, it is noted that posted speeds will be at 50 km/hr, and to a maximum 60 km/h in rural areas to ensure reasonable travel times.

Heavy vehicles and dangerous goods movement should be restricted in residential areas, with the exception of service vehicles and public transport. Kerbside bus stops are generally appropriate, although indented bays may be required to maintain safety at some locations.

The provision of pathways is generally not necessary, although this may be appropriate in some instances as a requirement of network planning. No specific pedestrian crossing provision is required. No special cycle facilities are needed as these users should be able to share the road space due to the low traffic volumes and speeds.

No specific parking provision is required on these streets.

Intersection spacing is a minimum of 40~60m in urban areas and 100m in rural areas. Some intersections may be controlled by roundabouts; otherwise, priority control should be sufficient. These streets should have a two lane cross section, or one lane where necessary, with reasonable travel efficiency.

Environmental street design may be required in urban areas to moderate speeds and minimise through traffic penetration. Streetscaping would also assist in ameliorating visual impacts on abutting land uses.

If significant development occurs in the future in rural areas, then it may be appropriate to reclassify these streets as ‘major collector’ if the catchment size or density increases significantly. Accordingly, allocations should be made in the network planning.

In urban areas, the primary design objective is to maximise safety and amenity for adjacent properties and adjacent activities/users (i.e. pedestrians, cyclists, car parking, children playing). The most important design standard in this regard is the maximum design speed. Travel time efficiency will be compromised over safety and amenity aspects by appropriate subdivision design. Such design includes consideration of the maximum volume (by catchment size), the design speed (by street length) and the travel time efficiency (by connectivity of streets). It is this category of roadway whereby design standards are well defined because of the clear principles set out in such documents as *Queensland Streets* and *Complete Streets.*

In rural areas, the primary design objective is to minimise the cost of roadway provision whilst still maintaining acceptable performance levels (as a result of the very low volume use). Travel time efficiency will be compromised over safety and amenity aspects. There may be an issue with dust nuisance, which may be one of the factors considered when determining whether the road should be sealed or not. The low traffic volumes anticipated on some collector streets requires the need for a single lane cross section alternative, as well as the two lane form. There may also be a demand for the provision of horse trails within the road verge, and in this case a widened verge may be required to cater for these.

(e) **Non residential local street**

Similar roles apply to collector streets in commercial (including CBD) and industrial areas. Generally, higher traffic volumes can be tolerated on such streets than accepted in residential areas. Fewer lots would be served in commercial and industrial areas by these streets than low density residential areas,

due to the high trip generation of the land uses. Significantly higher heavy vehicle proportions and tolerances for environmental factors such as noise would be acceptable on such streets in industrial areas.

Key performance criteria for collector streets in industrial areas are as follows:

(i) traffic volumes not greater than 3,000~6,000 vpd depending on the environmental cell type;

(ii) speed environment of 50~60 km/h;

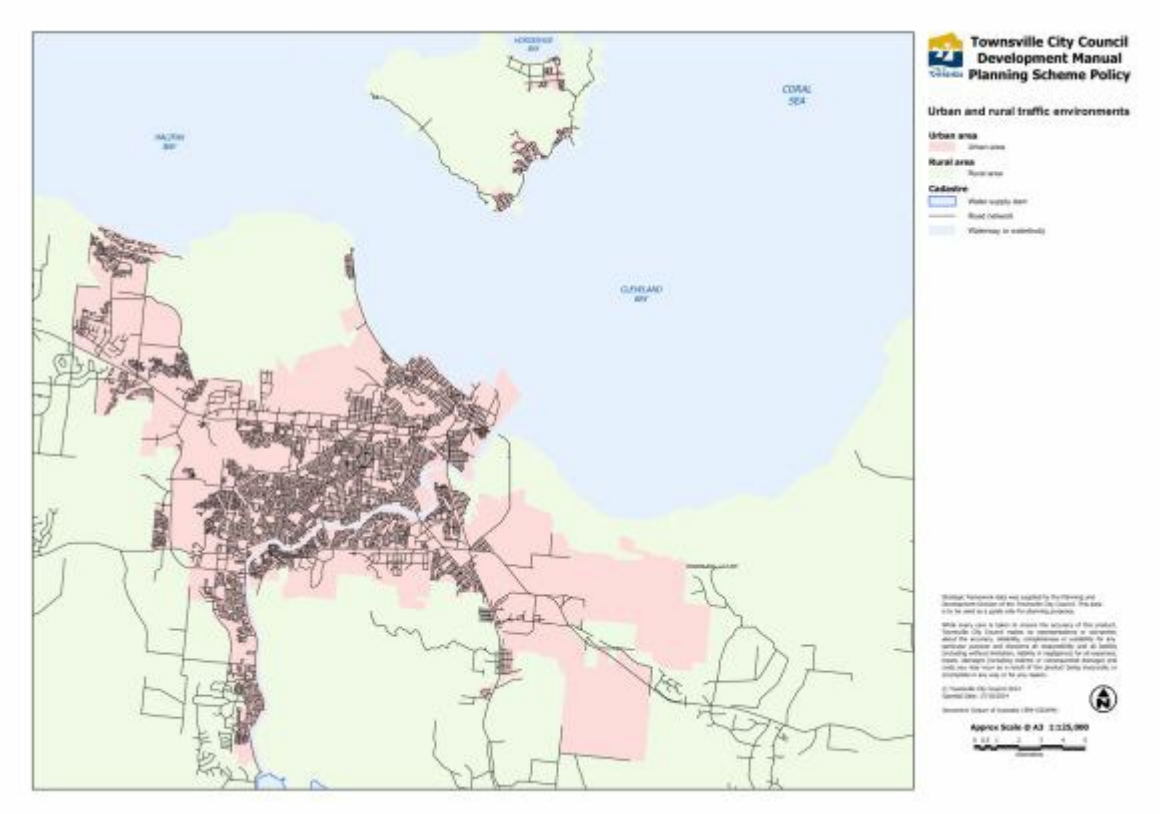
(iii) provision of parking lanes on both sides of the street;

(iv) provision of bike lane on the carriageway;

(v) provision of paved pathway on either or both sides of the street; and

(vi) sufficient heavy vehicle turning radius at access points or in cul-de-sacs.

SC6.4.3.13 Attachment A Urban and rural traffic environments map



Click here to view PDF high resolution map.

SC6.4.3.13 Attachment B1 Road hierarchy elements and their objectives in urban areas

LEVEL 1: PURPOSE							
	Roads						Streets
• to carry through traffic							• to provide local property access; and • to collect local traffic
LEVEL 2: FUNCTION							
Arterial roads			**Sub-arterial roads**			**Major collector roads**	**Local streets**
• through traffic movements across town; • longer distance strategic traffic movements; • primary connection between suburbs and employment, economic, education or entertainment centres; • line haul public transport task; • primary freight and dangerous goods routes; and • regional cycle movements.			• through traffic between arterial roads; • connections between local areas and arterial roads; • access to public transport; • through movement of public transport; • regional – local cycle movements; and • pedestrian movements.			• balance between carry traffic and access within the specific area; • direct access to grouped properties; • access to public transport; • pedestrian movements; and • local cycle movements.	• direct access to properties; • pedestrian movements; and • local cycle movements.
LEVEL 3: MANAGEMENT							
Highway/ Motorway	**Arterial**	**Arterial main street***	**Traffic distributor**	**Controlled distributor***	**Sub-arterial main street***	**Major collector**	**Local street**
The aim of management policies for these categories will be to facilitate:							
• longer distance traffic movements between towns; and • regionally and nationally significant movements.	• longer distance traffic movements between suburbs and other centres.	• longer distance traffic movements; • access to commercial properties; • car parking; • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operation*	• connection of local areas to arterial roads; • through movements between arterial roads; and • access to major developments	• connection of local areas to arterial roads; • access to properties (certain existing cases) • car parking; and • pedestrian movements. *Treatment may control some aspects of traffic operations to ameliorate impacts*	• connection of local areas to arterial roads; • access to commercial properties; • car parking; and • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operations.*	• connection of local streets to arterial roads; • access to grouped/ commercial properties and community facilities; • car parking; and • pedestrian movements *Treatment may involve preservation of aspects of local amenity in balance with traffic operations.*	• connection of local streets with traffic carrying roads; and • access to individual adjacent properties • connection to other local streets.
LEVEL 4: DESIGN							
According to relevant guidelines and codes including SC6.4 Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, *Queensland Streets*, Australian Standards and *Complete Streets* for the local streets level.							

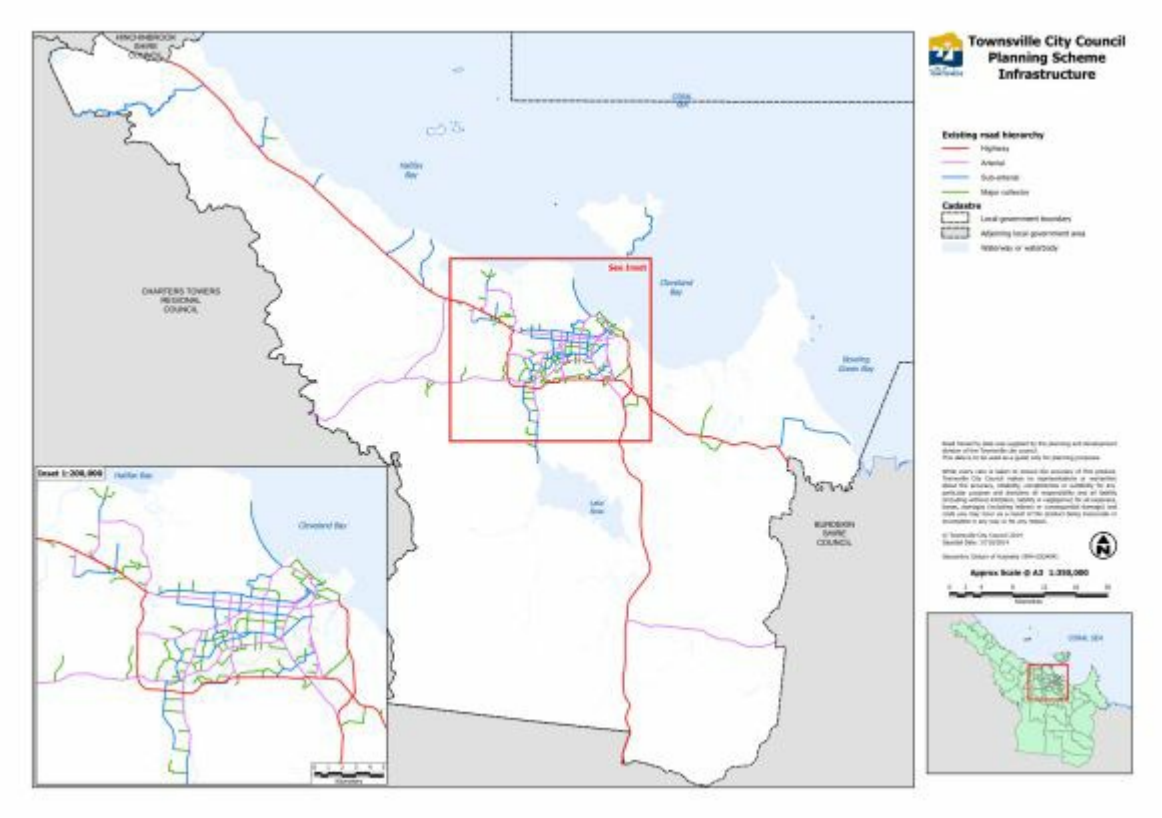
Note—* Only permitted in existing cases or special cases. Therefore treatment may involve preservation of existing land use but discouraging further access points to the adjacent land development.

SC6.4.3.13 Attachment B2 Road hierarchy elements and their objectives in rural areas

LEVEL 1: PURPOSE						
	Roads					Streets
• to carry through traffic						• to provide local property access; and • to collect local traffic
LEVEL 2: FUNCTION						
Arterial roads		**Sub-arterial roads**		**Major collector roads**		**Local streets**
• through traffic movements between towns; • longer distance strategic traffic movements; • primary connection between town and employment, economic, education or entertainment centres; • line haul public transport task; • primary freight and dangerous goods routes; and • regional cycle movements.		• through traffic between arterial roads; • connections between local areas and arterial roads; • access to public transport; • through movement of public transport; and • regional – local cycle movements.		• connections between local streets and arterial/sub-arterial roads; • carry traffic having a trip end within the specific area; • direct access to grouped properties; • access to public transport; and • local cycle movements.		• direct access to properties; • pedestrian movements; and • local cycle movements.
LEVEL 3: MANAGEMENT						
Highway/ Motorway	**Arterial**	**Traffic distributor**	**Controlled distributor***	**Major collector**	**Local street**	
The aim of management policies for these categories will be to facilitate:						
• longer distance traffic movements between towns; and • regionally and nationally significant movements.	• longer distance traffic movements between town and other centres.	• connection of local areas to arterial roads; • through movements between arterial roads.	• connection of local areas to arterial roads; • through movements between arterial roads; • access to properties (certain existing cases) or industrial/commercial properties; • car parking; and • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operation*	• connection of local streets with traffic carrying roads; and • access to individual adjacent properties.	• access to individual adjacent properties; and • connection to other local streets	
LEVEL 4: DESIGN						
According to relevant guidelines and codes including the SC6.4 Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, Queensland Streets and Australian Standards.						

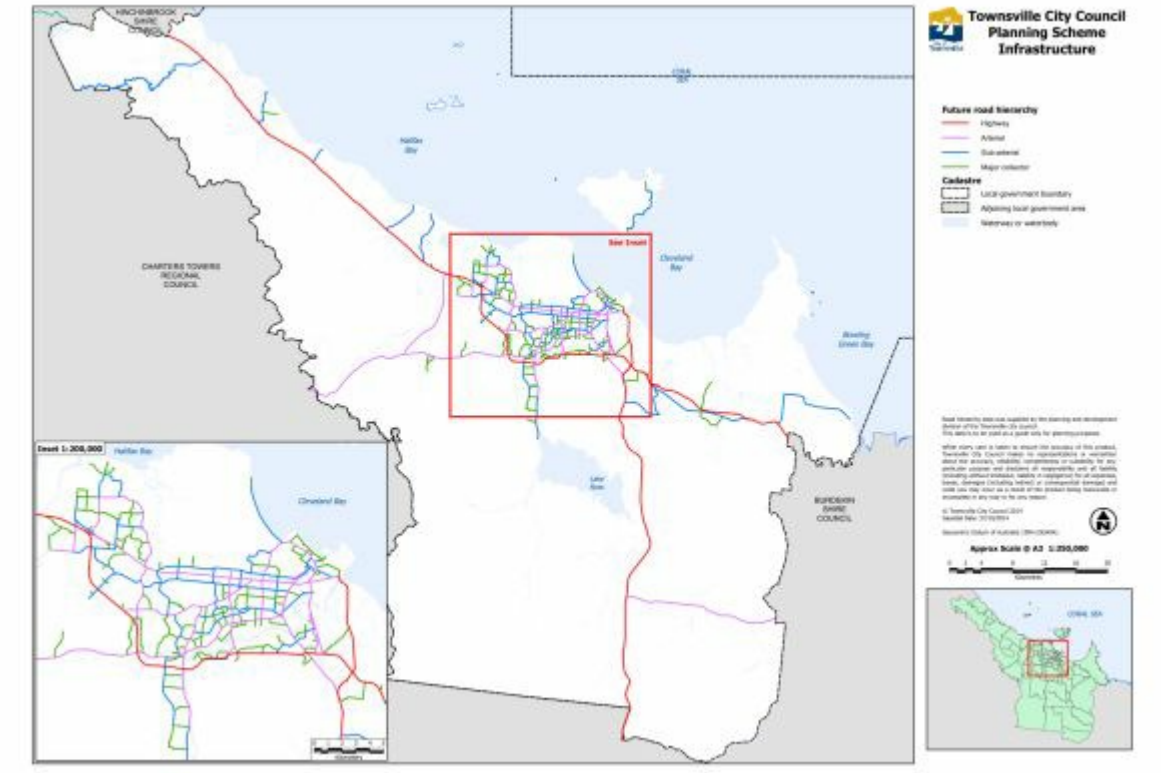
Note—* Only permitted in existing cases or special cases. Therefore treatment may involve preservation of existing land use but discouraging further access points to the adjacent land development.

SC6.4.3.13 Attachment C1 Townsville road hierarchy map (existing)



Click here to view PDF high resolution map.

SC6.4.3.13 Attachment C2 Townsville road hierarchy map (future)



Click here to view PDF high resolution map

SC6.4.3.13 Attachment D1 Road hierarchy desirable performance criteria in urban areas

Criterion	Roads							Streets
	Arterial roads			Sub arterial roads			Major collector roads	Local streets
	Highway/ motorway	Arterial	Arterial main street*	Traffic distributor	Controlled distributor*	Sub arterial main street*	Major collector	
Functional Characteristics								
Dominant linkage	Regional	City, Suburbs, Major centres	City, Suburbs, Major centres	Specific area	Specific area	Specific area/ main sites	Main Sites/ Environmental cell	
Traffic carrying function	Volumes not restricted	Volumes not restricted	Volumes not restricted	preferably <25,000vpd	preferably <20,000vpd	preferably <15,000vpd	<12,000vpd	
Residential access function	Nil	Nil	Nil, consolidated/ no new access	Nil	Nil desirable, site specific-subject to negotiation with council/ no new access	Nil desirable, site specific-subject to negotiation with council/ no new access	Limited-subject to negotiation with council	
Commercial access function	Nil	Nil	Site specific	site specific-subject to negotiation with council	site specific-subject to negotiation with council	site specific-subject to negotiation with council	site specific-subject to negotiation with council	
Industrial access function	Nil	Nil	Nil	Nil	Nil	Nil	site specific-subject to negotiation with council	
Desirable traffic speed environment	>=100km/h	70-80km/h	60km/h	60-80km/h	60km/h	60km/h	50~60km/h	
Heavy traffic movement	Primary freight routes	Primary/ secondary freight routes	Should bypass except for access	Secondary routes	Should bypass except for destination or return only	Should bypass except for destination or return only	Destination or return only	
Dangerous goods movement	Primary routes	Selected routes only	Inappropriate except for access	Selected routes only	Selected routes only	Inappropriate except for destination or return only	Inappropriate except for destination or return only	Refer to SC6.4.4 Design specification and standard drawings
Public transport facilities	Line haul, priority treatments use high frequency, limited stops, peak express, local and feeder	Line haul, priority treatments	Bus route, bus lanes where required	Bus route	Bus route, bus lanes where required	Bus route, bus lanes where required	Bus route	

Cycle facilities	Trunk Routes, off carriageway	Trunk Routes, off carriageway or cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	District/ Neighbourhood routes, cycle lanes on road
Paved footpath *As per council standard*	Only where linkage required, separate from road	Only where linkage required	Both sides	One or both sides	One or both sides	Both sides	One or both sides
Frictional Characteristics							
Preferred access control	No access	No access	Selective access control	Combined sites only tolerated	Selective access control tolerated	Selective access control tolerated	Combined site access preferred
Parking provision	No parking on roadway	No parking on roadway	Selective routes or corridors	No parking on roadway	Selective routes or corridors	Selective routes or corridors	Provide for kerbside parking
Bus stop provision	None on road	None on road	Indented bays	Indented bays	Indented bays	Indented bays	Indented bays
Pedestrian crossing Locations	Grade separated	Signalised	Controlled points	Controlled points	Controlled points	Controlled points	Some controlled points
Typ. Intersection spacing	1-2km highway >=2km motorway	500-1000m	500m desirable, 150m minimum	200~500m	200~500m	150-500m	80-200m
Preferred intersection treatments	Grade separated	signal/ roundabout	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority
Number of traffic lanes	Volume driven, desirably divided	4~6 lanes, desirably divided	4~6 lanes, desirably divided	4 lanes, desirably divided	4 lanes, desirably divided	4 lanes or 6 lanes where PT needed, desirably divided	2~4 lanes, could be divided
Impact Characteristics							
Abutting land use types	Non sensitive	Non sensitive, vehicle associated	Retail/ commercial	Non sensitive to traffic	Preferably non sensitive to traffic	Retail/commercial	As specified under zoning
Land use impact amelioration	Barriers/ buffers/ Setbacks	Buffers/ streetscape/ setbacks	Streetscape	Streetscape/ Setbacks	Streetscape	Environmental street design/ streetscape	Environmental street design/ streetscape

Note— Only applied in existing cases or special cases.

A bus stop provision is required to be integrated with the paved footpath system

traffic study will determine. e.g. TIA (Traffic Impact Assessment).

SC6.4.3.13 Attachment D2 Road hierarchy desirable performance criteria in rural areas

Criterion	Roads					Streets
	Arterial Roads		Sub Arterial Roads		Collector Roads	Local Streets
	Highway/ Motorway	Arterial	Traffic Distributor	Controlled Distributor*	Major Collector	
Functional Characteristics						
Dominant linkage	Regional	Intra-regional, suburbs	Specific area	Specific area	Local area	Refer to SC6.4.4 Design specification and standard drawings
Traffic carrying function	Volumes not restricted	Volumes not restricted	Volumes not restricted	preferably <15,000~25,000vpd	preferably <10,000~15,000vpd	
Residential access function	Nil	Nil	Nil	Nil desirable, consolidated/ no new access	Consolidated	
Commercial access function	Nil	Nil	Consolidated	Consolidated	Desirably consolidated, site specific	
Industrial access function	Nil	Nil	Nil	Nil desirable, consolidated/no new access	Desirably consolidated, site specific	
Desirable traffic speed environment	>=100km/h	80-100km/h	80-100km/h	60~80km/h	60km/h	
Heavy traffic movement	Primary freight routes	Primary/secondary freight routes	Secondary routes	Should bypass except for access	Access only	
Dangerous goods movement	Primary routes	Primary/secondary routes	Nominated routes only	Nominated routes only	Inappropriate except for access	
Public transport facilities	Line haul, priority treatments	Line haul, priority treatments	Bus route	Bus route	Bus route	
Cycle facilities	Regional, off carriageway	Regional, on or off carriageway	Regional/local, on or off carriageway	Regional/local, on or off carriageway	Local on or off carriageway	
Pedestrian movement facilities	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	
Frictional Characteristics						
Preferred access control	No access	No access	Selective access control	Selective access control	Combined site access preferred	
Parking provision	Nil	Nil	Nil	Nil	No specific provision	
Bus stopping provision	None on road	Dedicated bays where appropriate	Dedicated bays where appropriate	Dedicated bays where appropriate	Dedicated bays where appropriate	
Pedestrian crossing Locations	Grade separated	Controlled points	Controlled points	Controlled points	May require controlled points	
Typ. Intersection spacing	4-8km (maximum 12km)	>1km	>300m	>300m	>200m	

Preferred intersection treatments**	Grade separated/ priority	Roundabout/ priority	Roundabout/ priority	Roundabout/ priority	Roundabout/ priority	
Number of traffic lanes	Volume driven	Reservation for 4~6 lanes	Reservation for 4 lanes	Reservation for 4 lanes	Reservation for 2~4 lanes	
Impact Characteristics						
Abutting land use types	Non sensitive, vehicle associated	Non sensitive, vehicle associated	Non sensitive to traffic	Preferably non sensitive to traffic	As specified under zoning	
Land use impact amelioration	Setbacks	Setbacks	Setbacks	Setbacks	Setbacks	

Note— Only applied in existing cases.

A bus stop provision is required to be integrated with the paved footpath system

Traffic study will determine, e.g. TIA (Traffic Impact Assessment)

SC6.4.3.14 Traffic impact assessments

SC6.4.3.14.1 Introduction

A traffic impact assessment (TIA) is a process of compiling and analysing information on the impacts that a specific development proposal is likely to have on the operation of roads and transport networks. The assessment will not only consider general impacts relating to traffic management (road efficiency and safety), but will also consider specific impacts on land use environment and all road users including on-road public transport, pedestrians, cyclists and heavy vehicles.

Developers should refer to the *Guide to Traffic Management* produced by Austroads as a primary reference, and in particular, *Part 12: Traffic Impacts of Development.* The TIA sub-section has been produced to supplement Part 12 by establishing criteria for low, moderate and high traffic impact developments, and to supply additional information pertinent to particular land uses, climate and traffic characteristics in Townsville. If a discrepancy exists between this document and the *Guide to Traffic Management*, this sub-section will prevail.

(1) TIA scope and purpose

(a) TIA purpose

Council requires a TIA in order to:

(i) assess the adequacy of the existing or future transportation system to accommodate additional traffic generated by a proposed development, redevelopment or land use change; and

(ii) to assist in determining what improvements may be required to transport infrastructure (e.g. roadways, pathways, public transport and traffic facilities, parking, etc.) to maintain a satisfactory level of service for the Townsville community.

Within the context of the matters outlined above, the aim of this sub-section is to ensure that:

- traffic impact assessment of developments is undertaken in a uniform manner leading to consistent treatment of similar developments;
- the level of impact assessment is appropriate for the level of potential impacts;
- a road or a road network continues to operate at an agreed level of service following the opening of a development;
- both "soft" solutions (e.g. road use management such as alternative routes) and "hard" solutions (e.g. changes to infrastructure) are considered when mitigating impacts;
- the needs of all road users are considered and appropriate facilities (e.g. bicycle lanes, footpaths, bus lanes, intersection widening or upgraded intersection controls) are provided in a timely manner;
- a development is considered within its proposed environment and not in isolation from nearby features such as intersections, footpaths and other driveways;
- cumulative impacts on transport networks of other developments in an area or region are considered; and
- road safety and environmental impacts (both natural and built) are considered.

(b) TIA scope

A TIA may be required where a development affects the function, safety and efficiency of the transport network. The requirements for a TIA are outlined in this policy sub-section.

The scope of a TIA will depend on the location, type and size of the development and the ability of the road network to handle traffic generated by the development. Therefore, some developments will require an extensive and detailed TIA, while others will require only a brief TIA.

(2) How to use this document

The following steps will guide the applicant in determining the level of TIA required with regard to land use and traffic environment perspectives.

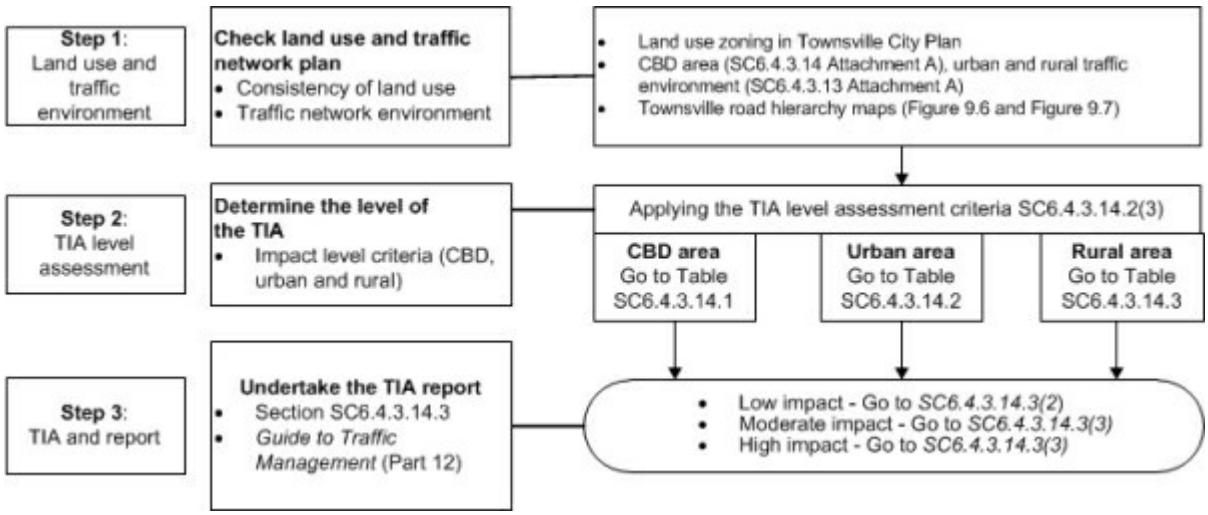


Figure SC6.4.3.14.1 How to use SC6.4.3.14 Traffic impact assessment guidelines

(3) Terminology

AADT	Annual Average Daily Traffic
CBD	Central Business District as per the *Townsville CBD Master Plan* or Attachment A.
DTMR	Queensland Department of Transport and Main Roads
DoS	Degree of saturation
Inconsistent development	development that is not consistent with the planning scheme, or development that is inconsistent as described in Section 650 in the *Planning Act 2016*.
Level of dervice (LOS)	a qualitative measure using a sequence of letters from A through F to describe the quality of operational conditions within an intersection, transit or a roadway link. Refer to the *Highway Capacity Manual for details*.
PCE	Passenger Car Equivalent
PCU	Passenger car unit
PT	Public transport
TIA	Traffic impact assessment
Traffic facility	roads, streets, bikeways, highways, their networks, terminals, traffic signs, public transport/car park and abutting lands related to all modes of transportation, i.e. people, vehicles, goods.
Transportation demand management (TDM)	the application of strategies and policies to reduce travel demand (specifically that of single-occupancy private vehicle), or to redistribute this demand in space or time.
Trip	a single or one-direction person or vehicle movement.

Trip generation	the total number of trips measured in trip ends (i.e. trip production or trip attraction) entering and exiting the site for the defined period, e.g. one hour, one day etc.
VPD	Vehicles per day

(4) Reference and source documents

(a) Legislation

Planning Act 2016
Transport Infrastructure Act 1994

(b) Australian Standards

AS2890 Parking facilities (Part 1: Off-street car parking, Part 2: Off-street commercial vehicle facilities, Part 3: Bicycle parking facilities, Part 5: On-street parking, Part 6: Off-street parking for people with disabilities).

(c) Austroads

Cycling Aspects of Austroads Guides, 2011
Guide to Traffic Management, 2009 (in particular, Part 12)

(d) Townsville City Council

CBD Master Plan (2013)
SC6.4.3.5 Car parking and public transport facilities
SC6.4.3.13 Townsville road hierarchy

(e) Queensland Department of Transport and Main Roads,

Guidelines for Assessment of Road Impacts of Development, 2006 *(GARID)*
Manual of Uniform Traffic Control Devices (MUTCD), 2003
Traffic and Road Use Management Manual (TRUM)
Road Planning and Design Manual (TRUM)
Roads and Maritime Services NSW (RMS), Guide to Traffic Generating Developments 2002 Version 2.2

(f) Other

Transportation Research Board, *Highway Capacity Manual* (HCM), 2010

SC6.4.3.14.2 Determining the level of the TIA

The scope, intent and degree of traffic impact will vary. This will depend on the land use of the proposed development, direct access locations and current land use zoning. For example:

- development based on the current land use zoning and character of the locality;
- location of the development: CBD, urban, rural area;
- the existing and future planned transport network;
- direct access to the external road hierarchy system;
- staging, size and type of the development;
- the traffic environment at the time of the proposal;
- existing approved (but not delivered) development within the area;
- current development applications within the area; and
- any strategic planning determining future land uses such as the Townsville State Development Area.

(1) Land use environment

Due to the different desirable service standards in the CBD/Urban and Non-urban areas, council has different impact assessment thresholds depending on whether the development is in the CBD, urban or rural traffic environments. These areas are defined as follows:

(a) *The CBD* (see SC6.4.3.14 Attachment A); or

(b) *Urban* area – with the exception of the CBD, refer to the map in SC6.4.3.13 Attachment A; or

(c) *Rural area* – areas not in the urban area, or CBD, refer to the map in SC6.4.3.13 Attachment A.

These TIA land use traffic environment definitions relate to the character of the land for the purpose of assessing the traffic impacts on the site and the adjacent network.

(2) Three levels of the TIA

For each of the development locations identified above, and in conjunction with the defined Townsville Road Hierarchy system, (SC6.4.3.13 Townsville road hierarchy) there are three different levels of traffic impact assessment. The anticipated level of impact will require different methodologies of traffic forecasting and analysis, as described below.

Low impact (SC6.4.3.14.3(2) Low TIA report):

The development is likely to have a very minor impact as the land use is consistent with the Townsville City Plan but a review is still required to ensure potential traffic issues are assessed in terms of traffic safety and amenity issues, etc. A low level TIA report will comprise of a statement of impact, and a corresponding statement of proposed mitigation measures and measures to optimise the network.

Moderate impact (SC6.4.3.14.3(3) Moderate/High TIA Report):

The development is likely to have a moderate traffic impact on the surrounding existing and future land uses, traffic network and operations. For a moderate level TIA Report, either a manual forecasting or mesoscopic traffic simulation modelling (e.g. SIDRA Network, Aimsun or an equivalent model) or microscopic traffic simulation modelling (e.g. Aimsun or an equivalent model) (Refer to SC6.4.3.14.4.2(a)) may be a suitable methodology of traffic forecasting due to:

- a moderate threshold, in terms of additional or new traffic generated as defined by the CBD/Urban/Non-urban TIA impact level assessment criteria;
- insignificant impact on existing and future transport and traffic systems, e.g. no additions or changes to the road hierarchy system; and
- the characteristics of the road network in the immediate vicinity of the development.

Note—if broader traffic network modelling (e.g. masterplan) has been recently done in that area (i.e. less than two years old), a high impact assessment may be assessed at the moderate level (upon confirmation with council), as long as the development is consistent with the land use or assumptions made within the previous modelling study.

High impact (SC6.4.3.14.3(3) Moderate/High TIA Report):

The development is likely to have a high impact on the surrounding existing and future land uses, traffic network and operations. For a high level TIA report, which does require a comprehensive assessment approach, council encourages the use of an appropriate traffic modelling program, e.g. EMME (for strategic traffic modelling), Aimsun, or an equivalent model, (Refer to SC6.4.3.14.4.2(a)) particularly where:

- additions or changes to the road hierarchy system are proposed, i.e. a new/changed arterial, sub-arterial or major collector road; or
- significant trip behaviour changes and impacts are expected, as defined by the CBD/Urban/Non-ruban TIA impact level assessment criteria, e.g. trip generation, trip distribution, mode choice and trip assignment; or
- changes to council's and/or DTMR's future major traffic network programmes are proposed.

Note—occasionally a TIA may have a high anticipated impact, but the area of impact is restricted to a corridor rather than a network within the TIA area. In this circumstance, either a manual forecasting or mesoscopic traffic simulation modelling may be a suitable methodology of traffic forecasting.

(3) Applying the TIA impact level assessment criteria

Use Table SC6.4.3.14.1 to Table SC6.4.3.14.3, whichever is relevant to the location of the development, i.e. CBD, Urban, or Non-urban area, and assess the development against the TIA impact level assessment criteria whilst also taking into account the following:

(a) the applicant must consider the actual or potential traffic impacts of all land/development under their common ownership or control (for example, by a joint venture agreement), at one location.

Editor's note—The phrase "at one location" means all adjacent land of the applicant, the property lines of which are contiguous or nearly contiguous at any point, or separated by other land of the applicant, or a public or private street, road, highway, or utility right-of-way or other public or private right-of-way.

Editor's note—"All land/development" includes existing development and planned/potential development.

An applicant must not avoid the intent of this policy sub-section, and that of Townsville City Plan, by submitting partial or segmented applications or approval requests for development plans, subdivisions, etc. If the properties will form an integrated or complementary development, council expects the applicant to submit one consolidated TIA report based on the integrated level of impact;

(b) if the criteria that apply are spread across two or more impact columns, the highest level of impact will apply. For example, if the development is low for all criteria, except for one criterion that is in the high column, a high level TIA will be required;

(c) Council may require additional information as part of the traffic impact assessment at the Information and Referral stage of an application for a Development Permit, which will be decided on a case by case basis;

(d) if the proposed development land is zoned for rural purposes but the development proposed is an urban land use that will either be surrounded by a rural traffic environment or adjoin an urban area, Table SC6.4.3.14.2 Urban TIA impact level assessment criteria must be used, rather than Table SC6.4.3.14.3 Rural area TIA impact level assessment criteria;

(e) council may request a more thorough analysis if negative impacts on traffic facilities have been identified, or if particular factors of the development cause concern to the safety, efficiency and operation of the transport network; and

(f) if the proposed development has roads that are not identified in the Road Hierarchy Map (e.g. in the development of new subdivision plans), a new link(s) road hierarchy in the subjected development area may be proposed by the developer, with council's agreement.

Note—if any of the above conditions apply, or more details are required, council encourages a pre-lodgement meeting to be arranged prior to commencing the TIA.

Table SC6.4.3.14.1 CBD area TIA impact level assessment criteria

Criteria	Impact		
	Low	Moderate	High
Trip generation	New or additional trip generation in a peak hour of <10 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 10 to 100 trips directly accessing a street. New or additional trip generation in a peak hour <100 trips directly accessing a major collector, sub-arterial, arterial, or highway[1].	New or additional trip generation in a peak hour of more than 100 trips.
Commercial vehicles	3 or less new or additional commercial vehicles per day.	More than 3 and up to 100 new or additional commercial vehicles per day.	More than 100 new or additional commercial vehicles per day.
Car parking	An increase or decrease of 9 or less on-site car park spaces. Loss of 2 or less line marked on-street car parks and no loss of loading zones.	An increase or decrease of 10 or more on-site car park spaces. Loss of 3 or more line marked on-street car parks, or any loading zones.	

Public transport	No impact on any bus zone or taxi operations.	Relocation of any bus zone or taxi rank. Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Change to permitted vehicle movements at a T-intersection.	Change of permitted vehicle movements at a crossroads or multiple intersections.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

Table SC6.4.3.14.2 Urban area TIA impact level assessment criteria

Criteria	Impact		
	Low	**Moderate**	**High**
Trip generation	New or additional trip generation in a peak hour of <20 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 20 to 300 trips directly accessing a street. New or additional trip generation to a major collector, sub-arterial, arterial, or highway[1].	New or additional trip generation in a peak hour of more than 300 trips directly accessing a road system.
Commercial vehicles	5 or less new or additional commercial vehicles per day in a residential area. Less than 10 new or additional commercial vehicles per day in a non-residential area.	More than 5 and up to 300 new or additional commercial vehicles per day in a residential area. More than 10 and up to 300 new or additional commercial vehicles per day in a non-residential area.	More than 300 new or additional commercial vehicles per day.
Car parking	Increase or decrease of 9 or less on-site car park spaces. Loss of 2 or less line marked on-street car parks, or loading zones.	Increase or decrease of 10 or more on-site car park spaces Loss of between 3 or more line marked on-street car parks, or loading zones.	
Public transport	Relocation of any bus zone or taxi rank.	Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Changes to the connectivity between local streets and collector roads.	Changes to the connectivity between arterial and sub-arterial roads.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

Table SC6.4.3.14.3 Rural area TIA impact level assessment criteria

Criteria	Impact		
	Low	**Moderate**	**High**
Trip generation	New or additional trip generation in a peak hour of less than 30 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 30 to 300 trips directly accessing a street. New or additional trip generation directly accessing a sub-arterial, arterial, or highway[1] <300.	New or additional trip generation in a peak hour of more than 300 trips.
Commercial vehicles	Less than 30 new or additional commercial vehicles per day.	More than 30 and up to 300 new or additional commercial vehicles per day.	More than 300 new or additional commercial vehicles per day.
Public transport	Relocation of any bus zone or taxi rank.	Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Changes to the connectivity between local streets and collector roads.	Changes to the connectivity between arterial and sub-arterial roads.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

(4) Collaborative traffic impact assessments
If the anticipated traffic impact is determined to be of significant impact on the existing or future transportation system due to its location, development type, or land use characteristics, the traffic impact assessment may require a more strategic and holistic assessment to be prepared collaboratively with council and any other relevant stakeholders.

(5) Associated reports
Road Safety Audit - If the TIA Report indicates that significant safety issues may occur, the developer must engage a qualified road safety engineer to undertake an independent Road Safety Audit, in line with the *Guide to Road Safety Part 6*, Austroads 2006-2009c.

Noise - A road noise assessment may be required if there is a forecasted volume that will increase traffic over 3000 VPD (link traffic) in the subjected TIA study scope, or if noise sensitive receptors are identified. Refer to sub-section SC6.4.3.15 Noise and vibration assessment guidelines for more information.

SC6.4.3.14.3 TIA report requirements
The TIA will be used to help evaluate whether the development is appropriate for the site and what type of transportation improvements may be required. The TIA Report should address any traffic issues outlined in this document and the *Guide to Traffic Management Part 12*: *Traffic Impacts of Development* (Austroads, 2009).

The TIA report must identify the type and amount of additional traffic expected to be generated by the proposed development on the adjacent transport network and include recommendations on any site specific and external upgrading or network management works required to cater for short-term and long-term traffic and transportation planning.

It is important that early contact be made with the Planning and Development Division of council during the TIA process. This should commence at the outset and continue as required during the course of TIA preparation. For example, if council's concerns about access to the council road network are identified early, this may be able to be addressed through minor amendments to the on-site layout of the development. For larger developments, it may be appropriate to consult with council regarding consideration of the project's scope, methodology and other possible planning consideration during the development of the initial project concept.

(1) General requirements

The TIA Report must demonstrate that the proposed development is consistent with the traffic and transportation aims of the planning scheme for that area. The intent of the TIA is to evaluate *worst case traffic scenarios*. For example, if several different uses are proposed, the land use with the greatest overall traffic impact must be assumed in the study, unless the applicant specifies the uses for the site.

(a) TIA consultant qualifications

A low impact TIA report may generally be prepared by the developer. However, if existing traffic facilities need to be changed, then recommendations for mitigation must be made by a Registered Professional Engineer of Queensland (RPEQ) qualified person at a minimum. The moderate or high impact TIA is to be prepared by an impartial professional traffic/transportation consultant who is appropriately experienced and holds current RPEQ qualification. The document must be certified by the appropriately qualified and experienced RPEQ.

(b) Report documentation

The TIA Report must fully document the approach, methodology, and assumptions of the analysis. It must clearly explain the reasons for any adjustments to the trip generation rates and assumptions used for trip distribution and assignment. Figures (drawings and maps) are to be used to help illustrate these assumptions. The report must summarise the results of the Level of Service (LOS) calculations in tabular or map form, and include figures showing the traffic volumes for the project alone and for each scenario. The report must also include any mitigation measures, appropriately tested by the model. All worksheet and analysis input and output data must be included as appendices to the report, if applicable.

(c) Impact on other stakeholders

If there are other jurisdictions or stakeholders impacted within the area of influence, for example, DTMR, Queensland Rail (QR), or Bus/taxi companies, the consultant should arrange a scoping meeting with all relevant agencies to discuss the issues. This will provide improved coordination and reduce the potential for later revisions to the TIA.

(d) Updating an existing TIA

A TIA requires updating when the amount or character of traffic is significantly different from an earlier study; for example, changes to the land use, road hierarchy or road networks. Any traffic study may also need to be revised if the study is older than 2 years and council determines that the existing conditions have changed enough to invalidate the study results or if the initial study assumes an incorrect build out period. A TIA may require updating sooner in rapidly developing areas and not as often in slower developing areas. In these cases, consultation with council is recommended.

(e) Possible additional requirements

At times, council may extend the study to additional street segments and/or intersections on the public street system. Council will make this determination based on the scale, location, and/or nature of the proposed development and the condition or state of development of the street network in the vicinity of the site.

(2) Low TIA report

1. Justification for low impact assessment;
2. A brief description of the development in terms of site location, direct site access(es), land use, size and expected year of completion;
3. Analysis/Findings, e.g. impact on existing traffic facilities, heavy vehicles turning path and other safety issues;
4. Recommendations and Mitigation; and
5. Appendices if applicable.

(3) Moderate/high TIA report

Executive summary

- a brief description of the development (site location, internal layout, all site access(es), land use/size and year of completion);
- a brief overview of trip generation and analysis result (LOS), Degree of Saturation (DoS) and Average Delay;
- parking demand; and
- mitigation plan and conclusion/recommendation.

Note—desirably, the executive summary should be no longer than five pages, complete in itself, and not dependent on supplementary data included by reference.

1. Introduction and summary

1.1 Justification for moderate or high impact assessment

1.2 Study objectives and scope

- Time horizon - year of completion assuming full build-out and occupancy and 10 years after total completion. This also needs to be assessed at key stages of the development, or if traffic environment changes have occurred in the meantime
- TIA Area – where:
  - (a) the amount of additional traffic likely to be generated is more than 5% of existing total links and intersection volumes during a peak hour; or
  - (b) the likely increase in the proportion of heavy vehicle traffic is more than 5% during a peak hour associated with the development.

2. Proposed development

2.1 Land use and intensity;

2.2 Site plan/layout;

2.3 Phasing and timing; and

2.4 Specific information of the proposed development (operation hours, number of employees, type of service vehicles, etc.).

3. Existing conditions

3.1 Study area land use:

- existing land use/zoning; and
- anticipated future development (background); land use/traffic network.

3.2 Existing traffic analysis:

- roadway system;
- traffic volumes and analysis;
- active mode facilities (public transport stops/route, pathway, bike lane, trip end facilities);
- parking (car park type, operation, existing/potential car park demand);
- traffic accident data (traffic safety); and
- other.

4. Traffic forecasting and analysis

4.1 Method of projection.

4.2 Background traffic (each horizon year):

- traffic model calibration or validation if applicable; and
- forecasting and analysis.

4.3 Site traffic (each horizon year):
- trip generation;
- trip distribution;
- modal split;
- trip assignment; and
- analysis.

4.4 Summary of analysis (with/without development scenario).

5. Improvement analysis

5.1 Improvements to accommodate background traffic.
5.2 Additional improvements to accommodate all site traffic.
5.3 Alternative improvement.
5.4 Need for any improvements (e.g. TDM).
5.5 Status of improvements already funded, programmed, or planned.
5.6 Independent road safety audit, if required.
5.7 Summary.

6. Parking

6.1 Method of projections
6.2 Parking demand forecasting and analysis (including all service vehicles and bikes)
6.3 Site circulation and parking layout (including all service vehicles)

7. Public transport and pathway

7.1 Possible/desirable PT system.
7.2 Internal/external pathway network system (type, location).

8. Recommendation

8.1 Site access/circulation plan.
8.2 Roadway improvement:
- on-site;
- off-site; and
- phasing, if appropriate.

8.3 PT, bicycle and pathway system.
8.4 Other.

9. Conclusion

10. Special analysis/issues (if applicable, refer to SC6.4.3.14.4(8))

11. RPEQ Certification

Appendices

SC6.4.3.14.4 Essential technical guidance

(1) Existing conditions

(a) Traffic count data
Traffic trends and counts data may be available from DTMR and council. Traffic data must reflect existing normal conditions and should not be used if more than two years old at the time of the TIA submission or if significant changes have occurred at or near the count location or as otherwise requested by council. The traffic consultant or the applicant is responsible for providing traffic counts that are not available through DTMR or council.

(b) Traffic accident and safety
Accident data is available from the State traffic accident reporting system and can be obtained through Data Analysis at the Queensland Department of Transport and Main Roads. Accident data requests should be made as early as possible to enable the information to be provided in a timely manner.

(2) Traffic forecasting and analysing

(a) Townsville Strategic Traffic Model 2011 (TSTM11)

Townsville Strategic Traffic Model 2011 (TSTM11 on the Emme platform) has been developed and calibrated with various Townsville traffic survey results, 2011 demographics and network conditions. Its ownership has been established between council and DTMR.

Associated with land use development, council has used the Townsville Growth Model to develop future demographic data, in 5 year intervals up to 2036.

Upon request, or following a pre-lodgement meeting agreement, TSTM11 and future demographic data are available to use under license among council/DTMR and the applicant. Also, depending on the process of council/DTMR traffic model development, meso/micro simulation models for other areas will be available, such as CBD SATURN. Council encourages the use of these models, as they have been developed for the agreed network structure and their methodology is transparent and consistent for all users. For background traffic forecasting, the use o f data TSTM11 must be used in the first instance. Data obtained from TSTM11 for background traffic forecasting must be calibrated to existing traffic volumes at the time of analysis.

All traffic modelling data should be calibrated and validated at the time of the assessment prior to using the data and details of this process are required to be included in the report. It should be acknowledged that TSTM11, especially, is intended for use with high level traffic network modelling and is not designed for small size or individual lots of development. It is important to apply the correct level of traffic modelling work/methodology to forecast the traffic demand associated with the development.

Council retains intellectual property ownership rights to the latest data for council purposes. Applicant must ensure that any consultants engaged to undertake this work are aware of this stipulation.

Any updated or developed input/output traffic modelling data as part of the TIA study, must be submitted. If the applicant intends to develop new traffic modelling as part of the TIA report, council encourages the use of the same platform of traffic modelling, i.e. EMME, Sidra Intersection and Aimsun. If the applicant uses an alternative equivalent traffic model, this must be agreed to by council prior to the TIA commencing. The agreement will cover issues such as network structure, demographic data and methodology.

(b) Trip generation rates

The trip generation rates for the residential component of dwellings are 8 VPD per dwelling in non-urban areas and 10 VPD per dwelling in CBD/Urban areas, unless actual survey data is available. In the same manner, all considered trip generation rate data must be provided in the TIA Report as source or reference data. Consideration must also be given for other ancillary uses proposed on the land. In the absence of specified trip generation rates within council documentation, the DTMR's Guidelines for Assessment of Road Impacts of Development, 2006 and Road Planning and Design Manual must be used.

(3) Traffic analysis performance criteria

The results of the traffic analysis must be compared using the Measure of Effectiveness (MOE), as set out in Table SC6.4.3.14.4 below.

Table SC6.4.3.14.4 MOE based on the traffic characteristics and type

Facility	Type	Measure of effectiveness (MOE)
Intersections	Unsignalised or prioritised control	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
	Traffic signals	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
	Roundabouts	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
Interrupted flow, e.g. Urban/CBD network		Average travel speed (km/hr) Volume/Capacity ratio
Uninterrupted flow, e.g. Non-urban/highway network		Density (PCU/km/lane) Volume/Capacity ratio
Two-lane uninterrupted flow, e.g. Non-urban/highway network		Average travel speed (km/hr) Volume/Capacity ratio
Pedestrian		Space (m^2/person) in queuing area Speed (person/min/m) in walkway
Transit		Headway (minutes or veh/hr) Passenger loading (m^2/person) Reliability (%)

Source :*Transportation Research Board, Highway Capacity Manual,* 2010.

The type and level of analysis and evaluation will include documentation of LOS for intersections. A saturation flow rate and all parameters for analysis should be considered in accordance with the SIDRA Intersection user guide and default parameters unless field measurements at the study area would indicate a more appropriate value. In this case, all source or reference data must be provided in the TIA report.

(4) The conversion of vehicle numbers to PCE
Table SC6.4.3.14.5 shows the conversion of vehicles (as classified by Austroads) to comparative number of passenger car equivalent (PCE) for the determination of trip generation, intersection capacity and LOS analysis.

Table SC6.4.3.14.5 Calculating passenger car equivalent

Austroads *Guide to Traffic Management Part 12* **vehicles classifications**	**Passenger Car Equivalent (PCE)**
Classes 1 to 2 i.e. short vehicles	1 PCU
Classes 3 to 5 i.e. light to medium trucks	2 PCU
Classes 6 to 9 i.e. heavy trucks	3 PCU
Classes 10 to 12 i.e. B-doubles, Triple Road Train	5 PCU

(5) Desirable service standard for links
According to the given MOE in Table SC6.4.3.14.4, the threshold for acceptable operation is the upper limit of LOS ‘D’ for CBD/urban roads and LOS ‘C’ for rural roads although the next level of LOS ‘E’ or ‘D’ could be accepted where weekend peaks are the defining event and occur on recreational routes.

(6) Desirable service standard for intersection/access
Any intersection analysis should demonstrate that the delays would be less than that shown in Table SC6.4.3.14.614.6 up to the ten year horizon after completion of the development. If they are not, improvements to the intersection layout and/or changes to the proper method of control must be assessed.

Table SC6.4.3.14.6 Desirable Service Standard for intersection/access operation

Criteria	Acceptable levels	
	CBD and urban	**Rural**
Signalised intersection	Control delay less than 55 seconds per vehicle (LOS D) or Degree of Saturation less than 0.9	NA
Roundabout	Control delay less than 35 seconds per vehicle (LOS D) or Degree of Saturation less than 0.85	Control delay less than 25 seconds per vehicle (LOS C) or Degree of Saturation less than 0.8
Priority intersection or give-way stop controlled intersection	Control delay less than 35 seconds per vehicle (LOS D)or Degree of Saturation less than 0.8	Control delay less than 25 seconds per vehicle (LOS C) or Degree of Saturation less than 0.7
Left or right turning lanes	Less than available storage length within 95 percentile queue	Less than available storage length within 90 percentile queue

Note—The delays above equate to the upper limit delay of Level of Service C or D for approach-based and intersection wide assessment. LOS is defined solely by control delay (2010 *Highway Capacity Manual*). LOS E means the intersection/approaches are at capacity.

(7) Parking

Adequate parking must be provided to meet site-generated demands and be consistent with the most current version of the references. If the consultant conducts a survey, or uses other source data, the car parking demand must be compared against SC6.4.3.5 Car parking and public transport facilities guidelines, with the greater car parking demand being applied. In considering car parking for a specific type of development, the consultant must use data from at least two different sources, or use the data compiled from both a survey and one source data, with the greater level of car parking demand being applied. All surveys or source data must be from a similar land use to the proposed development.

Specific dimensions, parking angles, and parking ratio requirements are addressed in the planning scheme and planning scheme policies (SC6.4.3.5 Car parking and public transport facilities guidelines), and Austroads Cycling Aspects of Austroads Guides.

Editor's note - From time to time, council may introduce incentive programmes that impact on parking requirements. Information on any incentive programmes is available from council.

(8) Special analysis/issues

Council may request specific traffic analyses relevant to the proposed development. These include details about access management, a TDM plan, cut-through traffic and residential quality of life analysis, truck estimates, Intelligent Transport System (ITS) strategies, pedestrian/bicycle safety, signage and access, safe routes to school, emergency routes, etc.

(9) Mitigation plans and conclusion

All mitigation plans identified as necessary to serve the proposed development should be listed in the TIA report, along with the timing of implementation.

During construction, private approaches should be located, and configured in such a manner as to avoid disruption to the public street system. If changes to traffic controls are proposed, warrants should be reviewed and documented in the report. Reference should also be made to SC6.4.6.30 Control of traffic.

The TIA report must provide a preliminary overall master plan map, and recommendations, and include the status (funded, programmed, or unfunded) of any existing traffic upgrading plans.

(10) TIA report appendices

The following appendices should be included in the TIA report submitted to council:

(a) raw traffic count data - average daily and peak hour turning movement traffic count data collected and/or obtained from other sources;

(b) printouts of analysis results - input/output; e.g. aaSIDRA;

(c) all traffic network modelling work as an electronic copy - e.g. network attribute data, demographic data and other relevant files (macro, excel etc);

(d) photographs of the site;

(e) additional tables or figures not included in the TIA report;

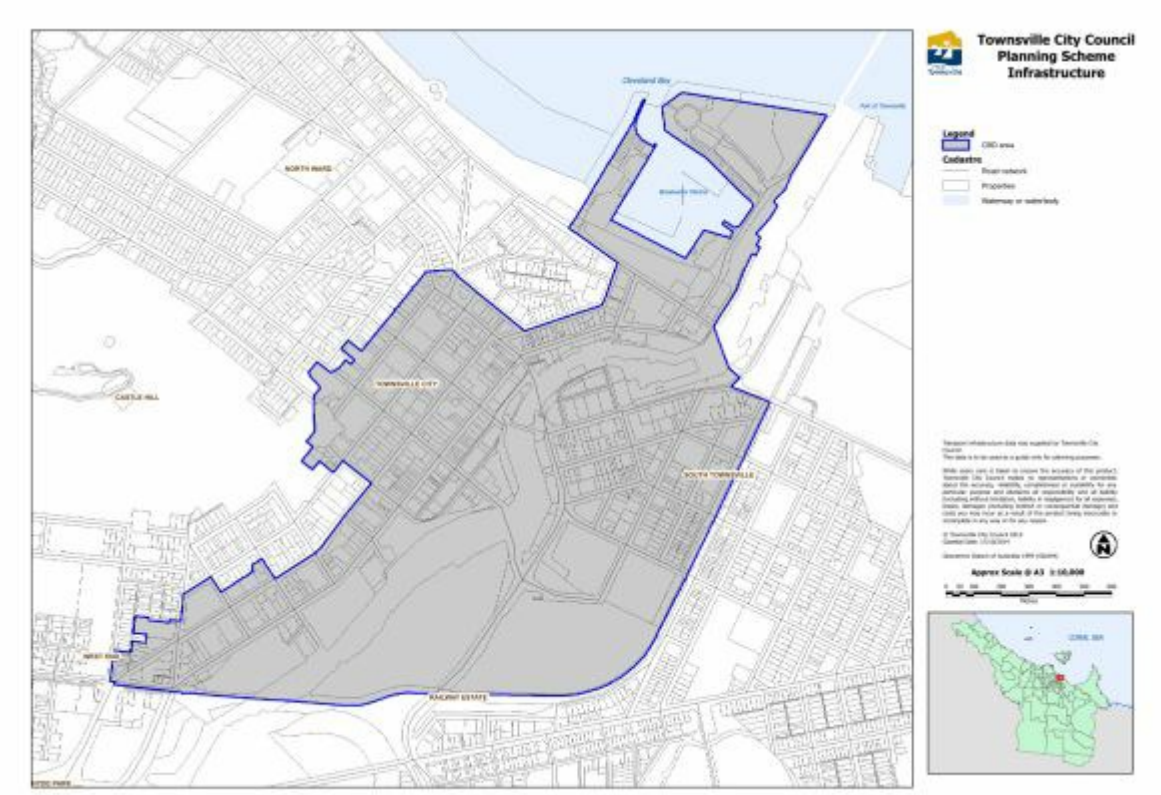
(f) description of methodologies and assumptions used in analysis;

(g) worksheets used in analysis - i.e. signal warrant, LOS, queuing, capacity etc.;

(h) notes on the outcomes of any meetings in regards to the development; and

(i) variations to the standard report (template) – RPEQ certification of any non-conformances with requirements.

SC6.4.3.14 Attachment A: Map of the CBD



Click here to view PDF high resolution map.

SC6.4.3.15 Noise and vibration assessments

SC6.4.3.15.1 Introduction

(1) Purpose

The purpose of this sub-section is to:

(a) provide information to developers and other related parties for use during the planning, construction, and operational stages of a development;

(b) provide guidance on preparing a noise or vibration impact assessment report; and

(c) ensure that development is managed in a way which prevents nuisance from the effects of noise and vibration on the health, community well-being and quality of life of an individual or the community, and wildlife.

(2) Terminology

Unless noted otherwise all terms have the same meaning as given in the most recent version of the *Environmental Protection Act 1994*, the E*nvironmental Protection Regulation 2008*, the *Environmental Protection (Noise) Policy 2008* and the relevant standards. If a definition given in the relevant standards is inconsistent with the Act or Regulation, the Act or Regulation prevails to the extent of the inconsistency.

Background creep	a progressive increase in background noise levels due to new noise generating activities locating in an area.

(3) Reference and source documents

(a) Queensland authorities/legislation:

Department of Transport and Main Roads (DTMR) – *Policy for development on land affected by environmental emissions from transport and transport infrastructure,* 10 May 2013
Department of Transport and Main Roads (DTMR) – *Road Traffic Noise Management: Code of Practice*
Department of Transport and Main Roads, Main Roads Technical Standard, *MRTS15 Noise Fences*
Environmental Protection Act 1994
Environmental Protection (Noise) Policy 2008 (EPP Noise).
Queensland Development Code MP Part 4.4 – Buildings in a Transport Noise Corridor.

(b) Australian standard/guideline:
Department Environment Heritage Protection - *Noise Measurement Manual 2013*
Department Environment Heritage Protection - *Planning for Noise Control 2016*
Environment Protection Authority (NSW) NSW Industrial Noise Policy 2000
AS1055.2: *Acoustics – Description and measurement of environmental noise – Application to specific situations.*
AS2107: *Acoustics – Recommended design sound levels and reverberation times for building interiors.*

(c) Austroads

AP-R277/05 - Modelling, Measuring and Mitigating Road Traffic Noise
Guide to Road Design Part 6B: Roadside Environment

SC6.4.3.15.2 Noise and vibration

Noise is often described as unwanted sound and, by its very nature, can cause varying degrees of nuisance. Some sounds are considered to be annoying by some people but not by others. However, in general, the louder the sound, the greater the annoyance or nuisance caused.

The nature and character of a sound, even at low levels, may also cause annoyance. Sound can have a number of characteristics and can be described in many ways. It is not possible to fully categorise every form of sound. However, this policy is intended to provide guidance for the majority of commonly experienced sounds. "Noise" has become synonymous with "sound" in common language. In this policy, noise will generally mean sound.

Furthermore, sound is defined in Queensland legislation to include vibration and therefore levels of acceptable vibration

are also included.

SC6.4.3.15.3 Development assessment

Preventing noise problems is always better than attempting to rectify noise impacts after the development and trying to resolve problems may not be always possible and can be costly. The management hierarchy under the Environment Protection (Noise) Policy 2008 (EPP Noise) is "to the extent that is reasonable to do so".

(1) Firstly - avoid; or

(2) Secondly - minimise; or

(3) Lastly - manage.

Council encourages development that is sympathetic to the amenity of a location, and minimises the occurrence of background creep. Where proposed uses are likely to increase noise levels at a locality, or be affected by existing noise sources, a noise (and vibration) impact assessment may be required or requested.

If the noise impact assessment report reveals that the use or activity has the potential to create nuisance or exceed acoustic quality objectives as prescribed by *Environmental Protection (Noise) Policy 2008* (EPP Noise), the developer will need to demonstrate by way of a noise (and vibration) control plan how the environmental values (noise) will be enhanced or protected to meet the standard as part of any submission for an operational works permit, or a compliance permit.

SC6.4.3.15.4 Noise and vibration impact assessments

(1) Subdivision layouts must be designed to ensure that acoustic mounds and acoustic fences over 1.8m are not included in lots with setbacks adjacent to the acoustic structure of 3m or less.

In support of the assessment provisions specified in the Townsville City Plan, a noise (and/or vibration) impact assessment report maybe in situations where:

(a) a new development is proposed that will create significant noise (e.g. new industry, or commercial premises with refrigeration, air conditioning or exhaust equipment); or

(b) a new noise-sensitive development is proposed in an area where existing noise sources are present (e.g. an existing industrial site, or a future or existing major road, is located nearby); or

(c) a new development will generate a significant amount of traffic noise, i.e. traffic volumes increase by around 3000 vehicles per day or more (determined by a Traffic Study Assessment); or

(d) building work including rock breaking, drilling or piling or other noisy activities are proposed; or

(e) it is required by council in order to complete an assessment of the proposed development.

The assessments are to be undertaken by a suitably qualified and experienced acoustic practitioner (e.g. a member of the Australian Acoustical Society, the Institution of Engineers, the Association of Australian Acoustical Consultants or a person with other appropriate professional qualifications).

(2) Information provided in an assessment report should include at least the following:

(a) background:

(i) the name and qualifications or experience of the person(s) preparing the assessment;

(ii) the project description, including proposed or approved hours of operation; and

(iii) the relevant guideline or policy that has been applied.

(b) impact assessment process:

(i) results of background and any other noise measurements (noise impact assessments need to consider not only existing developed property adjacent to the planned facility, but also any nearby undeveloped residential land);

(ii) meteorological conditions (wind speed and direction, temperature, atmospheric pressure and humidity) and other relevant details at the time of the measurements;

(iii) details of instruments and methodology used for noise measurements (including reasons for

settings and descriptors used, frequency weighting, height of microphone above the ground and distance to reflective surfaces calibration details);

(iv) a site map showing all noise sources, measurement locations and potential noise receivers; and

(v) any tonality impulsiveness or other noise characterises and all assumptions of noise propagation and attenuation due to distance, topography, barrier, etc, and

(vi) noise criteria applied to the project.

(c) impact mitigation and compliance:

(i) noise predictions for the proposed activity;

(ii) a comparison of noise predictions against noise criteria;

(iii) a discussion of proposed mitigation measures, the noise reduction likely and the feasibility and reasonableness of these measures; and

(iv) how compliance can be determined practically.

Editor's note—where it is demonstrated that noise and/or vibration is to have an adverse impact on a sensitive development to an acceptable and manageable level, attenuation treatments will need to be incorporated into the development to ensure that the sensitive development is protected from the identified adverse impacts. Treatments may need to address specific zone code requirements, particularly where street activation is sought from development.

SC6.4.3.15.5 Noise and vibration control plans

Where an impact assessment demonstrates that noise is likely to exceed thresholds contained within the *Environmental Protection (Noise) Policy 2008* or other relevant document or Australian Standard, a noise (and vibration) control plan will need to be submitted.

Editor's note—the noise assessment should have regard to the following – Queensland Development Code Part 4.4 – *Buildings in a Transport Noise Corridor*. Australian Standards AS1055.2 and AS2107;*or Department Environment Heritage Protection Noise Measurement Manual 2013* or *Environmental Protection Act 1994* and *Environmental Protection (Noise) Policy 2008* (EPP Noise); or *Department of Main Roads Road Traffic Noise Management – Code of Practice.*

Note—where in the vicinity of an airport, detailed designs showing how construction can ameliorate noise impacts are to be submitted in accordance with AS2107.

SC6.4.3.15.6 Information to include in a noise and vibration control plan

Aim	Typical actions
Community Relations **Editor's note—**noise and vibration control plans should describe the approaches to be applied when consulting with, and notifying the community where necessary. Large projects may also be required to develop a community relations plan which includes consultation, notification, and complaint management. Where this is the case the following is to be included in any noise (and vibration) control plan.	(a) Identify all noise and vibration sensitive receivers. Include characteristics of, and risks exposed to, existing buildings, fences, trees, property boundaries and services (within at least 1km for blasting operations). (b) Contingency actions must be developed if the relevant noise/vibration limits will be exceeded. (c) A complaints management system should be devised which includes corrective and preventative actions. (d) Consultation with and information supplied to nearby residents and other sensitive uses.
Hours of operation/construction schedule	Information regarding opening hours or hours of operation in accordance with the relevant planning scheme provisions. For construction hours, refer to SC6.4.5.2.1(2) Hours of work. Scheduling works at periods where people are least affected will also reduce impacts, and should flow on from consultation with the community (as above).

Potential noise and vibration generating activities	The choice of plant and equipment employed on the project can have a direct effect on noise and vibration levels. By selecting equipment of an appropriate size with low vibration generation characteristics, and by ensuring that the equipment is being operated correctly and that noise and vibration reduction devices are operating efficiently, the number of complaints received can be greatly reduced.
Potential noise and vibration mitigation methods	For construction, rock breaking, drilling, and/or piling the following mitigation methods should be considered: (a) maximising the distance between the noisy activities and noise sensitive land uses; (b) undertaking noisy fabrication work offsite where possible; (c) maintaining any pre-existing barriers or walls onsite as long as possible; (d) including construction barriers in the project design; (e) using building and stockpile materials as noise barriers during the earthworks phase which may be used in the final landscape design; and (f) installing purpose built noise barriers, acoustic sheds and enclosures. Road and rail noise attenuation will be considered in the following order of preference; a combination may also be provided: (g) a buffer between noise receptor and receiver; (h) service roads between noise receptor and receiver; (i) larger lots closest to the noise source that allow dwelling units to be set back from the noise source to achieve the applicable reduction level; (j) architectural treatments For class 1-4 buildings see *MP 4.4 Buildings in a transport noise corridor.* (k) incorporating mounding and landscaping into the design Noise barriers are to be provided in accordance with the principles of the Department of Transport and Main Roads *Code of Practice Chapter 5: Integrated Noise Barrier Design;* and (l) providing an acoustic fence: A detailed design is to be submitted as soon as possible in the planning process. Design and construction of barriers must meet MRTS15 *Noise Fences*. The acoustic fence must not be located on the road reserve, but within the boundary line of the abutting property. Refer to SC6.4.4.8 Standard drawings SD002, SD003 and SD004. Where acoustic reports identify that levels will be exceeded, all uses should be provided with attenuation requirements designed by suitably qualified consultants that will enable the use to meet the prescribed standard.
Noise and vibration monitoring	Where appropriate in relation to the use or activity. Include details such as monitoring equipment, standard employed, monitoring frequency, on-site meteorology, activity logs, and results handling procedure.

SC6.4.3.16 Rear lane design

SC6.4.3.16.1 Introduction

The following design principles set out standards, advice and guidelines for consideration where a proposed development includes the creation of a new rear lane or development of land that has a frontage to an existing or historic rear lane.

(1) Purpose of rear lanes:

- (a) to provide vehicular access to the rear of premises;
- (b) by nature and by design, to provide streets where pedestrians, cyclists and vehicles have shared use, but which do not create a more direct through route than provided by the adjoining street network;
- (c) used to alleviate access difficulties along frontage roads, such as where the lots are narrow, or along roads or streets carrying high volumes of traffic; and
- (d) in some cases, to improve both the streetscape and to relate the domestic environment more closely to the street frontage;

(2) Design of rear lanes should be undertaken in accordance with other relevant sections of the Development manual planning scheme policy including SC6.4.4.1 Geometric road design, SC6.4.4.2 Pavement design and SC6.4.3.6 Landscape policy.

(3) Design of rear lanes should have regard to the *Crime Prevention through Environmental Design Guidelines for Queensland* (CPTED).

Editor's note—for all setbacks, please refer to the relevant parts of the Queensland Development Code.

SC6.4.3.16.2 New rear lanes - development standards

This section outlines development standards and provides guidance and advice to inform appropriate development outcomes for the creation rear lanes associated with new development.

(1) Design outcomes

- (a) Rear lanes should be functional and provide good visibility and manoeuvrability. Development of rear lanes should:
  - (i) provide enough width to allow safe vehicle passage and turning into an out of garages, movement of pedestrians and cyclists, and with sufficient room for service vehicles;
  - (ii) enable easy and safe access from driveways;
  - (iii) utility services must be located with easy access for maintenance (including water, sewerage, stormwater drainage, gas, electricity, telecommunications, etc.) with appropriate clearances in accordance with minimum requirements;
  - (iv) ensure that subdivision of lots with rear lane frontage addresses the principal street, for example, that the letterbox is on the street and not the rear lane; and
  - (v) a minimum of one and a half on-street car spaces (unmarked) must be provided within 25m walking distance to each allotment. The car park may not be located within the rear lane.
- (b) Rear lanes are to be designed having regard to *Crime Prevention Through Environmental Design Guidelines for Queensland* (CPTED) principles, in particular:
  - (i) ensure rear yards of properties can be fenced in accordance with CPTED principles;
  - (ii) lighting of the rear lane is to meet road safety requirements and CPTED principles, while minimising overspill of light into abutting properties, impacting on amenity; and
  - (iii) ensure that boundary treatment and landscaping do not conceal recesses or provide opportunities for anti-social behaviour.
- (c) Rear lanes should be designed to accommodate the needs of abutting property owners and the streetscape, in particular:
  - (i) landscaping is to be designed to be low maintenance, without impacting on CPTED requirements;
  - (ii) landscaping to rear lanes should not impede any pedestrian or vehicle access; and

(iii) landscaping within rear lanes should not create recesses or provide uninvited opportunities for anti-social behaviour. As a guide, grass, ground cover, or visually permeable low-level vegetation are acceptable. Trees and shrubs that provide visual screening of activity are to be discouraged;

Editor's note—landscaping should otherwise be undertaken in accordance with the 9.4.3 Landscape code of Townsville City Plan.

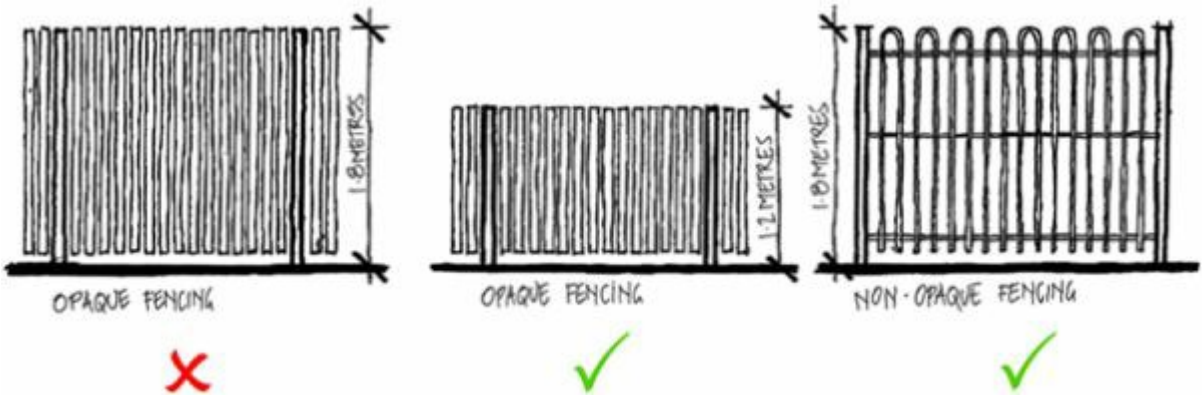


Figure SC.6.4.3.16.1 Inappropriate and appropriate screen fencing types at various heights

(iv) landscaping must not obstruct traffic movements and sightlines, particularly at driveways and intersections;

(v) the use of rear lanes as a short-cut route should be discouraged, as this may introduce through traffic travelling at high and unsafe speeds and reduce the amenity; and

(vi) a minimum of one off-street car park is to be provided per allotment.

(vii) fencing can be provided to the boundary fronting rear lanes to provide security, discourage uninvited access and enhanced amenity. The following advice is provided in respect of fencing, which should be in accordance with CPTED principles. Figure SC6.4.3.16.1 provides examples of inappropriate and appropriate fencing for rear lanes, in addition to the following:

(A) screen fencing and gates that are opaque should not be more that 1.2m in height;

(B) screen fencing and gates may be more 1.2m in height if they are non-opaque (e.g. pool fencing) but should not be greater than 1.8m in height;

(C) screen fencing and gates that are opaque and higher than 1.2m should be setback a minimum of 3 m from the rear lane boundary; and

(D) boundary fencing between properties, if opaque and higher than 1.2m, is to taper down to 1.2m to the rear lane boundary from a setback distance of 3m.

(2) Rear lane design standards

(a) Traffic flows on rear lanes should not exceed 100 vpd.

(b) Reserve widths for rear lanes must allow for:

(i) a road reserve width appropriate to allow for vehicle turning paths to access allotments and to contain stormwater drainage flows;

(ii) all services located within the rear lane maintaining appropriate clearance as per relevant standards and requirements;

(iii) water mains and connections for allotments provided to correlate to the addressing of the properties;

(iv) sewer mains and connections for allotments provided in accordance with SC6.4.3.21; and

(v) stormwater in accordance with SC6.4.4.4 Stormwater drainage design.

(c) Rear laneways should not exceed 75m in length, in order to maintain a maximum design speed of 30km/hr based on an intersection speed of 20km/hr.

(d) Horizontal and vertical alignment should incorporate curves to encourage low vehicle speeds by creating an environment where drivers are actively discouraged from driving above 30 km/hr.

(e) Traffic calming can be achieved through acceptable geometric methods.

(f) Rear lanes must be designed so that they are used as a short-cut between streets.

(g) street lighting must comply with SC6.4.3.20.

(h) intersections of rear lanes with other lanes and other streets must comply with SC6.4.4.1.

(3) Consideration of the final desired built form of adjacent lots being serviced will be a consideration to ensure sufficient operating space and clearance is achievable for waste collection vehicles. Access for emergency vehicles must also be a consideration.

Editor's note—the Development manual planning scheme policy sub-section SC6.4.3.22 Waste management provides additional information regarding waste collection standards.

SC6.4.3.16.3 Historic rear lanes

(1) The following design standards, advice and guidance are provided for consideration when addressing applications for reconfiguring a lot and involving a historic rear lane and where a historic rear lane forms a road frontage to the development.

Editor's note—while the following information is provided to guide development involving the historic rear lanes of Townsville, the principles may be useful for consideration of other existing rear lanes that are not historic.

SC6.4.3.16.4 Development intent for historic rear lanes

(1) Rear lanes are an inherent part of the historic make-up and character of some of Townsville's oldest suburbs, particularly South Townsville and Railway Estate. Historic rear lanes have been identified through studies undertaken by council as being worthy of preservation, as they contribute towards the unique character and amenity of Townsville's older suburbs. Importantly, historic rear lanes have influenced the character and built form.

(2) The purpose of this section is to ensure the character of historic rear lanes does not diminish, and to enhance the existing character provided by the rear lanes. Further, it is intended to discourage inappropriate development outcomes adjacent to these rear lanes.

(3) This part seeks to clarify the characteristics of development that are appropriate to historic rear lanes and therefore provide guidance and certainty to all stakeholders, whilst also adhering to best practice with regard to CPTED principles.

SC6.4.3.16.5 Description of historic rear lanes

(1) Description

Principally, rear lanes are found in Railway Estate and South Townsville. The use of the term "historic rear lanes" generally refers to historic rear lanes associated with land zoned as Character residential zone under Townsville City Plan.

The dominant physical characteristics of the historic rear lanes are as follows:

(a) rear lanes are typically 6m wide;

(b) they are between 50m and 350m long, with the majority being approximately 110m long;

(c) rear lanes are straight and occasionally intersect with other rear lanes;

(d) where sealed, the bitumen is approximately 2.7m to 3m wide and is in the centre of the rear lane. The space on either side of the bitumen is an unsealed landscaped grass verge;

(e) some rear lanes have not been sealed;

(f) rear lanes are generally one lane with two-way access;

(g) most properties with access to a rear lane have primary access via the street, however, some properties fronting Boundary Street, for example, have primary access via the rear lane only; and

(h) rear lanes are sometimes the primary point of access for local infrastructure such as sewerage and

water.

SC6.4.3.16.6 Development standards

(1) This section outlines development standards to guide appropriate development to retain and enhance the historic character of rear lanes.

Development affecting rear lanes should:

(a) ensure rear lanes remain functional and provide good visibility and manoeuvrability;

(b) provide appropriate width to enable safe and efficient vehicle movement, including for service vehicles;

(c) enable easy and safe access into and out of sheds, carports and garages;

(d) not create a more direct through-route alternative for vehicles, cyclists or pedestrians than the adjoining street network;

(e) be designed to ensure rear yards of properties can be fenced in accordance with CPTED principles (Queensland);

(f) ensure that boundary treatment and landscaping do not conceal recesses or provide opportunities for anti-social behaviour; and

(g) ensure that subdivision of lots with rear lanes addresses the principal street, for example, that the letterbox and water connection are on the street and not the rear lane.

(2) Waste collection vehicles will not service a rear lane unless the design facilitates safe vehicle access and operating conditions for a waste collection vehicle.

Editor's note—the Development manual planning scheme policy sub-section SC6.4.3.22 Waste management provides additional information regarding waste collection.

(3) Subdivision of lots in areas with rear lanes should be "vertical", down the centre of the block (see "b" in Figure SC6.4.3.16.2), creating two similar-sized rectangular blocks (approximately 10 m wide). This is consistent with lot sizes in parts of Workers Cottage precinct and South Townsville precinct in the Character residential zone, where the existing character of the lot sizes of some sites in Townsville's older suburbs is 10m wide by either 40m or 50m deep.

(4) Where subdivision of lots in areas with rear lanes is proposed to be "vertical", down the centre of the block, primary vehicular access via the rear lane is permitted.

(5) Where lots are configured in a "hatchet" configuration, as shown in "a", "c" and "d" in Figure SC6.4.3.16.2, primary vehicular access is not permitted via the rear lane. Generally, primary vehicular access to the block is to be from the street, with the exceptions as noted in Figure SC6.4.3.16.2 (b and c).

(6) Some properties that border Boundary Street in South Townsville may have exceptional circumstances in relation to the scenarios outlined in Figure SC6.4.3.16.2. These will be assessed on their individual merits.

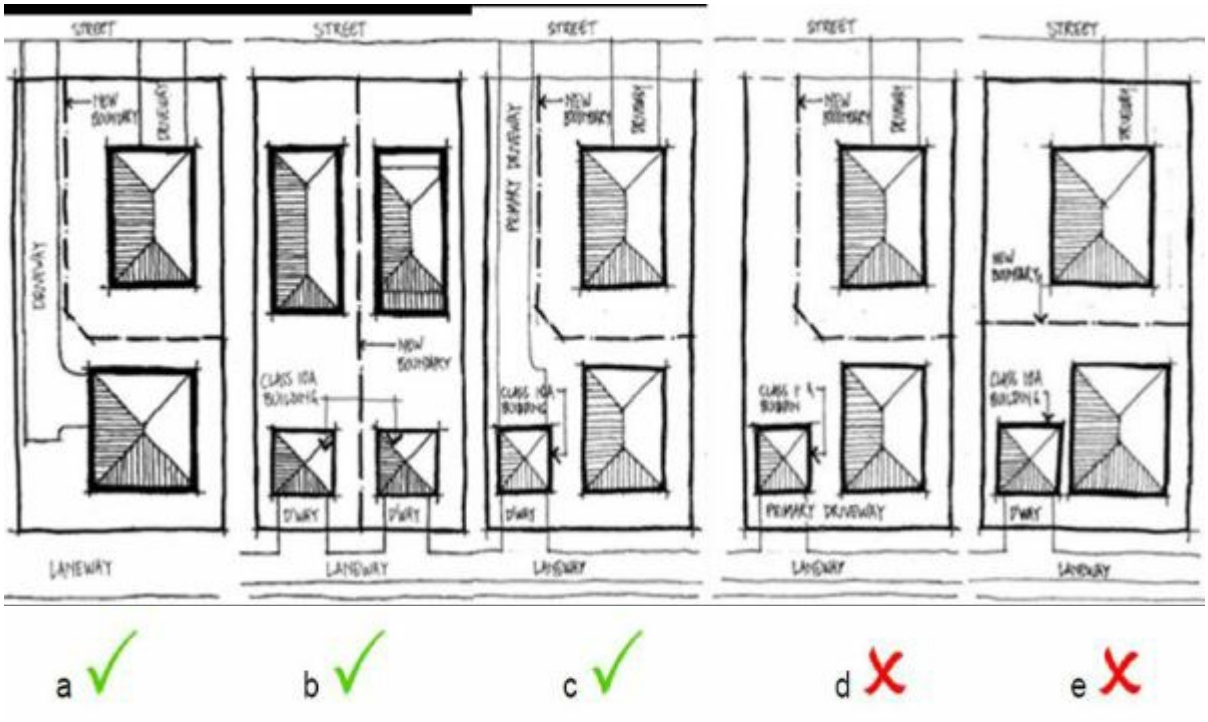


Figure SC6.4.3.16.2 Unacceptable and acceptable lot reconfiguration and access for properties adjacent to rear lane

(7) Crime prevention through environmental design considerations.

Editor's note—applicants should also have regard to *Crime Prevention through Environmental Design Guidelines for Queensland* in addition to the below specific guidelines.

(a) Lighting should be provided for buildings with vehicular or pedestrian access to rear lanes. Appropriate lighting may include sensor lighting, installed overlooking the driveway or pathway respectively.

(b) Tilt panel doors or other doors should not open directly onto the rear lane.

(c) Rear yards of properties may be fenced to support CPTED principles and improve amenity, security (casual surveillance) and vistas.

(d) Rear boundary fence gates to rear lanes are encouraged to increase activation of the space.

(e) Fencing can be provided to the boundary fronting rear lanes to provide security, discourage uninvited access and enhanced amenity. The following advice is provided in respect of fencing and should be provided with regards to the principles of CPTED. Figure SC6.4.3.16.1 provides an example of inappropriate and appropriate fencing for rear lanes, in addition to the following:

  (i) Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

(f) Historic rear lanes are generally not used for on-street parking with the exception of short-term parking by service vehicles. Parking should be discouraged through approved treatments, including landscaping, surface finish and limited signage (if necessary).

(8) Landscaping and driveways

(a) Landscaping, where provided to rear lanes should create local amenity and beautification of its environs and must be in keeping with established character of the particular rear lane.

(b) Landscaping, where provided within rear lanes should not conceal recesses or provide uninvited opportunities for anti-social behaviour. This can be achieved with grass, ground cover, or visually permeable low-level vegetation. Trees and shrubs that provide visual screening of activity are to be discouraged.

(c) Landscaping must not obstruct traffic movements and sightlines, particularly at driveways and

intersections.

(d) Driveways are to be constructed in accordance with the sub-section SC6.4.3.17 Driveways.

SC6.4.3.17 Driveways

SC6.4.3.17.1 Introduction

This sub-section details standards and provides advice and guidelines to assist in the design and construction of driveways (domestic, industrial, commercial and rural property access), location, and other aspects in relation to their impact on pedestrians, cyclists, other vehicles, stormwater and neighbours.

Note—the technical details depicted and described in SC6.4.4.8 Standard drawings must be adhered to.

(1) Reference and source documents to be read and applied in conjunction with this policy sub-section are as follows:

(a) SC6.4.4.8 Standard drawings

SD-006 *Typical Road Cross Sections – B-Double Turning Path and Access Plan Example Drawing*
SD-020 *Concrete kerbing*
SD-025 *Kerb Ramp*
SD-030 *Driveway access urban residential properties*
SD-031 *Driveway access industrial*
SD-032 *Driveway crossovers urban residential*
SD-090 *Driveway Access Rural Properties Type 1 - Access With Invert Slab H<300mm*
SD-091 *Driveway Access Rural Properties Type 2 - Conc. Access With Culvert Cast Insitu With Grate H≥300mm*
SD-092 *Driveway Access Rural Properties Type 3 - Gravel Access With Culvert Cast Insitu With Grate H≥300mm*
SD-093 *Driveway Access Rural Properties Type 4 - Conc. Access With Culvert Inverted Pre-cast Box Culvert H≥325mm*
SD-094 *Driveway Access Rural Properties Type 5 - Gravel Access With Culvert Inverted Pre-cast Box Culvert H≥325mm*
SD-095 *Driveway Access Rural Properties Type 6 – Access With Culvert Cast Insitu H≥450mm*
SD-096 *Driveway Access Rural Properties Type 7 - Conc. Access With Culvert 535mm<H<685mm*
SD-097 *Driveway Access Rural Properties Type 8 - Gravel Access With Culvert 535mm<H<685mm*

(b) Townsville City Council Local Laws
Local Law No. 1 *(Administration) 2011*
Local Law No. 4 *(Local Government Controlled Areas, Facilities and Roads) 2011*
Subordinate Local Law No. 1.1 *(Alteration or Improvement to Local Government Controlled Areas and Roads) 2011*
Subordinate Local Law No. 1.15 *(Carrying Out Works on a Road or Interfering with a Road or its Operation) 2011*

(c) Australian Standards: AS2890.1 *Off-street car parking*

(d) Queensland Development Code: NMP1.1 *Driveways*

(e) Austroads
Guide to Road Design Part 3 – Geometric Design
Guide to Road Design Part 4 - Intersections and Crossing - General

(2) Terminology

Driveway	unless stated otherwise, the term driveway in this sub-section refers to the access between the road and the property boundary; ie. on council-controlled land. This sub-section does not provide advice on the vehicular movement area within the private property.
Crossover	the part of a driveway that is located crossing the kerb and channel.

Local Road	a road under the control of a Local Government.
Property owner	entity, applicant, developer or owner/s who is responsible for the driveway at the time.
Queuing area	the area of a circulation roadway between the property boundary and the vehicle control point, available for the queuing of vehicles.
Regulated parking	parking controlled by traffic signs or line marking.
Rural area	an area where the urban criteria are not met as specified in the Townsville City Plan.
Road corridor permit	a permit issued by the Department of Transport and Main Roads authorising works on a State-controlled Road.
Road works permit	a permit issued by council authorising works within the road reserve on a Local Road; the area of land under the council's control, dedicated, notified or declared to be a road for public use.
Sight stopping distance	means the distance to enable a normally alert driver, travelling at the design speed on wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead. Refer to the *Austroads Guide to Road Design Part 3 – Geometric Design*.
State-controlled road	means a road under the control of the Department of Transport and Main Roads, including national highways.
Urban area	an area where the urban criteria are met in accordance with SC6.4.3.13.

Note—types of driveways include:
New driveways - must comply with the requirements of council's standard drawings. Works are at the property owner's cost and to the satisfaction of council.

Non-conforming driveways - existing driveways which do not meet council requirements that must be reassessed in the event of a redevelopment of the site. Works are at the property owner's cost and to the satisfaction of council.

Redundant driveways – existing driveways that are no longer in use and must be removed. Works are at the property owner's cost and to the satisfaction of council.

Unapproved driveways - driveways that have not been approved by council. Council may require these driveways to be removed or modified. Such works are at the property owner's cost and to the satisfaction of council.

Modified driveways - modifications to existing driveways must comply with the requirements of council's standard drawings. Works are at the property owner's cost and to the satisfaction of council.

Temporary driveways - Temporary property access during construction. Works are at the property owner's cost and to the satisfaction of council.

SC6.4.3.17.2 Responsibility

(1) The driveway is the responsibility of the property owner to construct and maintain. A Road Works Permit is required for all works within the road reserve under council control.

(2) Costs

The property owner is responsible for the cost to:

(a) prepare and obtain the appropriate permit(s);

(b) design and construct the driveway and associated works; and

(c) maintain the driveway.

SC6.4.3.17.3 Location

The location and layout of a driveway must consider the type of frontage road, land use of the property, and the type and volume of vehicles likely to use the access. It must be located to avoid being a hazard to any pedestrian and cyclist, through movement of traffic, and to minimise damage to the verge and vegetation/ landscaping. A separate, clearly distinguishable access for pedestrians and cyclists is to be provided.

The property owner must ensure that there are no impacts on stormwater, upstream or downstream, due to the driveway (refer to SC6.4.3.8 Stormwater) being constructed.

Rural driveway location and layout must also consider the through traffic volume, turning volume, vehicle type,speed environment, road layout, land use and general topography. It may be necessary to widen the shoulder or provide a turning lane to enhance safety for turning vehicle and through traffic.

(1) For all driveways, the location of the driveway should be:

(a) as far as practical from intersections to minimise points of conflict and confusion, and to improve safety. Driveways should not be situated within the functional area of at-grade intersections;

(b) to a road of a lower hierarchy where reasonable access can be provided;

(c) at least 6m from the tangent point, or where no tangent point exists, at least 12m from the intersection of two street property boundaries; and

(d) positioned to achieve adequate sight distance for all traffic movements associated with property accesses. Desirably, a driver has at least stopping sight distance available to react to a potential conflict and come to a stop.

Editor's note—refer to *AS2890.1 Off street car parking.*

(2) All driveways should avoid being located:

(a) opposite the terminating road of a T-junction on non-residential streets;

(b) within the signalised area (defined by extension of the signal stop lines to the road boundaries), within 25m of a signalised intersection, and not adjacent to auxiliary lanes, depending on the property frontage width. Access may be permitted if it can be demonstrated to council that the location of the driveway will be safe;

(c) within a roundabout area, nor desirably within 25m of the roundabout entrances or exits. Access may be permitted if it can be demonstrated to council that the location of the driveway will be safe;

(d) opposite or within 6m of a median opening in a major road; and

(e) within the bus stop boarding area and on the downstream side of the bus stop.

Note—on-site parking bays must be located clear of queuing areas. This allows vehicles to drive completely onto the property without having to stop for other vehicles to complete on-site parking manoeuvres.

(3) Driveways must be constructed at a right angle to the kerb line/road centreline unless demonstrated that it is not safe to have the driveway at a right angle.

(4) Driver visibility at the property line to pedestrians, cyclists and other vehicles must be clear of obstruction (e.g. fencing and landscaping), and should account for changes in grades or curves in road alignment.

Note—if sight distance is not adequate then a mirror, or other approved device, will be required to be installed at the property owner's cost.

SC6.4.3.17.4 Amenity

(1) The driveway should not adversely affect, impede or cause a nuisance to neighbouring properties.

(2) The driveway crossover of one property should not encroach onto the frontage of any adjacent property, except where it is required to achieve the desired outcome and has received approval from council.

(3) The driveway should minimise the vehicle headlight impact on the adjacent neighbourhood.

SC6.4.3.17.5 Materials

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

SC6.4.3.17.6 Clearances

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

SC6.4.3.17.7 Gradient

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

Note—this may not be practicable in some particularly hilly residential locations. Driveways with higher gradients can be constructed by using the expertise of a professionally qualified engineer and with the approval of council.

SC6.4.3.17.8 Number of driveways

(1) The number of driveways will be one per lot.

(2) Two may be permitted where:

(a) there will be more than ten metres or less than four metres between the driveways; and/or

(b) the property has two street frontages; and

(c) an analysis of on-street parking demonstrates that on-street parking will continue to be adequate even if a second driveway is constructed.

Where parking bays are marked on the street including service bays and bus stops and alteration to these bays is required to accommodate the second driveway, there is to be no loss of use. Displaced bays can be included in the off street parking component of a commercial development where considered appropriate. The applicant is responsible for the alterations to the line marking and signage.

(3) Commercial and industrial properties with separate entry and exit points or two or more entry levels or multiple ramps can have more than two driveways. Where two or more access driveways are permitted for industrial or commercial sites, the two access driveways must be separated by a minimum spacing of ten metres from the edge of the driveway at the kerb and channel.

SC6.4.3.17.9 Stormwater

(1) The property owner must ensure that there are no impacts upstream or downstream as a result of the works.

(2) In rural areas in particular, the driveway must not block or significantly impede stormwater flow along the road table drain.

(3) Where a box culvert is installed under the access, the minimum clearance below the level at the property boundary or the edge of the bitumen roadway (whichever is the lower) to the top of the access is provided in accordance withSC6.4.4.8 Standard drawings. This clearance must be achieved to allow water flowing in the drain to surcharge over the access before entering onto the roadway or the adjacent property.

SC6.4.3.18 Geotechnical investigations

SC6.4.3.18.1 Introduction

(1) Purpose

This policy sub-section provides advice and guidance and assist applications

(a) on the preparation and assessment of geotechnical investigation reports;

(b) on the expected level of geotechnical investigation required for development based on the level risk or hazard identified; and

(c) information council may request for a development application.

(2) Background

Development on steep lands presents a unique set of design and engineering challenges, often requiring a greater degree of detail in the design and approval of allotments, earthworks, roads, services and built form.

There is a growing awareness of the risks, environmental values, and ongoing costs associated with development on steep slopes, which has resulted in an expectation of an improved standard of design in these environmentally and geologically sensitive areas. This is supplemented by an increased mindfulness of the risks and financial cost to construct and maintain the servicing in these areas and the need to consider these factors in the assessment of applications involving a landslide hazard.

Editor's note—certain existing steep land or hillside developments have demonstrated how inappropriate forms of land use and servicing can permanently damage local environmental features and diminish valued natural assets, particularly scenic qualities. In addition, it has been noted how the costs to maintain associated infrastructure can become a burden on the wider community due to the specialist nature of this infrastructure and the generally lower density in these areas. Whilst these areas do contribute to the diversity of housing choice, the pricing of lot and housing prices usually exceed the ability for the local economy to include these as affordable housing options.

(3) Application

This sub-section applies to development affected by the Landslide hazard overlay maps OM-07.1 and OM-07.2.

(4) Reference and source documents

Australian Geomechanics Society (AGS), *Australian Geomechanics*, Volume 42 No 1 March 2007.

Fell, R., Hungr, O., Leroueil, S. Riemer, W., 2000: *Keynote Lecture – Geotechnical engineering of the stability of natural slopes*, *and cuts and fills in soil*, GeoEng2000, 1, 21-120. Invited Papers, Technomic Publishing, Lancaster, ISBN: 1-58716-067-7, November 2000.

SC6.4.3.18.2 Geotechnical investigations

(1) Requirement of a site-specific geotechnical investigation report.

(a) Where development is subject to assessment against Part 8.2.7 Landslide hazard overlay code, an applicant will be required to undertake a geotechnical investigation of the likely impacts of the proposed development and to determine the measures to avoid or mitigate unacceptable risk and other adverse impacts.

(b) Table SC6.4.3.18.1 Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories specifies the level of investigation required for the particular hazard level affecting the subject land. Where the subject land has more than one hazard level mapped, the assessment technique shall be for the higher hazard level mapped. Table SC6.4.3.18.2 Applicability of site investigation methods to slope classes should be considered in conjunction with Table SC6.4.3.18.1.

(c) The planning and design of future development should consider the level of professional geotechnical input commensurate to the landslide hazard category which the development is subject to. In general, it is appropriate that geotechnical input for development be carried out in accordance with the reporting standards proposed by the AGS, 2007c Landslide Risk Management (Reference 8). This requires the

practitioner to consider not only the issues surrounding the landslide hazard (if one exists) but also the consequences if a landslide were to occur (i.e. the assessment need to be couched in a risk assessment context).

(d) The extent and detail of the investigation will vary dependent upon the level of hazard identified on the Landslide hazard overlay maps OM-07.1 and OM-07.2 and the nature of the development being proposed. Council will require each report to demonstrate a scope and depth of investigation appropriate to the level of hazard identified, for the specific site characteristics and the proposed development and works.

(e) Geotechnical reporting needs to clearly indicate whether the risk assessment is based on existing slope conditions or with risk treatment measures implemented (or both).

(2) Preparation of a site-specific geotechnical investigation report

(a) A geotechnical investigation report must document the following:

(i) introduction to the proposal including a description of the subject land, locality and proposed development;

(ii) description and investigation of existing conditions of the development site, including assessment of land stability and geotechnical constraints to development (see SC6.4.3.18.2(3) Investigation information requirements);

(iii) assessment of the suitability of the site for the development. This should include an assessment of the likely effects and impacts of the development upon slope stability or landslide hazard (see SC6.4.3.18.2(3) Investigation information requirements);

Editor's note— assessments should be undertaken and give sufficient consideration of the final intended development outcomes for the subject site, including staging of development and associated works.

(iv) measures recommended to mitigate impacts including siting, design, engineering, and any other necessary mitigation measures; and

(v) conclusion and recommendations (see SC6.4.3.18.2(3) Investigation information requirements).

(b) Geotechnical investigation reports are to reference Australian Geomechanics Society (AGS) Volume 42 No 1 March 2007, or any later guideline of the AGS as agreed by council.

(c) Geotechnical investigations are to be undertaken and certified by an appropriately qualified and experienced engineering geologist, geotechnical engineer or registered professional engineer appropriately experienced in slope stability investigations in accordance with Australian Geomechanics Society Volume 42 No 1 March 2007.

(d) The findings, recommendations and specific works of the geotechnical investigation report must be implemented and complied with to ensure that the risk level for the development will be no more than "low". If the engineer's assessment report finds that the site will be "low risk" after development without the need for specific works to achieve this, certification need not be required.

(e) Laboratory testing is required to be undertaken by a National Association of Testing Authority (NATA) certificated laboratory. All investigations, testing and design should be undertaken in accordance with industry practice and the provisions of relevant Australian Standards.

(3) Investigation information requirements

(a) Geotechnical investigations should cover the matters set out below, and may include, but need not be limited to:

(i) review of existing data sources including regional geology, topographic maps and geotechnical reports;

Editor's note— applicants may also refer to SC6.4.3.7 Steep land development design guidelines for further information.

Note—where a geotechnical investigation has been previously undertaken and the report provided as supporting documentation to council for a previous application over the subject land, these documents must be clearly referenced in the report prepared for the subsequent application. Such supporting documentation must be made available to council and be current and specifically relevant to the proposed development.

(ii) stereoscopic viewing of vertical air photo pairs to facilitate terrain mapping;

(iii) preparation of site plan showing results of geomorphic and engineering geological mapping (to scale);

(iv) subsurface investigations including drill holes, auger holes, shafts and test pits with locations shown on to scale site plan;

(v) results of laboratory testing of samples recovered from the subsurface investigation;

Note—the results of all laboratory tests must be included in the geotechnical report, including the location and level (including datum).

(vi) groundwater and surface water studies including recording of groundwater conditions in sub surface investigation and mapping of surface seepages;

(vii) preparation of cross section(s) showing interpreted geotechnical and groundwater conditions with cross section location identified on site plan;

(viii) evidence of past slope stability performance;

(ix) evidence of history of slope instability with assessed trigger events, including in relation to adjoining land;

(x) identification of landslides, shown in plan and on section, and discussed in terms of the site geomorphology and slope forming process;

(xi) assessment of consequences to property and life for each landslide and or type of landslide with basis therefore;

(xii) assessment of risk for each landslide and or type of landslide;

(xiii) assessment of landslide frequency (probability) and or type of landslide;

(xiv) risk assessment in relation to tolerable risk criteria (e.g. published criteria where appropriate); and

(xv) risk mitigation measures and options, including revised risk assessment following implementation.

(4) Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories
Table SC6.4.3.18.1 has been prepared for the standard geotechnical techniques identified in AGS, 2007c which are applicable for the assessment of landslide risk. The various investigation techniques have different levels of applicability for the different hazard categories shown on the Development constraints overlay map – Landslide hazard OM-07.1 and OM-07.2. Table SC6.4.3.18.1 should therefore be considered as a guideline as to the applicability of professional geotechnical input for any hazard category.

Table SC6.4.3.18.1 Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories

Investigation techniques	Landslide hazard				
	Landslide hazard Map OM-07.1				OM-07.2
	Very Low	Low	Medium	High	>23degrees
1. Review of existing data sources including regional geology, topographic maps and geotechnical reports	B	A	A	A	A
2. Stereoscopic viewing of vertical air photo pairs to facilitate terrain mapping	B	B	A	A	A
3. Preparation of site plan showing results of geomorphic and engineering geological mapping (to scale)	B	B	A	A	A
4. Subsurface investigations including drill holes, auger holes, shafts and test pits with locations shown on site plan.	C	B	A	A	A
5. Results of laboratory testing of samples recovered from the subsurface investigation	D	C	B	A	A
6. Groundwater and surface water studies including recording of groundwater conditions in sub surface investigation and mapping of surface seepages	C	B	B	A	A
7. Preparation of cross section (s) showing interpreted geotechnical and groundwater conditions with cross section location identified on site plan.	C	B	B	A	A
8. Evidence of past slope stability performance.	B	B	B	A	A
9. Evidence of history of slope instability with assessed trigger events, including in relation to adjoining land	B	B	B	A	A
10. Identification of landslides, shown in plan and on section, and discussed in terms of the site geomorphology and slope forming process	C	B	B	A	A
11. Assessment of landslide frequency (probability) and or type of landslide.	C	B	B	A	A
12. Assessment of consequences to property and life for each landslide and or type of landslide with basis therefore	C	B	B	A	A
13. Assessment of risk for each landslide and or type of landslide	C	B	B	A	A
14. Risk assessment in relation to tolerable risk criteria (e.g. published criteria where appropriate).	D	C	C	B	A
15. Risk mitigation measures and options, including revised risk assessment following implementation	C	B	B	A	A

Note— A – Strongly Applicable B – Applicable C – May be applicable D – Seldom applicable

(5) Applicability of site investigation methods to slope classes
Table SC6.4.3.18.2 summarises the applicability of various site investigation techniques for natural and constructed slopes of various scales. The requirements for site investigations shown in Table SC6.4.3.18.1 should be considered in the context of the hazard categories given in Table SC6.4.3.18.2.

Note—
1. A – Strongly applicable, B – Applicable, C – May be applicable, D – Seldom applicable.
2. In similar areas.
3. SPT, CPT, CPTU.
4. Permeability.
5. During construction.

Table SC6.4.3.18.2 Applicability of site investigation methods to slope classes

Site investigation method	Natural slopes				Constructed slopes			
	Small/ shallow	Medium	Large	Existing cut	New fill	New cut	New fill	Soft clay
Topographic mapping and survey	A	A	A	A	A	A	A	A
Regional geology	A	A	A	A	A	A	A	A
Geological mapping of project								
Area	B	B	A	A	B	A	B	C
Geomorphological mapping	A	A	A	B	B	B	B	D
Satellite imagery interpretation	D	D	C	D	D	D	D	D
Air photograph interpretation	A	B	A	C	C	C	C	C
Historic record	A	B	B	A	B	B (2)	B (2)	B (2)
Dating past movements	B	C	B	D	D	D	D	D
Geological methods	C	C	B	C	C	C	D	C
Trenches and pits	B	A	B	B	B	B	B	C
Drilling/boring	C	A	A	C	B	B	B	A
Downhole inspection	C	B	B	C	D	C	D	D
Shafts and tunnels	D	C	B	D	D	D	D	D
In situ testing of strength								
Permeability	C (3)	C (3)	C (4)	D	B (3)	C	C	A (3)
Strength and permeability								
monitoring pore pressures,								
rainfall, etc.	C	A	A	A	A	C	C	A (5)
Monitoring of displacements	C	B	A	B	B	B (5)	C (5)	A (5)
Laboratory testing	C	A	B	B	B	B	C	A
Back analysis of stability	C	B	A	C	B	B (2)	C (2)	C (2)

Source: (Fell, Hungr, Leroueil and Reimer, 2000)

SC6.4.3.19 Road and street naming

SC6.4.3.19.1 Introduction

(1) Objectives

The objectives of this sub-section are to:

(a) provide a consistent procedure and setting of standards for road and street naming within the Townsville City Council Local Government Area to contribute towards a legible road and street network;

(b) ensure urban and rural addressing are simple as possible, unique and clearly identifiable;

(c) identify the information council may request for a development application or as a condition of approved; and

(d) provide guidance or advice about satisfying an assessment criteria.

(2) Terminology

Estate	an Estate is a group of homes and other buildings built together as a single development (e.g. housing development).
Roadway	is considered to be any public or private land- based thoroughfare or course navigable by vehicle or foot that can be used for assigning addresses or allowing access between points or to a feature. Examples of roadways include alleyways, roads, streets, highways, laneways, fire tracks, bike paths and walking tracks.
Roads	are generally through routes for the movement of vehicular traffic.
Streets	are generally for providing property access, pedestrian and cycle movement with more localised vehicular traffic.

(3) Reference and source documents

(a) Australian standards
AS/NZS 4819 – *Rural and urban addressing*

(b) SC6.4.4.8 Standard drawings
SD065 Street Name Sign and Installation Details
SC6.4.6.2 Minor concrete works
SC6.4.6.24 Signposting

SC6.4.3.19.2 Information requirements

(1) In order for council to consider a name for a new road or street, the following information is required, in support of the request:

Note—an application for road/street name approval must be submitted to and approved by council prior to the submission of any operational works application.

Editor's note— fees are to be paid in accordance with the *Planning and Development Schedule of Fees and Charges* for formal applications for road and street naming approval. *Planning and Development Schedule of Fees and Charges* – Schedule 1 can be found on council's website.

(a) for new developments not associated with an Estate, three proposed names for each proposed road/street;

(b) for a new Estate, a list of proposed names to be used within the Estate; and

(c) the origin of each name should be clearly stated on the submitted proposal for consideration. Requests

for roads/streets to be named after significant individuals are to be accompanied by a summarised autobiography of each individual to be recognised. For groups of names with similar origins, a bulk explanation is acceptable if the theme generated is from the same source.

Editor's note - For roads/streets that are existing gazetted roads, whether constructed or not, names must be submitted to council for approval

Editor's note - The approved road/street names as well as the road/street type must be shown on the engineering drawings submitted for subsequent operational works approval.

SC6.4.3.19.3 Criteria for the naming of roads and streets

The following criteria will be used in assessing requests for road and street naming:

(1) Australian standard (AS/NZS 4819 – *Rural and urban addressing*)

This sub-section adopts the parts of AS/NZS 4819 – *Rural and urban addressing* identified below, for use in the naming of roads and streets:

(a) **Section 1** – Scope and General;

(b) **Section 4** – Road definition and naming; and

(c) **Appendix A** – Road types – Australia.

Where this sub-section is silent on a matter, Sections 1, 4 and Appendix A of AS/NZS 4819 shall apply and, further, they will prevail to the extent of any inconsistency with this sub-subsection.

(2) Name duplication

Name duplication (both existing names and approved names) within the Townsville City Council Local Government Area will not be approved. This requirement is to ensure consistency and to avoid confusion and misunderstanding in the delivery of goods or services or in the dispatch of emergency vehicles.

(3) Sources

(a) The preferred sources for road and street names include:

(i) indigenous names of significance to the area, subject to prior approval of the relevant local Aboriginal or Torres Strait Islander Land Council via council's Aboriginal and Torres Strait Islander Advisory Committee;

Note—the relevant local Aboriginal or Torres Strait Islander Land Council should be consulted via council's Aboriginal and Torres Strait Islander Advisory Committee when choosing Aboriginal or Torres Strait Islander names, unless council already has an agreed list of appropriate names.

(ii) flora and fauna, generally using the common name and excluding lengthy or complex scientific names;

(iii) names of founding mothers and fathers, prominent citizens or identities, excluding living persons;

(iv) war casualty lists;

(v) local heritage values; and

(vi) existing road/street naming themes in the suburb or area.

(b) Names should be appropriate to the physical, historical or cultural character of the area concerned.

(c) The origin of each name should be clearly stated on the submitted proposal for consideration. Requests for roads/streets to be named after significant individuals are to be accompanied by a summarised autobiography of each individual to be recognised. For groups of names with similar origins, a bulk explanation is acceptable if the theme generated is from the same source.

(d) A variation to these sources will be considered on the individual merits of the proposal.

Note—all proposed names will be considered on their individual merit.

(4) Communication

(a) Names should be reasonably short, easy to read, spell and pronounce in order to assist service providers, emergency services and the travelling public. Proposed names should not be similar in spelling or sound to existing names.

(b) Names must not be offensive or discriminatory.

(c) Unduly long names and names composed of two or more words should be avoided:

(i) a given name should only be included with a family name where it is essential to identify an individual or where it is necessary to avoid ambiguity, e.g. Angus Smith Drive, John Melton Black Drive, Sir Leslie Thiess Drive etc. The use of given names should generally be avoided; and

(ii) whilst street and cul-de-sac names should have only one word it is recognised that some roads require a two word name because of their geographic relationship e.g. Old Common Road, Ross River Road etc.

(5) Spelling

(a) Where it is intended that a road/street have the same name as a place or feature with an approved geographical name, then particular care should be taken to ensure that the correct spelling is adopted.

(b) Where names have been changed or corrupted by long established local usage, it is not usually advisable to attempt to restore the original form; that spelling which is sanctioned by general usage should be adopted.

(c) Generally, road/street names proposed or approved should not contain abbreviations. For example, the "Creek" in "Wallaby Creek Road" must not be abbreviated. There is, however, one exception: "ST" should always be used in place of Saint.

(6) Form

(a) "The" must not be used in place of a name followed by a road type for example, "The Boulevard".

(b) Prepositions in road names should not be used, for example, "Hampton on Boulevard".

(c) No directional indicators are to be used, for example, "Gold Road West" and "Gold Road East".

(d) Prefixes such as "Upper", "New", "North" or "South" must not be used unless the name has been specifically derived from a name that includes these.

(e) The apostrophe mark must be omitted in the possessive case, e.g. ‘Smith’s Road’ should be "Smiths Road".

(f) Hyphens are not to be used.

(g) Full stops are not to be used.

(h) No symbols, diacritical marks or special characters are to be used. The exception is macrons for Maori names.

(i) Numerals are not to be used. Any numbers in a name must be written in full. Only standard A to Z alphabet characters may be used.

(7) Road types

(a) Particular attention should be paid to the use of street, road, court, crescent, drive etc., to ensure that the road type is representative of the road being described. Road/Street types are to be in accordance with AS 4819 Appendix A and read in conjunction with section 4.3 of AS 4819.

(b) The road/street type/s is required to be submitted to council as part of the application for consideration of road/street names. The road/street type/s is to be submitted for checking by council on plans associated with operational works approval. The road/street type must be appropriate for the road layout.

(8) Holding of approved names

Approved names remain valid for the following periods:

(a) 5 years for developments not associated with Estates; and

(b) for Estates, the applicant is to advise council at the time of the request for approval of names, the proposed, estimated time period for the completion of the Estate. Approved names will be held for this time period.

SC6.4.3.19.4 Street name signs

The street name signage must be in accordance with standard drawing SD065 Street Name Sign and Installation Details and installed and constructed in accordance with SC6.4.6.28 Minor concrete works and SC6.4.6.24 Signposting.

SC6.4.3.20 Public lighting and utility services

SC6.4.3.20.1 Introduction

(1) Purpose

The purpose of the Public lighting and utility services sub-section is to provide standards, advice and guidelines for the design, installation and construction of public lighting and utility services.

(a) Public lighting is provided to:

(i) allow for the use of and safe movement in public spaces;

(ii) provide improved safety and security for the community at night; and

(iii) enhance the public amenity.

Council encourages the design and use of efficient lighting systems that support council's commitment to sustainability and meet the requirements of AS/NZS 1158 *Lighting for roads and public spaces*.

(b) Utility services

A purpose of a road reserve is to provide a corridor for the delivery of utility services such as water supply, sewerage, gas, telecommunications (including future telecommunications) and electricity to all properties fronting the road, street or rear lane. The verge or footpath area between the road reserve boundary and the edge of the roadway provides the space for these service corridors and these guidelines are designed to achieve the following aims:

(i) provide a convenient location for the installation and safe access to all utility services for maintenance and retrofitting purposes;

(ii) provide a corridor for street furniture including road lighting poles;

(iii) minimise possible conflict with other underground services; and

(iv) provide an opportunity for street landscaping.

Council standard drawings (SC6.4.4.8 Standard drawings) for service corridors provide details of utility alignments within the footpath/verge and should be read in conjunction with SC6.4.4.1 Geometric road design

(2) Scope

(a) Public lighting includes:

(i) road lighting (urban and rural);

(ii) lighting for footpaths and cycle paths;

(iii) lighting for parks;

(iv) lighting for sports grounds and sports complexes;

(v) lighting for public buildings;

(vi) lighting for off-street car parks; and

(vii) feature lighting which may include bollards and in ground lighting.

(b) Utility services include (but are not limited to):

(i) reticulated water supply;

(ii) reticulated sewerage supply;

(iii) reticulated gas supply and its supporting infrastructure;

(iv) reticulated telecommunications network, including future services (fibre optic);

(v) reticulated electricity, both underground and overhead supply; and

(vi) lighting networks, including road, open space, community facilities and off-street parking.

(3) Consultation

Developers and sporting groups are encouraged to consult with council and the relevant servicing authority and determine any requirements these authorities may have before undertaking any detailed design.

Developers should obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

If there is an expectation that an application may have higher servicing demands, details of these additional demands should be provided to council and the servicing authority.

(4) Reference and source documents

(a) Council specifications and drawings
SC6.4 Development manual planning scheme policy - all specifications and drawings for design and construction.

(b) Australian Standards, in particular
AS/NZS 1158 - *Lighting for roads and public spaces*
AS/NZS 1596 - *The storage and handling of LP gas*

(c) Other
Australian Government, *Disability Standards for Accessible Public Transport 2002*
Electricity Act 1994
Electrical Safety Act 2002
Energy Queensland, *Developer's Tool Kit* (web-based)

Editor's note—the *Developer's Tool Kit* can be found on the Energy Queensland website.

SC6.4.3.20.2 Public lighting (urban and rural)

(1) Public lighting general
There are a number of types of public lighting infrastructure which meet a range of different needs. Infrastructure associated with public lighting generally consists of poles, outreach arms, lamps, luminaires, photoelectric cells, switch gear, footings and connections to a supply. The size and type of lighting infrastructure will be determined by the size and type of the use, the intensity of lighting required, remoteness from supply and the time of operation.

All lighting designs must be prepared and certified by an appropriately qualified Registered Professional Engineer of Queensland prior to submission to council with a development application.

Road and public space lighting must be designed in accordance with AS/NZS 1158 and Energy Queensland's requirements.

(2) Road lighting general
Lighting infrastructure must be chosen from the list of products supported by Energy Queensland, unless specifically otherwise agreed by council. Road lighting chosen from the list of products supported by Energy Queensland will become infrastructure owned by Energy Queensland, on a Rate 2 Tariff.

All Category P lighting in new residential areas must be LED lights as approved by Ergon Energy.

If other road lighting infrastructure is preferred by a developer for aesthetic or other reasons including for environmental protection, which the developer expects to hand to council for ongoing maintenance, justification must be provided on how this will fit into any lighting master plans for the area. Without approval council gives no guarantee that this infrastructure will be adopted by council, and if it is adopted, that it will be maintained in that form. Any "non standard" road lighting would be on a Rate 3 Tariff.

Editor's note—council does not support shading of lights on the basis that it would be a penalty to road users, particularly cyclists and pedestrians.

(a) Road lighting in rural residential areas
Flag lighting is to be provided at:

(i) all intersections on roads;

(ii) on curves where the advisory speed through the curve is 15 km/h lower than the gazetted speed limit of the road; and

(iii) at the ends of cul-de-sacs.

A maximum 150W luminaire should be used at a mounting height of 10.5m.

Lighting on roads under the control of the Department of Transport and Main Roads must be designed to meet their requirements.

(b) Road lighting in urban areas
Lighting must be provided in accordance with the relevant sections of AS 1158 and the following:

(i) Category V3 Lighting on arterial and sub-arterial roads;.

(ii) Category V5 Lighting on major collector streets;

(iii) Category P4 Lighting on, access Streets, access Places, industrial streets, and commercial precincts unless otherwise determined by council, e.g. higher lighting levels to assist with CCTV surveillance; and

(iv) lighting in public transport infrastructure (compliance to the *Disability Standards for Accessible Public Transport 2002*).

(c) Lighting for bicycle, pedestrian and shared paths
Lighting Category P1 – P4 for bicycle, pedestrian and shared paths as advised by council after consideration of location, hours of use and risk to the public.

(d) Lighting for parks
Lighting requirements for parks will be determined by council based on where the park fits into the hierarchical structure. A point of supply is required to most parks and where required, the precise location of the supply will be advised by council. This lighting may have a sub-metered supply.

(e) Lighting for sports grounds and sports complexes
Lighting requirements for sports grounds and sports complexes will be determined by council based on where the park fits into the hierarchical structure.

A point of supply is required to most parks and where required, the precise location of the supply will be advised by council.

(f) Lighting for public buildings and spaces
Lighting requirements for public buildings and spaces will be determined based on a risk assessment considering location, time of use, number of people, relevant building codes and AS/NZS 1158.

(g) Lighting for off-street car parks.
Lighting must be provided in accordance with the relevant sections of AS 1158. A point of supply is required to most off-street car parks. Lighting shall be provided in accordance with the lighting master plan for the area, unless otherwise approved by council. This lighting must have its own separate metered point of supply.

(3) New subdivision marketing banners on light poles

It is common practice for developers to place marketing banners on light poles along local roads within the boundary of the new subdivision. Banners are lightweight and made of a non-rigid material.

The developer must obtain approval from Ergon Energy to erect marketing banners on light poles and comply with all Ergon Energy conditions. Banners on light poles must not be a driver distraction on the road or at an intersection. Banners must not interfere with an official traffic sign, distract a drivers attention at a critical time, obscure the drivers view of a road hazard, give instructions to stop, imitate an official traffic sign, nor be an obstruction to the road or a hazard to all other road users. A high level of safety for road users must be maintained.

At the time of on maintenance council may accept the marketing banners on light poles, but the developer must indemnify council for all matters arising from the banners erected on light poles. The banners may remain on the light poles for twelve (12) months. If banners are required beyond this time then the developer must

submit a request to council for a twelve (12) month extension of time. Council may request the developer to remove any marketing banner on any light poles at any time.

Editor's note – there may be additional related requirements in Subordinate Local Law No. 1.4 (Installation of Advertising Devices) 2011.

Council will not give consent for advertising banners to be placed on street lights that are owned and maintained by council.

SC6.4.3.20.3 Utility services

(1) All utility services are to be underground.
All services to new developments must be constructed underground unless otherwise approved by council.
Layout plans for all service installations must be submitted to council as part of the developmentapplication.

(2) Alterations to existing services
Care should be taken during the design to avoid other existing underground services, and where this is unavoidable it will be the developer's responsibility to undertake the necessary alterations to the satisfaction of the asset owner at the developer's cost.

Where it is necessary to install conduits under existing roads, this installation must be undertaken by boring unless otherwise approved by council.

Telecommunication cabinets and electricity supply pillars
The proposed location of on street telecommunication cabinets and electricity supply pillars must be shown on plans and be located clear of access driveways to properties, and clear of any water and gas services in accordance with any requirements of the relevant authority.

(4) Electricity supply general
An overhead supply approved by the relevant energy authority where in the rural residential zone, special purpose zone or high impact industry zone or where on a lot of less than 2,500 m^2 within an area where the existing supply is overhead is acceptable.

In exceptional circumstances, remote access properties in the rural zone may be permitted provide an electricity supply that is not connected to the grid. It shall be demonstrated by the applicant that an adequate and reliable supply that maintains standards for safety, environmental, health and amenity is achievable. Acceptable alternatives may include solar or other similar self-generating system.

Electricity and/or telecommunications services must be designed in accordance with the relevant utility provider's guidelines. Electricity design plans submitted to council with an RPEQ certification are only accepted by council to permit the utility provider (e.g. Energy Queensland) to formally approve the design.

In the construction phase only conduits for both electricity and telecommunications utilities are installed, with the relevant utility provider installing the actual service after the works are complete.

(5) Gas supply
Where it is proposed to provide a reticulated gas supply to a development, the gas service pipe must be installed in the verge or footpath on the alignment shown on SC6.4.4.8 Standard drawings.

If a storage cylinder is proposed as part of the development, the cylinder must be installed and maintained on a separate freehold parcel of land in accordance with all safety regulations contained in the AS/NZS 1596 *The storage and handling of LP gas*. Details for servicing the gas cylinder must be provided to council as part of the development application.

SC6.4.3.21 Townsville Water planning and design guidelines

SC6.4.3.21.1 Introduction

(1) General

This sub-section has been developed by the Programs and Technical Support (PATS) department within Townsville Water and Waste, to document the procedures undertaken during the delivery of their services.

(2) Intent of the sub-section

This sub-section has been developed to detail relevant information pertaining to planning and design projects and to collate Townsville Water and Waste practices not documented elsewhere. Its intended use is as a reference manual for:

(a) internal Townsville City Council staff including Townsville Water and Waste and Planning and Development (Infrastructure Planning Unit and Development Assessment);

(b) external consultants engaged to perform specific commissions; and

(c) developments that include water and wastewater infrastructure.

(3) Application

These guidelines shall apply to sewerage and water supply distribution, collection, pumping and treatment and effluent reuse in the areas of:

(a) planning;

(b) design;

(c) technical specifications for approval;

(d) preparation of technical contract documentation; and

(e) collection and submission of as-constructed details.

It excludes: information on the presentation of drawings.

(4) Purpose

The purpose of these guidelines is to ensure that:

(a) all water supply, sewerage and effluent reuse works are designed and constructed to common standards throughout Townsville city, and comply with codes and standards established by the relevant government authorities;

(b) the reticulation and pumping systems provided are hydraulically adequate for the demands from the currently planned stage of development within any particular Water Supply/Sewerage Scheme at any point in time;

(c) the total system of reticulation pumping and treatment is progressively developed with adequate capacity to meet the ultimate requirements of the particular Water Supply/Sewerage Scheme; and

(d) the quality of water supplied and the quality of effluent disposed by Townsville Water and Waste meets acceptable minimum standards established by the relevant government authorities.

(5) Triple bottom line

Any new works undertaken by Townsville Water and Waste and development must meet the requirements of a triple bottom line approach to sustainable development, and be economically, environmentally and socially viable.

(6) Acceptance of designs and documentation

The design of infrastructure shall comply with the requirements that are detailed in Townsville Water and Waste's Total Management Plans where relevant.

Externally produced designs and documentation including drawings shall be certified by a Registered Professional Engineer of Queensland (RPEQ).

SC6.4.3.21.2 Water supply design

(1) Introduction

(a) Scope

The work to be carried out under SC6.4.3.21.2 includes the design of a water supply system either as a stand-alone project or as part of a development.

(i) Inclusions

SC6.4.3.21.2 covers the design of:

(A) pump stations;

(B) storage reservoirs;

(C) water mains – including trunk and reticulation mains; and

(D) property connections.

(ii) Exclusions

SC6.4.3.21.2 does not cover requirements for:

(A) bulk water storage – dams etc.; and

(B) water treatment plant design considerations.

Bulk water supply infrastructure will be planned and designed by council in conjunction with experienced specialist consultants.

(b) Documents

(i) Reference and source documents

SC6.4.3.21.2 is to be read in conjunction with the current version of the following documents.
Australian Drinking Water Guidelines (National Health and Medical Research Council)
Planning Guidelines for Water Supply and Sewerage, Department of Energy and Water Supply (*DEWS Guidelines*)
(WSA 03) Water Supply Code of Australia
Workplace Health and Safety Queensland, *Safe Design of Structures – Code of Practice*

(ii) Document precedence

The order of precedence (highest to lowest) of documents shall be:

(A) SC6.4.4.8 Standard drawings;

(B) this sub-section;

(C) WSA 03; and

(D) DEWS Guidelines.

(c) Standard drawings

SC6.4.4.8 Standard drawings shall be read in conjunction with this sub-section. Standard drawings other than water and sewerage (such as road crossings) also contain information on water and sewerage infrastructure and shall also be referred to.

(i) Amendments to WSA 03

The design of water supply systems shall comply with *WSA 03 Water Supply Code of Australia* unless otherwise specified herein, and shall be constructed in accordance with *WSA 03 Water Code of Australia Construction Specification.* Amendments required by Townsville Water and Waste to WSA 03:2011 are included in Table SC6.4.3.21.1. Any conflicting information in later codes shall be referred to Townsville Water and Waste for clarification.

Table SC6.4.3.21.1 Amendments to WSA 03:2011 – Water Supply Code of Australia

WSA 03 Section	Amendments to WSA 03 – Water Supply Code of Australia:
2.3	Demand parameters are set in SC6.4.3.21.2(2). Variations from these parameters are to be approved by Townsville Water and Waste.
Figures 2.1(a) and 2.1(b)	Dead end mains are not permitted.
2.4	Minimum mains sizing – DN100 (with fire service provision) on one side of the street, in conjunction with DN63 (rider main) to the other side.
2.5.3	Minimum service pressure shall be 22 m at the service connection under peak flow conditions, with a minimum service flow rate of 30 L/minute.
2.9	Storage reservoirs shall be sized to not empty under 7 consecutive days of 95% peak day demands.
3.1.5	Water supply systems shall be designed for fire fighting capability in accordance with parameters set out in Table SC6.4.3.21.3.
3.3 and 3.8	Minimum Class of pipe shall be PN16.
4.7	GRP pipe is not permitted.
5.6	Shared Trenching is not permitted without prior written approval.
5.10	Dead end mains are not permitted.
5.11 and 15.8	Property Service and Water Meters shall only be installed by Townsville Water and Waste upon application.
9.2.2	Longitudinal section drawings shall be provided for water mains DN200 and above.
14.2, 16.0	Pipe embedment and support: For flexible pipes refer to AS2566.2, Tables G1, G2 and G3 for suitable material types.
15.20.1	An access hatch is required on the steel main to reinstate cement mortar lining.

(2) Water supply planning

(a) Scope

Water supply system planning covers the requirements of the water distribution and reticulation system from the bulk supply system to the service connections. This includes pump stations, storage reservoirs, trunk water mains, and reticulation mains.

(b) Hydraulic loading assessment

(i) General

Hydraulic loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

(A) designated value of EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of Townsville City Plan;

(B) the location of various zone types as specified in Townsville City Plan;

(C) an assessment of the ultimate population, including the expected peak occupancy rates and the quantity of undeveloped land for each zone type listed in Townsville City Plan; and

(D) estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by an analysis of historic consumption and consultation with the institution regarding future development.

Editor's note - Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Townsville City Council Growth Model which is available from Planning and Development (Infrastructure Planning Unit). This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU), Office of Economic and Statistical Research within the Queensland Government, Department of Treasury and Trade.

(iii) Design flows

Peak demands are to be calculated from Table SC6.4.3.21.2.

Table SC6.4.3.21.2 Water supply unit demand parameters

Parameter	Unit Demand	Peaking Factor
Average Day (AD)	600 L/day/EP	
Mean Day Max Month (MDMM)	900 L/day/EP	1.5 AD
Peak Day (PD)	1125 L/day/EP	1.25 MDMM
Peak Hour (PH)	0.033 L/s/EP	2.56 PD

In addition to the residential demand, the AD irrigation demand is 60L/EP.

(iv) Design criteria

Water supply systems shall be sized in accordance with the requirements of:

- *Planning Guidelines for Water Supply and Sewerage.*

The design criteria for water supply infrastructure are summarised in Table SC6.4.3.21.3.

Table SC6.4.3.21.3 Water supply infrastructure design criteria

Design Criteria	Value
System Pressure NB: measured immediately upstream of the customer's water meter not downstream of water meter. Max Head loss through a water meter is 25kPa i.e. 2.5 m (AS3565.1)	
Minimum Operating Pressure	22 m to the meter
Maximum Operating Pressure	80 m to the meter
Fire Fighting Requirements	
System Pressure	12 m minimum at the property boundary and any point within the system
Fire Flow	Rural Residential (Zone 1 or 2) – 7.5L/s Residential – 15 L/s Commercial and industrial – 30 L/s
Background Demand	PH > 3,000 person communities 2/3 PH < 2,000 person communities Linear interpolation between 2/3PH and PH for 2000 and 3000 persons communities
Reservoir level	Mid-water level
Reservoir Storage	
Ground Level Storage	7 days of 95% PD Demand; Cases where inflow is MDMM Demand this equates to:- 7*(0.95*1.2*MDMM-MDMM) = 1.31 MDMM
Elevated Storages	6*(PH-1/12 MDMM) + Fire fighting reserve (150 kL)
Pumping Capacity	
Duty Pump Capacity	Sized for MDMM flows with 20 hours operation
Pumps serving Elevated reservoirs	(6*PH-Operating Volume)/(6*3600)
Standby pump capacity	To match the capacity of the largest pump in the station

Design Criteria	Value
Pipeline Design	
Pipe Capacity - Distribution Mains	Sized for MDMM flows.
Pipe Capacity - Reticulation	Based on peak instantaneous demands; of PH and Fire Flow.
Fire Services Pumps	TWW preference is for pumped fire services to be connected downstream of a fire tank. If fire pump is directly connected to the water reticulation main applicant must provide evidence that the selected pumps will not have adverse impact on the surrounding network.

Friction factors to be adopted for the pipe network modelling are detailed in Table SC6.4.3.21.4.

Table SC6.4.3.21.4 Hazen Williams pipe friction coefficients

Mains	Diameter (mm)	Adopted "C" Values	
		Cement Lined Pipe	Plastic Pipe
Distribution	< 300 300-600 > 600	110 120 125	130 140 150
Reticulation	<= 150 225 – 300 > 300	100 110 120	120 130 140

(c) Network planning

(i) Purpose

The purpose of network planning is to determine the most effective means of providing a service to an area through analysis of both infrastructure and non-infrastructure based solutions. The determination of the most effective solution should be made through analysis of whole of life costs and consideration of non-financial aspects such as operations, maintenance, and environmental obligations.

Section SC 6.4.3.21.2(2)(c) details the circumstances under which a network plan should be prepared.

When preparing planning reports for both water and sewerage assets, the author shall refer to Section 6 of the DEWS *Planning Guidelines for Water and Sewerage.*

(ii) Network modelling

A water network model is required for all code or impact assessable material change of use (MCU) and reconfiguring a lot (RoL) applications where:

(A) new trunk and/or reticulation mains are to be constructed as part of a development;

(B) the development requires trunk infrastructure identified in council's Plans for Trunk Infrastructure to be constructed ahead of its planned date, or out of sequence identified in master planning;

(C) the proposed land use results in an increase in demand greater than what is presently allowed for Townsville City Plan; or

(D) water mains are required to be relocated or reconfigured as part of the proposed works, and these works are expected to change the hydraulics of the existing supply.

TCC also requires the development of a network model for:

- the preparation of Infrastructure Master Plans; and
- the preparation of Priority Infrastructure Plans (and Plans for Trunk Infrastructure).

Network modelling shall be undertaken in accordance with SC6.4.3.23 Water and sewerage network modelling guidelines.

(iii) Levels of assessment

Depending on the type of works in question, simplified or detailed modelling may be required to demonstrate compliance with these guidelines. Simplified or detailed assessments are defined below:

(A) "Simplified Assessment" – an assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

(B) "Detailed Assessment" – an assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

SC6.4.3.23 Water and sewerage network modelling guidelines outline the process to be followed to obtain council advice as to what level of assessment is required.

(iv) Timeframes

Master planning shall be undertaken over a 30 year timeframe. The capacity of the existing network to service ultimate demand should be assessed and any system augmentations to service ultimate requirements identified. The staging of infrastructure works is an essential consideration and should be incorporated into the planning and design process. Staging of infrastructure works should be also considered at no greater than 10 year intervals until the ultimate horizon.

For developments being completed in less than a 5 year timeframe, network modelling shall be undertaken for existing case, and full development.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.

Net present value cost analysis should be undertaken using a range of interest rates (typically 3%, 5% and 7%), as well as the rate for weighted annual cost of capital (WACC) which can be sourced from council. Timeframes of 10, 20, and 30 years shall be applied.

Longer timeframes will enable assessment of the impacts of major replacement and upgrade works on the viability of the system. Council may require longer timeframes for analysis.

Cost assessments should only consider an engineering cost assessment, with loan interest and depreciation considered separately by council when considering a business case for a particular project. The following on-cost allowances should be made:

Establishment	2%
Project management/engineering design/council management costs	15%
Contingency	30%

(3) Bulk water storage and water treatment

(a) General

New bulk water storages and storage upgrades, new water treatment process design and upgrades are complex and site specific, and are typically undertaken as one-off projects and performed by experienced designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of specialist consultants suitable to carry out the project.

(b) Re-chlorination

At locations within the distribution system it may be necessary to re-chlorinate the water supply to maintain the free chlorine residual within the target range of 0.5 – 1.5 mg/L.

Re-chlorination stations should be located either at pump stations or at reservoir sites.

For safety, re-chlorination stations are to be fitted with appropriate signage and alarms to comply with

work, health and safety codes and requirements.

(4) Pump stations

(a) General

This section covers the design of:

(i) bulk water supply pump stations to service reservoirs; and

(ii) smaller booster pump stations to boost pressure in the distribution system. Booster pump stations should be avoided wherever practical by appropriate reticulation design, and will only be permitted with written approval by Townsville Water and Waste.

(b) Capacity and pump sizing

(i) Pump station capacity

Pump stations shall be sized to meet the system requirements for the planning horizon. Multiple pump units can be used to achieve the required pump duty.

(ii) Booster pump stations

Pump stations acting as reticulation boosters will supply the range of flow and head duties from Minimum Flow to Peak Hour conditions.

(iii) Hydraulic analysis

Hydraulic analysis is to be used to determine the flow and head requirements for the pump station.

(iv) Pump and rising main sizing

Pump size in combination with the delivery main size is to be designed to minimise whole of life costs covering capital, operating and maintenance costs.

(v) System resistance curves

System Resistance Curves covering all expected duties of the pumps, including maximum and minimum head cases shall be prepared. A net positive suction head available (NPSHA) curve shall also be prepared.

(vi) Pump selection

Pump selection shall achieve all expected duties as per the system resistance curves.

Redundant (standby) pump capacity shall be provided. Standby pump capacity shall be at least equal to the capacity of the largest pump unit.

(c) Building structure and general arrangement issues

(i) Materials

Pump stations shall be contained in above ground structures, constructed from reinforced masonry block and/or reinforced concrete walls with concrete or metal (Colourbond) roofs.

In undeveloped areas metal clad buildings may be acceptable subject to suitable compliance with noise emission requirements and adequate site security/vandalism restraint, and with approval from Townsville Water and Waste (See SC6.4.3.21 Attachment C).

(ii) Buildings general

(A) Permits – a development permit is required for building work (IDAS Form 2) for permanent pump station buildings.

(B) Location - pump station location and visual appearance shall be approved by Townsville Water and Waste, and shall generally complement the amenity of the local area. Pump stations in built-up areas should have appropriate external appearance to match the surrounds.

(C) Security – pump station shall be secure, and protected against vandalism, vermin and birds. Buildings shall be designed for Importance Level 3 (minimum) in accordance with the *Building Code of Australia* Table B1.2a as well as with designs shown in SC6.4.3.21 Attachment C.

(D) Level – pump station floor to be located a minimum of 300 mm above 1% AEP flood level,

be subject to a flood risk assessment, and shall be approved by Townsville Water and Waste.

(E) Noise management – pump stations shall be designed to comply with the relevant noise emission legislation, regulations and policies.

(F) Ventilation – ventilation or air-conditioning where required shall be provided as necessary to control heat from equipment within the building. Independent ventilation of chlorinator rooms shall be provided to meet work, health and safety requirements.

(G) Internal drainage – provision shall be made to drain leakage/flows from pumps/pipework away from the building without flooding of switchboards and electrical components.

(H) Safety – Pump station structures shall be designed in accordance with Safe Design of Structures – Code of Practice.

(iii) Structure sizing
Pump stations structures shall be sized to:

(A) provide adequate access around all pumps and associated pipework, generally 1 m minimum clearance and for maintenance access to pumps, pipework, valves etc.;

(B) house the pump station electrical switchboard and telemetry;

(C) house necessary cranage (see also (v);

(D) house chlorination systems (where required) – a separate room is generally required for chlorination systems, independently ventilated; and

(E) wherever practical the pump station structure shall be sized to accommodate the pumps and equipment necessary to achieve the proposed ultimate pump station capacity.

(iv) Site access
All weather sealed access for maintenance vehicles shall be provided, including:

(A) sealed asphalt access road, minimum pavement width 4 m;

(B) provide access during a minimum 1% AEP flood event; and subject to a flood risk assessment;

(C) on-site turn-around for maintenance vehicle; and

(D) road geometry suitable for use by light vehicles and single axle trucks.

(v) Lifting requirements
Design of the building shall enable the use of mobile cranes for lifting of pump units, motors and other equipment.

Where this is not possible, permanent cranage is to be provided within pump stations to allow maintenance of equipment, consisting of a minimum of a monorail crane accessing the pumps and motors. Set-down areas shall be provided:

(A) within the pump station adjacent to large maintenance doors where the area can be accessed externally by a crane truck; or

(B) externally by extending the monorail outside the building to allow loading onto the back of flat bed vehicle (bed height 1.2 m).

(d) Pipework

(i) Each pump shall be provided with suction and discharge isolation valves and a non-slam non-return valve on the pump discharge.

(ii) At least one easily removable piece of pipework is required on each pump to enable efficient removal and replacement.

(iii) Steps and walkways in accordance with AS1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation shall be provided over pipework such that access is readily available to both sides of each pump.

(e) Disinfection system

(i) Chlorine residual booster stations shall be provided when required.

(ii) Chlorine dosing will be by the use of sodium hypochlorite solution or chlorine gas. Dosing control (either flow paced, fixed rate or other) is to be approved by Townsville Water and Waste.

(iii) Sodium hypochlorite or chlorine gas storage and dosing equipment shall be housed in a separate room, independently ventilated. The chemical unloading, storage and dosing facility should comply with the handling and safety requirements for the chemical.

(iv) Chlorine dosing should be into the pump station discharge pipework.

(v) A safety shower and eyewash facility and appropriate signage is to be provided to meet work, health and safety requirements.

(f) Power supply and telemetry/instrumentation

(i) Power supply for the site shall be provided in accordance with the requirements of SC6.4.3.21.4.

(ii) Backup power is not normally provided within water pump stations. Where deemed necessary emergency power shall be provided in accordance with SC6.4.3.21.4.

(iii) Telemetry/instrumentation - All pump stations shall be provided with telemetry monitoring. Reticulation system booster pump stations typically are controlled to maintain a constant pressure at the pump station discharge. Pump stations are normally monitored but not controlled by the Telemetry system. Control of the pumps is performed locally.

(g) Land tenure

The required land tenure for a pump station site is council-owned freehold title.
The land tenure for access to the pump station in order of suitability is:

(i) public road; or

(ii) council-owned freehold land; or

(iii) water supply easement in the name of Townsville City Council.

(5) Storage reservoirs

(a) Scope

This section covers the design of water supply reservoirs, including the requirements for on-ground storages and elevated tanks on steel tank stands.

Refer to SC6.4.3.21.2(5)(c) for structural design of reservoirs.

Editor's note–Townsville Water's Program and Technical Support maintains a set of internally used Standard Drawings for Reservoirs, which can be made available on request.

(b) Site

(i) Location selection

Selection of reservoir site shall be approved by Townsville Water and Waste and shall consider the following:

(A) proximity to the area(s) to be served and length of mains necessary to supply into the reservoir and distribute to the service area;

(B) elevation of land to achieve required top water level (TWL) and bottom water level (BWL), and minimum operation level for the reservoir;

(C) environmental impacts, including visual impact;

(D) access to site;

(E) ability to achieve required land tenure;

(F) geotechnical issues;

(G) impacts on other services and infrastructure;

(H) landscaping of the site should be provided where necessary to minimise the visual impact of the facility; and

(I) where the reservoir is not readily accessible from a public road, particular attention to the

following criteria is required:

- vehicle access and site manoeuvrability;
- access road cross section and drainage; and
- width of land required for access road.

(ii) Visual appearance

The location and visual appearance shall complement the amenity of the local area.

If deemed necessary, a landscape architect shall be engaged to design fast growth plantings to provide a visual screen.

(c) Reservoir tank design

(i) Size and design life

The reservoir and associated inlet and outlet pipes shall be sized in accordance with the planning requirements of this section.

The reservoir design life shall be 80 years minimum.

(ii) General arrangement

Reservoirs shall be circular where possible to provide the most economic construction.

Foundations – the entire tank structure shall be founded on undisturbed parent material. Founding on fill material is not permitted.

The reservoir shall include, but not be limited to:

(A) steel floor, walls and roof support columns:

- a zincalume (or Colourbond Ultra) double sided coated roof on zincalume coated steel purlins (with down-turned lip on bottom flange) and beams;
- inlet and outlet pipework with valves;
- scour pipework with valve;
- overflow pipe;
- lockable access ladders (external only);
- fall arrest system for safe roof access in form of a permanent static line from roof access hatch platform to centre of reservoir;
- davit arm provision for vacuum cleaning by divers;
- telemetry control and monitoring;
- flow meter;
- level sensor;
- natural vermin proof roof ventilation; and
- telemetry control on inlet valve.

(B) all reservoirs shall be roofed and made vermin and bird proof. Drainage from the roof shall not enter the tank; and

(C) personnel access – access shall be provided into the reservoir:

- external access consisting of a galvanised steel ladder to AS 1657;
- lockable roof access opening minimum dimensions 1 m x 1 m;
- minimum one wall access hatches with sampling tap; and
- external accesses shall incorporate features to prevent use by unauthorised persons.

(iii) Materials

The following applies:

(A) the reservoir shall be constructed from plate steel;

(B) steel reservoirs shall be cathodically protected; and

(C) painting – the interior and exterior of the reservoir shall be painted with an approved epoxy paint system, approved for immersion in potable water supply. Colours will be advised by Townsville Water and Waste.

(iv) Pipework

The following applies:

(A) reservoirs shall be provided with separate inlet and outlet pipes, on opposite sides of the reservoir tank to achieve circulation. the inlet shall have a bend to facilitate circulation;

(B) a control valve shall be provided on the inlet pipework where specified by Townsville Water and Waste;

(C) a non-return valve shall be provided on the outlet pipework only where specified by Townsville Water and Waste;

(D) scours shall be sized to enable the reservoir to be completely drained from full within 24 hours. Scours are to be specified to stormwater; and

(E) an overflow capable of carrying the ultimate design inflow shall be provided, with connection to scour pipework.

(d) Geotechnical

Geotechnical investigations shall be undertaken for reservoir sites to ascertain sub-surface conditions for the tank design and for stability of batter slopes. Founding must be on undisturbed ground. Construction on fill is not permitted. The following must be taken into consideration:

(i) slope stability for the reservoir site;

(ii) site excavation;

(iii) stability of excavation batters; and

(iv) design parameters for the access road pavement.

(e) Security

Fencing is required around reservoir sides. Refer to SC6.4.3.21.5(4) for details.

(f) Telemetry/instrumentation

Minimum telemetry monitoring requirements for reservoirs should be reservoir level by submersible pressure transducer.

(g) Land tenure

The required land tenure for reservoir sites is council-owned freehold title.

The land tenure for access to the reservoir site in order of suitability is:

(i) public road; or

(ii) council-owned freehold land; or

(iii) reserve for water supply purposes; or

(iv) water supply easement in the name of Townsville City Council.

(6) Water mains

(a) General

(i) Scope

This section covers the design of distribution and water supply reticulation mains:

(A) distribution mains – provide for the transfer of bulk water between treatment and storages infrastructure within the water supply network; and

(B) reticulation mains – provided for supply from the bulk water system to consumers through the reticulation network.

(ii) Extent

Mains shall be provided to service all properties within the development and where relevant also include bulk mains to service the declared water service area.

(b) Water main sizing

(i) Demands

Mains shall be sized to meet demands (including fire flows).

(ii) Network modelling and whole of life costs

Where specified by Townsville Water and Waste, appropriate network modelling shall be

undertaken to determine mains sizes within the development.
Where distribution mains are pumped, the main size is to be determined in conjunction with the pump size to minimise whole of life costs for the system including capital, operating and maintenance costs.

(c) Mains layouts and general arrangements

(i) Configuration

(A) Distribution mains shall comply with the following:

- configuration and extent of the main is to be determined to suit the requirements of the ultimate development to the approval of Townsville Water and Waste; and
- connections to reticulation mains network and consumers are not permitted, unless required under the project and approved by Townsville Water and Waste.

(B) Water reticulation mains layout shall comply with the following requirements:

- water mains are required down both sides of roads where service connections are provided. Cross-road service connections are not permitted, except in the Rural residential zone where a main on one side of the roadway is acceptable;
- Low density residential zone and Character residential zone streets shall have a minimum of DN 100 (with fire hydrants) on one side of the street and a minimum of DN 63 PE service main on the other;
- water mains (DN100 minimum with fire hydrants) are to be provided on both sides of the road in the cases of divided carriageways, centre, industrial, and medium or high density residential zones. In centre, industrial or high-rise building areas, one of the mains in the street shall be DN150 minimum; and
- permanent dead end mains are not permitted.

(ii) Temporary dead ends are not permitted for more than 12 month defect liability period, temporary loops are to be installed prior to end of defect liability period. Temporary ends/loops are to be design to allow for future connection without shutdown to existing residents, which may include in-line thrust block, valve and FH.

The location for water mains in order of preference is in:

(A) council controlled roads; or

(B) main roads controlled by State or Federal Governments; or

(C) reserves and unallocated state land; or

(D) council owned freehold land; or

(E) easements in privately owned freehold land.

Distribution mains alignment shall be as follows:

- the alignment of distribution mains is to be resolved with the appropriate control authority for the road, land or easement, and approved by Townsville Water and Waste.

Reticulation mains alignment shall be as follows:

- the alignment within a road reserve shall be in accordance with SC6.4.4.8 Standard drawings SD-015 Verge Service Corridors, General Type, Sections.

(iii) Cover requirements

Cover requirements shall comply with WSA 03 (Section 5.4.2) plus:

(A) distribution mains – minimum cover is to provide for the structural integrity of the pipe, meet the requirements of the appropriate control authority for the road, land or easement; and

(B) reticulation mains:

- minimum pipeline cover requirements for water mains shall be in accordance with standard drawing SD-325 Embedment and Trench Fill, Typical Arrangement; and
- maximum cover for maintenance purposes – 1.5 m.

(iv) Services and alignments

Consideration is to be given to other services in the area when selecting alignments.

Refer to WSA 03 Table 5.5 and SC6.4.4.8 for minimum clearance requirements from other services.

Minimum clearance requirements and/or conditions may be imposed by the service owner. Specific conditions apply to construction near services including:

(A) fibre optic cables;

(B) high pressure gas or oil mains;

(C) underground power; and

(D) overhead power - consider overhead power when selecting pipeline alignments for:

- safety and clearance issues with construction under or near overhead power lines; and
- the designer should avoid locating continuously welded steel pipelines in parallel to high voltage power lines (WSA 03, Section 5.4.12).

(v) Shared trenches

Shared trenching of water mains with other services will not be permitted without approval from Townsville Water and Waste.

(vi) Easements

Easements shall be taken over water mains constructed in private property.

The easement width shall be a minimum 3 m. For >DN375 mains, easement width shall be approved by Townsville Water and Waste.

Easement corridor widths shall be suitable to accommodate all water mains for the ultimate development, and approved by Townsville Water and Waste.

(d) Pipe

(i) Materials

Allowable pipe materials include:

(A) PVC-U, PVC-O, PVC-M (OD compatible with DICL fittings);

(B) ductile iron cement lined (DICL);

(C) mild steel cement lined (MSCL);

(D) ABS;

(E) polyethylene (PE);

(F) copper; and

(G) stainless steel.

Pipeline materials shall be in accordance with WSA 03.
Pipe shall be minimum pressure class of PN16 for all pipe sizes.

(ii) Pipe design

Pipeline material structural design shall be undertaken in accordance with WSA 03 for all internal and external loads applied to the pipeline.
The “PN” rating shall be selected to suit the pipeline design pressures.

In selecting the PN rating for plastic pipes, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer to WSA 03*).*

(iii) Pipe jointing

Pipelines should generally be rubber ring jointed. Mild steel cement lined pipes will normally be rubber ring jointed unless there are specific reasons for installation of continuously welded pipe segments. PE pipe shall be connected by butt thermal fusion or by electrofusion couplings. Up to 50 mm ID PE pipe may use compression fitting connections.

The following applies for flanged Joints:

(A) Flanged pipework shall be used where necessary at connections, to transfer thrust, or provide beam action for the pipeline to span;

(B) Flange classes shall be selected to suit the pipeline design pressures; and

(C) Flange classes shall be to AS/NZS 4087 *Metallic flanges for waterworks purposes* except where connecting to existing flanges from a different standard. Minimum flange classes shall be:

- Class 14 for Steel Cast Iron; and
- Class 16 for DICL.

(iv) Pipe anchorage

Water mains with unrestrained flexible joints shall be designed to resist the total unbalanced thrust and transmit all thrust loads to the adjacent native soil or rock.

Pipe anchorage and thrust blocks shall be provided in accordance with WSA 03.

Alternatively, TYTON-LOK joints or similar may be approved by Townsville Water and Waste in special circumstances. Marker tape shall be provided above the pipe to clearly show the extent of the restrained jointing.

(v) Concrete encasement

Concrete encasement of pressure mains is not permitted without written approval of Townsville Water and Waste.

(vi) Above ground water mains

Above ground construction is to be approved by Townsville Water and Waste.

Where a section of water main is to be laid above ground, the pipe materials, support and restraint for the pipes and fittings shall be in accordance with WSA 03, and the pipe manufacturer's recommendations.

(vii) Cathodic protection

Cathodic protection (CP) for steel mains laid through corrosive environments may be required if specified by Townsville Water and Waste.

CP shall be designed by an experienced specialist in accordance with WSA 03.

(viii) Pipe bedding

Pipe bedding for water mains shall be in accordance with WSA 03.

(ix) Restoration

Refer to WSA 03 for construction specification.
For restoration under roadways refer to standard drawing SD-055 Road Crossing and Footpath Reinstatement for Trench Laid Services.

(x) Geotechnical

Geotechnical matters shall be considered in accordance with WSA 03.

(xi) Trenchless construction

Where specified by other infrastructure owners or Townsville Water and Waste, trenchless construction methods may be required. Circumstances requiring trenchless construction methods may include:

(A) crossing of major roads;

(B) where the land controller specifies (e.g. rail and main roads); and

(C) crossing environmentally sensitive areas.

The designer is to provide the details of trenchless construction techniques proposed.
QR National requires compliance with their Specification: *MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services)*. Common forms of trenchless pipeline construction include:

- pipe jacking;
- horizontal direction drilling; and
- micro tunnelling.

The designer shall identify where trenchless construction techniques are necessary or economical during the design process.

(xii) Road and rail crossings of existing pipes

Road crossings for existing above ground pipes shall comply with the requirements of the standard road crossing drawing provided in SC6.4.3.21 Attachment B. Rail crossings will be designed on a case by case basis.

For existing underground pipes where road/rail upgrades or new roads/rails are proposed protection or relocation may be required. Concrete encasement may be approved on a case by case basis, preference however is for envelopers. This often is required at major road crossings, at rail crossings and sometimes at waterway crossings. Enveloper designs for road and rail crossings shall be undertaken in accordance with the Land Corridor controller's requirements. Where no specific requirements are provided refer to the standard drawings of WSA 03 and Townsville Water and Waste for further details.

The void between enveloper and carrier pipe shall be grouted at each end using low strength grout on completion of the pipe installation unless other arrangements are required by the Land Corridor controller.

(xiii) Disinfection

The designer shall specify the disinfection of all water mains after satisfactory testing in accordance with *WSA 03*.

(xiv) Pipeline drawings

Drawings shall include a Plan (1:500) for all mains, and Longitudinal Sections (1:1000 (H); 1:100(V)) for mains DN200 or greater.

(e) Pipeline appurtenances

(i) Hydrants

Hydrants shall be located such that:

(A) existing and future development lots are or will be within 40 m of the nearest hydrant;

(B) the spacing between hydrants does not exceed 80 m;

(C) hydrants are also provided at all high and low points of distribution mains and at (temporary) dead ends; and

(D) hydrants shall be located in accordance with SC6.4.4.8 Standard drawings SD-305 Street Positioning of Mains, Valves, Hydrants and Domestic Water Service connections and SD-355 Typical Valve and Hydrant Installation – Hydrants and Air relief Valves.

Hydrants may not be located within 10m of pole/pad mounted transformer.

Hydrants located within mixed commercial/residential zones must be installed on a tee with a valve to allow maintenance of hydrant without shutdown of the water main.

(ii) Stop valves

The following applies:

(A) stop valves for reticulation shall be provided in accordance with the requirements of WSA 03;

(B) stop valves shall be provided so that a maximum of ten dwellings are isolated for maintenance purposes, and a maximum of four valves to be closed to isolate any section of reticulation main (maximum of one block to be shutdown within the ten dwellings);

(C) valves shall be located to avoid conflicts with driveways, telephone house service pits, and underground electrical boxes;

(D) stop valves shall be anti-clockwise closing;

(E) maximum of 200m between valves; and

(F) stop valves are to be located on either side of a road crossing.

(iii) Valve and hydrant installation

Valve and hydrant installation shall be in accordance with the following standard drawings:

(A) SD-305 Street Positioning of Mains, Valves, Hydrants and Domestic Service Connections;

(B) SD-345 Valve and Hydrant Identification – Identification Markers and Marker Posts;

(C) SD-350 Typical Valve and Hydrant Installation – Valve Arrangement; and

(D) SD-355 Typical Valve and Hydrant Installation – Hydrants and Air Relief Valves.

(iv) Air valves

Air valves are to be provided at high points in distribution water mains. It is not normal practice to provide air valves in reticulation mains as air can be exhausted through hydrants and property connections.

Air valves shall be designed in accordance with WSA 03 and SC6.4.4.8 Standard drawings SD-355 Typical Valve and Hydrant Installation – Hydrants and Air Relief Valves.

(v) Scours

Scours shall be provided at low points in distribution mains and larger reticulation mains for maintenance purposes.

Scours are not normally provided in smaller reticulation systems. This function is performed using hydrants.

Scour design will be in accordance with WSA 03 and SC6.4.4.8 Standard drawings SD-360 Typical Appurtenance Installation – Scour Arrangement.

(vi) Pressure and flow control devices

The detailed design of a water reticulation system shall identify the need for pressure and flow control devices.

The designer shall specify, for ease of valve maintenance, fittings located within concrete valve chambers. Valve types shall be selected such that, wherever possible, servicing of the valve can be effected without its removal.

Pressure and flow control valve design shall be in accordance with WSA 03.

The designer is to refer to WSA 03 for detailing requirements for valves chambers.

(vii) Envelopers

Enveloper pipes shall be used where necessary, and as required by Townsville Water and Waste.

Enveloper designs for road and rail crossing shall be performed in accordance with the land corridor controller's requirements. Where no specific requirements are provided, refer to the standard drawings of WSA 03.

QR National requires compliance with their Specification: *MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services)*.
Suitable casing spacers/insulators shall be fitted to the pipe to ensure adequate spacing from the enveloper. The void at each end between enveloper and carrier pipe shall be grouted on completion of the pipe installation in accordance with SC6.4.4.8 Standard drawings SD-376 Buried crossings, Bored and jacked encasing detail.

(7) Property connections

(a) General

In most circumstances property service connections are not provided by the developer as part of the development, but are installed by Townsville Water and Waste on application from the property owner. Where small and/or narrow lots are created, and there is only one option for service connection location; or council has agreed to service connections within the road reserve or under concrete footpaths or driveways, they must be provided by the developer and located within a valve box to protect the service and to provide easy access.

(b) Property service mains

The following applies:

(i) distribution mains – Property connections from distribution mains are not permitted; and

(ii) reticulation mains – Property connections not permitted from reticulation mains > DN225. A smaller service main shall be provided for property service connections where necessary.

(c) Sub-metering

Sub-metering shall be in accordance with WSA 10 and subject to Townsville Water and Waste approval.

Point of supply for properties with sub-meters will be the master meter. Any equipment between the master and sub-meters is the responsibility of the property owner.

SC6.4.3.21.3 Sewerage system design

(1) Introduction

(a) Scope

The work to be undertaken in SC6.4.3.21.3 includes the design of a sewerage system either as a stand-alone project of as part of a development.

(i) Inclusions

SC6.4.3.21.3 covers the design of:

(A) property connections;

(B) gravity sewers;

(C) sewage pump stations;

(D) pressure mains; and

(E) reuse systems.

(ii) Exclusions

SC6.4.3.21.3 does not cover requirements for sewage treatment plant design considerations. Bulk sewerage infrastructure will be planned and designed by Townsville Water and Waste in conjunction with experienced specialist consultants.

(b) Documents

(i) Reference and source documents

This section is to be read in conjunction with the current version of the following documents.
Department of Energy and Water Supply *Planning Guidelines for Water Supply and Sewerage (*DEWS Guidelines*)*
Department of Energy and Water Supply, *Water Quality Guidelines for Recycled Water Schemes,* November 2008
National Water Quality Management Strategy, *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1),* 2006
National Water Quality Management Strategy, *Australian Guidelines for Water Recycling: Treated sewage and stormwater to augment drinking water (Phase 2)* 2008
Public Health Regulation 2005
Workplace Health and Safety Queensland, *Safe Design of Structures – Code of Practice*
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Supply Code of Australia* (as referenced by WSA 02)
WSA 04 *Sewerage Pumping Station Code of Australia*
WSA 07 *Pressure Sewerage Code of Australia*

(ii) Document precedence

The order of precedence of documents shall be:

(A) SC6.4.4.8 Standard drawings;

(B) this sub-section;

(C) All WSA codes; and

(D) DEWS Guidelines.

(c) Standard drawings

SC6.4.4.8 Standard drawings shall be read in conjunction with this sub-section. Standard drawings other than water and sewerage (such as road crossings) also contain information on water and sewerage infrastructure shall also be referred to.

(i) Amendments to WSA 02

The design of sewerage systems shall comply with *WSA 02 Sewerage Code of Australia* unless otherwise specified herein, and shall be constructed in accordance with *WSA 02 Sewerage Code of Australia Construction Specification*.

Amendments required by Townsville Water and Waste to WSA 02:2014 are included in Table SC6.4.3.21.5. Any conflicting information in later codes shall be referred to Townsville Water and Waste for clarification.

Table SC6.4.3.21.5 Amendments to WSA 02:2014 Sewerage Code of Australia and WSA 04:2005 Sewage Pump Station Code

WSA 02 Section	**Amendments to WSA 02 – Sewerage Code of Australia:**
2.3	A sewerage Master Plan is to be submitted by the Developer for approval at the discretion of Townsville Water and Waste.
2.4.2	Townsville Water and Waste requirement is ADWF of 230 L/EP/day.
5.2.8	Easements over gravity sewers are not required in Queensland. Easements over pressure sewers may be required in certain situations. Refer to Townsville Water and Waste.
Table 7.6.5	Maximum of four internal drops into a manhole.
7.0	Maintenance Structures (Manholes (MH), maintenance holes, maintenance chambers) required at a maximum spacing of 90 m (industrial zones 40m). Maintenance Shafts (MS and TMS), are not permitted except those approved by Townsville Water and Waste.
6.4.2	Multiple property connections (i.e. combine house drains) are not lawful in Queensland
7.6.9	Ladders, step irons and landings are not permitted.
8.2	Water seals are not permitted.
8.6	Inverted Siphons are not permitted.
8.9	Wet weather storage is not required, as it is impractical in tropical conditions. However, it may be considered upon written application to Townsville Water and Waste.
4.6.2	PVC Sewer Pipe – minimum SN10 for DN100 and SN8 for other sizes is required.
Construction Section	*Internal Epoxy Coating of Manholes – normally only required at Pressure Main receiving manholes.*
Construction Section	*Pipe embedment and support – For flexible pipes refer to AS2566.2 Tables G1, G2 and G3 for suitable material types.*
Appendix B	*Estimation of EP Flows – Townsville Water and Waste's alternative method is to apply EP densities from Townsville City Council Headworks Policy (* EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of the Townsville City Plan)
Appendix C	*Refer to comments above.*
General	Townsville Water and Waste's preference is to convey sewage by gravity systems only. Therefore, Townsville Water and Waste's written approval is required for a Pumping Station proposal, and its particular requirements including current electrical and telemetry standards, overflow and emergency arrangements, and compliance with Townsville Water and Waste's current Licence conditions.
WSA 04 Section	**Amendments to WSA 04-2005, Sewage Pump Station Code**
9.1.2	Minimum size of discharge pipework is DN100.
10.5.4	In selecting the PN rating, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer WSA 03 Planning and Design).
WSA Drawing	**Comments/Amendments to WSA Drawings**
All	These drawings shall be read in conjunction with SC6.4.4.8 Standard drawings: Where there is a conflict, the standard drawings take precedence.

(2) Sewage collection system planning

(a) Scope

Sewage collection system planning covers the requirements of the sewage collection system from service connection to treatment facility. This includes collection sewers, trunk sewers, pump stations and pressure mains.

(b) Hydraulic loading assessment

(i) General

Hydraulic loading shall be determined for all catchments being assessed. Loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

(A) designated value of EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of Townsville City Plan;

(B) the location of various zone types as specified in Townsville City Plan;

(C) an assessment of the ultimate population, including the expected peak occupancy rates and the quantity of undeveloped land for each zone type listed in Townsville City Plan; and

(D) estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by analysis of historic consumption and consultation with the institution regarding future development.

Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Townsville City Council Growth Model which is available from the Infrastructure Planning Unit. This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU), Office of Economic and Statistical Research within the Queensland Government, Department of Treasury and Trade.

(iii) Design flows

The flow in a sewer comprises domestic sewage, industrial wastes, groundwater infiltration, stormwater inflows and rainfall dependent infiltration.
Design sewage flow shall be calculated in accordance with WSA 02 with the following amendments:

Design Flow(PWWF)	=5 * ADWF
	PDWF = C2 x ADWF
Where	ADWF = Average Dry Weather Flow = 230L/EP/day; PDWF = Peak Dry Weather Flow
	$C2=4.7 \times (EP)^{-0.105}$

(iv) Sewage pump station design flows

Design flows for sewage pumps stations shall be determined in accordance with SC6.4.3.23 Water and sewer network modelling guidelines.

(c) Network planning

(i) Purpose

The purpose of network planning is to determine the most effective means of providing a service to an area through analysis of both infrastructure and non-infrastructure based solutions. The determination of the most effective solution should be made through analysis of whole of life costs and consideration of non-financial aspects such as operations, maintenance, and environmental obligations.

Section 6.4.3.21.3 (2)(c)(ii) Network modelling details the circumstances under which a network plan should be prepared.

When preparing planning reports for both water and sewerage assets, the author shall refer to Section 6 of the DEWS *Planning Guidelines for Water and Sewerage.*

(ii) Network modelling

A sewer network model is required for code and impact assessable material change of use (MCU) and reconfiguring a lot (RoL) applications where:

(A) the proposed land use results in an increase in load greater than what is presently allowed for in the planning scheme; or

(B) the development requires trunk infrastructure identified in council's Plans for Trunk Infrastructure to be constructed ahead of its planned date, or out of sequence identified in master planning;or

(C) the development requires the construction of new trunk infrastructure not already identified on council's Plans for Trunk Infrastructure; or

(D) existing sewer infrastructure is required to be relocated as part of the development, and such relocation may impact the hydraulics or operational functionality of the system. End of line works are excluded from this requirement.

TCC also requires the development of a network model for:

- the preparation of Infrastructure Master Plans; and
- the preparation of Priority Infrastructure Plans (and Plans for Trunk Infrastructure).

Network modelling shall be undertaken in accordance with SC6.4.3.23 Water and sewer network modelling guidelines.

(iii) Levels of assessment

Depending on the type of works in question, simplified or detailed modelling may be required to demonstrate compliance with these guidelines. Simplified or Detailed assessments are defined below:

(A) "Simplified assessment" – an assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

(B) "Detailed assessment" – an assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

SC6.4.3.23 Water and sewer network modelling guidelines outline the process to be followed to obtain council advice as to what level of assessment is required.

(iv) Timeframes

Master Planning shall be undertaken over a 30 year timeframe. The capacity of the existing network to service ultimate demand should be assessed and any system augmentations to service ultimate requirements identified. The staging of infrastructure works is an essential consideration and should be incorporated into the planning and design process. Staging of infrastructure works should be also considered at no greater than 10 year intervals until the ultimate horizon.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.
For developments being completed over a shorter timeframe, network modelling shall be undertaken for existing case, full development.

Net present value cost analysis should be undertaken using a range of interest rates (typically 3%, 5% and 7%), as well as the rate for weighted annual cost of capital (WACC) which can be sourced from council. Timeframes of 10, 20, and 30 years shall be applied. Longer timeframes will enable assessment of the impacts of major replacement and upgrade works on the viability of the system.

Council may require longer timeframes for analysis.

Cost assessments should only consider an engineering cost assessment, with loan interest and depreciation considered separately by council when considering a business case for a particular project. The following on-cost allowances should be made:

Establishment	2%
Project Management/Engineering Design/Council Management Costs	15%
Contingency	30%

(d) Sewerage systems

(i) General

Where possible the sewer system shall be designed to use gravity to convey the sewage.

Proposals for systems including pumping stations and rising mains require Townsville Water and Waste's written approval, including particular requirements for current electrical and telemetry standards, overflow and emergency arrangements, and compliance with Townsville Water and Waste's current Licence conditions. Undulating terrain or other economic considerations may preclude the viability of a purely gravitational system.

As such, Townsville Water and Waste may opt for sewage pumping stations and pressure mains to transport wastewater into an adjacent catchment or direct to the WWTP and will be at the approval of Townsville Water and Waste.

(ii) Alternative sewer systems

Alternative sewer systems (e.g. common effluent drains, vacuum sewerage, pressure sewer systems, etc.) will only be considered with an analysis showing the benefits of such systems using a triple bottom line approach, and require Townsville Water and Waste's written approval.

(iii) Sewers

Sewer layouts, pipe sizing and grading shall be determined in accordance with WSA 02, unless detailed elsewhere in this guideline.

(iv) Sewage pump stations and pressure mains

Sewage pump stations are to be provided where gravity systems cannot be utilised or sewers become uneconomically deep (usually > 5m).
Sewage pump stations are to be provided where approved in writing by Townsville Water and Waste.

Pump stations shall be planned and designed to optimise construction, operation and maintenance costs for the total-life cycle of the infrastructure and equipment. This shall include the pump station along with the discharge pressure main.

Pump station and pressure main planning shall be undertaken in accordance with WSA 02 and WSA 04 and as amended by this guideline. Unless detailed elsewhere in this guideline.

(3) Property connections

(a) Scope

SC6.4.3.21.3(3) covers the design of property connection sewers (PCS).

(b) Location

Location of property connection points shall generally be in accordance with WSA 02 and the following constraints:

(i) to connect directly to maintenance holes where possible Industrial/Commercial properties connections must be to maintenance holes;

(ii) the property connection jump-up must be 1.5 m from the property boundary, unless council has agreed to the service connection being located within the road reserve, in which case the jump up must be located within a valve box that is easily identifiable and located for access and maintenance;

(iii) combined sanitary (house) drains are not permitted; and

(iv) dual connections to a single jump-up are not permitted permitted and no property connections are allowed to trunk mains.

(c) Maximum depth

The depth at the property connection shall not exceed 1.5 m.
Property connections shall not be made into sewers >3 m deep. In cases of deep sewers private connections must be
MHs or construct a shallow sewer.

(d) Type

Property connections shall be buried interface method in accordance with WSA 02 (Type 2 and 4 Appendix H).
Water Seals on property connections are not permitted.

(e) Size

Minimum size shall be DN100.

(residential) or DN150
(commercial/industrial).

(f) Length

The maximum length of property connection sewers shall be:

(i) DN100 – 10 m

(4) Gravity sewer design

(a) Scope

SC6.4.3.21(4) covers the design of gravity sewers.

(b) Sewer layout

(i) Extent

Sewer layouts shall be prepared to demonstrate drainage of the specified catchment, including the "most disadvantaged lot".

The sewer configuration is to be developed to minimise the overall length of sewers.

Sewers are to be designed to control the whole of the area of each allotment being sewered, except in industrial areas where a lesser area of control can apply if approved by Townsville Water and Waste.

Sewers are to be extended to the boundaries of the site to serve existing lots and potential upstream development sites where specified by Townsville Water and Waste.

(ii) Configuration

The sewers shall comply with the following additional requirements:

(A) be a minimum of DN150 (except property connections);

(B) located at the rear of allotments, except

- in areas where safe work area for staff and equipment, including access from the road frontage to the infrastructure (in particular the maintenance structures) cannot be achieved, sewers may be located in the front clearance area of the lot.
- in small and narrow lots where the alignment is within the road reserve at an alignment agreed to by council and in accordance with the considerations in WSA02
- in industrial and commercial developments where the alignment is within the property 1.5 m back from street frontage; and

(C) alignment is 1.5 m from property boundary. Environmental considerations are must be taken into account when selecting sewer alignments.

The designer must refer to WSA 02 for additional considerations such as alignment with road reserves and pathways. Sewers in road reserves are only permitted when:

- environmental considerations preclude alignments within the properties; and
- approved by Townsville Water and Waste.

(c) Sewers

(i) Sewer loading

Sewer loading shall be determined in accordance with this sub-section.

(ii) Sizing and grading

Sewers shall be sized to carry the design flow with the depth of flow no greater than 70% of internal diameter for initial and any future conditions (WSA 02).

The design flow shall be calculated by the method nominated in this sub-section.

Refer to WSA 02 for minimum sewer sizes and grades to meet required pipe capacities.

(iii) Minimum cover and services clearance requirements

Refer to WSA 02 for minimum cover requirements over sewer mains and requirements for minimum clearance from other services.

(iv) Above ground sewers

The following applies:

(A) above ground sewers are to be avoided where possible;

(B) above ground sewers are to be constructed from DICL or MSCL pipe unless otherwise approved by Townsville Water and Waste; and

(C) the designer of an above ground sewer shall take into account the considerations listed in WSA 02.

(v) Pipe material

The following applies:

(A) pipeline materials shall be in accordance with WSA 02;

(B) PVC pipe shall be a minimum of SN10 for DN100 and SN8 for other sizes;

(C) DICL and MSCL sewers shall be Cement Mortar Lined

(D) FRC and concrete pipes are not permitted; and

(vi) Pipe jointing

Pipelines shall be rubber ring jointed or butt welded in the case of PE pipe.
If flanged pipe is required, minimum flange classes shall be AS4087 Class 14 for Steel pipes and Class 16 for DICL.

(vii) Concrete encasement

Concrete encasement of sewers is not permitted except with the approval of Townsville Water and Waste.

(d) Maintenance structures

(i) Maintenance holes

The design and location of maintenance structures shall be in accordance with *WSA 02.*
Requirements include:

(A) maximum spacing between MHs is 90 m;

(B) a MH is required at the end of all sewers (except PCS see *WSA 02*);

(C) MHs are to be provided at all sewer changes of directions or grade;

(D) MHs on sewers within industrial subdivisions are to be either at 40 m maximum centres or on every second property;

(E) MH may have up to 4 internal drops;

(F) the top of a standard MH must be 150 mm higher than the finished surface level or known flood level (100 year ARI);

(G) MHs may be constructed from pre-cast concrete or cast in-situ concrete;

(H) full depth cylindrical MHs shall be used in lieu of a taper tops;

(I) step irons, ladders or landings are not permitted within MHs for safety considerations; and

(J) internal epoxy coating of MHs is not normally required (except at pressure main receiving MHs).

(ii) Maintenance chamber

(A) Maintenance chamber will only be permitted with the approval of Townsville Water and Waste.

(B) The use of terminal maintenance chamber will not be approved. Maintenance Shafts (as per WSA02-2014) will not be permitted.

(iii) Pressure main discharge maintenance hole

(A) Pressure main discharge MHs shall be in accordance with SC6.4.4.8 Standard drawings SD440A Pressure Main Discharge to Manhole.

(B) Discharge MHs shall be internally epoxy coated.

(C) Discharge MHs shall be vented in accordance with SC6.4.4.8 Standard drawings SD-450 Vents at Sewerage Rising Main Receiving Inspection Chambers and Pump Stations.

(e) Pipe bedding

Pipe bedding for sewers shall be in accordance with WSA 02.
For flexible pipes refer to AS 2566.2 *Buried flexible pipelines - Installation*, Table G1, G2 and G3 for suitable material types.

(f) Restoration

Refer to WSA 02 for construction specification.
For restoration under roadways refer to SC6.4.4.8 Standard drawings SD-055. For state controlled road restoration should be design and constructed in accordance with their standards and requirements.

(g) Geotechnical

For geotechnical matters that should be considered refer to WSA 02.

(h) Envelopers

Enveloper pipes shall be used where necessary at major road crossings, at rail crossing and at major waterway crossings.

Enveloper designs for road and rail crossing are to be undertaken in accordance with the requirements of the Land Corridor controller's requirements. Where no specific requirements are provided refer to the standard drawings of WSA 02.

QR National requires compliance with their specification: MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services).

Suitable casing spacers/insulators shall be fitted to the pipe to ensure adequate spacing from the enveloper. At each end of the void between enveloper and carrier pipe is to be grouted on completion of the pipe installation.

(i) Land tenure

Easements are not required over gravity sewers.

(j) Emergency relief structures

All pumped catchments shall be provided with an "Emergency Relief Structure" in accordance with SC6.4.4.8 Standard drawing SD-445 Overflow Maintenance Hole Arrangement.

(k) Inverted syphons or water seals

Inverted syphons or water seals are not permitted.

(l) Colour coding pipes

Where sewer pipes are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipe the designer shall provide for the pipes to be colour coded (in accordance with WSA02 Table 4.1) and shown on the drawings accordingly.

(5) Sewage pump station design

(a) Scope

This section covers the design of sewage pump stations within the sewerage collection system, and also incorporates the requirements for the sizing of sewage pressure mains.

(b) Pump station design

(i) Pump station types

(A) Type 1 - Low lift pump stations
Low lift pump stations are characterised by short pressure mains with the ability of sewage to overflow into the downstream sewer;

(B) Type 2 - Small submersible pump stations (up to 30 L/s)
Small submersible pump stations consist of a single circular 1.8 - 2.3 m diameter wet well containing two submersible pump units;

(C) Type 3 – Medium size submersible pump stations (30 L/s to 200 L/s)
Medium size pump stations consist of a submersible type pump station with total pumping capacity of up to 200 L/s. They may consist of one single large diameter pump well housing multiple pumps or multiple smaller diameter wells housing individual or multiple pumps; and

(D) Type 4 – Large pump stations (>200 L/s)
Large pump stations are the major pump stations often delivering to the sewage treatment works. These stations may be wet well or wet/dry well configuration.

(ii) Design guidance

The *WSA 04 Sewerage Pump Station Code* and DEWS Guidelines shall be consulted in conjunction with this sub-section for Pump Stations Types 1, 2 and 3. These guidelines are based on twin pump submersible configurations in a duty/stand-by arrangement.

Type 4 pump stations require specialist input and shall be designed by experienced pump station design engineers.

Pump stations shall be designed to comply with the Code of Environmental Compliance, ERA 63(3) - Sewage Treatment (EHP) as applicable.

However refer to Townsville Water and Waste for the latest agreement with EHP for this guideline as some sections are not regarded as appropriate.

(iii) Importance level

Buildings shall be designed for Importance Level 3 (minimum) in accordance with the *Building Code of Australia* Table B1.2a.

(c) Pump system design

(i) General

The design of the pressure main and pump station should be considered together.

Pump system design requires the consideration of the interaction of the pump station and pressure main. The design principle is to determine the whole-of-life least cost solution for the pump station and pressure main considering both initial construction costs and on-going operating costs.

The sewage pressure main system within Townsville City consists of two general configurations:

(A) pressure mains that discharge into gravity systems or other sewerage pump stations; and

(B) pressure mains that connect into combined pressure main systems from a collection of pump stations.

The major sewage transport systems within Townsville City are characterised by combined pressure mains. The combined pressure main systems tend to consist of a major trunk pressure main with individual pump stations mains delivering to the trunk main through separate pressure mains up to several kilometres in length.

These combined systems can result in very significant variations in the operating head requirements of the pump depending upon the instantaneous flows from other stations within the combined system.

To service the wide variation in pressure head requirements for the differing conditions it may be

necessary to have several different capacity pumps to cover all conditions.

(ii) Design loading

Design loading for the pump station shall be determined in accordance with this sub-section.

(iii) Design flow

The design flow for the pump station shall be determined for both dry weather and wet weather (peak flow) conditions.

Dry weather flow:

(A) peak dry weather flow (PDWF) shall be based on 2*ADWF unless better information is available.

Wet weather flow:

(B) the peak wet weather flow factor (PWWFF) is defined by:

Peak wet weather flow (PWWF) = PWWFF * ADWF.

The PWWFF shall be determined based on an analysis of the existing pump station flows but in no case should PWWFF be less than 5.

(iv) Pump and pressure main sizing

Pump units shall be sized for the full range of operating conditions that the pump delivery system will be exposed to. This includes initial and long term operational conditions.

Pump units and pressure main sizing shall be:

- optimised for normal ADWF conditions; and
- be capable of performing under PWWF conditions.

For Type 2, 3 and 4 pump stations it may be necessary to provide for each duty.

Pump and pressure main sizing shall be performed in accordance with WSA 04 with the following additional conditions:

(A) a minimum of two pumps shall be provided in a duty/standby arrangement;

(B) pump stations may utilise all pumps within the station to achieve PWWF;

(C) if different size pump units are provided within the station, an environmental assessment shall be performed on the consequences of overflow to determine if a redundant (standby) unit is required for the large pump, and is subject to written approval from Townsville Water and Waste. If the consequences are acceptable Type 2 and 3 pump stations may use a single pump unit for PDWF and a single pump unit for PWWF conditions; and

(D) pumps are able to operate within their safe operating range under all conditions. VSD, high speed and grinder types may be considered, subject to written approval from Townsville Water and Waste.

Pump size in combination with the delivery main size is to be designed to minimise whole of life costs covering capital, operating and maintenance costs.

(v) System resistance

System resistance curves shall be developed for the pump station covering the full range of pump operating conditions. System curves shall be developed in accordance with WSA 04 with the following additional requirements:

(A) separate system curve bounds are to be developed for PDWF conditions and PWWF conditions;

(B) upper and lower bound curves shall be prepared for each case;

(C) upper bound curves are to be based on:

- minimum Hazen “C” value;
- well at pump stop level; and
- in the case of a combined rising main, with all contributing pumps operating; and

(D) lower bound curves are to be based on:

- maximum Hazen “C” value;
- well at pump start level; and

- in the case of a combined rising main, with no other contributing pumps operating.

For Hazen "C" values actual figures shall be derived from calibration data where possible. Where data is not available the values in Table SC6.4.3.21.6 may be used.

Table SC6.4.3.21.6 Range of Hazen C Values

Material	Min C	Max C
Cement Lined and FRC	100	150
Plastic pipes	110	160

Complex pressure main systems will require pipe network analysis packages to assist with the development of the curves.

A net positive suction head available (NPSHA) curve shall also be prepared.

(vi) Pressure mains

Pressure mains shall be sized in conjunction with the pump stations to optimise overall whole-of-life costs.

(vii) Pressure main velocity

The minimum velocity for pressure mains should comply with the requirements of *DEWS Guidelines*. The target velocity at the duty point of the pump is 1.0 m/s with a range of 0.75 m/s to 1.5 m/s.

The minimum velocity in pressure mains is to be 0.75 m/s. Where a small and large pump combination is proposed, 0.5 m/s for the smaller pump may be permissible if the larger pump flushes the main regular intervals of no greater than weekly. Acceptance by Townsville Water and Waste will be based on the individual merits of the design. Pump operation is described in TCC24, Standard Specification for Electrical Switchboards, clause 18.2.

The maximum velocity in pressure mains shall not exceed 1.5 m/s (single) and 2.5 m/s (all pumps).

(viii) Pressure main hydraulic models

Wherever possible pump and pressure main system hydraulics shall be performed using calibrated hydraulic models.
Townsville Water and Waste has a number of network models for the complex pressure main system. These hydraulic models have been developed in SewerGEMS modelling software.

These models shall be used for the analysis of pumping system that is part of the pressure main network system in conjunction with Townsville Water and Waste.

(d) Pump well sizing

Pump well sizing shall be performed in accordance with WSA 04.

The required pump operating volume shall be calculated as follows:
$V = 900 \times Q^P/S$
where:
V = cut-in/cut-out volume (L);
Q^P = pump capacity (L/s); and
S = allowable number of starts per hour.

The maximum number of starts per hour shall be:

(i) Motors <= 50 kW: 12 Starts per hr; and

(ii) Motors > 50 kW: 5 Starts per hr.

For fixed speed pumps, the pump capacity shall be based on the capacity of the largest pump unit within the well.

For variable speed pumps, the pump capacity should be based on the flow rate associated with the minimum velocity requirements of the pressure main.

Operating and control levels within the well shall be in accordance with WSA 04.

(e) Overflow management

(i) General

Systems shall be designed to minimise overflow of sewage to the environment.

All pumped catchments shall be provided with an emergency relief structure accordance with SC6.4.4.8 Standard drawing SD-445. Refer to other sections of this sub-section and ERA 63(3), Code of Environmental Compliance, on requirements for pump station failure or overload management.

An environmental assessment shall be performed to determine the most appropriate overflow location.

The system shall provide, as a minimum, 6 hours of ADWF flow as emergency storage. For remote sites this may need to be increased dependent upon emergency response times.

Methods for limiting the risk of sewage overflows include:

(A) emergency storage;

(B) provision of emergency power at the site; and

(C) inter-catchment overflows.

Pump stations shall be fitted with telemetry monitoring to communicate alarms of system failures to emergency operations personnel.

(ii) Level and location of relief structures

The level of relief structures shall be designed to prevent sewage from exiting through disconnector gullies or maintenance hole lids. Relief structures shall be located as close as practical to pump station.

(iii) Emergency storage

Emergency storages shall be provided in accordance with the requirements of WSA 04.

(iv) Emergency power

Stand-by generators are required at all Type 2, 3 and 4 pump stations.

Sufficient fuel shall be stored to operate the pump station at full capacity for 24 hours.

The electrical system shall be equipped with an automatic change-over switch and start system for the stand-by generator in the event of mains power failure.

(f) General arrangement and site infrastructure

(i) Location and layout

Issues to be considered when sighting a pump station are discussed in WSA 04.

(ii) Standard drawings

Type 2 pump stations shall be in accordance with standard drawing SD-420 Small Sewerage Pump Stations Typical Plans, Sections and Details

(iii) Flood level

Pump stations are to be constructed 300 mm above 1% AEP flood level (refer WSA–04).

(iv) Site fencing

Security fencing is not normally required.
In urban areas where site fencing is deemed to be necessary, fencing shall be in accordance with SC6.4.3.21.5(4).

(v) Landscaping

Sites shall be landscaped to minimise visual impact whilst not compromising access to the pump station and equipment. For landscaping requirements refer to WSA 04.

(vi) Water supply

Water supply shall be provided to all pump stations for wash-down purposes and general amenity. Backflow prevention is required on the water supply service.

Water services shall be provided in accordance with WSA 04.

(vii) Power supply

The power supply connection to the pump station site shall be underground.

Refer to other sections of this guideline for the provision of power for the site.

(viii) Site buildings

If specified by Townsville Water and Waste, site buildings shall be provided for pump stations to house large switchboards and other associated equipment.

Buildings shall be architecturally designed.

A Development Permit is required for buildings.

(ix) Lifting requirments

Permanent cranage or davits are not normally required. Exceptions to this are where equipment is located within buildings and require removal on a basis of more than once every 10 years.

If specified by Townsville Water and Waste, permanent cranage or davits shall be incorporated into the design of the pump station or building. The design shall be approved by Townsville Water and Waste.

Set-down points of the cranage equipment shall be:

(A) in an area able to be reached by a crane truck where the mass and reach are within the crane truck capacity;

(B) paved access is provided for the crane truck to reach the necessary position;

(C) on back of flat bed vehicle (bed height 1.2 m) elsewhere; and

(D) if these requirements are impractical, other lifting arrangements may be considered such as removable roof or local lifting equipment with provision for trolleying to a suitable crane pick-up point.

(x) Valve pits

Valve non-return and isolation pits shall be provided and be in accordance with the general concepts detailed in *WSA 04:2005.*

(xi) Ventilation pole

Ventilation poles are required.

(g) Vehicular access

(i) Access road

Sealed access road shall be provided to pump stations to enable all-weather access for maintenance vehicles. Access requirements shall be in accordance with WSA 04 with the following additional requirements:

(A) sealed asphalt access road;

(B) provide access during 1% AEP flood event;

(C) minimum road width of 4 m;

(D) on-site turn-around for maintenance vehicle; and

(E) parking area provided adjacent to all equipment to be lifted for a crane truck maintenance vehicle. Parking is only required for a single vehicle.

Design of access is to be approved by Townsville Water and Waste.

(ii) Maintenance vehicle reconfiguration

Allowance shall be made for maintenance vehicles that are 10 t (8.8 m long) crane-trucks Medium Rigid Vehicles (AS 2890.2 *Parking facilities - Off-street commercial vehicle facilities*) with

mounted crane positioned centrally on the rear end of the vehicle.

(h) Odour control and septicity control

(i) General

If directed by Townsville Water and Waste, odour and septicity control shall be incorporated into the design of the pump station, and the design shall be approved by Townsville Water and Waste.

The generation and release of hydrogen sulphides can result in odours as well as increasing the corrosiveness of the environment within and around the pump station.

The extent of hydrogen sulphide generation is related to the age and retention time of the sewage, and the turbulence generated when discharged from pressure mains.

For further readings on the generation and management of odours, refer to:

(A) WSA 04*;*

(B) *Hydrogen Sulphide Control Manual;* Volumes 1 and 2, Technological Standing Committee on Hydrogen Sulphide Corrosion in Sewerage Works (1989); and

(C) DEWS Guidelines.

(ii) Management

On-site odour management shall be designed. Options management in order of preference include:

(A) passive control of odour release from sewage (by appropriate pump station design);

(B) odour scrubbing with activated carbon; and

(C) chemical masking.

Air and oxygen injection are not preferred.

(i) Durability

(i) General

The following applies:

(A) pump station structures and equipment shall be designed for the design lives set out in accordance to other sections of this sub-section;

(B) all metalwork within the wells shall be grade 316 stainless steel. Connections to concrete shall be by stainless steel chemical anchors;

(C) all pipework within the wells shall be coated with a fusion bonded coating or high build epoxy coating system that provides long term protection;

(D) submersible pumps shall be provided with stainless steel lifting chains;

(E) guide rails shall be in accordance within other sections of this sub-section; and

(F) covers for wells and pits shall be fabricated from aluminium.

(ii) Well type

Refer to SC6.4.3.21.5(3)(g) Pump stations and wet well materials

(j) Safety

The following applies:

(i) ladders shall not be provided into confined spaces. This includes the pump well and valve pits;

(ii) pits and wells shall be designed for confined space entry access of a person lowered from a tripod system;

(iii) forced ventilation shall be provided for all pump station dry wells;

(iv) the designer shall make provision for temporary fencing around well openings, and permanent grates for times when the covers are open; and

(v) signage shall be provided in accordance with the work, health and safety regulations identifying confined space areas and appropriate actions for entry.

(k) Flotation

Structures shall be designed to resist flotation in accordance with AS/NZS 1170 *Structural design*

actions.

(l) Instrumentation requirements

Control level probes shall be provided in accordance with other sections of this sub section.

Type 3 and 4 pump stations shall be provided with electromagnetic flow meters to measure the entire pump station outflow. Selected Type 2 pump stations may require electromagnetic flow meters – consult with TWW.

(m) Land tenure

The land tenure for the pump station and any associated infrastructure including valve pits, vent poles, etc., is in order of preference:

(i) council owned freehold land; or

(ii) council controlled road or reserve; or

(iii) easement over freehold land.

(n) Documentation

All new pump stations, and any modification works to existing pump stations, require a comprehensive documentation suite including: design and as constructed drawings, equipment operation and maintenance manuals and initial procurement and logistics data.

(o) Operations and Maintenance Manual (O&M Manual)

TheOperationsandMaintenanceManualcomprisesallrelevantdocumentsforthepumpstation. The document structure for the O&M manual shall be adhered to and not altered unless approved by TWW.

Where modifications are being undertaken to an existing pump station, TWW shall provide any existing available O&M manual or relevant documentation to the designer for update.

(p) Document Requirements Schedule (DRS)

The DRS is a control document summarising all documents required in the O&M manual, quantities of each document to be provided at completion of commissioning (Practical Completion, or date of “On Maintenance”).

The DRS lists up to 4 hold points during the design and construction process where TWW require review of documentation. Some elements of documentation may be deleted from the DRS/O&M Manual at the discretion of TWW. The DRS, including necessary documentation and hold points shall be discussed and agreed with TWW prior to commencing detailed design. Hold points shall be adhered to through the design and construction process.

The baseline DRS schedule to be used as a starting point for development of sewage pump station documentation can be made available on request.

(q) Process and Instrumentation Diagram (P&ID)

A Plant and Instrument Diagram (P&ID) is to be delivered with each new pump station and existing P&ID are to be revised by any project modifying or upgrading a pump station.

The P&ID provides the standard symbols and naming/tagging conventions for all equipment delivered. This includes piping, Instrumentation and Mechanical process equipment.

The TWW Process and Instrumentation Sheet includes relevant symbols to be applied to P&IDs. This information can be provided on request.

Unique Tag numbers developed in accordance with the Tagging conventions are to be allocated to each equipment item delivered and included on the P&ID. The tag numbers are to be used as the reference for each document delivered for that specific equipment item. Tag numbers should be used to refer to equipment in Inspection and Test Plans (ITP’s) and as much design documentation as is practical.

(r) TWW Sewage Pump Station Equipment Schedule (TWW SPS Equip Schedule)

An equipment schedule is to be prepared for each new pump station and existing equipment schedules are to be revised for any project modifying or upgrading a pump station. The document is referenced by Tag number and lists, in summary, critical design and performance data for mechanical, electrical, radio and telemetry, and instrumentation and control equipment. The schedule is a required document in all O&M manuals.

The schedule is the cross reference document between the tag number and the actual equipment item delivered. The schedule is a useful tool when selecting equipment as it contains relevant process parameters for each equipment item. The sample Equipment Schedule to be used and can be provided on request.

(6) Pressure main design

(a) Scope

SC6.4.3.21.3(6) covers the design of sewage pressure mains.

(b) Pressure main sizing

Pressure mains shall be sized in association with the pump stations. Refer to SC6.4.3.21.3(5)(c) for guidance on sizing.

(c) Alignment

(i) Location

The location for pressure mains in order of preference is in:

(A) council controlled road; or

(B) council owned freehold land; or

(C) easement in privately owned freehold land.

The alignment within the Road shall be in accordance with SC6.4.4.8 Standard drawings SD 015.

(ii) Service allocations

The designer is referred to the sub-section SC6.4.3.2 Building over or adjacent to services in selecting alignments in other areas:

(iii) Minimum cover

Minimum pipeline cover is 600 mm in accordance with SC6.4.4.8 Standard drawings SD-325 and WSA codes.

(iv) Services and alignments

Refer to WSA 04 for minimum clearance requirements from other services.

Minimum clearance requirements and conditions imposed by other services owners shall be complied with. Minimum clearance requirements may be imposed by the service owner. Specific conditions apply to construction near:

(A) fibre optic cables;

(B) high pressure gas mains; and

(C) underground power.

Refer to the service owner for conditions on clearances.

Consider overhead power when selecting pipeline alignments. Construction with excavation equipment under or near overhead power lines has difficulties with monitoring and clearance requirements.

(d) Pipe

(i) Materials

Allowable pipe materials are:

(A) PVC-U, PVC-O, PVC-M

(B) DICL;

(C) mild steel cement lined; and

(D) polyethylene.

Pipeline materials shall be in accordance with WSA.

Pressure mains shall be a minimum of PN12.

In selecting the PN rating for plastic pipes, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer to WSA 03).

(ii) Pipeline material structural design shall be carried out in accordance with WSA 03.

(iii) Pipe jointing

Pipelines shall be rubber ring jointed or butt welded in the case of polythene pipe.

Flange classes shall be selected to suit the pipeline design pressures. Flange classes should be AS/NZS 4087 *Metallic flanges for waterworks purposes* except where connecting to existing flanges from a different standard.

Minimum flange classes shall be Class 14 for Steel and Cast Iron and Class 16 for DICL.

(iv) Concrete encasement

Concrete encasement of pressure mains are not permitted, unless approved by Townsville Water and Waste.

(v) Above ground pressure mains

The design of above ground pressure mains will be in accordance with WSA 03.

(e) Appurtenances

(i) Air releases

Air releases shall be provided on all high points along the pipeline, unless specifically omitted by Townville Water.

Air release shall be avoided wherever possible by maintaining a continuous rising grade away from the pump station.

Manual air releases shall be used where the release is located in developed residential areas where odours will be noticed. Automatic air valves can be used at other locations. Automatic air valves shall be suitable for use with sewage.

(ii) Scours

To the greatest reasonable extent, a designer shall avoid the occurrences of low points within a pressure system to prevent the use of scours. If a low point is unavoidable, a scour shall be used to assist with clearing of accumulated solids.

Scours shall be directed back into the pump station or adjacent sewer where possible. Where not possible, the scour shall be directed into a manhole designed to allow pump-out into a tanker.

(iii) Isolation valving

Isolation valves shall be provided at the following locations:

(A) outside of pump station;

(B) on the branch of any tees;

(C) at 500 m maximum spacing;

(D) either side of significant waterways; and

(E) either side of major road crossings.

(f) Colour coding of pipes

Where pressure mains are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipe the designer shall provide for the pipes to be colour coded to Australian Standard and shown on the drawings accordingly.

(g) Pipe bedding

Pipe bedding for pressure mains shall be in accordance with:

(i) WSA 02 for sewers; and

(ii) WSA 04 for pressure mains.

For flexible pipes refer to AS/NZS 2566.2 *Buried flexible pipelines - Installation*, Table G1, G2 and G3 for suitable material types.

(h) Restoration

Refer to WSA 02 for construction specification.

For restoration under roadways refer to SC6.4.4.8 Standard drawings SD-055.

(i) Geotechnical

Refer to the following for geotechnical matters:

(i) WSA 02, Section 8.6 for sewers; and

(ii) WSA 03, Section 5 for pressure mains.

(j) Marker tape

Detectable marker tape is required on non-metallic pressure mains(refer to SC6.4.4.8 Standard drawings SD325) and shall be in accordance with WSA PS-3.18 Marking Tape, Detectable.

(7) Scope

Wastewater treatment process design is complex and site specific.

New plants and plant upgrades are typically undertaken as one-off projects and performed by experienced wastewater treatment plant designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of suitable specialist consultants to undertake the project.

(8) Recycled water systems

(a) General

(i) Scope

SC6.4.3.21.3(8) covers the design of recycled water distribution infrastructure.

(ii) Design citeria

Design of a recycled water scheme shall comply with the requirements of the documents referenced in SC6.4.3.21.3(1)(b).

The design of a proposed recycled water project shall address, as a minimum, the following issues:

(A) be consistent with council's latest practices

(B) quality of treated water appropriate to proposed usage;

(C) maintenance of treated water quality standards within the storage and distribution system; and

(D) distribution system infrastructure including, storage, pumping and mains distribution network and irrigation networks.

Details of the proposed design are to be submitted to Townsville Water and Waste for review and approval.

(b) Infrastructure

(i) Sizing

The methodologies used for the sizing of water supply infrastructure of mains, pump stations and reservoirs can be applied to recycled water.

Reservoirs, pump stations, and mains are required to be sized to maintain the desired flow and minimum pressure at the property connection.

Refer to SC6.4.3.21.2 Water supply design for design requirements, and SC6.4.3.21.3(2) Sewage collection system planning for guidance on sizing requirements.

(ii) Colour coding

All recycled mains and connections and outlets shall be colour coded to AS 2700 *Colour standards for general purposes* to differentiate from other infrastructure.

Mains, taps and meters shall be coloured Lilac P23.

(c) Reticulation mains layout

(i) Extent

Mains shall be provided to service intended connections within the area being serviced.

(ii) Mains

Mains shall be designed with isolating valves, pressure and control regulating valves (as required), air valves and scours to *WSA 03*.

(iii) Scours

Scours from recycled water mains shall be directed into sewers where possible.

(iv) Meters

Water meters are to be provided on all service connections. Left-hand threads shall be used on all fittings to prevent accidental cross connection to potable water.

SC6.4.3.21.4 Electrical and mechanical

(1) Introduction

(a) Scope

SC6.4.3.21.4 addresses the electrical and mechanical design considerations applicable generally to water and sewerage pump stations but can extend to treatment plants.

(b) Treatment plants

New treatment plants and plant upgrades are typically undertaken as one-off projects and performed by experienced treatment plant designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of specialist consultants suitable to carry out the electrical aspects of the project including issues of supply, transformers, HV, plant and motor control and monitoring.

(c) Legislative requirements

Electrical designs and works shall consider relevant legislative requirements including:

(i) *Electrical Safety Act 2002* including associated regulations and Codes of Practice;

(ii) *Electricity Act 1994* and associated regulations;

(iii) *Electricity National Scheme (Queensland) Act 1997;*

(iv) *Building Act 1975* and associated regulations; and

(v) *National Electricity Rules.*

(d) Reference and source documents

The following documents shall be referred to.
TCC – 24 *Townsville City Council Standard Specification for Electrical Switchboards*
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Code of Australia*
WSA 04 *Sewerage Pump Station Code of Australia*
Townsville City Council Standard Specification for Standby Generators

(e) Standards

In general the following standards, codes and manuals are applicable to the design and documentation of typical pumping stations.

Workmanship and design:

Standard	Name
Australian Standards	All relevant Australian Standards
IEC and British Standards	Relevant International Electrotechnical Commission (IEC) and British Standards where no Australian Standard exist.
BCA	Building Code of Australia
NER	National Electricity Rules
ECMM	Queensland Electrical Connection and Metering Manual

Preparation of electrical drawings:

Standard	Name
AS1100	Technical Drawings
AS1102	Graphical Symbols for Electro-technology
AS3702	Item Designation in Electro-technology
TCC24	Townsville City Council Standard Specification for Electrical Switchboards

(2) Electrical supply requirements

(a) General

(i) Provision of power supply

Energy Queensland is the electrical distribution entity responsible for the connection of power supplies to all Townsville Water and Waste infrastructure assets.

The designer shall where possible, commence discussions with the electrical distribution entity at an early stage as part of the overall planning process for the proposed construction of new water and sewerage infrastructure or for the augmentation of existing water and sewerage infrastructure. Early involvement of the distribution entity shall be sought in order to resolve network considerations and availability to meet the anticipated electrical loads. Budget costs where possible shall be obtained from the distribution entity for any required upgrading of the existing power supply network, and provided to Townsville Water and Waste for inclusion in project budgets. The current distribution entity policy is that no cost estimates are provided unless the full application process is completed with a detailed design. This shall be considered in the design program.

The designer shall obtain plans of existing infrastructure in the vicinity from the Dial Before You Dig service of the existing and proposed electricity supply network in the vicinity of the proposed infrastructure. The location of the existing network will have a bearing on the proposed locations of the infrastructure, and electrical “point of supply”. The optimum location for the electrical “point of supply” should be as near as practicable to either the largest electrical loads or the proposed location of the electrical main switchboard and/or motor control centre.

The designer shall seek advice from suitably experienced people where information from the distribution entity is not forthcoming as to potential electrical supply issues.

Electrical power supply connections shall comply with the requirements of the *Queensland Electrical Connection and Metering Manual* available from their web site.

(ii) Energy retailer

The energy retailer may not necessarily be the energy supplier to the infrastructure asset. As the Queensland electricity market is a contestable market, Townsville Water and Waste may decide to obtain electrical energy from another Energy Retailer. The designer shall consult with Townsville Water and Waste to determine current Townsville Water and Waste commercial agreements in regard to energy retailer contracts to be applied to the new infrastructure.

(iii) Clearances

The location of water and sewerage structures such as treatment plant and pump station buildings shall be such that minimum clearances are maintained from overhead and underground electrical cables. These clearance distances are contained within the *Electrical Safety Act 2002* and AS/NZS 3000 *Electrical installations (Australian and New Zealand Wiring Rules)* and are dependent upon variables including the voltage of the overhead power lines. Guidance shall be sought from the distribution entity regarding the voltages of overhead power lines to ensure adequate clearance distances are maintained. The supply authority normally prohibits the construction of structures beneath overhead power lines. The designer shall also consider clearance distances for cranage during construction maintenance and demolition of these structures.

(iv) Ownership of HV infrastructure

Townsville Water and Waste's preference is for ownership and on-going maintenance of high voltage transformers and switchgear to remain with the distribution entity.

Where the designer seeks to have Townsville Water and Waste retains ownership and on-going maintenance of the high voltage supply assets, a detailed financial breakdown of the cost of ownership including initial capital cost and on-going maintenance costs shall be undertaken.

(v) Connection of power supply

It is Townsville Water and Waste's practice that costs associated with the connection of the required power supply to each location (including the distribution entity capital contribution) is normally included in the contract price by the Contractor performing the works. Tender documentation shall state this requirement.

All forms required to be submitted for the connection of the power supply shall be completed by the Contractor and forwarded to Townsville Water and Waste for signature. Submission of the forms shall be by the Contractor. However, circumstances may arise where the arrangements for power connection may be excluded from the contract and undertaken by Townsville Water and Waste directly with the distribution entity, including:

(A) requirements for a capital contribution by the distribution entity; and

(B) extended application timeframes within Energy Queensland and design program requirements where costs may not be known at the time of tendering the works.

(b) Submission of application to distribution entity

The designer shall be responsible for the calculation of the electrical loads for the proposed infrastructure or the additional electrical loads where existing infrastructure is proposed for augmentation. These shall be submitted with the application in the format required by the distribution entity.

(c) Fault levels

In order to determine the applicable fault level for the installation, particularly for HV connections, advice will be required from the distribution entity as to the applicable fault levels at the site connection. This information can then be used during the design process to calculate the fault levels throughout the site and to enable equipment selection.

In practice, this information, particularly for LV connections, is generally not forth coming from the distribution entity within typical project design time frames. To enable design progression, suitable experienced designers shall by site inspection determine as far as possible the existing LV networks configuration and based on anticipated works determine the most likely fault level for the site.

Suitable allowance for future augmentation of the proposed infrastructure shall be taken into account when calculating the prospective fault levels. The designer shall seek advice from Townsville Water and Waste to determine any proposed future upgrading at the facility.

(d) Retail energy metering

All retailer energy metering shall be designed, installed and connected in accordance with the relevant retailer requirements.

Metering locations shall be accessible to the retailer's meter reading personnel during normal working hours. Typically for new installations, the metering panel is not located within a building or locked compound. Where old facilities are being refurbished, the designer shall relocate the meters to an accessible location.

Phone line connections etc. should be provided at each metering location in accordance with the requirements of the distribution entity. Where the installation of GSM modems for remote downloading of energy readings is required, the location of the meter panel shall be such that adequate mobile telephone coverage is achieved.

(e) Energy tariff

(i) Tariff selection

Should it be determined that the site will be connected as a regulated energy tariff connection

rather than as a contestable site then:

(A) the designer shall provide a detailed analysis of energy consumption at the site, taking account of equipment run times and hours of operation. The analysis shall provide indicative comparison; and

(B) submit details of the energy consumption along with monthly metering charges and all other additional costs payable to Townsville Water and Waste, and seek their approval prior to the installation and connection of energy meeting.

(ii) Energy cost minimisation

The electrical design shall encompass all energy cost savings applicable due to off-peak electrical consumption. Where pumps and other large electric motors are installed, control systems shall be configured to only operate pumps within high energy cost periods to maintain minimum levels in reservoirs and pump stations where possible. Major pumping shall occur during periods of off-peak low energy costs. These tariff control measures shall be provided with manual override facilities both locally and as part of any SCADA based control system.

Other constraints particularly in the sewerage network (e.g. pump station storage, or peak flows into sewerage treatment plants) may prevent the use of “off-peak”, for example the storage then delivery of large quantities of raw sewerage to biological treatment plant processes.

Retailer energy charges are in Queensland presently based on real energy measurement with regulated limits on the amount of reactive power that may be produced or consumed at each site.

Some other states in Australia also charge for reactive power consumption, the rate for reactive power is generally higher than real power providing ability to determine a return on investment for power factor correction devices (other than by simple regulatory compliance).

Given potential for Queensland to alter present charging strategies in regard to reactive power design consideration should be given to provision of space for future ability to retrofit power factor correction equipment to the site. This provision may include space, switchgear, and busbar extension, and so on as required.

(3) Emergency power supply

(a) General

(i) Generator requirements

Each water and sewerage site shall have provision for either the permanent connection of a standby diesel generating set, or as a minimum be provided with facilities for the connection of a portable generating set as required by TCC24.

A formal risk assessment of the criticality of a particular infrastructure asset shall be made by the Designer in order to assess whether the standby generating set shall be permanently located and connected or provision made for connection of a portable generating set.

For sewerage pump stations the following general guidelines apply for the provision of standby generating sets:

(A) where a sewerage pump station has inter-area overflow capabilities, the installation of a manual transfer switching arrangement and plug-in type connection socket as a minimum is required; and

(B) where the sewerage pump station does not have inter-area overflow capability, a permanently connected standby generating set with automatic changeover facilities mounted within the electrical switchboard is required.

For water pump stations, it is not normal practice to provide permanent standby generators as water is normally continued to be supplied by gravity from reservoirs during power failures. The exception is where supply to consumers will fail during power outages. In such cases permanent generators are required.

Standby generating sets shall be sized to ensure that the largest pump load combination required at the site can be successfully started and run. Manual transfer switching arrangements shall also be sized for the largest electrical pump load combination required at the site.

Generators shall be fitted with protective circuit breakers on the supply cables.

Technical requirements for the generator are provided in the council's *Standard Specification for Standby Generators*.

(ii) Site location

The generator set shall be located on the site to allow for easy and safe access for servicing and maintenance (including removal from the site where necessary). This may require a suitable hardstand area.

Access shall allow all panels on the generating set to be easily opened without hindering access to the electrical switchboard or pump station.
Vandal proofing shall be to TCC24 minimum requirements.

(iii) Fuel storage requirements and alarms

The generator set shall have a fuel capacity for a minimum of 24 hours operation based on 100% of the rated load of the generating set.

The designer shall also take into account the reliability of fuel supplies to specific locations after severe storm and cyclone events which may prevent access to the sites for re-fuelling. Where the designer determines unacceptable risk to the supply of fuel to a critical site, additional fuel storage shall be provided to Townsville Water and Waste's satisfaction.

Remote locations (e.g. Magnetic Island, rural areas) shall be considered as special cases and the availability of fuel supplies at the site after severe weather events shall be a consideration in resolving the quantity of fuel stored on-site.

A low fuel alarm from fuel storage tanks shall be connected to the telemetry and SCADA systems. The alarm shall operate when the fuel level in the tank has fallen to a level which only provides two hours of remaining operation of the standby generating set at full load.

(iv) Environmental considerations – generating sets

Fuel containment - The generating set shall be located within a bunded area which provides drainage to a low point. A lockable draw-off valve shall be provided for discharge of liquid from the bunded area. Alternatively, suitable fuel containment and drip trays shall be provided within the emergency generator set base frame.

Noise - The generator shall be fitted with sound attenuation systems to meet the environmental requirements for allowable noise emissions.

(v) Battery charging

Each generating set shall have a battery charger powered from a dedicated circuit from the main sites switchboard or distribution board.

(b) Indoor standby generating sets

Where the electrical main switchboard and/or motor control centre are contained within a building structure, the standby generating set shall also be located within the same building structure.

The generating set shall be contained within a fire rated sound attenuated room that provides adequate airflow for cooling purposes. Airflow requirements shall be based upon the individual generating set manufacturer's recommendations.

Bulk fuel storage shall be located externally to the building. The bulk fuel storage shall have a lockable fuel cap.

A smaller day storage tank may be provided within the room. Automatic transfer of fuel between the

external bulk fuel storage tank and the smaller day tank shall be provided.

The location of the refuelling point and ability to access safely shall be considered for each site such that it allows accessibility for the delivery of fuel by the selected method.

(c) External standby generating sets

Where the electrical switchboard is either plinth or pole mounted externally, the generating set shall also be located externally provided requirements such as noise attenuation can be met.

Permanently connected standby diesel generating sets shall be fully enclosed and sound attenuated. Generating set enclosures shall offer easy access to all maintainable parts for maintenance personnel.

Externally installed generator installations shall be vandal resistant. No glass or plastic panels are to be provided on the generator exterior housing. All covers (including radiator and fuel caps) are to be pad-lockable. No controls (eg emergency stop) are to be external or accessible without opening a locked door or cover.

There should be no exposed “hot” parts, such as exhausts. It should not be possible to drop items down the exhaust pipe.

Surface treatment of the generator and acoustic enclosure and other exposed parts shall be selected for the environment at the site, and to provide a 15 year minimum design life.

(4) Determining electrical site loads

(a) General

The designer shall determine the site loading in accordance with AS/NZS 3000 *Electrical installations* requirements, and with consideration of the proposed pump/equipment operation combinations and sequencing. Load calculations shall be approved by Townsville Water and Waste prior to being forwarded to the electrical distribution entity.

The designer shall be responsible for the early submission of electrical load calculations to the electrical distribution entity to minimise delays with electrical connection works.

The designer shall ensure that the calculated motor drive sizing can be achieved by a recognised pump manufacturer selected from Townsville Water and Waste’s preferred equipment lists.

The electrical load calculations shall take into account Townsville Water and Waste’s planned future augmentation of the infrastructure. Where no future augmentation is planned, the electrical loads shall be calculated on the anticipated connected loads plus 25% extra.

(b) Pump stations

Electrical load calculations shall be based on the method of operation of the pumps to be supplied and installed e.g. Duty-Duty, Duty-Standby, Duty1-Duty2-Standby etc. The proposed method of operation shall also be discussed with the distribution entity to determine any potential network issues with the proposed arrangements. The design for motor starting shall meet the requirements of the distribution entity and TCC24.

(5) Electricity point of supply

The preferred method for the connection to the point of supply shall be by underground cabling.

The final location for the point of supply shall be agreed between the distribution entity and Townsville Water and Waste and shall be compatible with access to the site. Parts of the overall area serviced by Townsville Water and Waste are prone to flooding. All electrical infrastructure susceptible to flood damage shall be located above the design inundation levels adopted for the proposed site. Flood inundation level information is available from Townsville Water and Waste to assist in the location of electrical infrastructure above predicted inundation levels.

The point of supply within residential locations shall be via a galvanised steel property pole or underground URD

pillar. Where galvanised steel property poles are used, the pole location shall be such that the final consumer's mains cabling length is kept to a minimum. No aerial cables are permitted to cross over infrastructure or vehicle working areas.

All connectivity at points of supply shall be accessible for maintenance purposes.

(6) Cabling

(a) Consumer's mains cabling

The consumer's mains cabling shall be sized by the designer in accordance with the calculated electrical load at the particular site and the requirements of AS/NZS 3000 *Electrical Installations*.

Cabling shall generally be Cu PVC/PVC/XLPE installed underground in HD uPVC conduits run between the nominated point of supply and the site electrical Main Switchboard.

Where external cabling enters a building, the cabling may be installed on cable ladder or cable tray with mechanical protection as required under AS/NZS3000.

Where underground HD uPVC electrical conduits are installed, the designer shall provide for spare conduits, generally in the ratio of one spare conduit of the same diameter of the conduit installed for each conduit containing electrical cables.

(b) Sub-mains cabling

Sub-mains cabling shall be sized by the designer in accordance with the calculated electrical load at the particular location and the requirements of AS/NZS 3000.

Cabling shall consist of single or multi-core copper PVC/PVC or PVC/XLPE conductors generally installed underground where run external of structures in suitably sized cable ducts or within cable trays where run internally of building structures.

(c) Power and control cables

Power and control cables shall be circular type cabling to facilitate ease of waterproofing cable entries. Consideration shall be given to use of flexible type cabling to pumps to facilitate ease of removal and installation.

Power cables shall be a minimum of 2.5 mm². Control cables shall be a minimum of 1.5 mm². A minimum of two spare cores shall be provided for all control cables following installation. Only one control voltage shall be contained within any control cable.

Where the designer has deemed a higher risk of further mechanical damage, Steel Wired Armoured (SWA) cabling or other protection method shall be provided.

(d) Variable frequency drive cables

Cables run to motors driven by VFDs shall be flexible type cabling to facilitate ease of termination and removal from pumping equipment. Cabling type, length and installation method shall be selected to meet the applicable Electromagnetic Compliance (EMC) requirements. Typically a screened cable would be used with screen continuous from the motor terminal box to the VFD terminals.

(e) Instrumentation cables

Instrumentation wiring and cabling required to carry signals to the PLC or process instrumentation shall be selected to suit the intended application.
Generally, overall screened cables shall be used for digital signal while overall and individually screened pairs shall be used for analogue signals. Analogue and digital signals shall not be provided within the same cable.

Cables shall generally be Dekoron or approved equivalent of minimum conductor size of 0.75 mm². Adequate separation shall be provided between instrumentation cables and other cabling to ensure non-interference from AC power and control cables. As a minimum, cable trays shall have adequate partitions and instrumentation cabling not in trays shall be run in separate conduits.

Provision of surge suppressing transient barriers shall be provided for all instrumentation cabling run external of buildings.

(f) Control systems networks

Control system networks shall be designed to suit specific application by a control system specialist.

(g) Pump power cable connection

Power cable termination for pump units shall be determined in consultation with Townsville Water and Waste. The following applies:

(i) typical all electrical equipment shall be hardwired; and

(ii) remote sites or high maintenance sites shall be connected by decontactor style plug and socket connections.

Where plug-in connections are used, the designer shall ensure that cableways from the plug to the motor are sized to permit plugs to be withdrawn with all other cables in place.

(h) Lighting and power sub-circuits

Cabling for lighting and power circuits shall be sized in accordance with the requirements of AS/NZS 3000 *Electrical installations.*
Generally, sub-circuit cabling shall be circular multiple stranded 0.6/1kV Copper PVC/PVC insulated and sheathed conductors where not enclosed in ducting and single insulated where enclosed by ducting.

The following minimum cable cross sectional areas shall apply:

Lighting sub circuit cabling	1.5 mm²
Power sub circuit cabling	2.5 mm²

(i) Cable identification

All cables shall have an identification number engraved on a non-corrodible metallic tag secured by a non-corrodible metallic tie. Tags shall be fitted to both ends of every cable.

(7) Wiring enclosures

(a) General

Cables shall be installed within wiring enclosures to provide the required degree of mechanical protection in accordance with AS/NZS 3013 *Electrical installations - Classification of the fire and mechanical performance of wiring system elements*. The wiring enclosures shall typically consist of cable ladder or conduits.

Wiring System Classification (AS3013)	Conduit Type
WSX1	Light Duty uPVC or equivalent
WSX2	Heavy Duty uPVC or equivalent
WSX3	Metallic Rigid Conduit or equivalent

(b) Cable ladder

Cable ladders shall typically be a heavy-duty aluminium type conforming to NEMA20B. In wet or corrosive areas stainless steel ladder may be required. Cable ladder shall be the primary method of support for surface run cables. Ladder support systems shall be designed such that loadings on ladders shall not cause deflection in excess of 1:200 of span length. Typically supports for horizontal ladders shall not exceed 3000 mm spacing and for vertical ladders, 1500 mm. In no case shall manufactures guidelines be exceeded. Ladders installed external to buildings shall be fitted with covers – horizontal ladders shall have peaked covers; vertical ladders shall have flat covers. Cables on ladders shall not be exposed to direct sunlight. It may be necessary to fit covers to the underside of some ladders. Bends, Tees and other fittings shall be of the same manufacture as the cable ladder. All fixings shall be stainless steel. Cables shall be secured in ladders utilising ties or clamps. Where external to a building, the ties/clamps shall be a non-corrodible metallic type.

(c) Conduit

Conduits shall have a minimum diameter of 20 mm and shall be run as directly as practical with a minimum number of bends or sets. Surface run conduits are to be as inconspicuous as possible and shall be run parallel to walls, floors and ceilings where ever practical. Conduit fittings shall be of the same manufacture and be compatible with the conduit. Elbows and Tee type fittings shall not be used. Long radius bends/sets or suitably sized junction boxes shall be used. Metallic conduits installed in wet or

corrosive environments shall be stainless steel or aluminium. Corrugated PVC conduit shall not be acceptable.

Underground conduits shall typically be installed to a Category A system as classified in AS 3000. The depth of burial shall be selected to suit the site environment. Sand shall be used as a bedding material – the type and grade selected to provide the required thermal properties for the installation.

Underground cable systems shall use cable pits at each change of direction and every 50 m on straight runs. The pits, lids and method of installation shall be suitable for the maximum wheel loads that may occur in the area in which they are installed. Typically “plastic” pits shall never be used where they might be subject to vehicle traffic. The pits shall be sized to suit the number of conduit entries and size/type of cables to be installed. Ensure that cable manufacturer’s minimum bending radius is never compromised. All conduit entries shall be bell-mouthed.

Underground cable routes shall be identified at each end, each change of direction, each pit entry and every 30 m along straight runs by a non-corrodible metallic plate with direction arrow, set in a concrete block.

(d) Flexible conduit

Flexible conduit shall be used to make the final connection to an item of plant. The flexible conduit shall typically be a PVC sheathed metallic liquid tight type, though in certain environments other materials may be more suitable, e.g. in wet, chemical or hazardous area environments. The flexible conduit shall be terminated with correct fittings from the same manufacturer as the conduit. The length of flexible conduit shall be kept to the minimum required to make a final termination to an item of plant. Corrugated PVC conduit shall not be acceptable.

(8) Switchboard design guidelines

(a) General

The following applies:

(i) electrical switchboards including motor control centres, distribution boards etc. shall be constructed in accordance with the requirements of the TCC specification TCC24 and accompanying standard drawings;

(ii) these typical drawings shall be adapted to suit the application and the proposed switchboard general arrangement;

(iii) the switchboard main switch shall be rated for 125% of the current rating of the consumer mains cabling;

(iv) generator control and/or connectivity shall be included;

(v) switchboard design shall include shrouding of live terminals to prevent inadvertent contact;

(vi) sections of switchboards required to be accessed by non-electrical personnel shall be physically segregated from other sections of the switchboard and be supplied by extra low voltage 24VDC power supplies. Where this requirement is not achievable, lockable hinged escutcheons shall be provided to prevent access to electrical equipment by unauthorised persons;

(vii) where the electrical energy metering is included in the overall switchboard design, a separate compartment with pad-lockable access door shall be provided in where required by the energy retailer;

(viii) switchboards located adjacent to sewerage pump stations shall be mounted on a concrete plinth to the side of the well;

(ix) sufficient concrete hardstand area shall be provided for maintenance personnel servicing the switchboard. Switchboards shall be located such that the access doors do not open towards an access road or the actual pump well; and

(x) galvanised steel bollards filled with concrete shall be erected in the vicinity of external electrical switchboards to minimise accidental vehicular damage to the switchboard and to protect maintenance personnel.

(b) Design documentation

The following list contains the minimum design documentation required for switchboard and electrical design to be submitted to Townsville Water and Waste for approval:

(i) Detailed electrical drawings including but not limited to the following:

(A) power single line diagrams;

(B) control circuit drawings;

(C) PLC control and network drawings;

(D) switchboard general arrangement drawings; and

(E) layout drawings.

(ii) Detailed electrical calculations including but not limited to the following:

(A) electrical maximum demand calculations;

(B) fault level calculations;

(C) cable calculations; and

(D) earth fault loop impedance.

(iii) Detailed electrical schedules including but not limited to the following:

(A) cable schedules;

(B) I/O schedules;

(C) single line diagrams;

(D) electrical equipment lists; and

(E) technical data sheets.

(c) Switchboard construction

Switchboard construction and equipment shall be in accordance with TCC24 specification, including:

(i) construction from 316 grade brushed stainless steel (the use of zinc anneal switchboard enclosures may be considered in internal locations with air-conditioned switch room);

(ii) all switchboard hardware, including, but not limited to, hinges, locking devices etc. shall also be manufactured from 316 grade stainless steel;

(iii) padlockable, vandal resistant swing handle type locking mechanisms are preferred for enclosures to suit the standard keying system. The overall number of lockable compartments shall be kept to a minimum; and

(iv) ventilation/cooling requirements to ensure internal temperatures do not exceed manufacturer's recommendations for any equipment contained in the switchboard.

External switchboards shall be painted colours that provide reflection of direct sunlight to minimise heat build-up within the switchboards, and shall be orientated to minimise risks of direct sunlight affecting internal electronic components.

Externally mounted switchboards and control panels shall be provided with sunhoods to minimise heat build-up within the control panels and to provide cover to maintenance personnel when working on the switchboards in rain.

- separate compartments to locate electronic soft starters > 22kW;
- separate compartments for PLC and telemetry hardware, with associated cabling terminated on suitably rated terminal strips; and
- VFD equipment in external boards may require suitable mechanical refrigeration/cooling systems to extend equipment life.

Motor starters, motor protection, and switchboard instrumentation shall be in accordance with the requirements of TCC specification TCC 24.

Major main switchboards and distribution boards shall include arc detection and VESDA protection.

(d) Electrical switchrooms

Dedicated electrical switchrooms shall be provided for large scale pump stations, treatment plants or where required to suit equipment types or the application.

Switchrooms shall conform to the requirements of AS/NZS 3000, the Building Code of Australia (BCA), and Townsville Water and Waste's operational requirements. Emergency lighting and fire extinguishers shall be provided at each Main Switchboard located within a dedicated switchroom as a minimum.

(e) Lightning and surge protection measures

Transient and surge projection devices shall be provided as recommended by the relevant Australian Standards including:

(i) AS 1768 *Lightning protection*; and

(ii) AS 4070 *Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient over-voltages*.

(9) Monitoring/control guidelines

(a) Design outputs

Control loop and P and ID drawings shall be provided for all major infrastructure including treatment plants and large pump stations.

Functional specifications shall be produced for proposed PLC and SCADA based control systems. Integration works are to be approved by Townsville Water and Waste.

For design and construct works, control loop and P and ID drawings shall be provided as part of the evaluation phase.

(b) Monitoring/control methodology - pump stations

Pump stations shall generally be controlled as per TCC-24 including local automatic / local manual and system control mechanisms.
All pump stations are to be remotely monitored by the telemetry and SCADA system.

(c) Monitoring methodology - reservoirs

Reservoir level monitoring shall be performed using submersible pressure transducers or external differential pressure transmitters.
Where flow to the reservoir is controlled by a pump or control valves, the pressure transducer shall be used for pump and/or valve control.

(d) Monitoring/control methodology - treatment plants

Treatment plants shall be controlled by PLC and SCADA based control systems, utilising optical fibre communication cabling.

Systems shall be to Townsville Water and Waste's current requirements, and systems for plant augmentations shall be compatible with existing systems. SCADA system shall be Citect or ClearSCADA (Townsville Water and Waste to confirm). PLC equipment shall be Siemens S7 series.

A functional specification for the monitoring/control of treatment plant systems including design and redundancy is to be included in the detailed design brief for each project.

(e) Float switches

Encapsulated float switches are to be provided in sewerage pump stations to indicate high level alarms. The installation of float switches must allow for the float to be accessed from the top of the pump well without the need to enter the well.

(10) Field equipment installation, wiring and terminations

(a) General

Field equipment installation, wiring and terminations shall generally encompass all electrical works external to the switchboards and motor control centres including but not limited to the installation of field cabling and cable support systems, local control stations, marshalling boxes, motor and equipment isolation and field instrumentation.
Important considerations include:

(i) preferred method of support and environmental conditions - includes consideration of flood levels, UV and damage by insects or vermin;

(ii) segregation of cabling - separation of differing cable types;

(iii) cable carrier capacity - capacity for present and planned expansion;

(iv) cable bend limitations;

(v) cable labelling requirements; and

(vi) cable mechanical protection.

(b) Field instrumentation and installation

(i) General

Field instrumentation shall be supplied and installed in accordance with the process requirements and the manufacturers' recommendations. The location and height of each instrument shall be shown on the relevant "Layout" drawings.

Field instruments shall be located as close to their primary connection to ensure instrument accessibility while still facilitating ease of access for operation, inspection and maintenance.

An optimum working and/or viewing height for each instrument shall be 1500 mm above grade or finished surface level.

No LCD screens for instrumentation or other plastic components that may be susceptible to damage from UV radiation shall be exposed to direct sunlight and potential vandalism shall be considered when locating equipment.

Where process instrumentation is installed on process pipework, suitable isolation devices shall be provided to allow for instrument removal.

All power supplies to instrumentation shall be surge protected and filtered.

(ii) Installation

Instrument enclosures suitable for the prevailing environment and any potential hazardous area classification of the area shall be provided for all field instrumentation and shall be installed in safe accessible locations.

Transmitters shall be enclosed in their own weatherproof enclosure and in addition, those mounted outdoors shall be shaded by 316 stainless steel covers with sides, drip hood and back as a minimum. All brackets and mounting bolts etc. for sensors and transmitters shall be 316 grade stainless steel.

Instrumentation shall not be supported from handrails or from steel work or plant which may be subject to vibration. All brackets and supports shall be constructed of 316 grade stainless steel and be constructed so that vibration from wind, operation of surrounding equipment, etc. is negligible.

(iii) Specific instrument requirements

Pressure transmitters where installed shall be fitted with valve manifold blocks.

Hydrostatic type level sensors shall be installed such that they are not affected by turbulence by the use of either stainless steel weighted cables or stilling tubes.

Impulse lines shall be fitted with valves and strainers. Lines shall be constructed of either copper or stainless steel and be provided with draining facilities for cleaning and maintenance. Cables shall be identified by an engraved metallic tag with SS fixings.

(c) Labelling of equipment

Equipment labels in the form of "traffolyte" labels shall be provided at each field mounted instrument to identify the instrument and at each local isolator or stop/start station to identify the item of plant that the isolator or control stations controls. Labels shall be fixed to equipment with stainless steel screws.

(11) Radio telemetry and SCADA system

(a) General

Townsville Water and Waste operates a telemetry system to monitor and/or control sewage pump stations, water supply pump stations and reservoirs. The system is based on Schneider Scadapack Hardware Controls (previously Serck/Hunter Watertech) PDS and Enet hardware connected by narrow band analogue and digital UHF radio networks. Human machine interface is provided by various SCADA software.

Automated and manual alarm dial outs are provided from SCADA alarms.

(b) New facilities

All new sewerage pump stations, water supply pump stations and reservoirs are required to be connected to the Telemetry system for the purposes of monitoring and control as required in TCC 24.

Functional system requirements such as network and repeater interfaces for the site and frequency details shall be determined during the design in consultation with council's electrical systems engineer.

(12) Mechanical services

(a) Pump design - general guidlines

(i) Pump selection

Pump selection shall be based on the following criteria:

(A) Townsville Water and Waste preferred equipment lists;

(B) system resistance curves (refer SC6.4.3.21.2 Water supply design; and SC6.4.3.21.3 Sewerage system design [SC6.4.3.21.3(5) Sewage pump station design]). Pump selection shall achieve all expected duties as per the system resistance curves;

(C) redundant (standby) pump capacity shall always be provided. Standby pump capacity should be at least equal to the capacity of the largest pump unit;

(D) availability of local product support for maintenance purposes; and

(E) whole of life costs.

For all pumps supplied as part of contracted works, the NPV shall be based on a 15-year design life and 8% real discount rate.

(ii) Motors

All pump motors shall be afforded a minimum of IP56 and be tropic proofed.

(iii) Water void protection

Water void protection shall be provided for all water pumping applications. Water void protection on large installations shall typically consist of limit switches mounted on an extended shaft of the non-return valve.
On smaller applications, flow switches may be used for water void protection.

(iv) Document requirments

The following documentation shall be provided as a minimum by the Contractor and/or pump supplier:

(A) details of all recommended spare parts and servicing tools including a priced list of the costs for each individual item;

(B) operations and maintenance manuals which adequately detail servicing intervals and requirements, dismantling instructions, itemised parts lists;

(C) pump performance – pump/motor factory test curves;

(D) the results of specific pump/motor performance testing to AS2417, showing flow rate, pressure, current, efficiency, and NPSH as a minimum; and

(E) pump/motor specification plates – shall be fixed to the pump and motor. Two additional sets of specification plates shall be supplied, one for inclusion into the switchboard.

(b) Pumping applications

Types of pumps for typical applications shall generally be as follows:

(i) sewage pump stations shall be provided with wet well submersible centrifugal pumps for all new

locations. Existing pump stations that are planned for upgrades shall be converted to dry well mounted submersible centrifugal type pumps. Grinder style pumps may also be offered where conditions exist that may prevent an 80 mm sphere being passed through the pump and discharge pipework;

(ii) water pumping stations shall generally be centrifugal pumps, with the number of pump stages to suit the duty point required;

(iii) RAS and WAS pumps at Sewage Treatment Plants shall generally be centrifugal submersible type controlled by VVVF Drives; and

(iv) positive displacement type pumps shall generally be installed for sludge handling applications.

Where sand infiltration causes excessive abrasion at pump stations, wear rings with increased hardness shall be fitted to the pumps and consideration given to ceramic coatings on the wearing surfaces.

Where pumps are provided with a double mechanical seal, a barrier fluid conductivity probe shall also be provided. This type of system shall be capable of producing an alarm which will be registered in the pump's switchboard and possibly the telemetry system when a change in conductivity is sensed. It is assumed that this will alarm due to a mechanical seal fault.

(c) Chemical dosing pumps

Dosing pumps shall generally be small diaphragm type pumps with either electronic or manual stroke adjustment depending on the application. Pump type and material is to be suitable for the chemical to be dosed.

Critical dosing pumps may require installation with automatic alarm considerations and feedback signals to the telemetry or PLC. These dosing pumps will generally be installed with means of electronically recording/confirming the flow in the dosing line and a means by which the flow in the dosing lines can be diverted back to the dosed fluid reservoir.

Dosing pumps may be required to be flow paced. Flow pace settings shall be manually adjustable.

Larger dosing pumps for dosing rates of between 5 and 50 L/hr shall generally consist of centrifugal pumps with magnetic drive. In this instance fluid void protection is to be provided.

Mass balance dosing systems are not desirable.

Generally Sodium Hypochlorite tank levels shall only be monitored in treatment plant applications.

Townsville Water and Waste's standard P and ID control and pipework drawing shall be used for all dosing pump installations.

(d) Pumping equipment

(i) Motor cable
The designer is to consider the future application of the pump, including if future conversion to VVVFD operation is required. Pumps with present or future VVVF Drive requirements shall be fitted with screened flexible cable.

(ii) Guide rails
Guide rails for removal of submersible pumps shall generally be stainless steel pipe, SCH 40 or better and shall be a minimum of 40 mm diameter.

(iii) Lifting chains
Lifting chains shall be provided at each submersible sewage pump station. Lifting chains shall be selected to be suitable tensile strength to lift the attached pump and shall be manufactured from coated or galvanised steel.

(iv) Pressure gauges
Pumps for water pumping applications shall be supplied with suction and discharge pressure gauges.

(e) Vibration monitoring

Pumps shall generally be provided with the following vibration monitoring devices in three axis locations.

Motor Size	Vibration Monitoring Requirements
10 kW and under	No requirement for vibration monitoring devices
Over 10 kW and up to 99 kW	Vibration monitoring pads
100 kW and above	Inbuilt vibration monitoring devices

Inbuilt vibration monitoring devices shall have all alarms connected to the telemetry and/or SCADA-based monitoring system.

(f) Pump work testing

Works testing of pumps shall be performed for units rated at 5 kW and above. All other pumps shall be provided with a Type Test Certification from the pump manufacturer.

Works testing shall be performed to AS 2417 *Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2:*

(i) Class 1 for water supply pumps greater than 20 kW; and

(ii) Class 2 otherwise.

The pump supplier shall provide copies of all test certification prior to the pump being dispatched from the manufacturer's factory.

Works testing will normally negate the requirement for a draw-down test to be conducted at each individual site. Where specified draw-down tests may be used to judge the performance of the pumps installed.

(g) Mixers

Mixers shall be either of the submerged type or stool mixers.

(h) Manual valves

Pressure reducing valves shall generally be Derot 300 series (or approved equivalent) with throttling plugs. Vee Port valves shall only be used with the permission of Townsville Water and Waste.

(i) Actuated valves

Actuated valves shall generally be installed with AUMA or Rotork electric actuators (or approved equivalent), in accordance with Townsville Water and Waste's preferred equipment lists.

Electrically actuated valves shall be three phase 415 V rated.

Pneumatically actuated valves shall generally be installed with Tyco Keystone pneumatic actuators, limit switches and/or positioners. In general, "spring close" is required for this type of installation.

All actuated control valves shall have analogue 4-20 mA signal position feedback into PLC and SCADA based monitoring and control systems. Where the actuated valve is not a control valve, limit switches may suffice for positioning.

(j) Air supply blowers

Air supply blowers for treatment plant applications shall generally be lobe type or roots blowers. Townsville Water and Waste's preference is for Robuschi manufactured blowers (or approved equivalent) of the positive displacement rotary type.

Blowers shall be provided with sound attenuation devices to limit the operating noise to levels that are within the limits that provide a safe working environment without the need for ear protection and are in accordance with the relevant local laws and environmental requirements.

(13) Equipment manuals

When purchasing equipment the designer shall specify that, detailed operations and maintenance manuals are to be provided.

As a minimum operation and maintenance manuals shall contain details of:

(a) general description of systems and equipment;

(b) operation and maintenance of systems and equipment instructions which adequately detail servicing

intervals and requirements, dismantling instructions, itemised parts lists Maintenance of Systems and Equipment Instructions;

(c) equipment schedules;

(d) manufacturer's literature;

(e) as-constructed equipment drawings; and

(f) commissioning and test data.

The following copies of the manual shall be provided:

- three hard copies of the manuals; and
- one PDF copy of all documentation.

Specific requirements for sewerage Pump Stations shall refer to SC6.4.3.21.3(5)(n).

SC6.4.3.21.5 Structural and civil design

(1) Introduction

(a) General

SC6.4.3.21.5 sets out the minimum requirements for:

(i) the design of new steel and reinforced concrete structures;

(ii) modifications to existing Townsville Water and Waste steel and reinforced concrete structures; and

(iii) design of civil works including fencing and security, roads and access, site works and landscaping for Townsville Water and Waste infrastructure.

(b) Reference and source documents

SC6.4.3.21.5 is to be read in conjunction with the following documents.
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Supply Code of Australia*
WSA 04 *Sewerage Pumping Station Code of Australia*
Workplace Health and Safety Queensland – *Safe Design of Structures – Code of Practise*

(c) Codes and standards

All designs and materials shall conform to these guidelines, the relevant current versions of the following general codes and standards in Table SC6.4.3.21.7, and also to the standards referred to within following Sections (2) to (6).

Table SC6.4.3.21.7 Townsville Water and Waste general codes and standards

Code/Standard	Description:
General	
Building Code of Australia (BCA)	Structures shall be designed for a minimum Importance Level of 3 according to the Building Code of Australia Table B1.2a
AS/NZS 1170.0	Structural design actions; Part 0: General principles
AS/NZS 1170.1	Structural design actions; Part 1: Permanent, imposed and other actions
AS/NZS 1170.2	Structural design actions; Part 2: Wind actions
AS/NZS 1170.4	Minimum design loads on structures; Part 4: Earthquake loads
AS 1657	Fixed platforms, walkways, stairways and ladders – design, construction and installation
AS 1418.1	Cranes (including hoists and winches); Part 1: General requirements
Structural Steelwork	
AS 1210	Pressure vessels
AS 4100	Steel structures
AS 4600	Cold formed steel structures
AS 1163	Structural steel hollow sections
AS/NZS 1594	Hot-rolled steel flat products
AS/NZS 3678	Structural steel – hot-rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural steel – Part 1: Hot-rolled bars and sections
AS/NZS 3679.2	Structural steel – Part 2: Welded I sections
AS 3828	Guidelines for the erection of building steelwork

Code/Standard	Description:
AS/NZS 1554.1	Welding of steel structures
AS/NZS 1554.5	Welding of steel structures subject to high levels of fatigue loading
AS/NZS 2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
AS 1627	Metal finishing – Preparation and pretreatment of surfaces; Part 0 to Part 9
AS/NZS 2311	Guide to the painting of buildings
AS 4020	Products for use in contact with Drinking Water
AS/NZS 4680	Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS/NZS 4791	Hot-Dip Galvanised (Zinc) Coatings on Ferrous Open Sections, Applied by an In Line Process
AS/NZS 4792	Hot-Dip Galvanized (Zinc) Coatings on Ferrous Hollow Sections Applied by a Continuous or Specialised Process
AS 2832.4	Cathodic Protection of Metals – Internal Surfaces
AS 3774	Loads on Bulk Solids Containers
Australian Institute of Steel Construction.	Structural Design of Steel Bins for Bulk Solids
API 650	Welded steel tanks for liquid storage
AWWA D100	Welded carbon steel tanks for water storage
Concrete Design	
AS 2870	Residential slabs and footings
AS 3600	Concrete structures
AS 3610	Formwork for concrete
AS 3700	Masonry structures
AS 3735	Concrete structures retaining liquids
AS 2159	Piling design and installation
AS 5100	Bridge design
AS/NZS 4671	Steel reinforcing materials
AS 1379	The specification and manufacture of concrete
AS 1478	Chemical admixtures for concrete
AS 1012	Methods of testing concrete

Where a discrepancy exists between this sub-section and the documents referenced herein, this sub-section shall take precedence.

(d) Certification

All designs shall be certified by a Registered Professional Engineer of Queensland (RPEQ).

Designs shall require a structural design certificate signed by an RPEQ prior to acceptance by Townsville Water and Waste. Acceptance of the design by Townsville Water and Waste does not relieve the designer of their legal or contractual obligations.

(2) Structural steelwork design

(a) General

(i) Scope

This section sets out the minimum requirements for the design of new steel structures and modifications to existing Townsville Water and Waste steel structures.
Typical Townsville Water and Waste steel structures include:

(A) reservoir tanks;

(B) monorails

(C) walkways / platforms and ladders; and

(D) buildings and sheds.

These guidelines do not apply to the design of other types of structures or the following materials:

- aluminium structures (except aluminium walkways/platforms and ladders);
- stainless steel; and
- composite structures.

Design incorporating these materials or relating to other structures shall be performed by suitably

experienced and competent persons.

(ii) Design and materials

All steelwork designs and materials shall conform to these guidelines, the relevant current versions of the standards listed in Table SC6.4.3.21.7 and the standards referred to within them.

(iii) Connections

The following applies:

(A) minimum design actions for connections shall be as per the relevant loading codes;

(B) generally bolted connections shall be designed to be a minimum of 2 x M20 8.8S bolts through 10mm thick cleats. Generally weld sizing shall be designed by using GP welds using E48XX welding electrodes;

(C) seal plates, where required, shall be a minimum of 6 mm thick;

(D) cast in bolts for structural purposes shall be galvanised and at least M12 diameter. Structural fixings to insitu concrete or masonry shall be a minimum of 2 x M12 bolts; and

(E) base plates shall be a minimum of 10 mm thick and grout shall be a minimum of 35 mm thick.

(iv) Protective coating systems

The following applies:

(A) generally, the protective coating system of the steelwork shall conform with current version of AS/NZS 2312 and Standards and documents referred to therein;

(B) painting where adopted shall conform with the current version of AS 1627 and AS/NZS 2311, and standards and documents referred to therein;

(C) all painting on the internal surface of water storage structures shall conform with the requirements of AS 4020 *Products for use in contact with Drinking Water;*

(D) galvanising, where required, shall conform with the current version of AS/NZS 4680, AS/NZS 4791, AS/NZS 4792, and standards and documents referred to therein;

(E) the design and detailing of members to be hot dipped galvanised shall take into account the recommendations of the Galvanizers Association of Australia;

(F) protection of steelwork by a protective wrap shall be in accordance with the manufacturer's recommendations and specifications and to the satisfaction of the designer; and

(G) protection of internal surfaces of water storage tanks by cathodic protection shall be in accordance with the current version of AS 2832.4 and standards and documents referred to therein.

(b) Reservoirs

Reservoir structures shall be designed for a minimum importance level of 3 according to the *Building Code of Australia* Table B1.2a.

Townsville Water and Waste has a preference for circular steel reservoirs, with a steel floor and roof structure. Typical "standard" reservoir details can be made available by Townsville Water and Waste, on request.

"Non-standard" reservoirs shall be designed using the principles outlined in AS 3774 *Loads on Bulk Solids Containers and Structural Design of Steel Bins for Bulk Solids* published by the Australian Institute of Steel Construction.

Reservoir Design criteria shall incorporate:

(i) bird and vermin proofing;

(ii) the roof shall ensure adequate ventilation and sufficient fall to ensure adequate drainage for the adopted roof sheeting;

(iii) steel purlins shall have downturned lips to the bottom flange and be oriented to prevent ponding of moisture;

(iv) roof falls shall allow for rafter and purlin deflections. The exposure of the site will determine the roof

sheeting finish and type;

(v) a lockable access cover shall be provided through the roof to allow access for internal cleaning. No permanent access to the interior of the reservoir shall be provided. Access shall be via temporary means only;

(vi) the design of the reservoir shall incorporate an access ladder or stairway from ground level to roof level, with lockable cage to restrict unauthorised access;

(vii) the roof design shall incorporate sufficient fall arrest restraints or hand railing around the perimeter;

(viii) the design of the floor shall consider cleaning and maintenance required in the future; and

(ix) the foundations of the entire tank structure shall be founded on undisturbed parent material. Founding on fill material is not permitted.

(c) Monorails

The following applies:

(i) monorail beams and supports shall be designed in accordance with AS 4100 and AS 1418.1;

(ii) the safe working load (SWL) shall be clearly and permanently marked (not painted) on all monorails beams;

(iii) the minimum SWL shall be determined by the functional requirements of the monorail, but shall not be less than a minimum lift weight of 1000 kg;

(iv) unless known otherwise, monorail beams shall be designed based on the assumption that the centre of bearing of the trolley wheels is on the edge of the beam flange;

(v) deflections of monorails beams and supports shall not impair the functioning of the monorail but in no instances shall exceed the span/500;

(vi) the number of load cycles shall be calculated for each individual monorail based on a minimum design life of 50 years;

(vii) all monorail beams shall be load tested after erection; and

(viii) the design of the monorail beam shall consider future maintenance requirements.

(d) Walkways/Platforms and Ladders

The following applies:

(i) walkways, platforms and ladders shall be designed in accordance with AS 1657;

(ii) generic products conforming with the above Standard may be utilised;

(iii) all ladders greater than 2.5 m high shall be provided with a cage complying with AS 1657;

(iv) walkways, platforms and ladders may be galvanised, stainless steel or aluminium;

(v) where possible riser and going dimensions on stairs shall conform with both AS 1657 and the BCA; and

(vi) no ladders or stairs shall be designed for access to confined spaces as defined by workplace health and safety unless approved by council.

(e) Sheds

Typically, design of sheds will be outsourced to suitably experienced and competent persons.

(3) Concrete design

(a) General

(i) Scope

This section sets out the minimum structural requirements for the design of reinforced and plain concrete members, and reinforced concrete masonry block work for Townsville Water and Waste. Specifically, this section provides guidelines for the design of the following types of structures:

(A) thrust blocks, valve and fittings pits associated with pipelines;

(B) bored piers;

(C) slabs on ground;

(D) concrete pavements

(E) manholes;

(F) pump stations and wet walls; and

(G) retaining walls.

These guidelines do not apply to the design of post tensioned concrete. Design incorporating post tensioned concrete or relating to other structures shall be performed by suitably experienced and competent persons.

(ii) Design and materials

All concrete and false work designs and materials shall conform to these guidelines, the current relevant versions of the standards listed in Table SC6.4.3.21.8 and standards referred to within them.

All reinforcement and concrete materials shall be sourced from a quality assured manufacturer of such products.

Splicing and lapping of reinforcement shall be as per the requirements of AS 3600. All exposed corners shall be designed for a 25 x 25 chamfer.

The use of low ductility mesh as reinforcement in suspended concrete should be avoided.

(iii) Minimum concrete requirements

Concrete grades and cover for reinforcement shall be in accordance with the appropriate exposure classification in AS 3600 and AS 3735 with minimum values as set out in Table SC6.4.3.21.8.

Table SC6.4.3.21.8 Minimum concrete strengths

Construction Element	Minimum Concrete Strength
Access cover (sewer and stormwater)	N32
Thrust blocks	N20
Concrete surrounds for sewerage house connection branches	N20
Bored pier footings	N25
Pump stations and wet wells	N40
General concrete works (sign post bases, bases for post and rail fences etc.)	N20

Minimum reinforcement in reinforced concrete members shall conform with the requirements of AS 3600, AS 3735, AS 5100 or AS 2159.

(b) Thrust blocks and valve pits

Thrust blocks shall be sized in accordance with SC6.4.4.8 Standard drawings SD-371 Thrust Block Details – Concrete Blocks.

Valve pits shall be sized to provide adequate clearance around valves, pipes and fittings to allow for operations, maintenance and repair of the equipment. Pits required to provide in-line thrust shall be designed accordingly, taking into account the allowing bearing capacity of the soils. Pits shall be provided with lockable aluminium lids; and the designer is to refer to WSA-03 for detailing requirements for valve chambers.

(c) Bored piers

Bored pier design shall take into account the design loads and soil parameters. Soil parameters for the design of piers may be assessed visually by suitably experienced and competent persons if deemed suitable for the application.

Typically bored piers for building applications shall be a minimum size of 450 mm diameter by 900 mm deep in undisturbed ground. When steelwork is cast into piers the top surface of the concrete pier shall be worked to provide a positive fall away from the steelwork to the outside of the pier.

(d) Slab on ground

Slabs and footings for habitable buildings shall be generally designed and constructed in accordance with AS 2870. Assessment of site reactivity shall be in accordance with requirements of AS 2870. Beam

layouts and depths shall be as per AS 2870 except that all footings shall be continuous at re-entrant corners.

Non habitable buildings shall be designed using the guidelines in *Guide to Industrial Floors and Pavements* published by the Cement, Concrete and Aggregates Australia. The possible future uses of the building should be considered in determining the appropriate design for the slab and footings.

Minimum slab thickness shall be 100 mm and minimum reinforcement shall be SL72. Slab thicknesses and reinforcement shall be sufficient to support any loads from plant and maintenance equipment and sufficient to provide adequate cover to any slab fixings.

(e) Concrete pavement

Concrete pavement shall only be designed by suitably experienced and competent persons. Concrete pavement shall be designed in accordance with sub-section SC6.4.4.2 Pavement design and all standards and documents referred to in them.

(f) Access covers

Access covers shall be circular, and sized in accordance with the current version of the following standard drawings:

(i) SD-510 Maintenance Holes; Typical Manhole Cover Arrangements;

(ii) SD-205 Stormwater Manhole Details;

(iii) SD-210 Precast Stormwater Manhole Slab Top Details; and

(iv) SD-475 Typical MH Cover Arrangements.

(g) Pump stations and wet well materials

Pump station buildings shall be constructed from reinforced concrete and/or reinforced masonry block. Wet wells shall be constructed from reinforced concrete. Drainage of below ground structures shall be considered in the design.

Other materials (e.g. GRP) are subject to approval from council.

The structure shall be sized to allow for adequate clearances for maintenance and replacement work, with appropriate clearances for different valves and fittings. No permanent access ways shall be constructed within pump stations or wet wells. The size of the structure shall be the most cost effective combination allowing for concrete, reinforcement and formwork costs.

(4) Fencing and security

Townsville Water and Waste assets will generally require an assessment of fencing and security issues, some security designs are shown in Attachment C: General facility security.

(a) Reference and source documents

The following references shall be consulted.
Disaster Management Act 2003
AS/NZS 4360 *Standard for Risk Management*
Emergency Management Australia - *Critical Infrastructure Emergency Risk Management and Assurance* handbook to support AS/NZS 4360
Queensland Government - *Securing Queensland's Critical Infrastructure: Guideline for Owners/Operators*
LGAQ - *Local Government Counter Terrorism Risk Management Kit*
The National Security Australia web site www.nationalsecurity.gov.au

(b) Minimum fencing requirements

The minimum requirement shall be a 2.8 m high chain mesh fence with 4 barb extensions with top and bottom rails, with double access gates 6 m minimum width determined by site requirements as per SC6.4.3.21 Attachment C.

All gates shall be provided with the standard Townsville Water and Waste padlock.

Some installations may require additional interlocked padlocks for access by other services.

(5) Roads and access

(a) General

This section sets out the minimum requirements for the design of roads and accesses to Townsville Water and Waste facilities.

The facilities typically encountered include pump stations, storage reservoirs and roads, access and parking at treatment plants.

(b) Design standards

All roads, accesses and carparks shall be designed in accordance with the following sub-sections:

(i) SC6.4.4.1 Geometric road design; and

(ii) SC6.4.4.2 Pavement design.

(c) Minimum requirements

All weather sealed access for maintenance vehicles shall be provided including:

(i) sealed asphalt access road, minimum pavement width 4 m (spray sealed access roads may be considered for longer accesses or lower longitudinal grades in areas where vehicles do not manoeuvre);

(ii) special surface treatments e.g. pavers may be required for aesthetic reasons or usage/transport of chemicals at some facilities;

(iii) provide access during a 1% AEP flood event;

(iv) road geometry suitable for use by light vehicles and single axle trucks, including vertical alignment check to ensure vehicle clearance. All turning movements shall be analysed with turning path software. Three point turns are allowed for access at pump stations;

(v) bunding of tanker unloading areas will be necessary as well as associated storage and pump-out facilities; and

(vi) all accesses shall be provided with suitable signage and line marking.

(6) Stormwater drainage

(a) General

This section sets out the minimum requirements for stormwater drainage at Townsville Water and Waste facilities.

(b) Design standards

All stormwater drainage shall be designed in accordance with SC6.4.4.4 Stormwater drainage design.

(c) Minimum design requirements

The following are minimum requirements for consideration during stormwater design:

(i) all Townsville Water and Waste facilities shall be above the 1% AEP flood level plus 300 mm freeboard and above the 0.2% AEP storm surge level;

(ii) all accesses shall be above the 1% AEP flood level, where possible;

(iii) the design shall allow for both primary and secondary drainage paths;

(iv) the issue of contaminated water shall be addressed and pollution traps may be necessary; and

(v) erosion and sediment control plans shall be prepared for all projects.

(7) Site regrading

(a) General

This section sets out the minimum requirements for site regrading at Townsville Water and Waste facilities.

(b) Design standards

(c) All site regrading shall be designed in accordance with SC6.4.4.5 Earthworks. Minimum design requirements.

The following are minimum requirements for consideration during site regrading design:

(i) a geotechnical investigation may be necessary by a suitably qualified consultant;

(ii) excavation may expose acid sulfate soils and this must be addressed in accordance with

legislation;

(iii) excavation may expose hazardous substances and this is to be addressed in accordance with workplace health and safety legislation; and

(iv) if blasting is necessary suitably qualified personnel are to be consulted and all safety approvals and public consultation requirements are to be addressed.

Note—SC6.4.3.24 Geotechnical investigations, specifies requirements for undertaking geotechnical investigation works. Part 9.3.2 Healthy Waters Code of Townsville City Plan has requirements regarding ASS/PASS and accords to State requirements.

(8) Landscaping

Where specified, some Townsville Water installations will require landscaping. Refer to requirements in SC6.4.3.6 Landscaping policy.

(9) Blasting activities

All purposed blasting activities must be designed and certified by an RPEQ and specifically state that there will be no structural impact on council infrastructure. Refer to SC6.4.5 Construction management and SC6.4.6.10.4 Blasting general, for use of explosives during construction.

(10) Drafting deliverables

All drafting shall be to current Australian Standards.

All drawings submitted for approval shall be provided in A3 size paper format or digital PDF format as determined by the Townsville Water and Waste project officer.

Final drawing submission shall comprise the following:

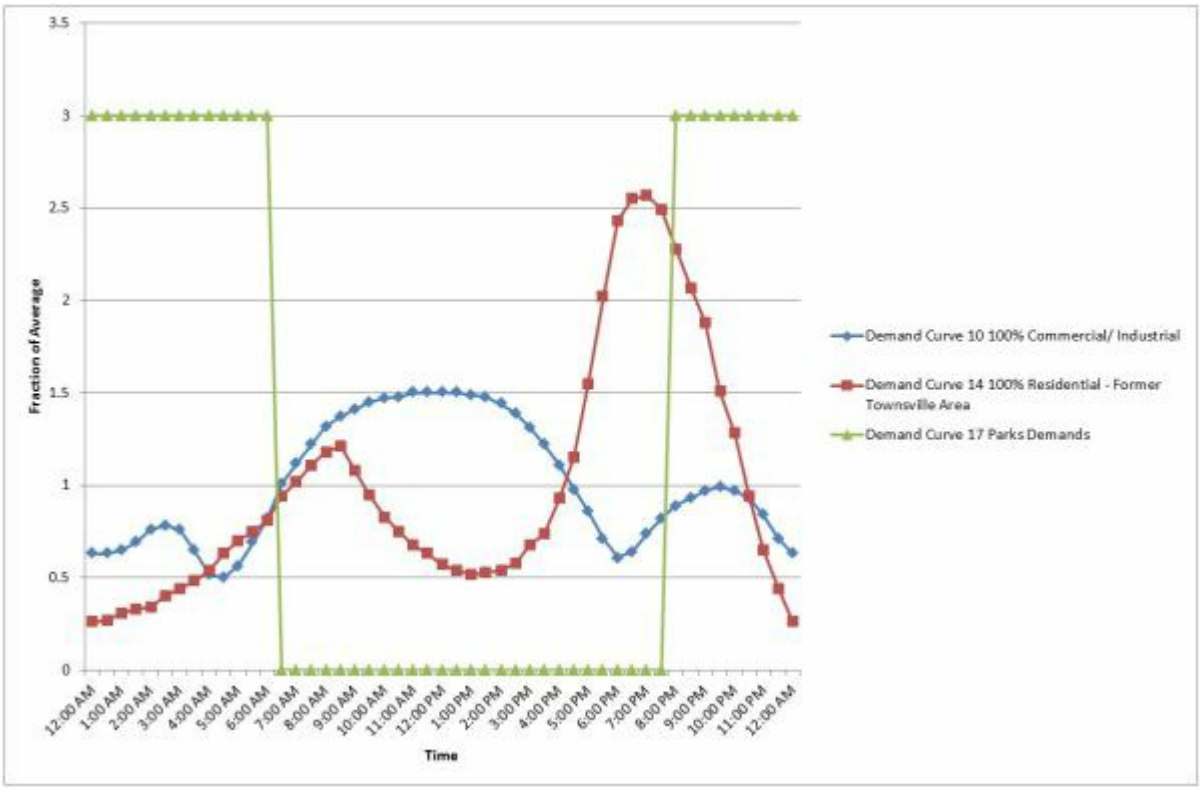
(a) digital DWG file in AutoCAD 2008 format on CD;

(b) digital PDF file on CD; and

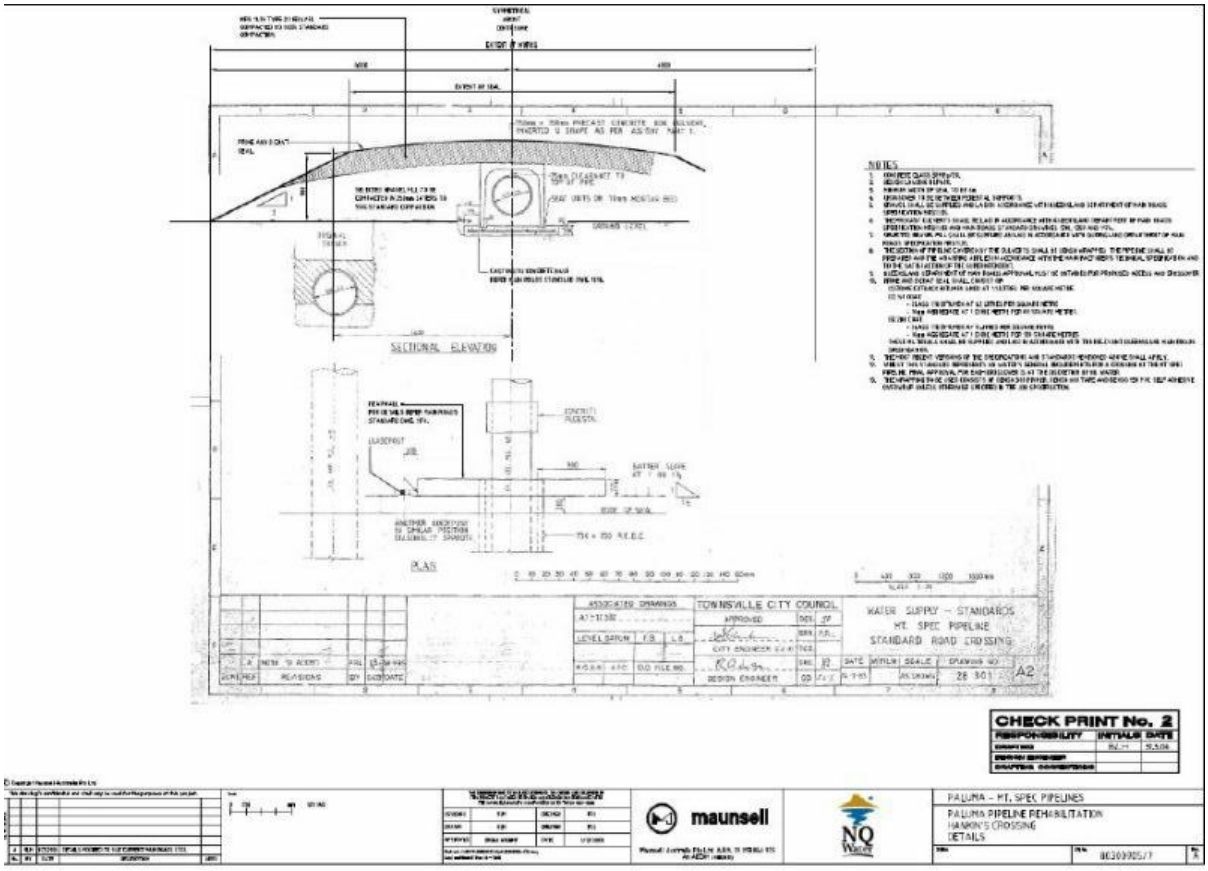
(c) one x A3 size paper copy.

SC6.4.3.21 Attachment A – Water supply diurnal patterns

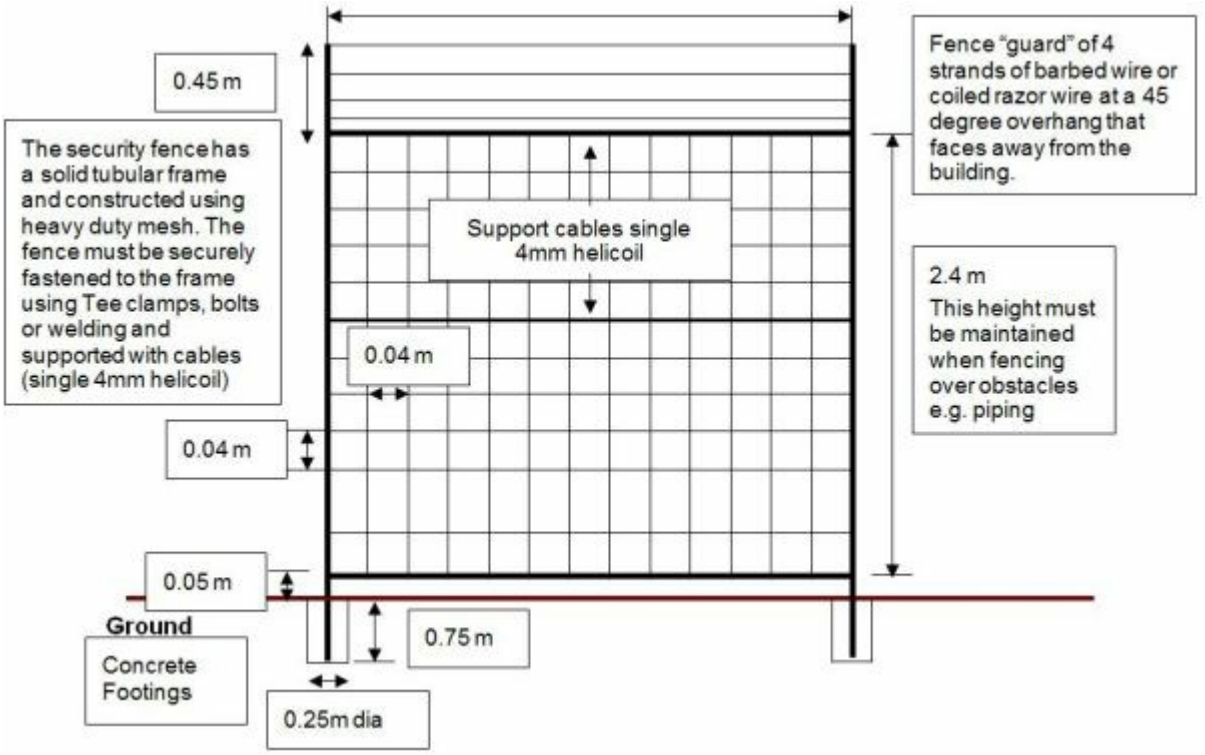
TIME	Demand Curve 10	Demand Curve 14	Demand Curve 17
	100% Commercial/ Industrial	100% Residential - Former Townsville Area	Parks Demands
12:00 AM	0.63	0.26	3
12:30 AM	0.63	0.27	3
1:00 AM	0.65	0.31	3
1:30 AM	0.69	0.33	3
2:00 AM	0.76	0.34	3
2:30 AM	0.78	0.40	3
3:00 AM	0.76	0.44	3
3:30 AM	0.65	0.48	3
4:00 AM	0.52	0.54	3
4:30 AM	0.50	0.63	3
5:00 AM	0.56	0.70	3
5:30 AM	0.69	0.75	3
6:00 AM	0.82	0.81	0
6:30 AM	1.01	0.94	0
7:00 AM	1.12	1.02	0
7:30 AM	1.22	1.11	0
8:00 AM	1.32	1.18	0
8:30 AM	1.37	1.21	0
9:00 AM	1.41	1.08	0
9:30 AM	1.45	0.95	0
10:00 AM	1.47	0.83	0
10:30 AM	1.48	0.75	0
11:00 AM	1.50	0.68	0
11:30 AM	1.50	0.63	0
12:00 PM	1.50	0.57	0
12:30 PM	1.50	0.54	0
1:00 PM	1.49	0.52	0
1:30 PM	1.48	0.53	0
2:00 PM	1.44	0.54	0
2:30 PM	1.39	0.58	0
3:00 PM	1.31	0.68	0
3:30 PM	1.22	0.74	0
4:00 PM	1.11	0.93	0
4:30 PM	0.98	1.15	0
5:00 PM	0.86	1.55	0
5:30 PM	0.71	2.02	0
6:00 PM	0.61	2.43	0
6:30 PM	0.64	2.55	0
7:00 PM	0.74	2.57	0
7:30 PM	0.82	2.49	0
8:00 PM	0.89	2.28	3
8:30 PM	0.93	2.07	3
9:00 PM	0.97	1.88	3
9:30 PM	0.99	1.51	3
10:00 PM	0.97	1.28	3
10:30 PM	0.93	0.94	3
11:00 PM	0.84	0.65	3
11:30 PM	0.71	0.44	3
12:00 AM	0.63	0.26	3



TCC Daily Diurnal Variations

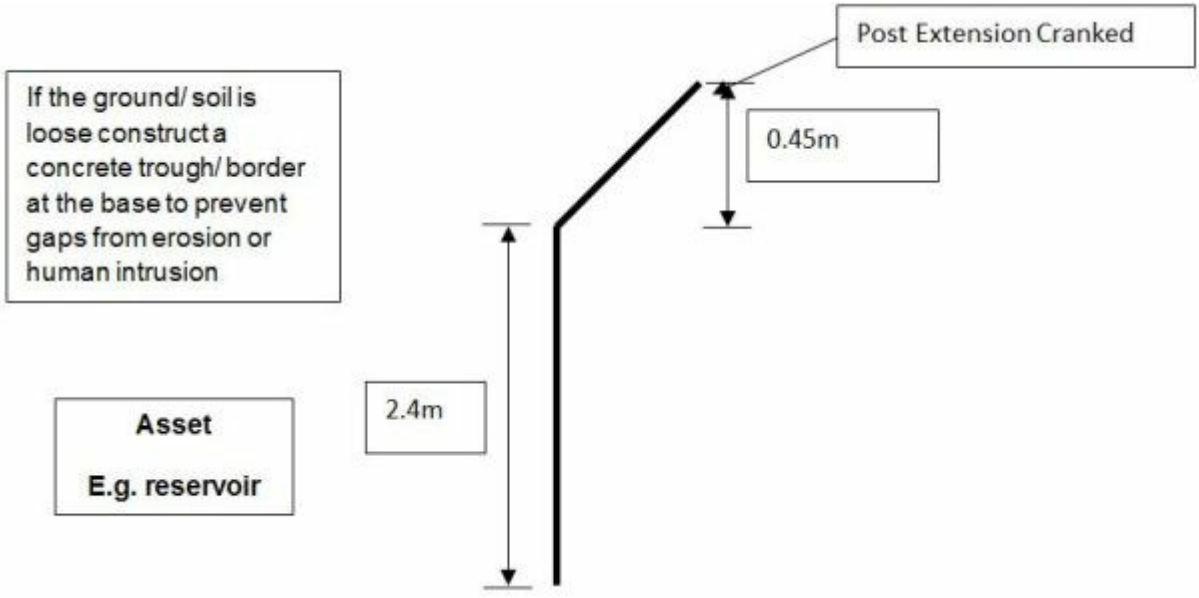


SC6.4.3.21 Attachment B – Standard road crossing



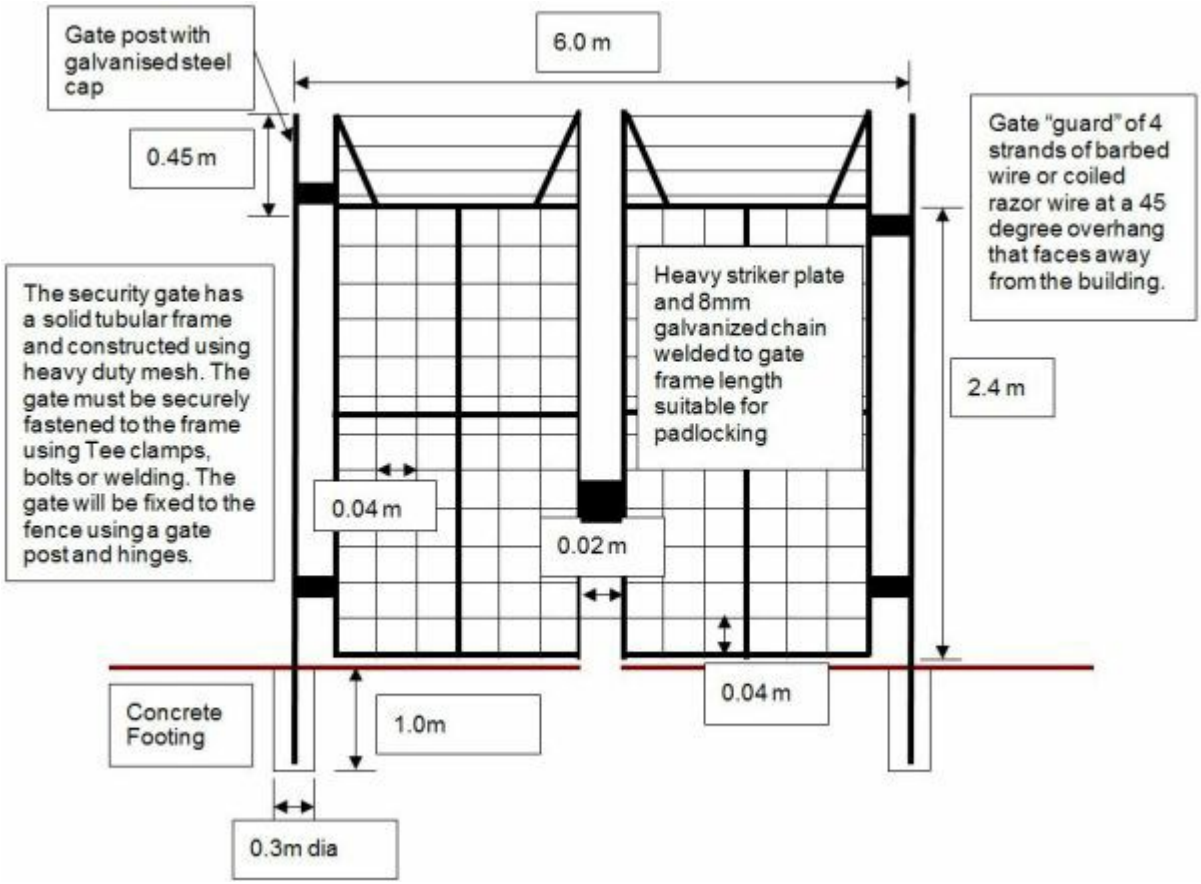
Security Fence Design Specifications
Figure SC6.4.3.21.1 Front view

SC6.4.3.21 Attachment C – General facility security



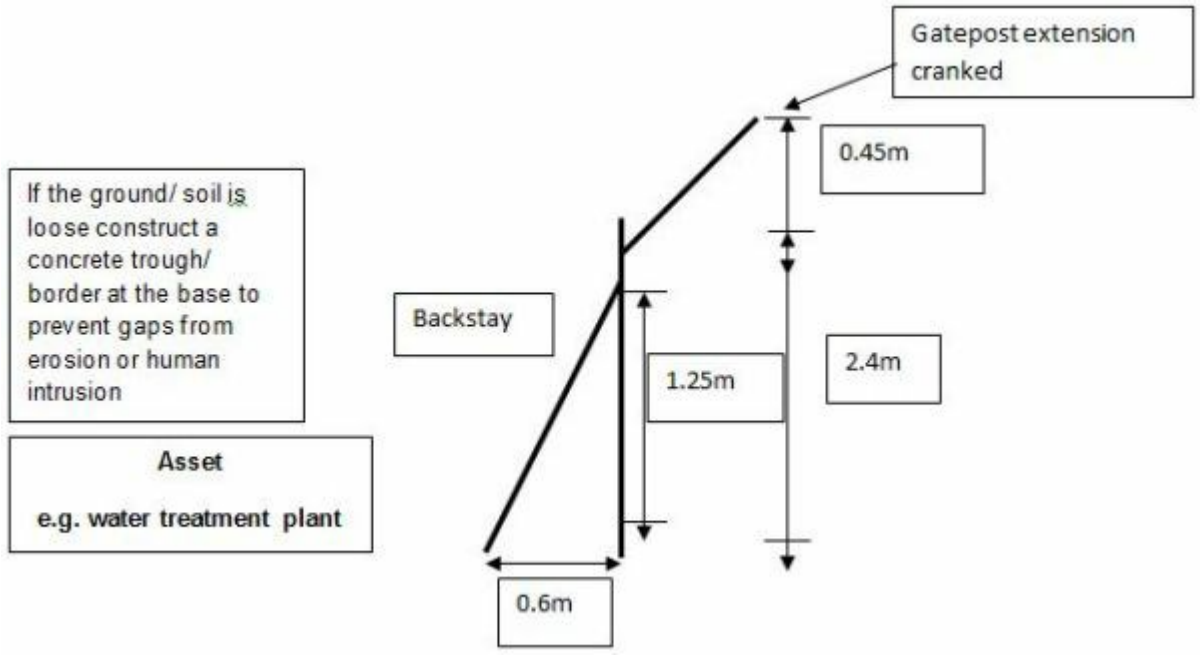
Security Fence Design Specifications
Figure SC6.4.3.21.2 Side view

SC6.4.3.21 Attachment C – General facility security



Security Gate Design Specifications
Figure SC6.4.3.21.3 Front View

SC6.4.3.21 Attachment C – General facility security



Security Gate Design Specifications
Figure SC6.4.3.21.4 Side View

SC6.4.3.21 Attachment C – General facility security

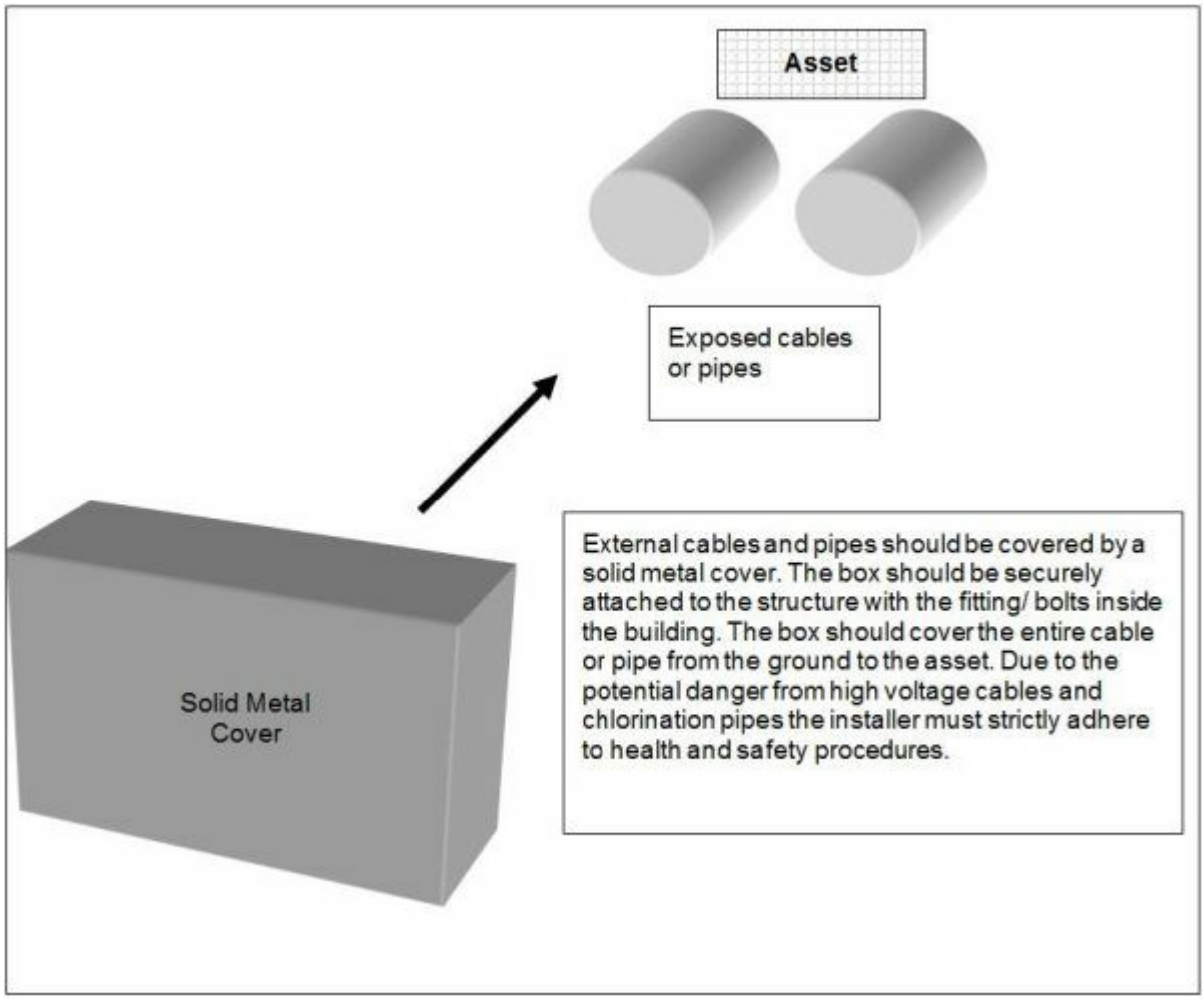


Figure SC6.4.3.21.5 External Cable and Pipe Cover Design Specifications:

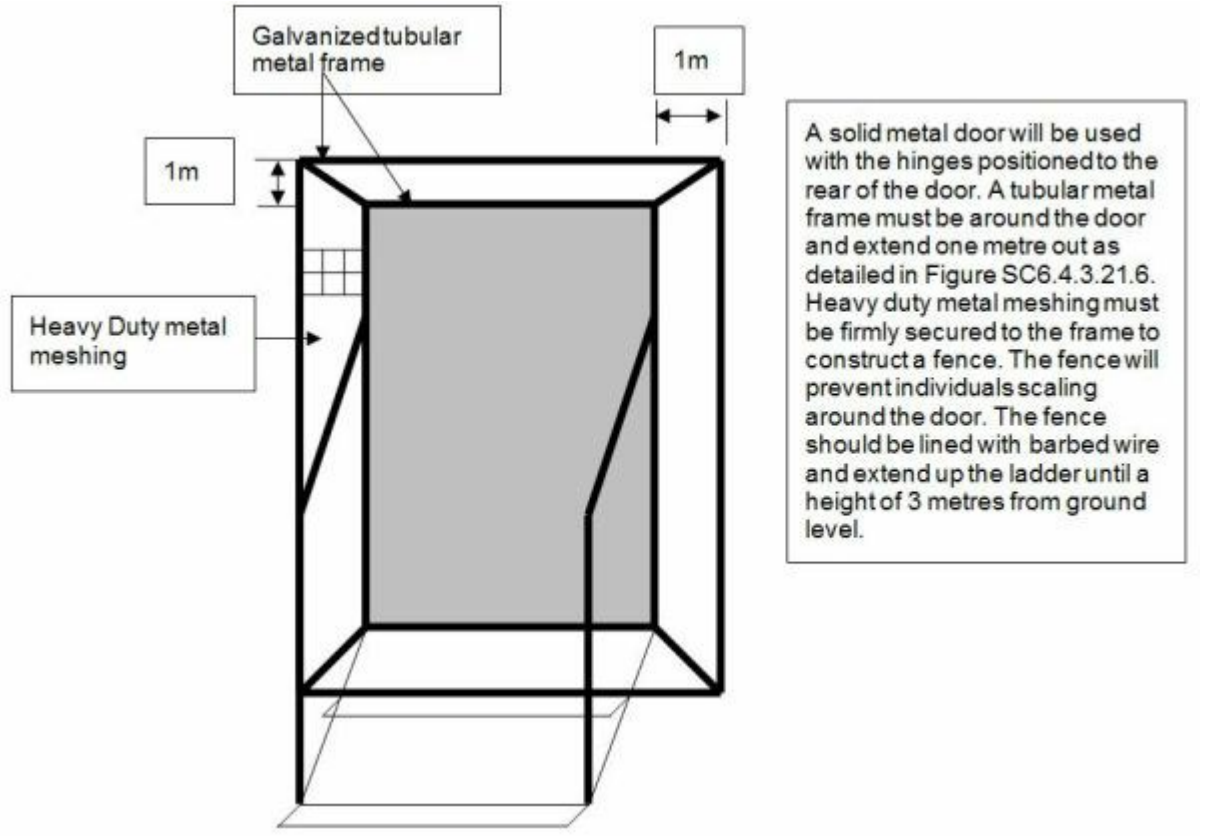


Figure SC6.4.3.21.6 Front View

Stairs or Bridge Gate Design Specifications:

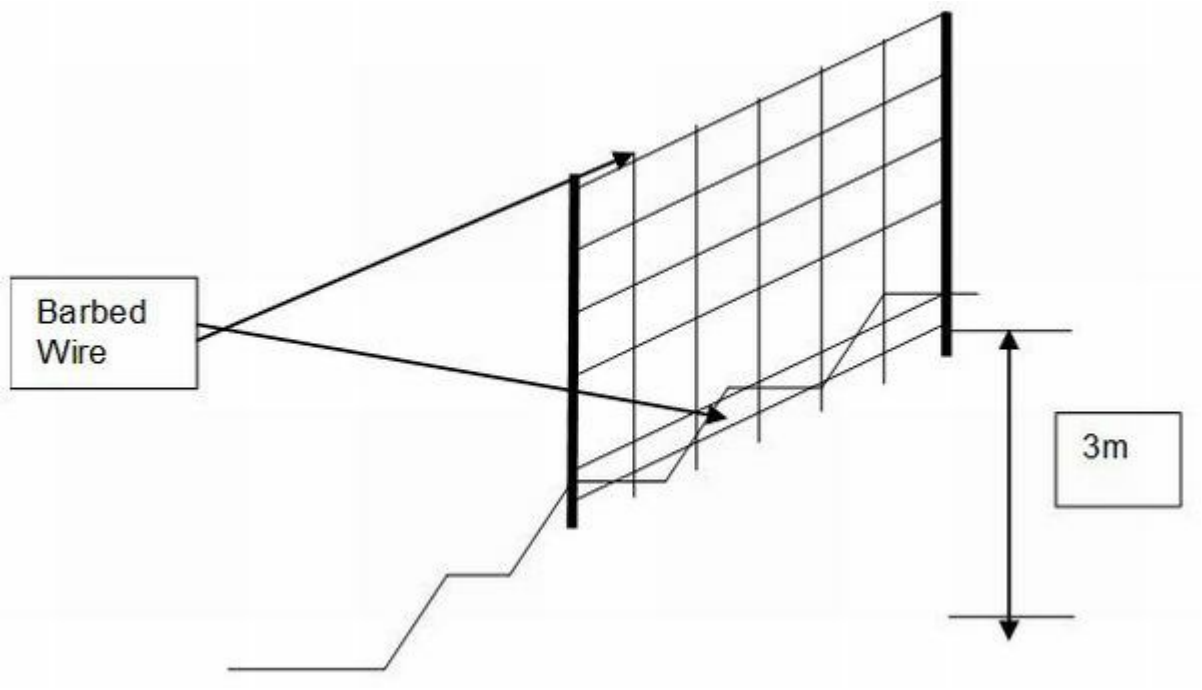


Figure SC6.4.3.21.7 Side View

Stairs or Bridge Gate Design Specifications:

SC6.4.3.22 Waste management guidelines

SC6.4.3.22.1 Introduction

(1) Purpose

The purpose of the Waste management guidelines is to:

(a) ensure development provides for the functional management of waste in a manner which is environmentally acceptable, safe and efficient and that does not have adverse amenity impacts on external properties or internal development;

(b) provide general guidelines and advice about achieving waste management outcomes of Townsville City Plan and satisfying any assessment criteria which identifies this planning scheme policy sub-section as providing that guidance or advice;

(c) state standards for waste management, storage and servicing identified in assessment criteria and which identifies this planning scheme policy sub-section as providing the standards; and

(d) provide guidelines about the preparation of a waste management plan.

(2) Reference and source documents

Reference and source documents and other policy sub-sections listed below shall be used, applied and read in conjunction with this planning scheme policy sub-section.

(a) Development manual planning scheme policy sub-sections that are to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscaping
SC6.4.3.17 Driveways
SC6.4.4.1 Geometric Road Design

(b) Legislation
Environmental Protection Regulation 2008
Environment Protection (Water) Policy 2009
Environmental Protection (Waste Management) Regulation 2000

(c) Townsville City Council
Townsville Waste Services Requirements for Waste Chute Guidelines, 2012
Liquid Trade Waste Policy, 2009

(d) Australian Standards
AS/NZS 3816 - *Management of clinical and related waste*
AS/NZS 2890 - *Parking facilities*
AS 4123 – *Mobile waste containers*

SC6.4.3.22.2 Waste management plans

Where proposed developments are likely to generate unusual or large amounts of waste, a waste management plan (WMP) may be required in demonstration of providing appropriate waste storage and waste servicing.

(1) Council may require submission of a waste management plan for development involving the following development thresholds:

(a) a residential use with more than 10 dwellings;

(b) a business/commercial/industrial use with a gross floor area greater than 500m² or any use likely to generate large or unusual amounts of waste, including educational establishment, rooming accommodation, hotel major sport, recreation and entertainment facility;

(c) an environmentally relevant activity (as defined by Schedule 1 of the *Environmental Protection Regulation 2008)* and/or development involving the use of a hazardous materials or chemicals;

(d) operational works involving substantial waste materials resulting from removal and construction of new infrastructure or demolition and major earthworks; and

(e) another use or activity where identified as having significant waste management requirements.

(2) Where WMPs are required to support a development application, it should be tailored to the needs of the proposal.

(3) Short-term activities or small-scale, uncomplicated developments require relatively simple and short WMPs.

(4) Larger proposals will require detailed plans covering the different stages of the development, operations or works program.

(5) A WMP should be submitted detailing how the proposal will meet the requirements of the Townsville City Plan and consider the following issues:

(a) Residential applications:

(i) types and amounts of waste that may be generated based on number of dwellings;

(ii) how the waste will be disposed including number of mobile storage bins or nomination of a suitable size bulk bin;

Note—all residential waste must be removed by council.

(iii) access and egress for council waste collection vehicles;

Editor's note—applicants should refer to sub-sections SC6.4.3.5 Car parking and public transport facilities guidelines and SC6.4.3.17 Driveways for additional information on design and access requirements.

(iv) screening of waste facilities by landscaping or other suitable means and where required, nomination of separation distances to property boundary or other residential buildings;

Editor's note—applicants should refer to sub-section SC6.4.3.6 Landscaping for additional information regarding landscape treatments.

(v) design of facility incorporating requirements from SC6.4.3.22.3 Waste management for development and Table SC6.4.3.22.1 General requirements;

(vi) sensitivity of the receiving environment and neighbouring residents (adequate setbacks of waste areas from adjoining property boundaries so as to prevent odour, dust or noise nuisance);

(vii) nomination of collection times where bulk refuse containers are required to protect nearby and on-site sensitive land use; and

(viii) designated bin wash down facilities to be identified for the contained cleaning of waste bins.

Note—bin washing water is not to be disposed of into stormwater facilities.

(b) Commercial and industrial applications:

(i) types and amounts of waste that may be generated by the authorised activities;

(ii) how the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with;

(iii) procedures for identifying and implementing opportunities to minimise the amount of waste generated, promote efficiency in the use of resources, and otherwise improve the waste management practices employed, including recycling;

(iv) access and egress for those disposing waste and waste collection vehicles;

Editor's note—applicants should refer to SC6.4.3.5 Car parking and public transport facilities guidelines and SC6.4.3.17 Driveways for additional information on design and access requirements.

Note—if the waste is stored in a secured underground shelter, then the waste must be taken out and presented to Townsville Waste Services on collection day.

(v) noise management for collection (collection methods and times);

(vi) screening of waste facilities by landscaping when used in combination with other suitable means and where required, nomination of separation distances to property boundary or other sensitive land uses;

Editor's note—applicants should refer to sub-section SC6.4.3.6 Landscaping for additional information regarding landscape treatments.

(vii) details of any accredited management system employed, or planned to be employed, to deal with the waste;

(viii) how often the performance of the waste management practices will be assessed;

(ix) the indicators or other criteria on which the performance of the waste management practices will be assessed;

(x) staff training on matters relevant to waste management;

(xi) details of the responsible person for implementing the WMP;

(xii) procedures for dealing with accidents, spills and other incidents;

(xiii) sensitivity of the receiving environment, and neighbouring residents (adequate setbacks of waste areas from adjoining property boundaries so as to prevent odour, dust or noise nuisance);

(xiv) management of odour;

(xv) extent and life of the proposed activities;

(xvi) details of bunding arrangements to contain waste where appropriate; and

(xvii) designated bin wash down facilities to be identified for the contained cleaning of waste bins.

Note—bin washing water is not to be disposed of into stormwater facilities.

(6) Council may request other reasonable management strategies in relation to individual developments.

(7) The WMP must be implemented during construction and at commencement of the use or the signing of the survey plan.

(8) WPMs should take into account any staging of a development.

(9) Consideration of screening treatments will include ensuring structural safety, durability to minimise whole of life costs, and where practical, integration into the building design and constructed from similar materials used in the building design (integration). Screening must be to a minimum of the height of the bins used and should ensure screening addresses adjoining uses and public spaces.

(10) Any amendments to a WMP must not be implemented until approval from council is received.

SC6.4.3.22.3 Waste management for development

(1) The waste management standards for development are identified in the following section and in Table SC6.4.3.22.1 General requirements.

(2) In addition to the requirements of Table SC6.4.3.22.1 General requirements, the following standards shall be considered for development:

(a) access for a refuse collection vehicle to an on-site or kerbside bin or a compactor is maintained at all times; or

(b) "No Standing Any Time" signs are to be installed in designated refuse truck turning areas including residential developments, cul-de-sacs and other locations to enable safe access for waste refuse vehicles; or

(c) a development application is to indicate the days and times that a refuse removal service is to operate. If evidence from a refuse collection contractor indicates that collection will occur outside normal service/delivery or business times, it may be permissible to allow a refuse collection vehicle to utilise

service bays or parking spaces on the site for access; or

(d) where applicable, development is to provide the vertical and horizontal clearances for the service to safely and efficiently operate. Unless otherwise stated in Table SC6.4.22.1 General requirements, the minimum vertical clearance required for movement of a refuse collection vehicle is 6.5m. Larger operational clearance dimensions may be required depending on site specific requirements; or

(e) where applicable, a development that proposes to utilise a waste collection system requiring clearances less than 6.5m for vehicle movement is to include a written confirmation from the proposed waste collection provider giving full details of the proposed system, bin sizes, number of bins, frequency of collection and the refuse collection vehicle size; or

(f) all refuse collection for residential development is to be collected by council, whilst office refuse may be collected by the council or a private operator and retail, shop or industrial refuse collection is to be collected by a private operator; or

(g) whether domestic refuse collection is from a bulk storage area or bins located throughout a unit development, all circulation and access roads utilised by a refuse vehicle are to be a minimum of 6.5m wide; or

(h) where a development has access onto a road, all refuse collection is from within the site. For access to a road the refuse truck is required to enter and leave the site in a forward direction; or

Editors note - Applicants should refer to SC6.4.3.13 Townsville road hierarchy for additional information.

(i) industrial development is to indicate the location of the refuse collection area in the development application and provide an indication of the proposed method of disposal of refuse and waste, including trade waste. Where disposal of industrial or commercial liquid waste by discharge to a road tanker application is necessary, the road tanker is able to stand totally on-site and comply with all other relevant regulations; or

(j) the owner/occupier must keep the bins clean, in good repair and securely covered.

(k) the property must be designed to store the bin/s at ground-level, and generally located towards the rear of the premises or, if not, out of sight of the general public, except when put out for collection (one day maximum); or

(l) where required, the property must be designed to facilitate the placing of the bin/s out (on the specified collection day) as follows:

  (i) on, or as close as possible to, the kerb adjacent to the premises, with the bin axle away from the road;

  (ii) with no structure or obstacle preventing the waste/ recycling crew from picking the bin up; and

  (iii) with at least 500mm spacing between the bins; or

(m) particular serviced premises may be required to keep the bin on an elevated platform or an imperviously paved area, enclosed and/or with drainage; or

(n) council may also instruct certain residential premises to dispose of their waste by an approved environmental licensed authority.

(3) Applications must ensure that adequate unhindered access for waste collection vehicles is possible, ensuring that not only the road reserve widths accommodate a waste collection vehicle, but that vehicles can safely and efficient collect kerb side waste.

(4) Waste collection from properties in cul-de-sac heads or hammer heads may require kerb side concrete hardstand areas to be constructed to ensure that kerb side collection remains possible. SC6.4.3.22.5 Concrete hardstand design for wheelie bins provides the design specification for kerb site domestic wheelie bins.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(5) Waste collection from a laneway is only permitted when the laneway has through access, sufficient width to accommodate the waste collection vehicle and the identification of wheelie bin collection points. Overhead

services also need to be clear of the waste collection area.

(6) Private access handles where multiple lots may be serviced from are not accessible by a waste collection vehicle. In such instances, a safe designated kerb side collection point is to be nominated. SC6.4.3.22.5 Concrete hardstand design for wheelie bins provides the design specification for kerb side domestic wheelie bins.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(7) Where waste collection points are nominated away from the property being serviced (cul-de-sacs, laneways, access handles), nominated collection points are not permitted adjacent to a park and are not to compromise the safe use or access to pedestrian or other utility service.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(8) Where staged residential estates result in temporary no through connection roads (for example, until subsequent stage construction is complete), compacted gravel (or equivalent) is required to be created at the end of a constructed road within a public tenure (i.e. road reserve).

Editor's note—waste collection vehicles will not be permitted to use privately owned land to turnaround.

(9) In instances where roads terminate to adjoining land and adjoining land is in separate/different ownership or not subject to the development application, applicants will need to provide a turnaround area within the development site until future through connection can be established. In this instance, the turnaround area will need to be constructed of durable material.

(10) If a rear lot, the frontage is to include an additional truncated area to provide sufficient space for the servicing of mobile waste containers. These truncated collection points are to avoid obstructing any driveway or encroachment onto neighbouring frontages.

(11) If there are two or more rear lots, no more than two adjoining truncated areas are provided for the servicing of mobile waste containers.

(12) Collection points are not located:

(a) near intersections;
(b) near roundabouts or traffic calming devices (or other traffic management devices);
(c) on arterial road frontages;
(d) in narrow lanes (where refuse collection vehicle access is difficult or impossible); and
(e) near bus stops.

(13) Where on-street (kerbside) waste collection is proposed for standard domestic waste containers sufficient kerbside space is provided adjacent to the frontage of the premises for the required number of bins and such space is:

(a) clearly separated from car parking bays, loading bays and other similar no-standing areas;
(b) clear of overhanging branches, awnings and other such hindrances to servicing by a lifter arm;
(c) clear of footpaths and pedestrian access connections to the road;
(d) not in front of shop entrances or private residential premises;
(e) not blocking the vision of vehicles using the roadway or entering and exiting the property;
(f) capable of being serviced safely without the collection vehicle impeding traffic flow during servicing; and
(g) capable of being serviced while the collection vehicle travels forward (i.e. without the vehicle needing to

reverse).

SC6.4.3.22.4 Regulated waste guidelines

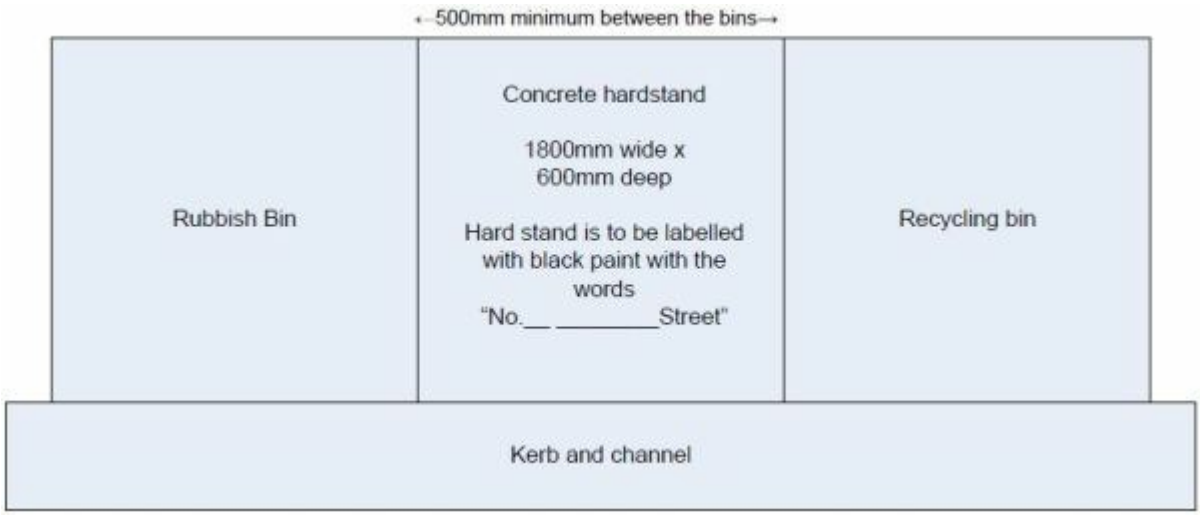
(1) Regulated waste is administered by the Department of Environment and Heritage Protection.

(2) Transport, storage, recycling or disposal of regulated wastes are environmentally relevant activities.

(3) Environmentally relevant activities that are prescribed activities are generally industrial activities but can also include some agricultural activities. A full list of all of the prescribed ERAs can be found in Schedule 2 of the *Environmental Protection Regulation 2008.*

SC6.4.3.22.5 Concrete hardstand design for wheelie bins

Where waste collection vehicles are unable to collect wheelie bins directly in front of a property due to access restrictions, owner/occupiers must take the bin/s to a designated collection point. The diagram below demonstrates the dimensions required for a hardstand for these bins at the designated collection point.



SC6.4.3.22.6 Examples of bin storage area

Figure SC6.4.3.22.1 Concrete hardstand for mobile waste containers or a bulk bin

A: Courtside entrance: The height of the roof is 1m in the middle receding downwards.
B: Interior: The height is 2.5m to the top of the pillar/ gutter level.
C: Exterior entrance: The gate is 1.9m of the total 4m depth and is accessed by a key.
D: Kerbside view.

Figure SC6.4.3.22.2 Enclosed concrete hardstand for bulk waste and recycling mobile waste containers

SC6.4.3.22.7 Bulk bin specifications

Note—refer to AS 4123 for the standard sizing of bulk bins. Bulk bins must be ordered well in advance to ensure availability.

Table SC6.4.3.22.2 Bin dimensions in litres (L) and cubic metres (m^3)

Recycling and Waste bins available for units, multi-dwelling units and commercial units
240 L plastic
360 L plastic (recycling)
Bulk Recycling and Waste bins available for multi-dwelling units and commercial units
660 L plastic/metal
1100 L metal
Bulk Waste bins available for multi-dwelling units and commercial units
0.75 m^3 metal
1 m^3 metal
1.5 m^3 metal
3.0 m^3 metal
Bulk Waste bins available for commercial units
4.0 m^3 metal

Table SC6.4.3.22.3 Weekly bin collections in relation to bulk bin size

Number of units (dwellings)	Bulk bin Size	Collection frequency (per week)
6	0.75 m^3	Twice
6	1 m^3	Twice
6	1.5 m^3	Once
12	1.5 m^3	Twice
12	3 m^3	Once
24	3 m^3	Twice

Table SC6.4.3.22.1 General requirements

	General details	Access and collection	Locality of storage areas/design of facility
Residential (dwelling house dual occupancies)	Mobile waste containers (240 L) are used for both waste collection and recycling. Owner/occupiers may also choose to pay a small additional charge for a 360 L recycling bin.	Where sloping areas exist (≥15%), an adequate level hard stand area with sufficient space to accommodate all bins for collection is to be made available along the street frontage for the collection of mobile waste and recycling containers collected fortnightly. Refer to SC6.4.3.22.5 for an auto court concrete hardstand design for wheelie bins. Other arrangements may be negotiated.	Mobile waste containers must be stored at a location within the property boundary that avoids nuisance to neighbouring properties.

Residential (including multiple dwelling, residential care facility retirement facility and the like)	Developments containing a maximum of 10 dwellings will be issued with new mobile waste containers unless there is insufficient footpath to place the waste and recycling bins for collection. Where on-street access for collection of mobile garbage (wheelie) bins is not available, or multiple dwellings contain more than 10 dwelling (or similar) the developer must provide bulk refuse facilities. Refer to SC6.4.3.22.7 for more information on bulk bin collections. Recycling bins will be allocated at the rate of: 1-4 dwellings 1 bin per dwelling 5-10 dwellings 5 bins More than 10 dwellings 1 bin per 2 dwellings If constructing waste chutes, refer to council's Waste Chute guidelines.	Access roads must be designed and constructed to accept vehicle loadings of not less that G.V.M. 33 tonnes. If the road system is incapable of allowing waste vehicle access, tailored solutions will be negotiated with the developer in association with the Waste Services Division. Vehicles must be capable of exiting the site in a forward gear. A turning circle of 25m is required. Waste collection facilities are to be located within the curtilage of the premises in an accessible location to receive the service. Facilities should be sited in front of any entry gates to the building. Where security gates cross the driveway restricting vehicular access to the site, bin storage areas are to be located within property boundaries on the street side of the gate. A minimum overhead clearance of 6.5m is required (with an additional 2m if located near power lines). This must be unobstructed by anything overhead such as trees, wires, sails, awnings, fascia or other structures. Where sloping areas (≥15%) such as steep road reserves exist, an adequate level hard stand area with sufficient space to accommodate all bins for collection is to be made available along the street frontage for the collection of mobile waste containers (collected weekly), and recycling mobile waste containers (collected fortnightly).	For multiple dwellings where there is sufficient room for each dwelling to store their mobile waste containers; the resident of each dwelling is responsible for the storage of their bins (including recycling bins). Where there is insufficient space for individuals to accommodate their bins, a common waste storage area must be provided of a sufficient size to accommodate all bins (including recycling bins). Storage areas must provide convenient access for owners, tenants and collection vehicles. Refer to SC6.4.3.22.6 for examples of bin storage areas. Facilities must provide a suitable level enclosure with a concrete slab floor, graded and drained through an approved sediment/silt trap to a legal sewer connection. A hose cock and hose must be fitted in close proximity to the enclosure. Enclosure dimensions for bulk bins must exceed the size of the nominated bin size by at least 300mm at the rear and both sides and 600mm at the front; and be oriented to allow convenient access for collection. Where mobile waste containers are in use, an adequate storage area must be provided. Facilities must be enclosed/screened such that they are not visible from any street frontage.

Commercial and business industrial	The proprietor is to arrange for the removal of waste from the premises by a suitably licensed waste transport contractor. Putrescible waste arising from activities undertaken on this development must be collected and removed at periods not exceeding seven days. (a) The collection of waste is to be undertaken to minimise, so far as reasonably practicable, excessive noise to neighbouring occupants. The collection method must ensure that waste is adequately managed to prevent escape or contamination. (b) Where the development has the potential to generate or handle clinical and regulated waste material; clinical and medical related waste is to be handled in accordance with AS/NZS 3816; and the *Environmental Protection (Waste Management) Regulation 2000*. (c) Where practicable, all loading and unloading shall take place within the containment area (storage area). This area is to be constructed in such a way that any spills from loading or unloading are not permitted to escape to areas exposed to storm water. No clinical and related wastes shall be disposed of via the storm water drainage system. (d) Trade Waste is to be managed in accordance with council's Liquid Trade Waste Management Plan 2009.	Access roads and driveways must be designed and constructed to accept vehicle loadings of not less that G.V.M. 33 tonnes. Vehicles must be capable of exiting the site in a forward direction. A turning circle of 25m is required. A minimum overhead clearance of 6.5m is required (with an additional 2m if located near power lines). This must be unobstructed by anything overhead such as trees, wires, sails, awnings, fascia or other structures.	Facilities are to be located within the curtilage of the premises in an accessible location to receive the service. Facilities should be sited in front of any entry gates to the building. Where security gates cross the driveway restricting vehicular access to the site, bin storage areas are to be located within property boundaries on the street side of the gate. Adequate provision must be made for the collection of the waste storage containers within the premises. Storage of waste must not cause odour, dust or noise related nuisance to neighbouring properties. Facilities must provide a suitable level enclosure with a concrete slab floor, graded and drained through an approved sediment/silt trap to a legal sewer connection. A hose cock and hose must be fitted in close proximity to the enclosure. Bulk bin enclosure dimensions must exceed the size of the nominated bin size by at least 300mm at the rear and both sides and 600mm at the front; and be oriented to allow convenient access by the collection vehicle. Where mobile waste containers are in use, an adequate storage area must be provided. Facilities must be enclosed/screened such that they are not visible from any street frontage.

SC6.4.3.23 Water and sewer network modelling guidelines

SC6.4.3.23.1 Introduction

(1) General

Water and sewerage network models are important engineering technical tools that are used to inform both forward infrastructure planning and network design. Where used appropriately as part of the planning and design process, models can assist to achieve the following outcomes:

(a) value for money infrastructure delivery;

(b) utilisation of existing infrastructure to its full capacity; and

(c) provision of accurate information for future infrastructure planning decisions.

(2) Purpose

The purpose of these guidelines is:

(a) to outline an approach to the development of new models to enable a consistent approach to modelling to be followed by both council, external service providers and developers;

(b) to provide guidance regarding modelling approaches to demonstrate compliance of designs with SC6.4.3.21 Townsville Water planning and design guidelines; and

(c) to provide details on reporting requirements to be submitted as part of design reports and planning reports.

(3) Scope

SC6.4.3.23 Water and sewer network modelling guidelines are to be used in conjunction with:

(a) SC6.4.3.21 Townsville Water planning and design guidelines;

(b) Townsville City Plan; and

(c) *Planning Guidelines for Water and Sewerage*, Department of Environment and Water Supply (Latest version).

Editor's note - These guidelines are not intended for use in building hydraulic services or irrigation design.

(4) Terminology

AD	Average Day Demand
ADWF	Average Dry Weather Flow
CSS	Customer Service Standards
DAU	Development Assessment Unit Within TCC
DSS	Design Service Standards
EP	Equivalent Population
FF	Fire Flow Demand
GWI	Groundwater Infiltration
HGL	Hydraulic Grade Line
IP	Infrastructure Planning Unit Within TCC
MDMM	Mean Day Maximum Month
PD	Peak Day Demand
PDWF	Peak Dry Weather Flow
PIA	Priority Infrastructure Area
PIP	Priority Infrastructure Plan
PFTI	Plans For Trunk Infrastructure
PH	Peak Hour Demand
PWWF	Peak Wet Weather Flow
RPEQ	Registered Professional Engineer of Queensland
TCC	Townsville City Council
TWW	Townsville Water and Waste (The Water Service Provider)

SC6.4.3.23.2 Determining when to complete a network modelling analysis

The circumstances under which a network model is required is listed under clauses SC6.4.3.21.2 Water supply design and SC6.4.3.21.3 Sewerage system design of SC6.4.3.21 Townsville Water planning and design guidelines. The process flow chart in SC6.4.3.23 Attachment A demonstrates the decision process that is to be followed when considering the requirement for a network analysis.

(1) Available information

Planning demand and loading rates for water and sewerage infrastructure design are listed in Part 4 Priority infrastructure plan of the Townsville City Plan.

Council has established a number of sewer network models covering service catchments across the city. A map showing sewer catchments, modelling status and latest planning report information can be requested from the Development Assessment Unit (DAU) of council.

A city wide water network model is also available for use.

Editor's note—Access to council's city wide water network model is available to appropriately qualified users approved by the Infrastructure Planning Unit of TCC. Refer to SC6.4.3.23.3 (2).

Plans for Trunk Infrastructure (PFTI) are available and detail trunk infrastructure that is planned for by council to service the Priority Infrastructure Area (PIA). These should also be referred to in order to determine if your development may affect or should take into consideration planned infrastructure in its vicinity.

(2) Preparing a preliminary needs analysis

An applicant for a development must complete a “Preliminary Needs Analysis” form (SC6.4.3.23 Attachment B) for their development which enables identification of any potential impacts on the water and sewer network. Where an impact is anticipated, it is likely that an analysis will be required to demonstrate compliance with design standards. The level of modelling assessment required is dependent on the impact expected.

Editor's note - If your preliminary analysis results in a modelling assessment being required, you should contact the DAU of council to confirm the level of modelling necessary. It is encouraged that this assessment be completed prior to application lodgement to ensure an efficient approval process.

The completed "SC6.4.3.23 - Attachment B - Form M1 - Network model needs analysis form" is required to be included with your analysis and application to justify the level o analysis undertaken.

Editor's note—The "Preliminary Needs Analysis" will determine if:

(a) a network analysis is not required; or

(b) you are required to do a simplified network analysis; or

(c) you are required to do a detailed network analysis, involving establishment of a new model, or use an existing model; or

(d) you need to incorporate a network modification in your application, with details specified by council.

If a network analysis is required, it must be done in accordance with these guidelines

SC6.4.3.23.3 Provision of the TCC Network Model Data

(1) Requesting information to inform your analysis

Modellers may request boundary condition information from council, and/or access to council's network models by submitting a “Request for Network Modelling Information” form included in SC6.4.3.23 Attachment C - Form M2 - Request for network modelling information.

Editor's note—"SC6.4.3.23 Attachment C - Form M2 - Request for network modelling information" is an electronic form.

In most cases it is desired that boundary condition information is sufficient to enable a modeller to prepare their own network model. However, depending on the size or impact of the development being considered, it may be necessary for the modeller to utilise council’s network models to demonstrate:

(a) in the case of the sewer network:

(i) receiving network capacity is sufficient; and

(ii) modified or realigned infrastructure as a result of the development has not adversely affected existing or planned for system hydraulics; and

(b) in the case of the water network:

(i) network supply capacity is sufficient; and

(ii) existing network hydraulic capacity is not adversely affected by any changes to the supply network as a result of the proposed development.

Generally, where trunk infrastructure may be affected by the proposed works, council's network models must be used to verify the impact and identify required mitigation/augmentation options.

(2) Access to council models

Access to council's network model/s is available to appropriately qualified users approved by the Infrastructure Planning Unit of TCC.

Editor's note—For information on the approval process applicants should contact the Infrastructure Planning Unit of TCC.

Council will make available at their offices a computer to enable analysis of a development or for viewing existing network model information. The applicant must apply for access to council's network model/s by submiiting the "SC6.4.3.23 - Attachment C - Form M2 - Request for network modelling information" form. The modeller will need to agree to council's terms of use on this form.

SC6.4.3.23.4 General requirements for network models

(1) Scale and spatial reference

"Simplified Models" may be developed as representative schematics of the proposed network. Manual calculations without the use of network modelling software may be permitted.

"Detailed Models" shall be constructed based on proposed design and/or development layouts. The layouts may be schematic but should remain representative of the proposed development layout. In order to enable import of models into council's existing network models, they shall be developed to the GDA1994 MGA Zone 55 coordinate system unless otherwise notified.

(2) Modelling timeframes

Timeframes for modelling shall be as per clauses SC6.4.3.21.2(2) and SC6.4.3.21.3(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

(3) Model calibration

Where possible, calibrated models shall be used to verify system capacity.

(4) Modeller experience and qualifications

Network modelling must be carried out by professionals suitably experienced and qualified in the undertaking of network modelling analysis and design. Models, associated reports and designs must be certified by the appropriately qualified and experienced RPEQ.

SC6.4.3.23.5 Water network modelling

(1) Scope

A water network model is required where listed under the requirements of SC6.4.3.21.2(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

(2) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations or simplified network models to demonstrate compliance with design standards. A simplified assessment must include:

(a) assessment of design demands in accordance with SC6.4.3.23.5 (3)(d) of this sub-section;

(b) where necessary, hydraulic calculations based on fixed boundary conditions for both peak hour and fire-fighting demand;

(c) calculations can be undertaken manually, using spread sheets or using network modelling software. Where modelling software is used, the model files shall be provided to council as part of the submission;

and

(d) a brief report covering the requirements of SC6.4.3.23.5 (3)(f) of this sub-section. Sketches of results are to be provided where they make it easier to interpret results.

(3) Model requirements – detailed assessment

(a) Format

Bentley WaterGEMS must be used for the development of new water network models. Models shall be set up such that all scenarios and options considered for the study are incorporated into a single model file. The model file(s) shall be provided to council as part of the submission.

(b) Scenario planning

A scenario plan must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A “parent” scenario should be applied for each design horizon or stage, and ultimate development. The following model structure provides an example of a model scenario structure.

---Scenario 1000- Existing Peak Day Demand (Extended Period Analysis)
----------Scenario 1100- Existing Peak Hour Demand (Steady State Analysis)
----------e.g. Scenario 1110 - Existing Peak Hour with Infrastructure Option 1
----------e.g.Scenario 1120- Existing Peak Hour with Infrastructure Option 2 (Preferred)
----------Scenario 1121- Existing Fire Fighting Assessment (Steady State analysis, automated)
---Scenario 2000- Ultimate Peak Day Demand (Extended Period Analysis)
----------Scenario 2100- Ultimate Peak Hour Demand (Steady State Analysis)
----------e.g.Scenario 2110- Ultimate Peak Hour with Infrastructure Option 3 (Preferred)
----------Scenario 2111- Ultimate Fire Fighting Assessment (Steady State analysis, automated)

As shown the scenario structure naming should be clear and transparent as to which design case it represents and the preferred option applied for the design should be marked.

(c) Technical specification

(i) Hydraulic method

Modelling must be undertaken using the Hazen Williams hydraulic calculation method, with pipe friction coefficients as listed in Table SC6.4.3.21.4 of SC6.4.3.21 Townsville Water planning and design guidelines.

(ii) Losses across valves

Where control valves are required in the system, the valve should be modelled with appropriate loss factors/curves. The modeller must ensure that loss factors applied for design of a system can be achieved in reality by available products, and where possible apply the loss factor or curve for a design valve.

(iii) Pump curves

A design duty (single point pump curve) may be used initially when designing a pumping system however the modeller is to ensure that the pump duty proposed can be achieved by readily available pumps. Where possible an actual pump curve for a design pump shall be applied for modelling purposes.

(iv) Pump controls

Pumps shall be modelled with simple controls where possible. The modeller must consult with council when applying pump controls to ensure it meets the requirements of Townsville Water operators.

(v) Reticulation

Master Planning Models shall model trunk infrastructure only. Refer to Part 4.7 Definitions of the Townsville City Plan for the definition of trunk infrastructure.

Design Models shall model reticulation down to a DN63 pipe.

(d) Demands

(i) General

Design demands are to be calculated in accordance with SC6.4.3.21.2(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

Demands must be applied as Peak Day demand in litres per second (L/s), with the appropriate diurnal pattern applied for the particular land use.

Demands should be applied at the nearest network node, and within 40 m of the property boundary.

Where a node represents demands generated from different land uses, separate demand entries should be applied to the node to enable quick identification of the source of the demand.

(ii) Use of unit demand factors

WaterGEMS enables unit demand factors to be applied, such that the resultant demand from the unit load, loading rate and peaking factors are calculated as part of the modelling process. The use of this feature is required for master planning models, enabling tracking of design EPs modelled.

(iii) Diurnal patterns

Diurnal patterns represent fluctuations in demand load across a day. Patterns for various land uses are included in SC6.4.3.21 Attachment A of the Townsville Water planning and design guidelines.

(e) Scenarios

(i) Extended period analysis

Extended period analysis is used to demonstrate compliance with SC6.4.3.21 Townsville Water planning and design guidelines. Extended period analysis must be utilised when considering networks that incorporate reservoirs, pump stations or other hydraulic controls.

Extended period analysis enables assessment of the bulk water transportation capacity of the network to ensure that:

(A) reservoirs never empty;

(B) reservoir minimum contingency storage levels are maintained;

(C) the reservoir supply system has a net delivery capacity equal to or greater than Peak Day;

(D) pumping systems are designed within operational limits; and

(E) system pressures are achieved across a day.

(ii) Council requires two scenarios of extended period analysis to be modelled:

3 day extended period analysis

Boundary conditions:

- reservoirs commencing water level 90% capacity;
- pump stations – all pumps in station initially off; and
- demand applied: Peak Day demand.

7 day extended period analysis

Boundary conditions:

- reservoirs commencing water level 90% capacity;
- pump stations – all pumps in station initially OFF; and
- demand applied: 95% of Peak Day demand.

(iii) Steady state analysis

Peak hour

Where a peak day analysis is required for a model, a separate steady state analysis to demonstrate compliance with design standards for Peak Hour is not necessary. Rather, the results at Peak Hour on the Peak Day may be reported at that specific time step.

Peak hour analysis is used to assess network pressures at Peak Hour to ensure the design requirements of SC6.4.3.21 Townsville water planning and design guidelines are met.

Boundary conditions:

(A) demands may be applied directly as Peak Hour demand, or at Peak Day demand with peaking factor to represent Peak Hour.

Fire-fighting analysis

Fire fighting analysis is used to assess network capacity of the network water mains with respect to the design requirements listed the SC6.4.3.21 Townsville water planning and design guidelines.

Use of automated analysis, where fire-fighting conditions are tested at each node/hydrant within the network, should be employed.

Boundary conditions:

(A) reservoirs commencing at mid water level; and

(B) demand applied: Peak Hour unless otherwise advised by council.

(f) Reporting requirements

A water network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction:

(A) development locality, lot/plan description, application number (if applicable);

(B) objectives of study – design/master plan; and

(C) brief methodology – describe level of modelling undertaken (simplified/detailed), software used, reference to model overview in appendix.

(ii) Population and demand assessment:

(A) population assessment based on land use categories, site plan showing layout and land use;

(B) demand assessment showing demand calculation and peaking factors applied;

(C) summary table showing total demand, with breakdown for each land use category, Average Day (kL/d), Peak Day demand (kL/d or L/s); and

(D) summary table showing demand breakdown for each service catchment, where applicable.

(iii) Modelling assessment:

(A) modelling method – simplified or detailed assessment;

(B) scenarios analysed, including description or reference to design standards applied;

(C) modelling assumptions;

(D) existing network description, including proposed connection points; and

(E) modelling assessment:

- existing system capacity;
- existing system + ultimate development; and
- augmentations, new infrastructure options analysis including assessment of options at interim stages - 10y/20y/ultimate horizons.

(iv) Options analysis:

(A) triple bottom line analysis; and

(B) net present value assessment.

(v) Summary:

(A) preferred option, justification, capital works program.

(vi) RPEQ Certification statement as detailed in SC6.4.2.

(vii) Appendix:

(A) for detailed models, model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);

(B) model map showing model layout (nodes, pipes, labels and any relevant boundary conditions, e.g. reservoirs or head points applied); and

(C) tabulated data and results – to be provided at peak hour analysis and fire fighting analysis:

Nodes	• Element ID • Node Elevation • Peak Hour Demand • Calculated Hydraulic Grade (m) • Calculated Pressure (m) For fire-fighting analysis • Available fire-fighting flow • Available pressure at fire fighting demand
Pipes	• Element ID • Pipe diameter • Material and class • Length • Start node • Stop node • Hazen Williams C value • Flow rate • Velocity • Headloss gradient
Pump Stations	• Element ID • Pump type (fixed, variable speed) • Pump configuration (duty/standby etc.) • Pump curve, if selected
Reservoirs	• Element ID • Reservoir Capacity • Top Water Level • Bottom Water Level

(D) pump stations - system resistance curve with pump curve overlaid. Pump curve may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (i.e. it needs to be physically achievable).

SC6.4.3.23.6 Sewer network modelling

(1) Scope

A sewer network model is required where listed under the requirements of clause SC6.4.3.21.3 of SC6.4.3.21 Townsville water planning and design guidelines.

(2) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations to demonstrate compliance with design standards. A simplified assessment must include:

(a) assessment of design loads in accordance with SC6.4.23.6(3)(d) of this sub-section;

(b) where necessary, hydraulic calculations based on fixed boundary conditions for Peak Wet Weather Flow loading;

(c) calculations can be undertaken manually, using spreadsheets or using network modelling software. Where modelling software is used, the model files shall be provided to council as part of the submission; and

(d) a brief report covering the requirements of SC6.4.23.6(3)(f) of this sub-section. Sketches of results are to

be provided where they make it easier to interpret results.

(3) Model requirements – detailed assessment

(a) Format

Bentley SewerGEMS sanitary must be used to undertake detailed assessments of sewer networks. This will enable models to be incorporated into council's existing network models.

Models shall be set up such that all scenarios and options considered for the study are incorporated into a single model file.

(b) Scenario planning

A scenario must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A "parent" scenario should be applied for each design horizon or stage and ultimate development. The following provides an example of a model scenario structure.

---Scenario 1000- Existing Average Dry Weather Flow
----------Scenario 1100- Existing ADWF Overflow Storage Assessment
----------Scenario 1200- Existing Peak Wet Weather Flow
---Scenario 2000- Ultimate Average Dry Weather Flow
----------Scenario 1100- Ultimate ADWF Overflow Storage Assessment
----------Scenario 1200- Ultimate Peak Wet Weather Flow
----------Scenario 1210- Ultimate PWWF Infrastructure Option 1
----------Scenario 1220- Ultimate PWWF Infrastructure Option 2 (Preferred)

(c) Technical specification

Hydraulic method

Mannings formula must be used for calculation of gravity network hydraulics, in accordance with the requirements of the *Sewerage Code of Australia* (WSA 02-2002).

Hazen-Williams method must be applied for pressure pipe systems in accordance with SC6.4.3.21 Townsville Water planning and design guidelines.

Inflow/Infiltration

Inflow/Infiltration shall be modelled intrinsically as a part of the calculated design loads, in accordance with SC6.4.3.21 Townsville Water planning and design guidelines.

Pump curves

A design duty (single point pump curve) may be used initially when designing a pumping system however the modeller is to ensure that the pump duty proposed can be achieved by readily available pumps. Where possible an actual pump curve for a design pump shall be applied for modelling purposes.

Pump controls

Pumps must be modelled with simple controls where possible. The modeller must consult with council when applying pump controls to ensure it meets the requirements of Townsville Water operators.

(d) Sewage flow calculation

Design loads are to be calculated in accordance with SC6.4.3.21.3(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

Loads must be applied to the model as an Average Dry Weather Flow (ADWF) base demand. A peaking factor multiplier applied as a fixed pattern on the load must be used to generate Peak Wet Weather Flow (PWWF).

Where a manhole represents demands generated from different land uses, separate demand entries must be applied to the node to enable quick identification of the source of the demand.

(e) Scenarios

(i) Static vs. dynamic modelling

Sewer network models should be run dynamically (i.e. over an extended period) to enable:

(A) assessment of system storage prior to overflow;

(B) ensure model stability when system is fully loaded; and

(C) ensure the interaction of pumps on a common system are assessed.

A minimum 24 hr simulation period is therefore recommended. The user should report results at the appropriate timestep (i.e. maximum conditions in system).

(ii) ADWF analysis

ADWF analysis is used to assess basic system performance under dry weather flow conditions. This analysis is also used to assess the amount of system storage available before an overflow is activated within the catchment (being inter-area or environmental).

(iii) PWWF analysis

PWWF analysis is used to assess network performance in respect to the design requirements listed in SC6.4.3.21 Townsville Water planning and design guidelines.

(f) Reporting requirements

A sewer network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction:

(A) development locality, lot/plan description, application number (if applicable);

(B) objectives of study – design/master plan; and

(C) brief methodology – describe level of modelling undertaken (simplified/detailed), software used, reference to model overview in appendix.

(ii) Sewage flow/loading assessment:

(A) population assessment based on land use categories, site plan showing layout and land use;

(B) load assessment showing calculation of ADWF and PWWF flows; and

(C) summary table showing total load, with breakdown for each pump station catchment or network subcatchment, average dry weather flow (L/s), (kL/d), peak wet weather flow (L/s), (kL/d).

Where an existing council model is being updated, a table comparing previous catchment loads to updated catchment loads must be provided.

(iii) Modelling assessment

(A) scenarios analysed, including description or reference to design standards applied;

(B) modelling assumptions;

(C) existing network description, including proposed connection points; and

(D) modelling assessment:

- existing system capacity;
- existing system + ultimate development;
- augmentations, new infrastructure options analysis including; and
- assessment of options at interim stages - 10y/20y/ultimate horizons.

(iv) Options analysis:

(A) triple bottom line analysis; and

(B) net present value assessment.

(v) Summary:

(A) Preferred option, justification, capital works program.

(vi) RPEQ Certification statement in accordance with SC6.4.2.

(vii) Appendix:

(A) model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);

(B) tabulated results of the manhole, gravity and pressure main outputs:

Manholes	• Element ID • Node Elevation • Design Load
Pipes - gravity and pressure mains	• Element ID • Pipe diameter/material and class • Grade • Upstream manhole • Downstream manhole • Pipe flow depth as percentage of diameter PWWF (gravity mains) • Flow velocity at PWWF (pressure mains) • Flow velocity under single pump operation (pressure mains)
Pump Stations	• Element ID

(viii) pump stations - system resistance curve with pump curve overlaid. Pump curve may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (i.e. it needs to be physically achievable).

SC6.4.3.23.7 Copyright and ownership of submitted models

When a technical report or study is submitted to council as part of a development application, this report/study, along with all components of the submission, can be made available to the public as part of the notification stage. The report can be provided to anyone seeking the report during this stage and following the approval. Use of the report for any third party use will be at the complete risk of the third party. It should be noted that only the approved report including any council requested amendments, will be referred to in future.

Once a development application is approved council is permitted to use the model for incorporation into its overall city water and sewer models to inform its infrastructure planning.

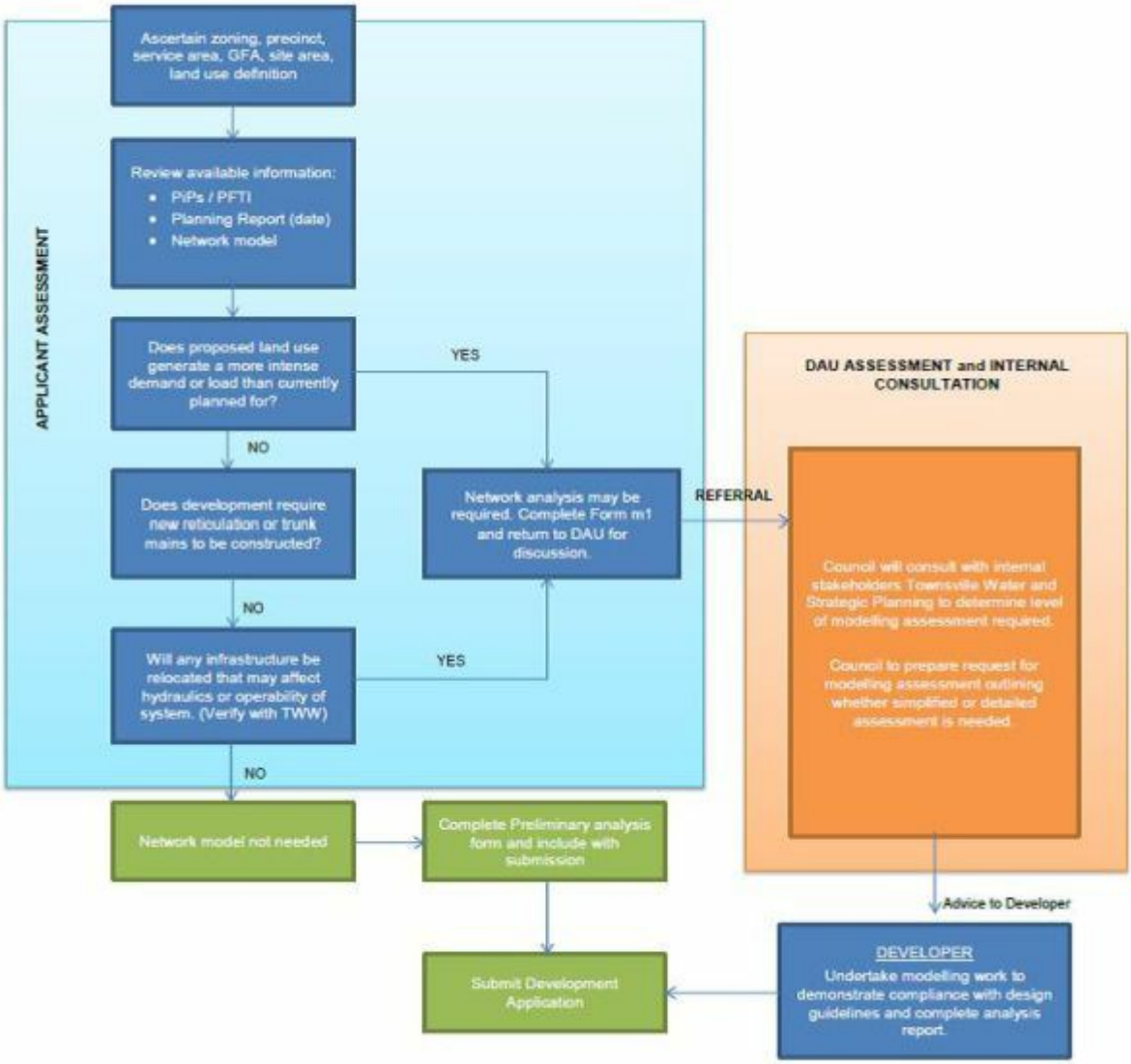


Figure SC6.4.3.23.1 Network model needs analysis, assessment and consultation process

Attachment B Preliminary needs analysis
Click here to obtain a copy of the following form.

Attachment C Form: Request for network modelling information
Click here to obtain a copy of the following form.

Attachment D Model setup summary
Click here to obtain a copy of the following form.

Attachment E Model submission checklist (water and sewer)
Click here to obtain a copy of the following form.

SC6.4.4 Design specification and standard drawings

SC6.4.4.1 Geometric road design

SC6.4.4.1.1 Introduction

(1) Purpose

(a) This sub-section sets out the specifications developed specifically for the design of roads using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.

(b) A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road.

(c) All relevant design principles must be integrated in the development of the road network, recognising the primary role of roads for transport function.

(d) The objective of road design is to recognise the carrying of through traffic.

(e) The objectives of street design are to recognise improving safety and security, increase vitality and interaction, reduce private motor vehicle dependence, improve development efficiency, provide valuable community space and retain economic activity in communities.

(2) Scope

(a) This specification must be read in conjunction with the IPWEAQ publication *Complete Streets: Guidelines for Urban Street Design*, with limited adoption in Townsville as follows:

(i) in areas with close nexus to CBD, and in areas where higher densities are encouraged and it can be demonstrated that there is high access and potential use of public transport, then a full adoption of *Complete Streets* while tying into existing road and street networks. For infill development and upgrades in these areas, development is to be in line with *Complete Streets* principles of pedestrian and cyclist friendly environments, encouraging developments that engage with active street frontages;

(ii) new, large, master planned developments are to adopt *Complete Streets*, although they will be required to recognise the particular role of public transport as an alternative to moving people between these sites and other areas of Townsville. Designs should emphasise pedestrian and cyclist movements, and allow for retrofitting of public transport options in the future, if and when they become viable;

(iii) other developments are to adopt updated cross-sections and road hierarchy, and apply priorities in line with *Complete Streets*, but layout is to be adapted to tie into existing road and street networks, recognising high car dependence, and lack of containment opportunities, where commercial centres, schools and retail facilities are not proposed within the development; and

(iv) curvilinear street designs are to be avoided wherever practical, with a focus on the grid structure in accordance with *Complete Streets and requirements of the Townsville City Plan.*

(3) Aims

A road system within a subdivision is to be designed so as to achieve the following aims:

(a) to provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists;

(b) to provide safe, logical and hierarchical transport linkages with existing street system, including consideration of crime prevention in streets, bikeways and pathways;

(c) to provide appropriate access for buses, emergency and service vehicles;

(d) to provide both a permeable and legible street network;

(e) to provide for a quality product that minimises maintenance costs;

(f) to allow for public utilities;

(g) to provide an opportunity for visual amenity, e.g. street landscaping;

(h) to provide convenient parking for visitors;

(i) to provide connecting streets and places through permeable networks without any corresponding increase in vehicle speeds or "rat-runs"; and

(j) to have appropriate regard for the climate, geology and topography of the area.

(4) Terminology

For the purpose of this sub-section the definition of terms used to define the components of the road reserve must be in accordance with these AS 1348 terms.

Carriageway	that portion of the road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes.
Footpath	the paved section of a pathway (verge).
Pathway	a public way reserved for the movement of pedestrians and of manually propelled vehicles.
Pavement	that portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
Shoulder	the portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
Verge	that part of the road reserve between the carriageway and the road reserve boundary. It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and plantings.

(5) Reference and source documents

(a) Council specifications and drawings:
SC6.4 Development manual planning scheme policy - all specifications and drawings for design and construction.
SC6.4.3.13 Townsville road hierarchy

(b) Australian Standards, in particular:
AS 1348 - *Road and traffic engineering – Glossary of terms, Road design and construction*.
AS 1428 - *Design for access and mobility.*
AS 1742 - *Manual of uniform traffic control devices*.
AS 2890 - *Parking facilities.*
AS/NZS 3845 - *Road safety barrier systems.*

(c) QLD State Authorities:
Department of Transport and Main Roads *Accessible Regional Bus Stops Guidelines, 2008*
Department of Local Government and Planning, *Queensland Residential Design Guidelines, 1998*
Department of Transport and Main Roads, *Queensland Manual of Uniform Traffic Control Devices*,
Department of Transport and Main Roads, *Road Planning and Design Manual*
Department of Transport and Main Roads, *Queensland Transport's Interest in Planning Schemes, 2008*
Queensland Health (2006) *Issue Guidelines for Natural and Built Determinants of Health*

(d) Austroads:
Road Design – *Guide to Road Design*
Design vehicles and turning path templates
Traffic management: *Guide to Traffic Management*

(e) Other
Queensland Government, *Active Healthy Communities*
Queensland Government, *Crime Prevention through Environmental Design,*
Institute of Public Works Engineering Australia, Qld Division, *Complete Streets: Guidelines for Urban Street Design, 2010*

Commonwealth Department of Housing and Regional Development, *Australian Model Code for Residential Development* (AMCORD): *A National Resource Document for Residential Development, 1995.*

SC6.4.4.1.2 Consultation and planning

(1) Consultation

(a) Designers are encouraged to consult with the council and other relevant authorities prior to and during the preparation of the design. Designers should, in addition to requirements of this sub-section, ascertain the specific requirements of these authorities as they relate to the designs in hand.

(b) The designer must obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

(2) Planning concepts

(a) In new areas (as distinct from established areas with a pre-existing road pattern) each class of route should reflect its role in the street and road hierarchy by its visual appearance and related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the required traffic speed, adjoining land-uses, and other factors. All higher order road networks under Townsville City Council jurisdiction must comply with SC6.4.3.13 Townsville road hierarchy.

(b) The road network for residential developments should have clear legibility for all road users, particularly pedestrians and cyclists.

(c) The road network should reinforce legibility by providing sufficient differentiation between the road functions.

(d) Distinct existing landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance their legibility.

(e) Whilst legibility can be enhanced by introduced physical features such as pavement and lighting details, the road network should by its inherent design and functional distinction provide the necessary legibility and place making.

(f) The road network should provide for shortest reasonable access from any lot to the major road system for all pedestrian cyclists and vehicles.

(g) Speed regulation should be built in to the street geometry, to create an environment where drivers are actively discouraged from driving above the legislated/design speed. Speed control devices, often known as Local Area Traffic Management (LATM), are considered unnecessary for appropriately designed new streets and should only be used where no other solution is viable, due both to their capital and maintenance costs and possible intrusive nature. Side friction may be considered to assist with speed regulation where appropriate.

(h) Provide convenient and safe access to all allotments for all road users including pedestrians, cyclists, public transport users, garbage trucks and motorists. Priority of consideration in streets should be as per *Complete Streets.*

(i) Include adequate network considerations in the placement and design of safe pedestrian crossing facilities especially across roads and high volume streets.

SC6.4.4.1.3 Urban design criteria

(1) Road and street hierarchy

(a) A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly. The design should convey to motorists the predominant function of the road.

(b) Transport routes are divided into two distinct levels (refer to SC6.4.4.8 Standard drawings):

(i) streets; and

(ii) roads

(c) The lowest order of transport route (streets) have as their primary function to facilitate public interaction

and movement through a place, village, town or city.

(i) Streets should be designed in accordance with the adjoining land uses.

(d) The highest order of transport route (Roads) should have as its main function the convenient and safe distribution of traffic and should be designed in accordance with the SC6.4.3.13 Townsville Road Hierarchy, Austroads and Department of Transport and Main Roads standards.

(2) Road network

(a) The design features of each type of road or street convey to the driver its primary functions and encourage appropriate driver behaviour.

(b) Traffic volumes and speeds on any road or street should be compatible with its adjoining land uses and function.

(c) The maximum length of a residential street should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints.

(d) The distance required for pedestrians, cyclists and drivers to travel between two points within the development should be minimised.

(e) Where local streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining local streets or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient and safe.

(f) The road network should ensure that no road intersects with another road which is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may intersect with others that are more than two levels apart with council approval, however, no local street should have direct connection to an access-controlled arterial road.

(g) The road and street layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan.

(h) The external road network should be designed and located to provide routes which are more convenient for potential through traffic within the network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate through network movements. The internal road system should not provide through routes that are more convenient than the external road network.

(i) The design of sub-arterial roads should achieve a context sensitive design by providing an acceptable balance between the level of service, safety, whole of life costs, flexibility for future upgrading or rehabilitation and environmental impact. Consequently, sub-arterial roads should provide a higher level of efficiency and safety with space for public transport, bicycle lanes and pedestrian facilities.

(j) Operations on sub-arterial roads must be in accordance with Austroads' *Guide to Road Design Part 2: Design Considerations,* taking into account:

(i) intersection spacing and control;

(ii) lane changing;

(iii) weaving;

(iv) merging;

(v) spacing of median openings;

(vi) reverse flow/tidal traffic control;

(vii) pedestrians;

(viii) cyclists;

(ix) parking (if permitted);

(x) transit lanes for buses and high occupancy vehicles (HOV);

(xi) provision for B-doubles and multi-combination vehicles;

(xii) provision for intelligent transport systems (ITS);

(xiii) bus stops;

(xiv) service roads;

(xv) driveway spacing and their distances from intersections (if permitted); and

(xvi) signage and line marking in accordance with Main Roads' *Manual of Uniform Traffic Control Devices* (MUTCD) and *Traffic and Road Use Management Manual* (TRUM).

(3) Design speed

(a) Design speed is generally used as the basic parameter in the specification of design standards, determining the minimum design value for other elements and is the 85th percentile maximum speed of traffic within the street. This is similar to the "Speed Environment" used in Austroads *Guide to Road Design*. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

(b) Adoption of a low design speed discourages speeding, however, where vertical or horizontal curves of low design speed are located in otherwise high speed sections (tangents) the result is a potentially dangerous section of road. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

(c) Design speed should allow for road characteristics such as:

(i) traffic volume;

(ii) width of carriageway;

(iii) grades; intersections;

(iv) the presence and spacing of consolidated property access;

(v) traffic characteristics; and

(vi) traffic composition (pedestrians, cyclists, public transport, passenger vehicles, heavy vehicles).

(d) The need for road safety barriers must be assessed and designed in accordance with SC6.4.6.25 Non-rigid road safety barrier system and AS/NZS 3845.

(4) Longitudinal gradient

(a) A general minimum gradient of 0.5 % should be adopted. In very flat conditions it may be reduced to 0.3% with council approval. Where underground drainage with gully pits or other special works are used it is preferable to allow near level grades rather than reverting to introduction of artificial undulations. Variable crossfall may be necessary to produce the required grade in the kerb and channel. The maximum longitudinal grade on any street should not exceed 12%, from consideration of pedestrian walking convenience.

(b) Grades over 8% must provide additional considerations for pedestrians, cyclists, public transport and heavy vehicles (e.g. garbage trucks, furniture vehicles) where appropriate. Exceptionally steep terrain may be allowed for very short lengths on steep streets of up to 16%. In these exceptional circumstances, the developer must demonstrate that alternate routes for pedestrians, bicycles and heavy vehicles are available.

(c) The longitudinal grade of the minor street on the approach to an intersection should not exceed 4% with sufficient length to accommodate a stationary single unit truck. Design of the road alignment and the grades used are interrelated. A steep grade on a minor side street is not acceptable if vehicles have to stand waiting for traffic in the major road.

(d) Turning circles in cul-de-sacs on steep grades should have grades less than 5%.

(5) Horizontal curves and tangent lengths

(a) The horizontal alignment of a road or street is normally in a series of tangents (straights) and curves which may be connected by transition curves. The choice of the horizontal alignment should be determined from the design speeds for a particular street, in particular the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road*

Design Part 3: Geometric Design. Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers of all vehicles can safely negotiate the curve. Curves which progressively tighten and sudden reverse curves must be avoided.

(b) While horizontal alignment is one means of limiting vehicle speed, the greater of the following requirements must be complied with:

(i) minimum curve radius for a street - 10 m; or

(ii) minimum curve radius for a road in accordance with DTMR design standards.

(c) Carriageway widening applies to all standard carriageway widths. Widening should be applied to the inside kerb line of the carriageway, in accordance with Austroads' *Guide to Road Design.*

(d) The minimum horizontal sight distance required at any point along the street is the general minimum sight distance for the spot speed relevant at that point. The sight distance is measure along the vehicle path, which may be assumed as the carriageway centreline for streets.

(6) Vertical curves

(a) The design of vertical alignment must reflect the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(b) Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 1%. The length of the crest vertical curve for stopping sight distance is based on speed and should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(c) In addition to the above general minimum sight distance, which is required to be provided at all points along the street, at locations where there may be channelisation or line marking, such as intersections or pedestrian crossings, the driver must be able to see such indications within the stopping distance, i.e. sight distance from 1.15m eye height to zero is not less than single-vehicle stopping distance.

(d) For adequate riding comfort, lengths of sag vertical curves should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(e) Junctions of roads should be located at a safe distance from a crest, determined by visibility from the side road. Location of a side road at a crest should only occur if there is no suitable alternative.

(f) Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) is suggested. To avoid water ponding in excessively flat sections of kerb and gutter, a minimum grade of 0.3% must be maintained in the kerb and channel.

(g) The three dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improved traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations. The following principles should be applied:

(i) the design speed of the road in both horizontal and vertical planes should be of the same order; and

(ii) combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.

(h) Horizontal curves should not be introduced at or near the crest of a vertical curve.

(7) Superelevation

(a) The use of superelevation in association with horizontal curves is an essential aspect of geometric design of roads with design speeds in excess of 60km/h. Streets which are designed for speeds of 40km/h or less and with curves of 60m radius or less generally have the pavement crowned on a curve instead of superelevation.

(b) The maximum superelevation for urban roads of higher design speeds should be 5%. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While all curves should be superelevated, negative crossfall should be limited to 3%.

(c) In general, curve radii larger than the minimum and superelevation rates less than the maximum should be used where possible. The minimum radius of curves is determined by the design speed, the minimum

superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve, and the maximum coefficient of side friction which allows safe lane changing. Refer to the *Road Planning and Design Manual* Table 11.1.

(d) Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are as per Austroads' *Guide to Road Design.*

(e) Plan transitions are required on superelevated curves for appearance and to provide a convenient length in which to apply the superelevation. On urban roads, superelevation may be conveniently applied to the road cross section by shifting the crown to 2m from the outer kerb. The axis of rotation of the cross section for urban roads will normally be the kerb grading on either side which best enables access to adjacent properties and intersections.

(f) Rate of Rotation for superelevation refer Austroads' *Guide to Road Design Part 3: Geometric Design* (Section 7.7).

(8) Road reserve characteristics

(a) The cross section of the road reserve must provide for all functions that the road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities and street scaping. Road reserve widths will depend on verge widths, service roads and pathway requirements, and sub-arterial and arterial roads must also allow for future upgrading.

(b) The carriageway width must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include trucks, emergency vehicles and, on some roads, buses. Excessive carriageway widths can be detrimental to safety, amenity, user convenience, capital expenditure and maintenance costs.

For example, for urban residential streets:

(i) narrower urban residential carriageways in accordance with Urban Type A of Standard Drawing SD-001 are allowable for shorter street lengths, with low parking demand, and serving standard residential allotments. This carriageway does not allow for any buses, bike lanes, or indented parking. Frequent staggered parking may occur on both sides of the street where there are less than 150 vehicles per day, otherwise on street parking should be infrequent or along one side of the street only. Generally leg lengths should be kept to a maximum length of 150m. These streets may not function as a through route, and must carry a low traffic volume;

(ii) standard urban residential carriageways in accordance with Urban Type B of Standard Drawing SD-001 are allowable where there is relatively frequent parking on both sides of the street with traffic volumes generally less than 750 vehicles per day;

(iii) wider urban residential carriageways in accordance with Urban Type C of Standard Drawing SD-001 are required where there is a higher density residential area with higher parking demand or higher volume of traffic (less than 3000 vehicles per day in accordance with SC6.4.3.13) and possible bus routes. Indented bus bays may be required, on advice from council;

(c) the safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width;

(d) the carriageway width should also provide for unobstructed access to individual allotments. Drivers should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway;

(e) the design of the carriageway should discourage drivers from travelling above the intended speed by reflecting the functions of the road in the network. In particular the width and horizontal and vertical alignment should not be conducive to excessive speeds;

(f) appropriate verge width should be provided to enable the safe location, construction and maintenance of required footpaths and public utility services (above or below ground), with acceptable clearances and to accommodate the desired level of streetscaping. Wherever possible, services should be located in common trenches;

(g) the verge when considered in conjunction with the horizontal alignment and permitted fence and property

frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements;

(h) stopping sight distances and junction or intersection sight distances, provided by the verge, should be based on the intended speeds for each road type;

(i) safe intersection stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout; and

(j) industrial roads and streets must be designed to allow access for larger vehicles including B-doubles and multi-combination vehicles into these areas, including safe turning manoeuvres at intersections and to and from allotments.

(9) Crossfall

(a) Roads should be crowned in the centre. Typical pavement crossfalls on straight roads are:

Pavement Type	**Crossfall**
Bituminous seal coat	3%
Bituminous concrete pavement	3%
Cement concrete pavement	3%

Source: Austroads, *Guide to Road Design*

(b) There are many factors affecting levels in urban areas which force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting one way crossfalls. Sustained crossfalls should not exceed 4%, although up to 6% may be used where unavoidable with council approval. The rate of change of crossfall should not exceed those adopted in SC6.4.4.1.3(7) Superelevation.

(c) The use of one way crossfalls should be limited taking into consideration overland drainage and the impact on open space, public footpaths and private properties.

(d) The crossfall on a higher order transport route should take precedence over the grade in minor side streets. Standard practice is to maintain the crossfall on the major road and adjust the minor side street levels to suit. The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street. A maximum change of grade of 2% in the kerb line of the side street relative to the centre line grading is acceptable.

(10) Verges and property access

(a) A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage and preservation of trees. Low level footpaths may only be used if normal crossfalls are impracticable. Crossfalls in footpath paving should not exceed 2.5%, in accordance with Austroads' *Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths*. Longitudinal grade usually parallels that of the road and this may be steeper than 5%.

(b) Differences in level across the road between road reserve boundaries may be accommodated by:

(i) cutting at the boundary on the high side and providing the verge at normal level and crossfall;

(ii) battering at the boundary over half the verge width with the other half against the kerb constructed at standard crossfall;

(iii) a uniform crossfall across the carriageway; and

(iv) the lower verge being depressed below the gutter level.

(c) The above measures can be used singularly or combined. The verge formation should extend with a 0.5m berm beyond the road reserve boundary.

(d) The designer must design a vehicular driveway centreline profile for the property access and check this design using critical car templates, to ensure that vehicles can use the driveway satisfactorily.

(e) Where commuter pedestrians and cyclist paths are proposed, appropriate shading and rain protection should be provided. An approved landscaping master plan must be provided for approval.

(11) Intersections

(a) The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on major collector streets.

(b) Intersection design for the junction of subdivision roads and streets with existing state rural or urban roads and national highways should generally be in accordance with the publication Austroads' *Guide to Road Design – Part 4, Intersections and Crossings.*

(c) Intersections with state roads or national highways are to be designed, approved and constructed in accordance with the requirements of the Queensland Department of Transport and Main Roads.

(d) Where major intersections are required to serve a development complete reconstruction of the existing road pavements may be necessary.

(e) Intersections should be generally located in such a way that:

(i) the streets intersect preferably at right-angles and not less than 70º;

(ii) the landform allows clear sight distance on each of the approach legs of the intersection;

(iii) the minor street intersects the convex side of the major street;

(iv) the vertical grade lines at the intersection do not impose undue driving difficulties;

(v) the vertical grade lines at the intersection will allow for any direct surface drainage;

(vi) two minor side streets intersecting a major street in a left-right staggered pattern must have a minimum centre-line spacing of 50m to provide for a possible right-turn auxiliary lane on the major street; and

(vii) a right-left manoeuvre between the staggered streets is preferable, avoiding the possibility of queuing in the major street, but only where staggered streets cannot be avoided.

(f) Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

(g) Appropriate provision should be made for vehicles to park safely, where required.

(h) Safe intersection sight distance - refer clause SC6.4.4.1.3(8)(i).

(i) The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross-section profile.

(j) All vehicle turning movements are accommodated utilising *Design Vehicles and Turning Templates*, as follows:

(i) for intersection turning movements involving low order roads, the "design semi-trailer" with turning path radius 15 m;

(ii) for intersection turning movements involving streets, the "design single unit" bus with turning path radius 13 m; and

(iii) for turning movements at the head of cul-de-sac local streets sufficient area is provided for the "design single unit" truck to make a three-point turn Driveway entrances are not to be used for turning movements. The minimum cul-de-sac head radius is 9m to kerb lip.

(k) Turning radii at intersections or driveways on major collector streets accommodate the intended movements without allowing desired speeds to be exceeded.

(l) On bus routes 3-centred curves with radii 15m, 10m, 30m are to be used at junctions and intersections.

(m) Un-signalised intersections on sub-arterial roads at grade should have a median width of at least five metres to allow for a two stage crossing from the side street.

(n) Design of traffic signals in sub-arterial roads must be in accordance with the Department of Transport and Main Roads' *Road Planning and Design Manual* (RPDM), Chapter 18. Council approval is required for use of equipment that is uniquely associated with traffic signals.

(o) Barrier kerb and channel must be used at intersection kerb turnouts extending to the tangent point. A one metre kerb transition must be used to connect barrier kerb and channel turnout with adjacent layback kerb and channel.

(12) Roundabouts

(a) Roundabouts are to be approved by council.

(b) Roundabouts should generally be designed in accordance with the requirements of *Austroads Guide to Road Design - Part 4B - Roundabouts.* Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

(i) safe provision for pedestrians, cyclists and public transport movements;

(ii) entry width to provide adequate capacity;

(iii) adequate circulation width, compatible with the entry widths and design vehicles e.g. buses, trucks, cars;

(iv) central islands of diameter sufficient only to give drivers guidance on the manoeuvres expected;

(v) deflection of the traffic to the left on entry to promote gyratory movement;

(vi) adequate deflection of crossing movements to ensure low traffic speeds;

(vii) a simple, clear and conspicuous layout; and

(viii) design to ensure that the speed of all vehicles approaching the intersection will be less than 40 km/h.

(13) Local area traffic management

(a) Local area traffic management (LATM) devices are unnecessary for appropriately designed new streets, but may be used to address speed and safety issues in existing streets, and must be approved by council.

(b) Calming devices such as thresholds, slow points, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the publication *Guide to Traffic Management Part 8: Local Area Traffic Management (LATM)* and the *Manual of Uniform Traffic Control Devices*. Device designs should generally comply with the following.

(i) Streetscape:

(A) reduce the linearity of the street by segmentation;

(B) avoid continuous long straight lines (e.g. kerb lines);

(C) short straights and short distances between intersections;

(D) enhance existing landscape character;

(E) maximise continuity between existing and new landscape areas;

(F) on-street parking; and

(G) mixed activity precincts.

(ii) Location of devices/changes:

(A) devices other than at intersections should be located to be consistent with streetscape requirements;

(B) existing street lighting, drainage pits, driveways, and services may decide the exact location of devices; and

(C) slowing devices are optimally located at spacings of 100-150m.

(iii) Design vehicles:

(A) emergency vehicles, garbage trucks and furniture vehicles must be able to reach all residences and properties;

(B) local streets with a “feeding” function between arterial roads and streets must be designed for an Austroads Design Single Unit Truck/Bus;

(C) where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers; and

(D) in newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be provided for.

(iv) Control of vehicle speeds:

(A) maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds;

(B) speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings); and

(C) speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by "segmenting" streets into relatively short lengths (less than 300 m), using appropriate devices, streetscapes, or street alignment to create short sight lines and by inducing in drivers a feeling of constriction through the introduction of side friction.

(v) Visibility requirements (sight distance):

(A) adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds;

(B) sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers; and

(C) night time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night time operation. Additional street lighting must be provided by the developer at proposed new speed control devices located away from existing street lighting.

(vi) Critical dimensions

Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

(A) pavement narrowings in accordance with *Guide to Traffic Management;*

(B) bicycle lanes (including adjacent to pavement narrowings) – 1.5m minimum, 1.2m absolute minimum with council approval (in accordance with *Guide to Traffic Management*, and *Guide to Road Design);*

(C) plateau or platform areas;

(D) 75 mm to 100 mm height maximum, with 1 in 15 ramp slope;

(E) width of clear sight path through slowing devices;

(F) The width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, (usually vegetation);

(G) dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates; and

(H) on bus routes, devices must allow the full-length of the bus to be contained between ramps.

(14) Road safety audits

(a) Road safety audits (RSA) should be carried out on sub-arterial road projects in accordance with *Guide to Road Safety Part 6: Road Safety Audit*. Confirmation from council is to be sought on which project stages require an RSA. The following stages of the project should be considered for an RSA, as appropriate:

(i) feasibility design;

(ii) completion of design development;

(iii) completion of final design;

(iv) during construction, where temporary traffic management measures are proposed;

(v) two weeks prior to opening to traffic; and

(vi) within one week of opening to traffic.

(15) Parking

(a) The parking requirements for normal levels of activity associated with any land use should be accommodated on-site.

(b) All on-site parking should be located and of dimensions that allow convenient and safe access and usage. All designs must account for a B99 (AS 2890) vehicle as the minimum requirement.

(c) Adequate parking should be provided within the road reserve for visitors, service vehicles and any excess resident parking since a particular use may generate a high demand for parking. Such parking is to be convenient to the use.

(d) The availability of parking should be adequate to minimise the possibility of driveway access being obstructed by cars parked on the opposite side of the street.

(e) On single lane local streets parking spaces should be provided within the verge. Such parking should be well defined and an all-weather surface provided. Such parking may not restrict the safe passage of vehicular and pedestrian traffic.

(f) Parking spaces provided on the verge or carriageway should be of adequate dimensions, convenient and safe to access.

(g) For non-residential land uses the opportunity for joint use of parking should be maximised by being shared by a number of complementing uses.

(h) On single lane carriageways a number of verge spaces are combined to provide for short term truck parking within 40m of any allotment.

(i) All verge spaces and indented parking areas are constructed of concrete, interlocking pavers, bitumen with crushed rock or other council approved base material and are designed to withstand the loads and manoeuvring stresses of vehicles expected to use those spaces.

(j) Right-angled kerbside parking is provided only on streets where posted speeds do not exceed 40 km/h.

(16) Bus routes

(a) It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 5% of residents should have to walk in excess of 5 minutes to catch a bus. Sub-section SC6.4.3.5 Car parking and public transport facilities guidelines details minimum criteria for bus route design, though local conditions, including climate and topography should be taken into consideration to demonstrate that bus routes are readily accessible to the majority of residents.

(b) Carriageway widths must comply with sub-sections SC6.4.4.8 Standard drawings, and SC6.4.3.13 Townsville road hierarchy. For indented bus bays on streets identified as bus routes, refer to SC6.4.4.8 Standard drawings. Shelters are subject to council's requirements.

SC6.4.4.1.4 Rural design criteria

(1) General

(a) In addition to the above, SC6.4.4.1.4 specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farms types of developments.

(b) Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in *Guide to Road Design.*

(c) Superelevation, widening and centreline shift and their associated transitions are to comply with Austroads Guides, where appropriate.

(d) Where the table drain is likely to scour, a stone pitched or suitably lined dish drain is to be constructed along the invert. For grades of less than 0.5%, the inverts of the drain are to be lined to prevent siltation. Drains with a minimum gradient of 0.25% are to be concrete lined.

(e) All rural subdivisions should be designed to restrict access to major roads.

(f) Access should be limited to one point on to street, major collector or arterial road networks.

(2) Sight distances

(a) Stopping sight distance should be provided at all points on the road.

(b) Stopping sight distance is the sum of the braking distance and the distance the vehicle travels during a reaction time of 2.5 seconds.

(3) Horizontal and vertical alignment

Horizontal and vertical curves are to be designed generally to the requirements of *Guide to Road Design*. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform with the terrain to achieve aesthetic quality and being in harmony with the landform.

(4) Intersections

(a) Intersections should generally be designed in accordance with the publication *Guide to Road Design Part 4: Intersections and Crossings and Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings.* The type of intersection required will depend on existing and planned connecting roads.

(b) Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location must be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

(i) ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.

(ii) ESD relates to the driver entering the intersection from a minor road and ability to observe the roadway layout and assess traffic gaps. SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration so as to provide adequate stopping distance in potential collision situations.

(iii) Tabulated speed/sight distance requirements together with detailed explanations for each of the sight distance criteria are given in the relevant sections of the *Austroads Guide to Road Design*. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.

(iv) Stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout.

(c) Staggered-T arrangements proposed for rural cross-intersections should preferably be of the “right to left” type. This arrangement eliminates traffic queuing in the major road, the need for additional pavement for right turn lanes and greater stagger length associated with “left to right” T-intersections. Figures and discussion on staggered-T treatments are given in the *Austroads Guide to Road Design.*

(5) Carriageways

Carriageway widths for rural roads should generally be as per SC6.4.4.8 Standard drawings SD-010 Typical Road Cross Sections – Rural Roads.

(6) Superelevation

Use of maximum superelevation will be considered where the radius of the curve in approaching the minimum speed environment. Reference should be made to *Austroads Guide to Road Design* for superelevation calculation. At low and intermediate ranges of design speed (i.e. below 80 km/h) all curves should be superelevated to at least a value equal the normal crossfall of straights.

(7) Table drains

Table drains to rural roads must comply with *Guide to Road Design Part 3: Geometric Design*. Minimum longitudinal grade of table drains is 0.50%. Refer to *Guide to Road Design Part 6: Roadside Design, Safety and Barriers for capacity of drains.*

(8) Scour protection

Scour protection of roadside drainage and table drains is required. The level of protection will depend on the

nature of the soils, road gradients and volume of stormwater runoff. Protection works may involve concrete lined channels, turfing, rock pitching, grass seeding, individually or any combination of these. Geotechnical investigations should be carried out of determine the level and extent of any protection works prior to proceeding to final design stage.

SC6.4.4.2 Pavement design

SC6.4.4.2.1 Introduction

(1) Objectives

The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs to its design functions and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design. In areas with a history of salinity problems, subsurface drainage may be prescribed to keep the groundwater table lower in the strata so as to avoid progressive deterioration of the health of topsoil and upper layers due to salinity levels increased by rising and/or fluctuating groundwater tables.

(2) Scope

(a) This sub-section covers the design guidelines for road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface, and the design of the subsurface drainage system for the road pavement and/or subgrade.

The sub-section contains guidance in the design of the following forms of surfaced road pavement construction types:

(i) flexible pavements consisting of unbound granular materials;

(ii) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;

(iii) rigid pavements (i.e. cement concrete pavements); and

(iv) concrete or clay segmental pavements.

(b) This sub-section generally sets out procedures in determining the following design criteria:

(i) design traffic;

(ii) design CBR of pavement subgrade (including method of sampling and testing);

(iii) determination of required subgrade treatments;

(iv) design methods for rigid and flexible pavement (pavement thickness);

(v) subsoil and foundation drains;

(vi) sub-pavement drains; and

(vii) drainage mats, including Type A and Type B mats.

(3) Terminology

Foundation drains	are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.
Sub-pavement drains	are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade.
Subsoil drains	are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings and fill areas.
Type A drainage mats	are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type B drainage mats are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

(4) Reference and source documents

(a) Development manual planning scheme policy sub-section to be read and applied in conjunction with this sub-section are as follows:

SC6.4.4.1 - Geometric road design
SC6.4.6.8 - Drainage mats
SC6.4.6.12 - Flexible pavements
SC6.4.6.13 - Asphaltic concrete
SC6.4.6.14 - Mass concrete sub base
SC6.4.6.15 - Plain and reinforced concrete base
SC6.4.6.16 - Sprayed bituminous surfacing
SC6.4.6.17 - Bituminous microsurfacing
SC6.4.6.18 - Segmental paving
SC6.4.6.20 - Subsoil, foundation and pavement drains
SC6.4.6.21 - Subsurface drainage

(b) Australian Standards

AS 1289 – *Methods of testing soils for engineering purposes*
AS 1289.4.2.1 - *Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method*
AS 2439.1 - *Perforated drainage pipe and associated fittings.*
AS/NZS 1477 - *PVC pipes and fittings for pressure applications.*

(c) Department of Transport and Main Roads

Pavement Design Manual – Supplemental to 'Part 2: Pavement Structural Design' of the *Austroads Guide to Pavement Technology.*
MRTS05 - Unbound Pavements
MRTS11 - Sprayed Bituminous Surfacing (Excluding Emulsion)
MRTS12 - Sprayed Bituminous Emulsion Surfacing
MRTS31 - Heavy Duty Asphalt
MRTS08 – Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends
MRTS13 – Bituminous Slurry Surfacing
MRTS17 - Bitumen
MRTS18 – Polymer Modified Binder
MRTS20 – Cutback Bitumen
MRTS21 – Bituminous Emulsion
MRTS30 – Asphalt Pavements
MRTS35 – Recycled Materials for Pavements
MRTS38 – Pavement Drains
MRTS39 – Lean Mix Concrete sub-base for Pavements
MRTS40 – Concrete Base in Pavements Jointed Unreinforced, Jointed Reinforced, Continuously Reinforced and Steel Fibre Reinforced Pavements

(d) Other

Austroads, *Guide to Pavement Technology (all parts).*
Austroads, *Guide to Road Design – Geotechnical Investigation and Design.*
Concrete Masonry Association of Australia:

CMAA – MA57 - Concrete Segmental and Flag Pavements – Guide to Specifying, 2010
CMAA - T45 - Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads
CMAA - T46 - Concrete Segmental Pavements - Detailing Guide.

Clay Brick and Paver Institute, *Design Manual 1 - Clay Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic.*

SC6.4.4.2.2 Pavement design criteria

(1) The design traffic loading must be calculated based on the following minimum design lives of pavement:

Table SC6.4.4.2.1 Design ESAs

Road or street type	Minimum design life
Urban streets and roads	20 years
Rural streets and roads	20 years
Rigid (concrete)	40 years
Segmental block	25 years

Design traffic loading for urban areas must be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity.

For new subdivisions, the design traffic loading must take account of the construction traffic associated with the subdivision development, and the in-service traffic for the subdivision and any future developments linked to that subdivision.

When designing staged developments, the number of vehicle trips must take into consideration the ultimate development that will eventually access each segment of the road under consideration with appropriate allowances for bus, garbage, construction and in-service traffic.

For interlocking concrete segmental pavements, the simplification of replacing ESAs with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA-T45 is acceptable up to a design traffic of 10^6ESAs. Beyond this, ESAs should be calculated.

The pavement design must include all traffic data and/or assumptions made in the calculation of the design traffic. The estimated design traffic must generally be made in accordance with G*uide to Pavement Technology* – in particular *Part 2 Pavement Structural Design* for the calculation of design traffic volumes up to and exceeding 10^6ESAs.

In the absence of other traffic data, the following traffic values (in ESAs) may be taken as a guide to the minimum design traffic, but are subject to variation depending on the circumstances for the particular development.

Table 6.4.4.2.2 Design ESAs

Street Type	Design ESAs - 20 year design life (minimum)
Urban Residential	
- Type A	2×10^4
- Type B	1×10^5
- Type C	1×10^6
Major Collector	2×10^6
Commercial and Industrial	5×10^6
Rural Roads	1×10^6

Traffic volume and annual growth rate can be obtained upon request to council as guidance in determining the design traffic loading to be used for pavement design. For roads, the design traffic loading must be determined using a design life as per SC6.4.4.2.2.(1), however, a practical design strategy to allow extensions of the pavement life to 35 years (minimum) must also be submitted.

For new residential developments where traffic data is not readily and accurately available, the design may consider the following data to determine the design traffic loading:

(a) traffic generation – 10 vehicles per day/allotment plus 20 ESAs per equivalent allotment for consideration of construction traffic;

(b) traffic growth rates – 0.5% – 2% for streets. Annual traffic growth rates for roads are subject to

confirmation by council and will be based on available traffic data;

(c) commercial vehicles – 3%-7% for streets. Commercial vehicle percentages for roads are subject to confirmation by council and will be based on available traffic data;

(d) ESA per heavy vehicle (ESA/HVAG) - Urban 0.7, Rural 0.9; and

(e) axle group per heavy vehicle (NHVAG) – Urban 2.5, Rural 2.8.

(2) The calculation of design traffic loading for rural area must adopt a similar approach to the urban areas while the design for industrial roads will require a detailed assessment addressing the following factors and must be designed using a mechanistic approach:

(a) traffic generation, including peak hour traffic volumes and truck volumes;

(b) details of the types of heavy vehicles that are expected to utilise the road; and

(c) predicted route patterns (heavy vehicles).

(3) The calculation of design traffic loading for industrial development must include the following factors:

(a) traffic generation of the proposed industrial development (including peak hour traffic volumes). Refer to *Guide to Pavement Technology Part 2* for the method of calculating load factors for each type of heavy vehicles;

(b) to Austroads Guide to Pavement Technology Part 2 for the method of calculating load factors for each type of heavy vehicles;

(c) details of types of trucks that will utilise the proposed road network with consideration to the proportion of heavy vehicles that will have full load; and

(d) predicted truck usage patterns with consideration to expected land use.

SC6.4.4.2.3 Geotechnical evaluation

(1) General

The designer must arrange a detailed geotechnical investigation of the naturally occurring material along the alignment of the proposed roads. The extent of any areas of filling and cutting must be determined including the strength of the underlying materials and considered in the overall pavement design.

The geotechnical investigation, including both field and laboratory testing must be undertaken in accordance with all relevant Australian Standards (e.g. AS 1289) and *Guide to Road Design* in particular *Part 7 Geotechnical Investigation and Design.*

(2) Subgrade testing

(a) Except where a mechanistic design approach is employed using Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*, the measure of subgrade support must be the California Bearing Ratio (CBR). Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support must be in terms of the elastic parameters (modulus, Poisson's ratio), e.g. for use in CIRCLY computerised pavement design methods.
In conducting subgrade tests, the following approach must be adopted for new roads:

(i) test pits/holes along the alignment of the road must have a spacing between 60m and 120m as appropriate for each urban residential and industrial street or a minimum of three test locations per street in a stage, whichever is greater;

(ii) test pits/holes along the alignment of a rural area must have a spacing of up to 300m or a minimum of 3 test locations per road whichever is greater;

(iii) test holes must be excavated to a minimum depth of 1 m and must extend a minimum 500mm below the proposed subgrade level;

(iv) if the depth of fill material over the natural subgrade is more than 500mm, then the fill material is considered to be the new subgrade and it must be assessed; and

(v) if the depth of fill is less than 500mm, investigation must assess the natural ground conditions and also the properties of the proposed fill material.

(b) The following factors must be considered in determining the design strength/stiffness of the subgrade:

(i) sequence of earthworks construction;

(ii) the compaction moisture content and field density specified for construction;

(iii) moisture changes during service life;

(iv) subgrade variability; and

(v) the presence or otherwise of weak layers below the design subgrade level.

(3) California Bearing Ratio (CBR)

(a) Notwithstanding the requirements of AS1289.6.1.1, this document specifies additional or differing requirements, including:

(i) CBR tests must be carried out with a maximum of 4.5kg surcharge; and

(ii) maximum correction allowable to the applied force is 0.5mm along the horizontal axis of the penetration curve.

(b) The calculation of the Design CBR must be based on either soaked or unsoaked conditions as appropriate.

(i) For boxed in pavements soaked conditions must be adopted for the calculation of Design CBR and must be based on a minimum of three 4-day soaked CBR laboratory samples for each subgrade area compacted to 97% of maximum dry density, standard compaction at optimum moisture content (OMC).

(ii) If it can be demonstrated that the subgrade is well drained and not less than 300mm above natural surface or table drain, e.g. Rural formation, in free draining material and not influenced by spring/seepage conditions then the unsoaked condition will be considered for design by council. When unsoaked conditions are to be adopted the calculation of Design CBR must be based on a minimum of three laboratory samples for each subgrade area compacted to 97% maximum dry density standard compaction at OMC and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone and soil type if appropriate (as per the guidelines in Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*) to give an estimate of equilibrium in-situ CBR.

(iii) The Design CBR for each subgrade area is computed by using the appropriate formula as follows:

Design CBR = Least of estimated CBRs, for less than five results

or

Design CBR = 10th percentile of all estimated CBRs, for five or more results

Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades.

The pavement design must include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

(4) Environment

The environmental factors which significantly affect pavement performance are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

(a) rainfall/evaporation pattern;

(b) permeability of wearing surface;

(c) depth of water table and salinity problems;

(d) relative permeability of pavement layers;

(e) whether shoulders are sealed or not; and

(f) pavement type (boxed or full width).

The effect of changes in moisture content on the strength/stiffness of the subgrade must be taken into account by evaluating the design subgrade strength parameters (i.e. CBR or modulus) at the highest moisture content likely to occur during the design life, i.e. the design moisture content. The provision of subsurface drainage may, under certain circumstances, allow a lower design moisture content, and hence generally higher design CBR.

The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of changes in temperature environment should also be considered for bound or concrete layers.

The pavement design must include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

(5) Expansive soils

Highly expansive materials are classified as highly reactive with high plasticity. Refer to the classification in Table SC6.4.4.2.1 Guide to classification of expansive soils, with prominence give to classification based on the CBR swell. Expansive soilds have the potential to exhibit significant volume changes with the variation in moisture content leading to possible loss of pavement shape and longitudinal cracking in the future pavement. For this reason, if test results indicate highly expansive materials (classified as "High" or "Very High"), the design CBR must be 3% or less. Materials having a measured CBR swell ≥2.5% must incorporate a low permeability treatment layer to minimise significant moisture changes in the underlying subgrade.

Table SC6.4.4.2.3 Guide to classification of highly expansive soils

Expansive Nature	Liquid Limit (%)	Plastic Index	PI x % <0.425mm	Potential Swell (%)*
Very High	>70	>45	>3200	>5.0
High	>70	>45	2200-3200	2.5-5.0
Moderate	50-70	25-45	1200-2200	0.5-2.5
Low	<50	<25	<1200	<0.5

*Swell OMC and 97% MDD using Standard compactive effort; 4 day soak based on 4.5kg surcharge.
(Source: Guide to Pavement Technology – Part 2).

SC6.4.4.2.4 Subgrade treatment

(1) General

Subgrade treatment may be required subject to ground conditions defined in Table SC6.4.4.2.4 Ground conditions for subgrade treatment.

Table SC6.4.4.2.4 Ground conditions for subgrade treatment

Category	Condition	Definition	Treatment Type
A	Excessively wet subgrade anticipated prior to construction and/or excessively wet subgrade encountered once construction commences	“Wet” subgrade	Working Platform
B	Low Design Subgrade Strength *	Soaked CBR ≤ 3%	Capping Layer
C	Highly or very highly expansive subgrade soil #	Swell ≥ 2.5%	Pavement Cover
D	Ground beneath pavement will be exposed to water (due to the effect of capillary rise and/or positive head)	“Water Exposure”	Drainage Layer

* CBR swell at OMC and 97% MDD using Standard Compactive effort; 4 day soak based on 4.5kg surcharge. (Source: Austroads Guide to Pavement Technology – Part 2)

Swell measured in CBR test described in SC6.4.4.2.3 (5)

Design subgrade CBR = 3% must be adopted into the pavement design if the subgrade soaked CBR is > 3% but with CBR swell of ≥ 2.5% (classified as highly or very highly expansive).

This specification does not provide direct criteria for determining the required depth of subgrade treatment in highly or very highly expansive soils (Category C). However, as Category C subgrade will need to be designed with CBR of ≤ 3%, the subgrade treatment of Category B (low design subgrade strength) will ensure that the total "Pavement Cover" is adequate to meet the cover requirements for an expansive subgrade soil. It is noted that the type of subgrade treatment that is acceptable will be depend on the expansive nature of the soil. A subgrade with CBR swell of ≥ 2.5% will require capping material to include a low permeability layer.

Subgrade Treatment selection is outlined in flowchart Figure SC6.4.4.2.1 Guide to determine subgrade treatment. Details for subgrade "Treatment Layer" is described in Table SC6.4.4.2.5 Selection of subgrade treatment type. Subgrade treatment may comprise one or a combination of the alternatives listed.

(2) Subgrade treatment types

(a) In-situ lime stabilisation of the subgrade;

(b) Plant mixed cement stabilised gravel;

(c) Unbound gravel;

(d) Select fill;

(e) Rock fill (geofabric wrapped) + min. 150mm select fill;

(f) Drainage layer material + min. 150mm select fill; and

(g) Geofabric separation layer.

The acceptable types and combinations of treatment are as outlined in SC6.4.4.2.4 (3).

(3) Selection criteria for subgrade treatment type

Figure SC6.4.4.2.1 Guide to determine subgrade treatment outlines subgrade treatment layers, denoted as Treatment L1 to L11. Table SC6.4.4.2.5 Selection of subgrade treatment type details which subgrade treatment options are acceptable for each condition.

Table SC6.4.4.2.6 Thickness of treatment layer outlines procedure for determination of the required thickness of the treatment layer under the pavement. Note that no prescription is given to the required thickness of Working Platform, as this will depend on the specific conditions encountered and the treatment layer selected.

(4) Required thickness of treatment layer

Table SC6.4.4.2.6 Thickness of treatment layer outlines procedure for determination of the required thickness of the treatment layer under the pavement. Note that no prescription is given to the required thickness of Working Platform, as this will depend on the specific conditions encountered and the treatment layer selected.

(5) Working platform

A working platform could comprise of any of the treatment type *(a)* to *(g)* as defined in Table SC6.4.4.2.5 Selection of subgrade treatment type.

(a) Except for treatment type (g) – geofabric separation layer, the working platform is required to meet the following minimum standards necessary for it to function when it becomes part of the subgrade for the operating service life of the pavement structure:

(i) at least 150mm compacted thickness, and as thick as necessary to provide support required;

(ii) have a surface maintained with a geometric tolerance of ± 10mm of the specified height and a maximum deviation from a 3m straight edge of 8mm at all points on the surface; and

(iii) where a treatment type (b) – plant mixed cement stabilised gravel is used, gravel must be of a standard no less than Type 2.3 with a minimum UCS of 0.8 MPa and a maximum UCS of 3.5 MPa at 28 days.

(b) The working platform must be designed by the Contractor to meet the particular requirements of the project including, but not limited to, the following considerations:

(i) the characteristics of the underlying subgrade materials;

(ii) the Contractor's construction traffic and equipment the Contractor intends to use to construct the

pavements and other works;

(iii) the full operating life of the working platform including, but not limited to:

- actual period during which the working platform will be required to provide access for construction traffic;
- actual periods during which the working platform will be required to provide a platform for construction traffic and equipment, including for construction of the pavement layers; and
- actual periods during which it is not in use prior to the construction of the overlying pavement;

(iv) provide protection to the underlying layers, including protection from water and stress;

(v) provide a platform for the construction of the overlying pavement;

(vi) suitability for the Contractor's construction program; and

(vii) be sufficiently stiff to enable the placement and compaction of the overlying pavement layers in accordance with their specified requirements.

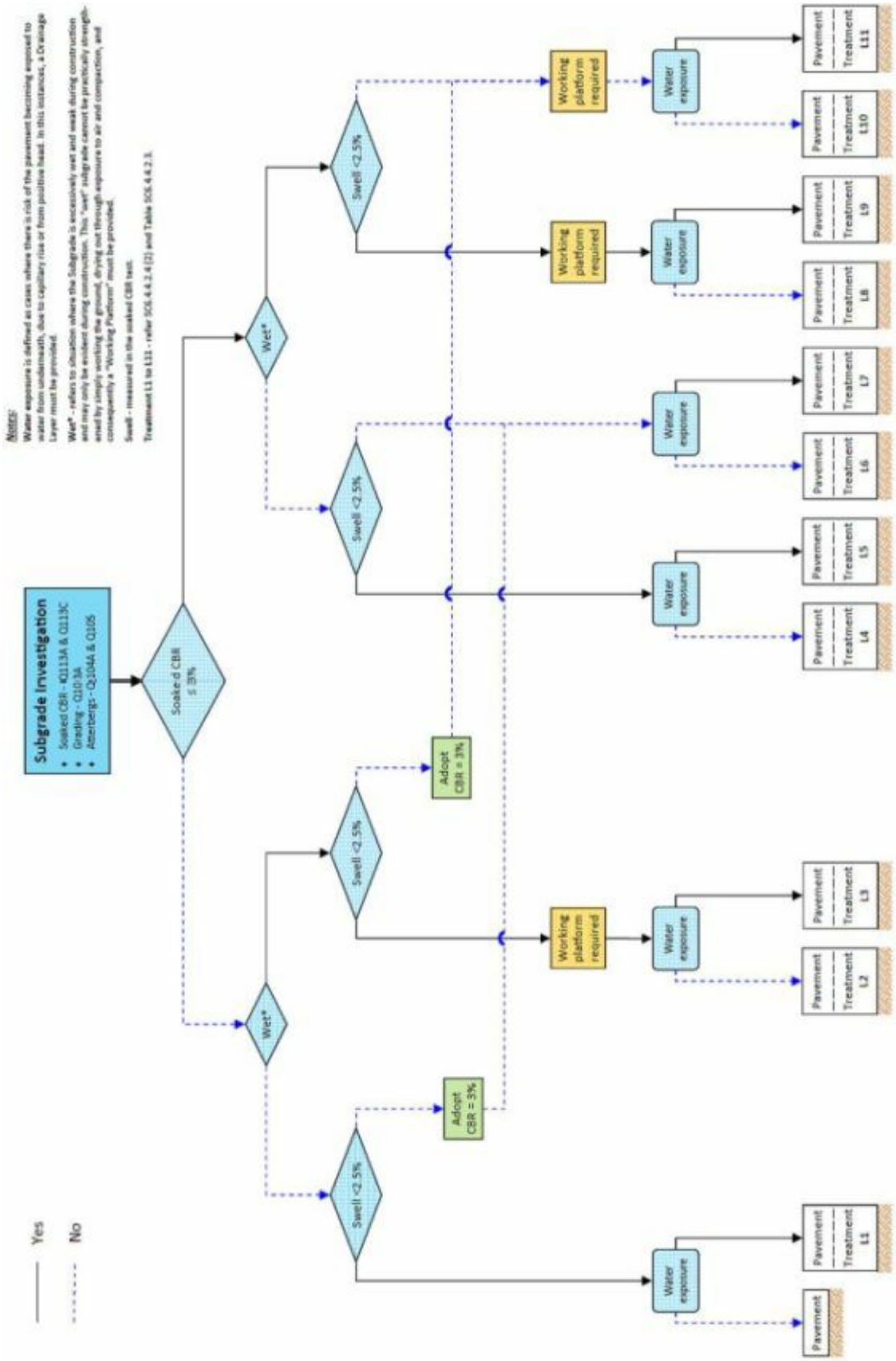


Figure SC6.4.4.2.1 Guide to determine subgrade treatment

Table SC6.4.4.2.5 Selection of subgrade treatment type

Treatment	Soaked CBR ≤ 3%	Wet at construction	Swell < 2.5%	Water Exposure	Acceptable Treatment Types	Treatment Name
-	X	X	✓	X	No treatment required	-
L1	X	X	✓	✓	(e) or *(f)*	Drainage layer
L2	X	✓	✓	X	If "Wet" layer entirely removed & replaced: (b) to (e) & (g)*. If not: (a), (b), (e) or *(g)**.	Working platform
L3	X	✓	✓	✓	(e)	Drainage layer & working platform
L4	✓	X	✓	X	(a) to (d)	Capping layer
L5	✓	X	✓	✓	(e) or (f)	Capping layer & drainage layer
L6	✓	X	X	X	(a), (b) or (d)	Capping layer & pavement cover
L7	✓	X	X	✓	(e) or (f)	Capping layer, pavement cover & drainage layer
L8	✓	✓	✓	X	If "Wet" layer entirely removed and replaced: (b) to (e). If not: (a), (b) or (e)	Capping layer & working platform
L9	✓	✓	✓	✓	(e)	Capping layer, drainage layer & working platform
L10	✓	✓	X	X	(a), (b) or (e)	Capping layer, pavement cover & working platform
L11	✓	✓	X	✓	(e)	Capping layer, pavement cover, drainage layer & working platform

* (g) – geofabric layer may or may not provide adequate as a working platform upon which pavement construction can proceed. This can only be determined by trial and error. If it proves insufficient support, other acceptable treatments will be required.

(6) Capping layer

Capping layer must be provided where the in-situ untreated subgrade has a design CBR ≤ 3%. Treatment types that are suitable for use as a capping layer and a reference to the quality requirements are as follows:

(a) in-situ lime stabilisation of the subgrade – refer SC6.4.4.2.4 (8);

(b) plant mixed cement stabilised gravel – refer SC6.4.6.12 Flexible pavements;

(c) unbound gravel – refer SC6.4.6.12 Flexible pavements;

(d) select fill – refer SC6.4.4.2.4 (7);

(e) rock fill (geofabric wrapped) + min. 150mm *(b)* or *(d)* – refer SC6.4.4.2.4 (9); and

(f) drainage layer material + min. 150mm *(b)* or *(d)* – refer SC6.4.4.2.4 (10).

(7) Select fill

Select fill can be used as part of a subgrade treatment solution when a "capping layer" and/or "pavement cover" is required, and could also be used as a "working platform" to replace a wet layer. Select fill may comprise a naturally occurring material from on site or imported to site, or may comprise a natural material that has its properties improved by addition of cement or lime. The natural material or improved product must meet the minimum requirements in Table SC6.4.4.2.7 Material properties for select fill.

Table SC6.4.4.2.6 Determining thickness of treatment layer

Treatment	Thickness of treatment	Treatment name
L1	Refer SC6.4.6.8 Drainage mats	Drainage layer
L2	Excluding *(g)* "geofabric layer", thickness is as required to successfully achieve compaction on top of the working platform, min. 150mm	Working platform
L3	Refer SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Drainage layer & working platform
L4	Refer SC6.4.4.2.7 (1) and (2)	Capping layer
L5	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Capping layer & drainage layer
L6	Refer SC6.4.4.2.7 (1) and (2)	Capping layer & pavement cover
L7	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Capping layer, pavement cover & drainage layer
L8	Refer SC6.4.4.2.7 (1) and (2). Greater thickness may be required to achieve an adequate working platform	Capping layer & working platform
L9	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer. Greater thickness may be required to achieve an adequate working platform	Capping layer, drainage layer & working platform
L10	Refer SC6.4.4.2.7 (1) and (2). Only types *(a), (b)* or a combination of a minimum 150mm of *(d)* on top of *(e)*, are acceptable due to expansive subgrade. Greater thickness may be required to achieve an adequate working platform	Capping layer, pavement cover & working platform
L11	150mm of *(d)* is required on *(e).* Thickness of *(e)* determined from SC6.4.6.8 Drainage mats. Combined thickness must also satisfy SC6.4.4.2.7 (1) and (2). Greater thickness may be required to achieve an adequate working platform	Capping layer, pavement cover, drainage layer & working platform

Table SC6.4.4.2.7 Material properties for select fill and treated material

Property	**Depth below Working Platform** [1]	
	≤ 150 mm	**> 150 mm**
Laboratory CBR (%) [1]	≥ 10	≥ 10
Maximum aggregate size (mm)	75	75
Plasticity index	≥7	≥7
Weighted plasticity index (WPI)	< 1200	< 2200
Swell (%) [2]	≤ 0.5	≤ 2.5
% passing 0.075 mm	15–30 inclusive	4–30 inclusive

Note—

(1) material may be chosen with a minimum CBR greater than specified above, ift his is considered to provide a better overall design solution. However, for design purposes, the layer may not be modelled with CBR of greater than1 5%. CBR to be tested in accordance with Q113C (97.0% MDD, OMC, standard compactive effort), 4.5kg surcharge and soaked for a period of four days.

(2) swell determined from CBR test described above.

(8) In-situ lime stabilised subgrade

In-situ lime stabilisation of the subgrade soil is the preferred means of satisfying "Capping Layer" and "Pavement Cover" requirements when the subgrade comprises plastic clay soils.

In-situ treatment of clay subgrades using lime involves mixing lime, which has been either previously hydrated or hydrated on site by adding water (slaking), into a subgrade to increase subgrade strengths. This may be done to modify the subgrade (i.e. usually achieve a temporary strength gain) or it may be added to stabilise it (i.e. achieve a permanent increase in strength). In the case of the latter sufficient lime must be added to ensure that these strength gains are permanent. It is essential that the purpose of the treatment is clearly identified and clear to all concerned.

No design benefit can be adopted if stabilisation is only for the purpose of "modifying" the subgrade soil properties. To qualify for use as a "Capping Layer" and/or "Pavement Cover", full stabilisation as outlined below is required.
Subgrade soil not suitable for lime stabilisation must include:

(a) unbound material with:
  (i) a plasticity index less than 10%; or
  (ii) less than 25% passing the 0.425 mm sieve; or
  (iii) Soluble sulphate > 0.2%

(b) any patch which may include:
  (i) concrete; or
  (ii) cement treated material; or
  (iii) asphalt.

Lime stabilisation of subgrade material must be carried out as a 2 day operation to a minimum depth of 250mm, except for natural subgrades with a representative strength of CBR 0.5% where stabilisation depth must be a minimum of 300mm. The required process is detailed in SC6.4.6.12 Flexible pavements.

(9) Rock fill (geofabric wrapped) + min. 150mm of *(b)* or *(d)*
Rock fill (geofabric wrapped) can be utilised in combination with treatment types *(b)* or *(d)* for application within a capping layer, a working platform and a Drainage Layer.

Rock fill must meet the quality requirements for rock Fill in TMR Specification MRTS04 and the Geofabric must be selected in accordance with TMR Specification MRTS27.

The minimum rock fill layer thickness must be twice the maximum particle size, but not less than 300mm. If a working platform is also required, the thickness must be sufficient to bridge the natural subgrade and provide solid support for the *(b)* or *(d)* overlying layer.

(10) Drainage layer + min. 150mm of *(b)* or *(d)*

A drainage layer must be provided where water exposure occurs, or is likely to occur, from beneath the pavement (due to the effect of capillary rise and/or positive head). The drainage layer must be a minimum 300mm thick (refer SC6.4.6.8 Drainage mats) and covered by a minimum 150mm of type *(b)* or *(d)*.

Treatment type *(f)* must not be used for situation where a working platform is also required due to the insitu material being wet and of low strength (which can be assessed by in situ dynamic cone penetrometer testing), and only treatment type *(e)* is acceptable.

(11) Equivalent subgrade CBR for design
Section SC6.4.4.2.4 (1) to (10) outlines the requirements of subgrade treatment and treatment type options acceptable by Council. Once subgrade treatment has been identified, the equivalent subgrade CBR value for pavement design calculation or modelling must be adopted as per Table SC6.4.4.2.8 Equivalent subgrade CBR.

As a capping layer is compulsory for treatment L4 to L11, there are two design conditions to determine the thickness requirement and equivalent subgrade CBR strength for the capping layer.

(a) Capping layer comprises in-situ lime stabilised subgrade or plant mixed cement stabilised gravel
The pavement above an in-situ lime stabilised subgrade or plant mixed cement stabilised gravel must be designed for an equivalent CBR derived from the natural subgrade CBR and the design traffic load (ESA's) as shown in Figure SC6.4.4.2.2 Design chart: Subgrade CBR equivalent to lime stabilised layer + natural subgrade (M. Matheson).

The capping layer depth required must be 250mm for natural subgrade CBR of > 0.5%, otherwise depth must be 300mm.

(b) Capping layer comprises unbound material

As detailed in section SC6.4.4.2.4 (6), unbound material that are acceptable to be used as capping layer include:

- unbound gravel;
- select fill;
- rock fill (geofabric wrapped) + min. 150mm select fill; and
- drainage layer material + min. 150mm select fill.

The required capping thickness is given in Table SC6.4.4.2.9 Capping thickness for unbound materials. However, for natural subgrade CBR ≤ 1.0%, a specific assessment is required.

Table SC6.4.4.2.8 Equivalent subgrade CBR

Treatment	Natural ground subgrade CBR (%)	Treatment type	Equivalent subgrade CBR
-	> 3	Nil	Use natural ground subgrade CBR
L1	> 3	*(e)* or *(f)*	CBR = 10%
L2	> 3	*(b), (c), (d), (e)* or *(g)**	If wet layer is removed and replaced: Use natural ground subgrade CBR
		(b), (e) or *(g)**	If wet layer remains: CBR = 3%
L3	> 3	*(e)*	CBR = 3%
L4	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(c) or *(d)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L5	≤ 3	*(e)* or *(f)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L6	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(d)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L7	≤ 3	*(e)* or *(f)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L8	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(e)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L9	≤ 3	*(e)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L10	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(e)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L11	≤ 3	*(e)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)

* (g) – geofabric layer may or may not provide adequate as a working platform upon which pavement construction can proceed. This can only be determined by trial and error. If it proves insufficient support, other acceptable treatments will be required.

Table SC6.4.4.2.9 Capping thickness for unbound material

Natural subgrade CBR	Minimum capping layer thickness (mm)
≥ 2.5% to ≤ 3.0%	150
≥ 2.0% to < 2.5%	200
≥ 1.5% to < 2.0%	300
≥ 1.0% to < 1.5%	400

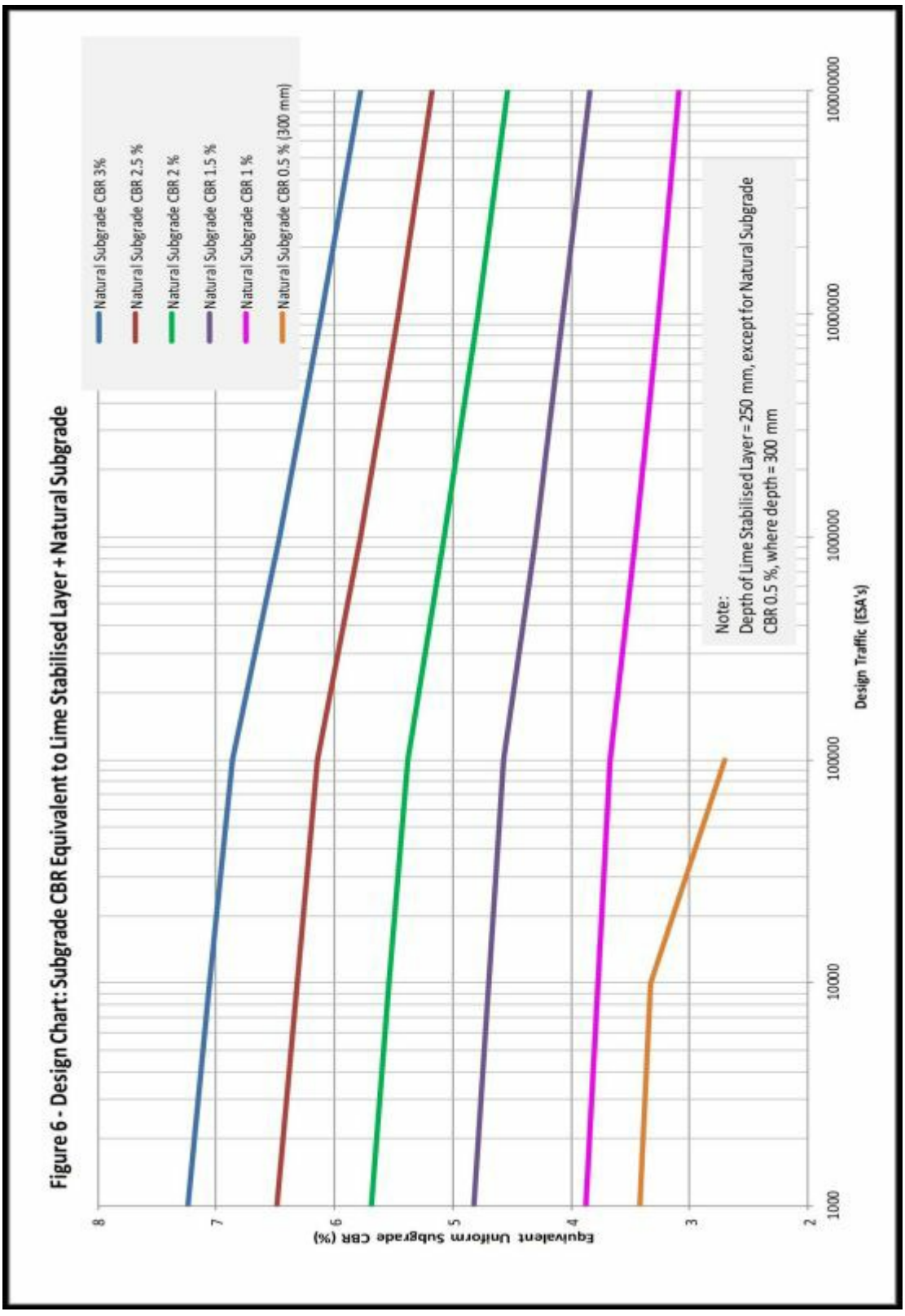


Figure SC6.4.4.2.2 Design chart: subgrade CBR equivalent to lime stabilised layer + natural subgrade (M. Matheson)

SC6.4.4.2.5 Pavement and surfacing materials

(1) Pavement materials can be classified into the following categories according to their fundamental behaviour under the effects of applied loadings:

- unbound granular materials;
- cement modified granular materials, also known as cement modified (0.8 MPa < UCS < 1.5 MPa);
- bound (cemented) granular materials, also known as cement treated (UCS >1.5MPa);
- asphaltic concrete;
- cement concrete; and
- heavy duty asphalt (deep lift asphalt).

(2) Surfacing materials can also be classified into essentially five categories or types:

- sprayed bituminous seals (flush seals);
- asphaltic concrete;
- cement concrete;
- concrete segmental pavers; and
- clay segmental pavers.

(3) Unbound granular materials, including modified granular materials, must satisfy the requirements of SC6.4.6.12 Flexible pavements.

(4) Bound (cemented) granular materials must satisfy the requirements of SC6.4.6.12 Flexible Pavements.

(5) Asphaltic concrete must satisfy the requirements of SC6.4.6.13 Asphaltic concrete.

(6) Cement concrete must satisfy the requirements of SC6.4.6.14 Mass concrete subbase, SC6.4.6.15 Plain and reinforced concrete base, as appropriate.

(7) Sprayed bituminous seals must satisfy the requirements of SC6.4.6.16 Sprayed bitumen surfacing.

(8) Concrete and clay segmental pavers must satisfy the requirements of SC6.4.6.18 Segmental paving.

(9) Heavy duty asphalt pavements must satisfy the requirements of MRTS31.

SC6.4.4.2.6 Construction and maintenance considerations

The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:

(1) extent and type of drainage;

(2) use of boxed or full width construction;

(3) available equipment of the Contractor;

(4) use of stabilisation;

(5) aesthetic, environmental and safety requirements;

(6) social considerations;

(7) construction under traffic;

(8) use of staged construction; and

(9) ongoing and long-term maintenance costs

These factors are further discussed in Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

SC6.4.4.2.7 Pavement design

Pavement design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design* unless otherwise stated in this document.

(1) Pavement Thickness

Notwithstanding subgrade testing and subsequent pavement thickness design, the minimum pavement thickness on local streets must not be less than 250 mm. This is necessary to ensure that council has sufficient thickness for future insitu stabilisation of pavements (without the risk of mixing the subgrade into the pavement during the process). Additionally, individual compacted layer thickness must be chosen to suit construction process and must be no less than 125 mm nor greater than 250 mm for optimal compaction and to avoid lamination of layers.

(2) Design subgrade CBR

The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.

Design CBR of untreated subgrade must be no greater than 3% unless otherwise approved by council who reserves the rights to carryout independent 3rd party geotechnical investigations to confirm adopted design CBR's and respective pavement designs.

Warrants for the provision of subsurface drainage are given in SC6.4.6.21 Subsurface drainage. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a design moisture content above the optimum moisture content (OMC).

Subgrade treatment must be carried out in accordance with this document on all natural subgrade CBRs ≤ 3% (97% maximum dry density standard compaction at OMC). The equivalent design subgrade CBR of the treated subgrade must be determined in accordance with this document. Pavement design over treated subgrades may adopt the equivalent CBR determined in accordance with this document.

(3) Pavement structure - general

Unbound granular materials used must comply with the requirements of MRTS05. Bound layers must comply with the requirements under MRTS08.

The subbase layer must extend a minimum of 150 mm behind the rear face of any kerbing and/or guttering. The base and surfacing must extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer must also extend a minimum of 150 mm behind the rear face of the kerbing and/or guttering.

For unkerbed roads, the subbase and base layers must extend for the full width of the formation.

The pavement designer must make specific allowance for traffic load concentrations within car park areas (e.g. entrances/exits).

The pavement designer must make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur. Compaction of the subbase, including 150mm behind the rear face of the kerb and channel, must be carried out before trenching of the subsoil behind the kerb.

(4) Unbound granular flexible pavements (bituminous surfaced)

Unbound granular flexible pavements with thin bituminous surfacings, including those with cement or lime modified granular materials, with design traffic up to 1 x 10^6 ESAs must be designed in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*.

Residential streets and rural roads with non-fixed level construction (future overlay possible) must be designed in accordance with Austroads Guide to Pavement Technology Part 2: Pavement Structural Design.

For design traffic above 1 x 10^6 ESAs, the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

An unsealed gravel pavement may be acceptable for assigned traffic volumes of less than 100vpd on lightly trafficked roads in rural areas. Where the connecting road to a reconfiguration is also unsealed, it must be upgraded to at least the gravel pavement standard, and, if the assigned traffic volume equals or exceeds 100vpd, it must be fully sealed, from its connection with an existing sealed road to a threshold point where the assigned traffic volume on the connecting road falls below 100vpd. Where an existing rural road is specified as upgraded to gravel pavement standard, the minimum pavement thickness is 100mm.

(5) Flexible pavements containing bound layers (bituminous surfaced)

Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than non-structural asphalt surfacings, must be designed in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(6) Rigid pavements

Rigid (concrete) pavements, with design traffic up to 1 x 10^6 ESAs must be designed in accordance with either CACA -T51 or Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

Rigid (concrete) pavements for design traffic above 1 x 10^6 ESAs, the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(7) Concrete segmental pavements

Concrete segmental pavements with design traffic up to 1 x 10^6 estimated commercial vehicles exceeding 3T gross must be designed in accordance with CMAA T45.

For design traffic above 1 x 10^6 ERAs estimated commercial vehicles exceeding 3T gross the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*, with the calculation of design traffic in terms of ESAs.

(8) Clay segmental pavements

Clay segmental pavements with design traffic up to 1 x 10^6 ESAs must be designed in accordance withAustroads *Design Manual 1 - Clay Segmental Pavements.*

For design traffic above 1 x 10^6 ESAs and up to 1 x 10^7 ESAs the design must involve consideration of both *Design Manual 1 - Clay Segmental Pavements* and Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design,* with the thicker and more conservative design of each of the two methods adopted.

For design traffic above 1 x 10^7 ESAs, the pavement must be designed in accordance with *Guide to Pavement Technology Part 2: Pavement Structural Design.*

SC6.4.4.2.8 Surfacing design

(1) Choice of surface type

Except where the pavement is designed for concrete or segmental paver surfacing, the wearing surface must be a bituminous wearing surface as follows:

(a) urban residential streets – urban Type A, B and C, major collector, sub-arterial and arterial roads—prime, plus one coat flush seal, plus asphalt;

(b) rural residential streets—access roads, collector roads, sub-arterial and arterial roads—prime, plus two coats flush seal; and

(c) commercial and industrial streets—prime and one coat flush seal plus asphalt;

In cases where it is required for the road to be opened to traffic upon completion of work, primerseal may be used with prior approval from council.

At intersection approaches and cul-de-sac turning circles on residential streets with flush seals, asphalt surfacing must be provided within the vehicle braking and turning zones.

Variations to these requirements may be approved by council in special circumstances.

(2) Sprayed bituminous seals (flush seals)

The design of sprayed bituminous (flush) seals, including primer seals, must be in accordance with the *Guide to Pavement Technology Part 3: Pavement Surfacings.*

7mm primer seals or prime and seals must be indicated on the Drawings below all flush seals, and asphalt surfacings. Where a 7 mm primer seal is impractical, a 10mm primer seal must be indicated in lieu.

Two-coat flush seals must be double-double seals, comprising a minimum of two coats of binder and two coats of aggregate. The preferred seal types are:

(a) 1st coat 14 mm; and

(b) 2nd coat 10 mm.

Single coat flush seals may be allowable if asphaltic concrete is to be applied as the finished surface. The preferred seal type is either 14mm or 10mm.

(3) Asphaltic concrete

In urban residential roads, medium to heavily trafficked commercial streets and in all industrial roads, the asphalt mix design must be a dense graded mix in accordance with the MRTS 30 06/09.

Asphaltic concrete surfacings must be designed to provide a nominal compacted layer thickness of not less than 30 mm (AC10) on light to medium trafficked residential streets, and 50 mm (AC14) minimum on medium to heavily trafficked residential, commercial roads and on all industrial and classified roads including all roundabouts and all cul-de-sac heads.

As a minimum, a 10mm primer seal or prime and seal must be indicated on the Drawings below the asphalt surfacing. Tack coat is to be used where the asphalt is used as an overlay.

Polymer Modified Bitumen in accordance with MRTS18 must be used in the asphalt in areas of heavy traffic where braking, turning, acceleration is to be experienced.

(4) Segmental pavers

Pavements must be sealed with a minimum of 10 mm primerseal prior to laying segmental pavers. Concrete segmental pavers must be 80mm thick, shape Type A, and designed to be paved in a herringbone pattern.

Clay segmental pavers must be 65mm thick, Class 4, and designed to be paved in a herringbone pattern. The edges of all paving must be designed to be constrained by either kerbing and/or guttering, or by concrete edge strips.

SC6.4.4.2.9 Documentation – pavement design criteria and calculations

All considerations, assumptions, subgrade test results, and calculations and other documentation required under this design specification must be submitted with the pavement design for approval by council.

The Drawings must clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing.

Pavement design criteria must be shown on the pavement drawings and include the ESA, CBR and expected design life.

SC6.4.4.2.10 Subsurface drainage design

(1) Subsoil and sub-pavement drains

(a) Warrants for use

(i) Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings and fill areas.

(ii) Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade.

(iii) Subsoil or sub-pavement drains must be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to

allow for likely variations in subgrade and pavement moisture contents:

(A) cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level;

(B) locations of known hillside seepage, high water table, isolated springs or salt affected areas;

(C) irrigated, flood-prone or other poorly drained areas;

(D) highly moisture susceptible subgrades, i.e. commonly displaying high plasticity or low soaked CBRs;

(E) use of moisture susceptible pavement materials;

(F) existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture; and

(G) at cut to fill transitions.

Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

(iv) The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation. The Design Drawings must be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

(2) Layout, alignment and grade

Typical cross sections of subsoil drains are shown in SC6.4.4.8 Standard drawing SD-080 – Subsoil Drain. In kerbed roads, the only acceptable location for the line of the trench is directly behind the kerbline. Pavement layers must extend to at least the line of the rear of the trench.

In unkerbed roads, subsoil and sub-pavement drains must be located within the shoulder, preferably at the edge of the pavement layers.

The minimum desirable longitudinal design grade is 1.0%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

Trench widths must be a minimum of 300 mm for a 100mm diameter slotted pipe or a minimum of 100mm for strip drains, Outlets must be spaced at maximum intervals of 150m into gully pits or outlet headwalls. As a salinity prevention measure and where practical, discharge must be on the downhill side of the embankment or in the cut-fill area to reduce the risk of recharge to the subsurface water table. Unless otherwise authorised, where subsurface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run must be specified. A small precast concrete headwall must be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

Cleanouts must be provided at the commencement of each run of drain, and at intervals not exceeding 80m. Cleanouts must generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

In salinity affected areas, the Designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation. Saline subsurface drainage should not be routinely discharged directly into natural watercourses. Reference to water quality targets for downstream watercourses is essential and the Designer must provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource or environmental protection authority.

SC6.4.4.2.11 Foundation drains

(1) Warrants for use

Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location must be shown on the Drawings. However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

Where the road formation traverses known swampy, flood-prone, salt affected areas or watercharged strata, the Drawings must be suitably annotated for the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

(2) Layout, alignment and grade

Typical cross-sections of foundation drains are shown below in Figure SC6.4.4.2.3.

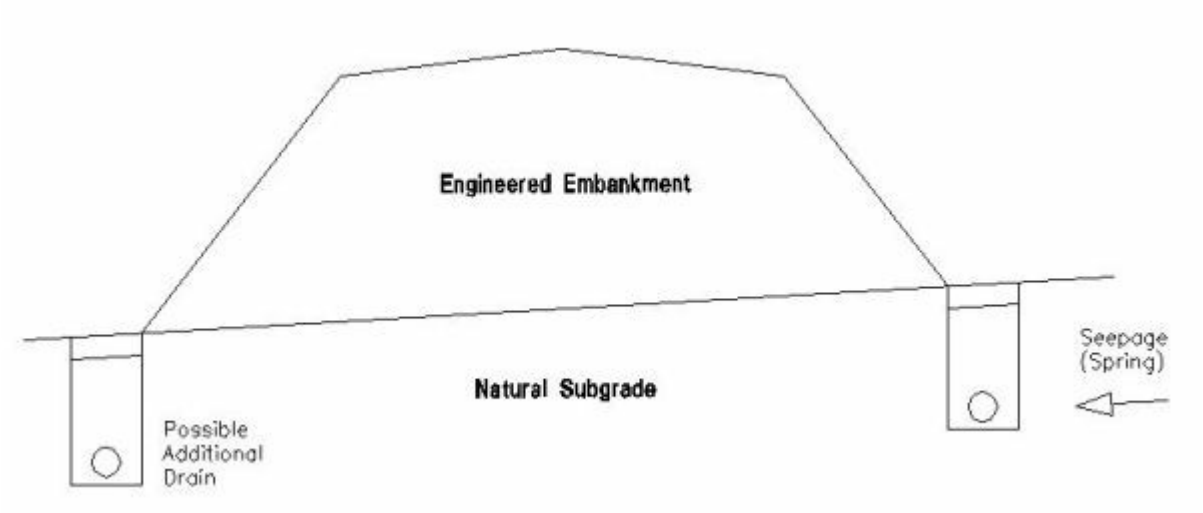


Figure SC6.4.4.2.3 Foundation drains

The minimum desirable design grade is 1%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Foundation drains must have a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

Outlets must be spaced at maximum intervals of 150m.

Where practicable, cleanouts must be provided at the commencement of each run of foundation drain and at intervals not exceeding 60 m. Where not practicable to provide intermediate cleanouts, outlets must be spaced at maximum intervals of 100m.

SC6.4.4.2.12 Drainage mats (blankets)

(1) Warrants for use

Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings. Type B drainage mats must be constructed after completion of the subgrade construction and before construction of the pavement.

The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

SC6.4.4.2.13 Materials

(1) Subsoil and sub-pavement drain pipe

Pipes designated for subsoil, foundation and sub-pavement drains must be 100mm dia. slotted pipe.

Corrugated plastic pipe must conform with the requirements of AS 2439.1. The appropriate class of pipe must be selected on the basis of expected live loading at the surface. Joints, couplings, elbows, tees and caps must also comply with AS 2439.1.

Slotted rigid UPVC pipe must be of a type and class approved by council.

All pipe must be slotted, and fitted with a suitable geotextile filter tube, except for cleanouts and outlets through fill batters which must be unslotted pipe.

(2) Intra pavement drain pipe

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses neither less than 150mm nor more than 200mm must be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses exceeding 200 mm must be slotted pipe of a type and class approved by council.

Pipes for use in Type B drainage mats must be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

(3) Filter material

The types of filter material covered by this sub-section must include:

(a) Type A filter material for use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats;

(b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains;

(c) Type C filter material comprising crushed rock for use in Type A drainage mats; and

(d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

Material requirements and gradings for each type of filter material are included in the construction sub-section SC6.4.6.21 Subsurface drainage.

The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) depends on the permeability of the pavement layers and/or subgrade and the expected flow rate. Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels. Further guidance to the selection of appropriate filter material is contained in *Guide to Pavement Technology.*

(4) Geotextile

To provide separation (i.e. prevent infiltration of fines) between the filter material in the trench and the subgrade or pavement material, geotextile must be designated to encapsulate the filter material. The geotextile must comply with the requirements included in sub-section SC6.4.6.21 Subsurface drainage.

Geotextile must also be designated for both Type A and Type B Drainage Mats.

SC6.4.4.2.14 Documentation – subsurface drainage drawings and calculations

The proposed location of all subsurface drains must be clearly indicated on the Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement. The location of outlets and cleanouts must also be indicated on the Drawings.

SC6.4.4.3 Bridges and other structures

SC6.4.4.3.1 Introduction

(1) Objective

This sub-section sets out design considerations to be adopted in the design of structural engineering elements associated with

(a) road traffic bridges;

(b) pedestrian/cyclist bridges;

(c) any structure designed to carry a road or a path over a waterway, depression or obstacle; and

(d) temporary works.

(2) Design considerations

Such structures may be primarily constructed of concrete, timber, steel or other materials appropriate to the application. The design should always have a primary emphasis on safety and whole of life cycle costs. The structure/s should comply with current Safety in Design principles and guidelines.

The design is to be certified that the proposed structure will not become unfit for use during its intended design life. This assessment will have measured regard to all associated issues with the proposed structure including:

(a) consideration of any future infrastructure planning;

(b) economic constraints;

(c) physical or structural constraints;

(d) aesthetic considerations;

(e) flooding or hydraulic capacities (if applicable);

(f) safety in design;

(g) maintenance and repair constraints;

(h) constructability; and

(i) fit for purpose.

(3) Basis of design

(a) The basis of the proposed bridge design is to principally conform to Austroads' road design standards, and AS 5100 as appropriate. The design must be based on sound engineering principles, and certified by a suitably qualified engineer (RPEQ).

(b) The safety and service performance of a structure will depend on the quality control exercised in fabrication, supervision of the site, control of unavoidable imperfections and the experience and skill of the personnel involved. Specific attention must therefore be given to these particular factors.

(c) All design criteria for bridges in the Townsville City Council local government area must be approved by council prior to the design being carried out. The Designer must make reference and address all issues outlined in Appendix A of AS 5100.1.

(d) Adequate management control and supervision by experienced engineers (RPEQ) is required at all stages of the design and construction to prevent the occurrence of any unapproved non-conformances with the plans and specifications.

(e) Specifications must be notated on the Drawings with sufficient details to ensure that the above described strategies are able to be effectively implemented throughout the construction stage.

(4) Reference and source documents

(a) Development manual planning scheme sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.4.1 - Geometric road design

SC6.4.4.2 - Pavement design

SC6.4.4.4 - Stormwater drainage design

SC6.4.4.7 - Bicycle, pedestrian and shared path design

(b) Australian Standards

AS 1158	*Lighting for roads and public spaces*
AS/NZS 3845	*Road safety barrier systems*
AS 5100	*Bridge Design*
AS1428	Design for access and mobility

(c)

AS1170	Minimum design loads on structure (SAA Loading Code)
AS1684	National timber framing code
AS3600	Concrete structures
AS3700	Masonry in buildings (SAA Masonry Code)
AS4100	Steel structures

Other codes and guidelines referred to in the Australian Standards, as relevant.

(d) Department of Transport and Main Roads Technical Specifications

MRS70	*Concrete (10/11)*
MRS71	*Reinforcing Steel (06/09)*
MRS72	*Manufacture of Pre-cast Concrete Elements (08/13)*

Other

Austroads, *Guide to Bridge Technology Part 4 - Design Procurement and Concept Design, 2009*
Queensland Department of Transport and Main Roads, *Road Planning and Design Manual, 2006*
Queensland Department of Main Roads, *Road Traffic Noise Management: Code of Practice, 2000*
Queensland Department of Energy and Water Supply, *Queensland Urban Drainage Manual*

SC6.4.4.3.2 Road traffic and pedestrian bridges

(1) Bridge design must only be carried out by properly qualified persons who are Registered Professional Engineers of Queensland (RPEQ) and experienced in structures design. If requested, such designers must submit evidence of these qualifications and experience to council prior to approval of any bridge design.

(2) The *Bridge Design Code* (AS 5100) must be used for all bridge design.

(3) Bridges must have low maintenance finishes. Adequate precautions must be taken for protection of the materials used in the bridge design; for example, timber and steel require special consideration. Heavy debris and bed loads may be characteristic of some streams so that large spans with slender piers are encouraged. If floodwater overtopping is to occur, pedestrian safety rails and road safety barriers could be omitted to reduce debris collection on the roadway. Flood depth indicators and appropriate signposting will be provided in such cases.

(4) Preventative maintenance is a key issue affecting the design life of the structure. The Drawings must specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design must also be shown on the Drawings.

(5) Hydraulic design of bridge/s must be in accordance with the requirements for major structures in SC6.4.4.4 Stormwater drainage design.

(6) Where structures are designed to be inundated, the effect of the backwater gradient on upstream property must be identified on the Drawings. Detailed consideration of alternate evacuation routes are also to be considered in the event that the bridge structure is to be inundated.

(7) Where no inundation is permitted, appropriate afflux must be adopted together with a 500mm freeboard to the underside of the bridge deck. All road structures with a 1% annual exceedance probability (AEP) designed waterway which is in excess of 5sqm must be modelled using current hydrological modelling practices (software) to determine the upstream impacts over the full range of storm events up to and including the 1% AEP. Impacts of the PMF are also to be assessed on the structure.

(8) The designer is to enquire with the appropriate authority on any current or likely provisions for public utilities or services on bridges. These should be concealed for aesthetic reasons. Consultation with the appropriate utility authority is to be undertaken during the course of the structural design, particularly in regard to the location and placement of existing and future public utilities.

SC6.4.4.3.3 Provision for pedestrians and cyclists on road bridges

(1) Provision for pedestrians and cyclists on bridges is required in rural residential as well as urban areas. The

minimum provision is a 1.5m footpath with a 150mm high kerb at the traffic lane edge. The design is to consider pedestrian on the bridge. A safety railing is to be provided between pedestrians and the trafficable lane together with 1.5m (min) wide shoulder to accommodate on-road cyclists.

(2) Council may require the provision of a combined cycleway and pedestrian footway should the risk to on-road cyclists be too high.

(3) Disability access across the proposed bridge is to be DDA compliant and generally in accordance with AS 1428.

(4) Urban bridge approaches should be lit in accordance with AS 1158.

SC6.4.4.3.4 Structures other than bridges, associated with roads

Public utility structures, major culverts, major sign support structures, retaining walls, and the like will be designed by a competent, practicing engineer (RPEQ certified) who is accredited in the design of such structures. The design must be in accordance with the SC6.4 Development manual planning scheme policy, relevant Austroads codes, all relevant Australian Standards, and the requirements of any utility owners that may be applicable.

SC6.4.4.3.5 Structures used for public safety

(1) Since the requirement of road safety barriers and pedestrian safety rails on bridges are different, the design engineer must consider whether separate traffic and pedestrian barriers can be detailed to satisfy the major functional requirements.

(2) The *Bridge Design Code* (AS 5100.1 Sections 10 - 12) and AS/NZS 3845 are recommended references in this regard.

(3) It is essential that all safety barriers and rails have been fully tested and accredited for the intended use under quality assurance provisions.

(4) Bridge crossings in urban and rural residential areas must be provided with street lighting in accordance with AS 1158. Such requirements will be noted accordingly on the drawings.

SC6.4.4.3.6 Temporary works

Structures which are proposed for the temporary support of roads, services and the like must be designed by a qualified Engineer (RPEQ certified) experienced and accredited in the design of such structures and designed in accordance with the *Bridge Design Code* (AS 5100). A construction programme, indicating the sequence of events leading to the implementation and removal of the temporary structures must be specified on the drawings. The design of such temporary structures is to mandate the safe constructability and use of these structures throughout the term of the construction works.

SC6.4.4.4 Stormwater drainage design

SC6.4.4.4.1 Introduction

(1) Objectives

(a) The objectives of SC6.4.4.4 Stormwater drainage design are as follows:

(i) to ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits;

(ii) to provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits; and

(iii) retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.

(b) In pursuit of these objectives, the following principles apply:

(i) new developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in QUDM (Third Edition 2013 – provisional or as amended); that is, the "major" system shall provide safe, well-defined overland flow paths for infrequent storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events; and

(ii) redevelopment - where the proposed development replaces an existing development, stormwater must be managed in a way that does not exacerbate flooding, and /or adversely impact on neighbouring land or road. The level of drainage provided must be consistent with new development.

(2) Scope

The work to be executed under this sub-section consists of the design of stormwater drainage systems for urban and rural areas.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with its sub-section are as follows:

SC6.4.6.4 Stormwater Drainage
SC6.4.6.5 Drainage Structures
SC6.4.6.6 Pipe Drainage
SC6.4.6.7 Precast Box Culverts
SC6.4.6.9 Open Drains

(b) Australian Standards

AS/NZS 1254	*PVC-U pipes and fittings for stormwater and surface water applications.*
AS/NZS 2032	*Installation of PVC pipe systems.*
AS/NZS 2566.1	*Buried flexible pipelines, structural design.*
ASNZS 3725	*Design for installation of buried concrete pipes.*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure).*
AS 4139	*Fibre reinforced concrete pipes and fittings.*

(c) The State of Queensland Department of Energy and Water Supply, *Queensland Urban Drainage Manual – Third Edition 2013 provisional, 2013*.

(d) Department of Transport and Main Roads*, Road Drainage Manual, 2015*

(e) *Other*

Argue, John, Australian Road Research Board, Special Report 34, Stormwater drainage design in small urban catchments: a handbook for Australian practice.

Australian National Conference On Large Dams, Leederville WA, ANCOLD 1986, Guidelines on Design Floods for Dams.

Australian Road Research Board, Research Report ARR368, The collection and discharge of stormwater from the road infrastructure, Allan Alderson, 2006.
Austroads, Guide to Bridge Technology.
Austroads 2013, Guide to Road Design Part 5: Drainage – General and Hydrology Considerations 2013, Austroads Ltd, Sydney NSW.
Chanson, H, Hydraulic Design of Stepped Cascades, Weirs and Spillways, Pergamon, Oxford 1994 .
Chanson, H, Hydraulics of Nappe Flow Regime Above Stepped Chutes and Spillways, Australian Civil Engineering Transactions, IEAust Volume 1 CE36 No. 1, January 1994.
Chow, Ven Te, Open Channel Hydraulics, 1959.
Concrete Pipe Association of Australia, Concrete Pipe Guide, charts for the selection of concrete pipes to suit varying conditions.
Hare CM., Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems, Transactions, Inst. of Eng. Aust., Feb. 1983.
Henderson, FM., Open Channel Flow, 1966.
Insearch Ltd, NSW Institute of Technology (NSWIT), Energy Losses in Pipe Systems, C.M. Hare in Advances in Urban Drainage Design, 1981.
Institute of Engineers, Australian Rainfall and Runoff (AR&R). A guide to flood estimation, Aug 1998.
Institute of Public Works Engineering Australia, Qld Division, Standard Drawings, 2000.
Main Roads Department, Urban Road Design Manual (URDM), Volume 2., Queensland. First Edition 1975 as subsequently amended.

(e) *Sangster, WM., Wood, HW., Smerdon, ET., and Bossy, HG, Pressure Changes at Storm Drain Junction, Engineering Series, Bulletin No. 41, Eng. Experiment Station, Univ. of Missouri 1958.*
SC6.7 Flood hazard planning scheme policy.

Townsville City Council SC6.4.4.8 Standard drawings
SD-015 Footpath service allocation new streets
SD-020 Concrete kerbing
SD-080 Subsoil drains
SD-085 Drainage connections
SD-200 Precast grated kerb inlet system and cast insitu stormwater manhole SD-205 Stormwater manhole details
SD-210 Manhole slab top details
SD-215 Raised grate field inlet manhole

SC6.4.4.4.2 Major and minor system design AEPs

(1) The Annual Exceedence Probability(AeP) is the probability of exceedence of a given rainfall intensity or discharge within a period of one year.

(2) The major system design AEP is the Defined Flood Event, being the 1% AEP, unless altered by Table 8.2.6.3(b) of the Flood hazard overlay code.

(3) The Minor system design AEPs must be in accordance with Table SC6.4.4.4.1.

Table SC6.4.4.4.1 Minor System Design AEP and ARI

Development Category	ARI (yrs)	AEP
Residential	2	39%
Commercial - Lower order (district centre and below)	2	39%
Commercial - Other (excluding Lower order commercial and Principal centre)	5	18%
Industrial	5	18%
Principal Centre (CBD)	10	10%
Rural Residential	20	5%
Parks and recreation areas (excluding community facilities)	1	1EY

(4) The Minor system design AEP for streets is as per the adjacent development category listed in Table SC6.4.4.4.1.

SC6.4.4.4.2 Hydrology

(1) Design rainfall data can be obtained from one of the following methods:

(a) Design intensity-frequency-duration (IFD) rainfall - IFD relationships shall be derived in accordance with Volume 1, Book II, of AR&R, 1998 for the particular catchment under consideration;

(b) The nine basic parameters read from Maps 1-9 in Volume 2 of AR&R shall be shown in the calculations submitted to council, except where the Bureau of Meteorology provides a polynomial relationship for the catchment; or

(c) Design IFD rainfalls can be obtained from the Bureau of Meteorology website for specific locations and these are to be submitted to council.

(2) Catchment area

(a) The area of land contributing stormwater runoff to the point under consideration. Consideration must be given to likely changes to individual catchment areas and catchment parameters caused by the full development of the catchment in accordance with the zonings in the Townsville City Plan.

(b) Where no detailed survey of the catchment is available, contour maps produced from council's GIS are to be used to determine the catchments and to measure areas. A suitable scale shall be chosen.

(c) Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

(3) Rational method

(a) Rational method calculations to determine peak flows shall be carried out in accordance with QUDM (Third Edition 2013 – provisional).

(b) All calculations shall be carried out or supervised by a qualified engineer (RPEQ certified) who is experienced in hydrologic and hydraulic design.

(c) Coefficients of discharge shall be calculated as per QUDM (Third Edition 2013 – provisional or as amended) and full details of coefficients utilised shall be provided.

(d) Details of percentage impervious for individual zonings are given in SC6.4.4.4 Attachment A.

(e) The time of concentration of a catchment is defined as the time required for storm run off to flow from the most remote point on the catchment to the outlet of the catchment. Most catchments will have multiple lengths of flow paths and gradients. The longest length flow path may not always govern the critical flow path. The hydrologic design should analyse several paths to assess any sensitivity to the catchment's time of concentration.

(f) Where the flow path is through areas having different flow characteristics or includes property and roadway, then the flow time of each portion of the flow path shall be calculated separately.

(g) The minimum time of concentration shall be taken as 5 minutes urban and 10 minutes rural.

(h) Flow paths to pits must be designed to accommodate the flows from the fully developed catchment and provide for anticipated obstructions such as fences, building pads, buildings and other likely obstructions. Any proposed changes to flow paths must be undertaken on a catchment wide basis to ensure flow paths are not diverted onto other land parcels which may result in damage or loss of enjoyment of the adjoining lands.

(i) Surface retardance "n*" shall generally be derived from information in Volume 1, Book 8 Section 1.5.4 of AR&R 1998. Values applicable to specific zoning types and overland flow path types are given below:

Flow across parks 0.35
Flow across rural residential land (sparse vegetation) 0.30
Flow across park residential (short prairie grass) 0.150
Flow across residential low density 0.21
Flow across residential high density flow across industrial 0.06
Flow across commercial 0.04
Flow across paved areas 0.01
Flow across asphalt roads 0.02

Flow across gravel areas 0.02.

(j) The design and analysis of stormwater drainage is to be based on the peak runoff flows from sub-catchments and from accumulated catchments. Designers are to show, by the assessment of partial catchment areas, that the peak flows have been identified.

(k) The rational method is not appropriate for use in catchments with floodplain storage, timing effects due to multiple flow paths, and detention basins.

(4) Hydrological models

(a) Council has carried out flood modelling for most area across Townsville. Hydrological information from these models such as peak flows should be obtained to assist with the design of the stormwater system.

(b) Other hydrological models may be used as long as the requirements of AR&R are met, summaries of calculations are provided and details are given of all program input and output.

Details on the modelling requirements should be obtained from SC6.7 Flood hazard planning scheme policy.
A sample of a summary sheet for hydrological calculations is given in SC6.4.4.4 Attachment B.

(c) Where computer analysis programs are used, copies of the final data files shall be provided on submission of the design to council and with the final drawings after approval by council.

SC6.4.4.4.3 Hydraulics

(1) Hydraulic grade line

(a) Hydraulic calculations shall generally be carried out in accordance with AR&R and shall be undertaken by a qualified person experienced in hydrologic and hydraulic design. The calculations shall substantiate the hydraulic grade line adopted for design of the system and shown on the drawings. Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output.

(b) The "major" system shall provide a safe, well-defined overland flow path for larger storm events up to the maximum defined flood event. The "minor" system shall be capable of carrying and design flows from the lesser nominated flood events based on the land zoning of the area.

(c) Downstream water surface level are to be obtained from council's current existing flood studies. If flood study information is not available, the most appropriate of the below is to be used:

(i) known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event;

(ii) where the downstream starting point is a pit and the hydraulic grade line is unknown, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line;

(iii) where the outlet is an open channel and the design storm is the minor event, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line. The top of the outlet pipe or the hydraulic grade line, or mean high water springs shall be the downstream control, whichever is higher;

(iv) where the outlet is an open channel, the design storm is the major event and downstream flood levels are not known, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line. The top of the outlet pipe or the hydraulic grade line shall be the downstream control whichever is the higher;

(v) where the outlet is an open channel, the design storm is the major event and downstream flood levels are known, the downstream control shall be the highest of all duration events for the defined flood event;

(vi) mean high water springs (MHWS) where discharges are to river or creek systems within the intertidal zone:
In some instances, the downstream water surface level may need to be determined with the

development of a flood study. Details on the flood study requirements should be obtained from SC6.7 Flood hazard planning scheme policy; and

(vii) the downstream water surface level used in the calculations should be provided to council.

(2) Major/minor system

Design of the drainage system should be in accordance with the major/minor flood management concept which recognises the dual requirements of the drainage system to provide for convenience and the protection of life and property for all storm events up to the defined flood event.

All design work undertaken should follow the guidelines set down in the *Queensland Urban Design Manual* (Third edition 2013 - provisional) unless otherwise instructed in this sub-section.

(3) Minor system criteria

(a) Minimum conduit sizes shall be as follows:

(i) pipes 375mm diameter; and

(ii) box culverts 600mm wide x 300mm high.

(b) Maximum velocity of flow in stormwater pipelines shall be 4m/sec. Minimum velocity shall be determined by ensuring self-cleansing velocity is achieved; this requirement shall be deemed to be satisfied if the product of slope and diameter (S x D) is not less than 0.0008m where S = slope (m/m) and D is pipe diameter (m).

(4) Roadway flow width and depth

(a) Flow width and depth criteria for major and minor storm events must comply with QUDM section 7.4.

(5) Inlet pits and Manholes

(a) Inlet pits and manholes must be provided:

(i) to enable access for maintenance;

(ii) at changes in direction, grade, level or class of pipe; and

(iii) at junctions.

(b) The maximum recommended spacing of pits and manholes where flow widths are not critical should be spaced every 80m for ease of maintenance purposes. Kerb inlets shall be constructed in accordance with SC6.4.4.8 Standard drawings SD 200.

(c) Pit entry capacity calculations must be undertaken to provide for adequate spacing of pits, and to ensure flow capture has been adequately analysed. Flow under weirs and/or orifice conditions must be carefully considered. Information on pit entry capacities is available in the following sources:

(i) Queensland Urban Drainage Manual;

(ii) Pit relationships given in Volume 1, Book 7 of AR&R 1998; and

(iii) manufacturers' design specifications.

(f) Blockage factors to be applied to theoretical inflow capacities of inlet pits are given in Table SC6.4.4.4.2:

Tables SC6.4.4.4.2 Allowable pit capacities

Condition	Inlet Type	Blockage factor
Sag	Side entry	20%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	"Letterbox"	50%
Continuous Grade	Side entry	20%
Continuous Grade	Grated	50%

Continuous Grade	Combination	90%
Field inlet	Flush	80%
Field inlet	Raised grate	50%

(6) Hydraulic losses

(a) Pressure change co-efficient "K" shall be determined from the appropriate charts given in *QUDM* Appendix 2.

(b) Allowable reduction in "K" due to benching is given in *QUDM* section 7.16.8.

(c) Computer program default pressure change co-efficient "K" shall not be acceptable unless they are consistent with those from the charts in *QUDM*. The chart used and relevant co-efficients for determining "K" value from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

(d) Bends may be permissible in certain circumstances and discussions with council regarding their use is required prior to detailed design. Appropriate values of pit pressure change co-efficient at bends are given in *QUDM*.

(e) The design must avoid clashes between services. However, where unavoidable clashes occur within the existing network, then the pressure change co-efficient "Kp" must be determined from the chart given in *QUDM* section 7.16.11.

(f) Requirements for private pipes entering council's system are given below:

(i) all pipe inlets, including subsoil pipes, must where possible, enter the main pipe system at junction pits. These must be finished off flush with and be grouted into the pit wall; and

(ii) if a junction has to be added then a junction pit shall be built at this location in accordance with this sub-section.

(g) Construction of a junction without a structure should be avoided where possible. Permission to do this is required by council prior to detailed design. Where this is unavoidable the pressure change coefficients Ku, for the upstream pipe and Kl, for the lateral pipe, must be determined from the chart given in *QUDM*.

(h) Going from larger upstream to smaller downstream conduits is not permitted without approval of council prior to detailed design. In going from smaller to larger pipes benching must be provided in pits to enable a smooth flow transition. Losses in sudden expansions and contractions are given in *QUDM*.

(i) Underground drainage systems must be designed as an overall system, with due regard to the upstream and downstream system and not as individual pipe lengths. Drainage system designs must clearly show the hydraulic grade line (HGL), especially in systems operation undue pressure.

(7) Major system – minimum freeboard criteria

(a) Where floor levels of adjacent buildings are above road level there must be a minimum freeboard of 300mm to floor level of adjacent buildings.

(b) Where floor levels of existing adjacent buildings are below, or less than 300mm above the top of kerb, and there is at least 100mm fall on the footpath towards the kerb, the maximum flow depth is 50mm above the top of kerb.

(c) Where floor levels of existing adjacent buildings are below, or less than 300mm above the top of kerb, and there is less than 100mm fall on the footpath towards the kerb, the maximum flow depth is at the top of kerb.

(d) Wave action wash that enters properties from passing vehicles must be considered.

(e) Road capacities and major system flood levels are to be determined adopting the roadway as an open channel. Assessment of flood impacts on adjoining properties must consider any effects of backwater from the adjacent waterway using backwater analysis techniques.

(8) Minimum grades

(a) Unlined drains must have a minimum grade of 0.5% and lined drains must have a minimum grade of 0.3%. This includes table drains and kerb and channel.

(b) Pipe and box culverts must have a minimum grade of 0.2%.

(9) Open channels

(a) Generally, open channels and swales must be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where council permits the use of an open channel to convey flows from a development site to the receiving water body, such a channel must comply with the requirements of this sub-section.

(b) Design of open channels must be in accordance with Volume 1, Book VIII of AR&R 1998. Open channels must be designed to contain the major system flow.

(c) Friction losses in open channels must be determined using Mannings "n" values. Mannings "n" roughness co-efficients for open channels must generally be derived from information in Chapter 14 of AR&R. Mannings "n" values applicable to specific channel types are given in the table below:

Surface Type	Mannings “n”
Concrete Pipes or Box Sections	0.011
Concrete (trowel finish)	0.014
Concrete (formed without finishing)	0.016
Sprayed Concrete (gunite)	0.018
Bitumen Seal	0.018
Bricks or pavers	0.015
Pitchers or dressed stone on mortar	0.016
Rubble Masonry or Random stone in mortar	0.028
Rock Lining or Rip-Rap	0.028
Corrugated Metal	0.027
Earth (clear of weeds and debris)	0.022
Earth (with weeds and gravel)	0.028
Rock Cut	0.038

For all grass channels refer to the *Road Drainage Manual* (Chapter 8) for grass retardance factors.

(d) Where the product of average Velocity and average flow Depth for the design flow rate is greater than 0.4 m^2/s, the design must specifically provide for the safety of persons who may enter the channel in accordance with Volume 1, Book VIII of AR&R 1998.

(e) Maximum side slopes on grassed lined open channels must be in accordance with section 9.5.3 of *QUDM* (3rd Edition 2013 – provisional, or as amended.).

(f) Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel. The width of the concrete lined channel section must be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor with an absolute minimum width of 1.5 m.

(g) Open channels should be wide and shallow in preference to narrow and deep in order to maintain natural invert level to reduce the expression of groundwater.

(h) Designers should also ensure that longitudinal grades are sufficient to prevent the ponding of storm water for periods of more than 2 days after a rain event.

(i) Transition in channel slopes is to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

(j) Drop structures must be designed in open channels were the water velocity exceeds 2m/s. The design must address the size and location of the structure as well as details of any stilling basins and revetment works surrounding the structure.

(k) Special consideration must be given to erosion control where sodic soils occur. Details of treatment proposals prepared by a competent person must be provided and approved by council.

(10) Major structures

(a) All major structures in urban areas, including bridges and culverts, must be designed for the 1% AEP storm event with minimal afflux. Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding does not inundate private property or critical infrastructure.

(b) A minimum clearance of 0.5m between the 1% AEP flood level and the underside of any structure is required to allow for passage of debris without blockage.

(c) Certified structural design must be provided for bridges and other major culvert structures and may be required on some specialised structures. Structural design must be carried out in accordance with the SC6.4.4.3 Bridges and other structures.

(d) Culverts (either pipe or box section) must be designed in accordance with information and charts provided in QUDM 3rd Edition - provisional (as amended).

(e) Safety limitations – overtopping of roadways. All floodwaters overtopping a major structure such as a culvert or bridge structures within a road are to be checked for safety and stability limitations for both pedestrians and vehicles. Assessment of the waterway crossing safety and stability is to be undertaken based on criteria outlined in *QUDM* 3rd Edition 2013 - provisional (as amended) – Table 7.4.3 and 7.4.4

Detention basins

(a) For each AEP a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin. Storm patterns shall be those given in Volume 1, Book III of AR&R. The critical storm duration with the retarding basin is likely to be longer than without the basin. A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

(b) Flood routing should be modelled by methods outlined in AR&R. Rational method approximations of flood hydrographs are unacceptable.

(c) The high level outlet to any retarding basin shall have capacity to contain a minimum of the 1% year AEP flood event. Additional spillway capacity may be required due to the hazard category of the structure. The hazard category should be determined by reference to ANCOLD.

(d) The spillway design shall generally be in accordance with the requirements for Open channel design in SC6.4.4.4.3(7) Open channels and *QUDM* (Chapter 5).

(e) The low flow pipe intake shall be designed in accordance with the requirements of QUDM, Section 5.08.

(f) Freeboard - Minimum floor levels of dwelling shall be 0.3m above the Defined 1% AEP flood level in the basin.

(g) Public safety issues - Basin design is to consider the following aspects relating to public safety:

(i) side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress;

(ii) water depths shall be, where possible, less than 1.5m in the defined AEP flood event. Where neither practical nor economic, greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered;

(iii) the depth indicators should be provided indicating maximum depth in the basin;

(iv) signage of the spillway is necessary to indicate the additional hazard;

(v) basins shall be designed so that no ponding of water occurs on to private property or roads;

(vi) no planting of trees in basin embarkment walls is allowed;

(vii) no basin spillway is to be located directly upstream of urban areas; and

(viii) submission of Drawings to the Dam Safety Committee is required where any of these guidelines are not met or council specifically requires such submission.

(ix) Stepped spillways are used in rare instances for energy dissipation and scour control. Guidance on hydraulic design and analysis of these structures is as per Chanson 1994.

(12) Tidal barriers

The use of tidal barriers on stormwater outlets are required in areas affected by tides. The device used should meet the following criteria:

(a) limited pressure head required to allow the discharge of stormwater from the system without any manual intervention. Specifications of the device used should be supplied to council prior to detailed design;

(b) barriers should not be able to be wedged open to an incoming tide by litter;

(c) council will not accept hinged flap gates as a suitable solution; and

(d) minimal requirements for repairs and maintenance of the device. Any maintenance information for the

device should be supplied to council prior to detailed design.

(13) Barriers at inlet and outlets

Provision shall be made for the safety of the public including children in regards to the inlet and outlet of the stormwater system and should be based on the following criteria:

(a) no opening into an underground system shall be wider than 150mm except at head walls to pipes and box culverts;

(b) headwalls on the inlets and outlets to underground drains in which the drain is longer than 30m and has a cross sectional area greater than 0.5m^2 must be protected with hand rails, guard rails or fencing which restricts easy access to the entry structure;

(c) trash screens or other forms of grates are not favoured across the front of inlets and are unlikely to be approved by council unless there is a tidal barrier on the outlet of the stormwater system – this may be considered by council;

(d) any grates over field inlet pits shall be set above the top of the pit so as to provide a 50mm gap between the top of the pit and the bottom of the grate. In areas of open space, marker posts must be used to identify each corner of the pit; and

(e) under no circumstances, should fixed barriers or grates be placed at the end of stormwater outlet.

SC6.4.4.4.4 Stormwater detention

(1) Installation of stormwater detention is required on all development sites where insufficient capacity in the downstream drainage systems exist and a minimum amount of detention will be that required to ensure no worsening of the flooding situation occurs during the defined flood event.

(2) The requirements for stormwater detention design are outlined in *QUDM.*

(3) The development must limit any increase in discharge rate for all storm events up to and including the defined flood event.

(4) The developed site must not discharge more stormwater than the discharge calculated for pre-development flows.

(5) Combined sedimentation and detention ponds must be designed in accordance with SC6.4.3.9 Water sensitive urban design guidelines so that remobilisation of sediment is minimised.

SC6.4.4.4.5 Interallotment drainage

(1) Interallotment drainage must be avoided wherever possible. Where interallotment drainage is proposed, the developer must demonstrate that no other drainage alternative is possible.

(2) Where interallotment drainage is unavoidable, it must not cover more than 2 allotments and must be contained within an easement not less than 3m wide. The easement must be provided over the entire length of the drainage structure in favour of lots benefiting from and affected by the pipe. All interallotment and allotment drainage, connector pipes and surface water collection infrastructure remains the responsibility of the lot owner.

(3) Where drainage is required over more than two allotments, a drainage easement is required in favour of council. See SC6.4.4.4.8 Drainage easements and drainage reserves.

(4) Interallotment drains must be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design AEP the same as the "minor system" per Table SC6.4.4.4.1.

(5) Major system flows within interallotment drains should be avoided where possible. In instances where this is unavoidable, the design of interallotment drainage must make allowance for major system flows, with appropriate freeboard.

(6) In lieu of a more detailed analysis, the fraction impervious for surfaces contributing runoff to the interallotment drain are as per SC6.4.4.4 Attachment A.

(7) Pipes must be designed to flow full at the design discharge without surcharging of inspection pits.

(8) Interallotment drainage pits must be located at all changes of direction. Pits must be constructed of concrete, with 100mm thick walls and floor and have a minimum 600mm x 600mm internal dimensions. Raised grated inlets are required at all locations. (including change in direction).

(9) The interallotment drainage must have a minimum longitudinal gradient of 0.2% or as agreed by council.

(10) The interallotment drainage must be constructed from either fibre reinforced concrete drainage pipe, reinforced

concrete pipe, or UPVC pipe which must conform respectively to the requirements of AS4139, AS/NZS4058 and AS/NZS1254 respectively.

(11) Where interallotment drainage and sewer mains are laid adjacent to each other they must be spaced with 1.5m between pipe centrelines (where the pipe inverts are approximately equal).

(12) Where there is a disparity in level between inverts the spacing must be submitted for approval.

(13) Where sewer mains are in close proximity to interallotment drainage lines they must be shown on the interallotment drainage plan.

SC6.4.4.4.6 Detailed design

(1) Conduits

(a) Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the Concrete Pipe Association's *Concrete Pipe Guide* or AS/NZS 3725. For uPVC pipes, the requirements shall be to AS/NZS 2032.

(b) Conduit jointing shall be in accordance with manufacturer's specifications. S.R.C pipes shall use external band joints.

(c) Drainage lines in road reserves shall generally be located behind the kerb line and parallel to the kerb. Drainage lines in easements shall generally be centrally located within easements. Refer to SC6.4.4.8 Standard drawing SD-015.

(d) Drop structures shall be designed on drainage lines where the pipe gradient exceeds 5 per cent or water velocity exceeds 4m/s. The design details shall address the size, and position in the trench as well as spacing along the line.

Note—Buried flexible drainage pipes
Particular situations may be identified during the design of a development for the use of buried flexible pipes instead of the pipes specified in SC6.4.6.6 Pipe drainage.

In such cases, the design will be required to select the flexible pipe type appropriate for the particular application and prepare the relevant technical specification clauses for the supply and construction with reference to AS/NZS 2566.1, Buried flexible pipelines Part 1: Structural design. The proposed additional clauses would then be submitted, as an addendum to the development consent, for review and approval by council.

(2) Pit design
Pits shall be designed in accordance with SC6.4.4.8 Standard drawings SD-200, SD-205, SD 210 and SD-215. Safety and safe access are important in pit design and grates shall be of "bicycle safe" design.

(3) Stormwater discharge

(a) Scour protection at culvert, pipe system or kerb and channel outlets shall be designed in accordance with the guidelines outlined in *QUDM 3rd Edition - 2013 – provisional*, Section 8.7. Council will discourage the use of any outlet structure that proposes ponding at the outlet

(b) Where a developer proposes to concentrate stormwater onto an adjoining property, council will require the Developer to provide written agreement from the adjoining owner(s) granting permission to the discharge of stormwater through their property and the creation of any necessary easements.

(c) Where it is proposed to discharge runoff to an area under the control of another statutory authority, the design requirements of that statutory authority are also to be met.

(d) Piped stormwater drainage discharging to recreation reserves is to be taken to a point of discharge nominated by council and in the manner nominated by council.

(4) Trench subsoil drainage
Subsoil drainage should be designed and installed as per SC6.4.4.8 Standard drawings SD 080.

SC6.4.4.4.7 Documentation

(1) Drawings

(a) Catchment area plans shall be drawn to scales of 1:500, 1:1000 or 1:5000, unless alternative scales are specifically approved by council and shall show contours, direction of grading of kerb and channel, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system.

(b) The drainage system layout plan shall be drawn to a scale of 1:500 for urban areas and 1:1000 rural areas and shall show drainage pipeline location, drainage pit location and number and road centreline chainage, size of opening and any other information necessary for the design and construction of the drainage system.

(c) The plan shall also show all drainage easements, reserves and natural water courses. The plan may be combined with the road layout plan.

(d) The drainage system longitudinal section shall be drawn to a scale of 1:500 horizontally and 1:50 vertically and shall show pipe size, class and type, pipe support type in accordance with AS/NZS 3725 or AS/NZS 2032 as appropriate, pipeline and road chainages, pipeline grade, hydraulic grade line and any other information necessary for the design and construction of the drainage system.

(e) Open channel cross sections shall be drawn to a scale of 1:100 natural and shall show the direction in which the cross sections should be viewed. Reduced levels are to be to Australian height datum (AHD), unless otherwise approved by council where AHD is not available.

(f) Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the drawings to scales appropriate to the type and complexity of the detail being shown.

(g) As constructed drawings shall be submitted to council upon completion of the drainage construction and prior to council's acceptance of completed works. The detailed drawings may form the basis of this information; however, any changes must be noted on these drawings.

(h) The as constructed plans must clearly identify the sections of the drainage system that will be owned by private residents as agreed by council.

(2) Easements and agreements

(a) Evidence of any Deed of Agreement necessary for the diversion of runoff through an adjoining property must be submitted prior to any approval of the engineering drawings required for operational works application. Easements must be created concurrently with the issue of the plan of survey.

(b) Where an agreement is reached with the adjacent landowners to increase flood levels on their property or otherwise adversely affect their property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to any approval of the application.

(3) Summary sheets

A copy of a Hydrological Summary Sheet providing the minimum information set out in SC6.4.4.4 Attachment B.

(4) Computer program files and program output

(a) Computer program output may be provided as long as summary sheets for hydrological and hydraulic calculations in accordance with this design specification are provided with plans submitted for checking and with final drawings.

(b) Copies of final computer data files (electronic and hard copy), for both hydrological and hydraulic models shall be provided for council's data base of flooding and drainage information in formats previously agreed with council.

SC6.4.4.4.8 Drainage easements and drainage reserves

(1) Specifications for new easements and reserves

(a) Easements must be of a size to enable necessary works including, but not limited to, construction, maintenance and inspection, to be carried out.

(b) Easement widths for drainage must be no less than the greater of the criteria in Table SC6.4.4.4.3.

Criteria	Type	Easement/Reserve Width
Pipe/Culvert	Pipe diameter/box culvert width ≤900mm	Minimum 3.0m
	Pipe diameter/box culvert width >900mm	Easement to extend to outside diameter/box culvert width + 1m each side of external edges of pipe/culvert
Channel/Drain	Base width ≤5m	Full bank width of channel/drain + 4m wide access path along one bank
	Base width ≤5m	Full bank width of channel/drain + 4m wide access path along both sides of channel/drain

(c) All drainage easements must be sized and located to ensure that they are not affected by, and do not impact on, an existing building's footing zone of influence, and give consideration to any future building footings on the subject or adjoining land.

(2) Residential, commercial and industrial areas
All major drainage is to be located within a drainage reserve with the minimum widths of that reserve being capable of containing the 1 per cent AEP design flows plus a 4m strip on each side for maintenance access and safety purposes.

(3) Rural residential areas

(a) Easement must be created over all drains and natural water courses through private property. Unless council determines the land is to be set aside for public use and is to be handed to council.

(b) In rural residential areas adjacent to a major watercourse, council may require drainage reserves or easements to be extended to cover identified areas of riparian vegetation, which maybe beyond the strip required for maintenance access and safety purposes.

(4) Rural areas

(a) Easements or reserves are not required over natural watercourses. However easements must be provided over all drains where stormwater is diverted from the natural flow path and be wide enough to contain the flows from the defined flood event plus adequate width for maintenance and safety purposes.

(b) Where the land falls away from the road, easements for drainage are required through private property over formed drains from road culverts and table drains. The location of these easements shall be fixed during design and approval of operational works for the roadworks concerned.

(5) Maintenance of easements

(a) A drainage easement over a property restricts the use of the area of land contained within the easement for drainage purposes. Council's level of service for drainage easements is restricted to ensuring the drainage easement is capable of performing its purpose of carrying stormwater flows through the property. If an owner desires a higher order of maintenance for other reasons, this will be at the owner's ongoing cost and must not compromise the drainage function of the easement. Altering of the drain in the easement by the owner without the approval of council may result in action being undertaken by council to restore the drainage path at the expense of the owner.

(b) Where subdividers are required to provide drainage easements and reserves over approved drainage paths, then these are to be acquired over the entire land at the first stage of subdivision. Where surcharge paths are terminated at the end of stages then drainage easements are required over balance lands, with such easements being released progressively with future stages that provide the surcharge path down the future roads or drainage reserves.

(6) Instruments relating to the terms – easements upon private property

Standard wording for the instruments setting out the terms for the various types of easements that can be acquired for drainage are to be utilised, with each document being cognisant of council's needs for future grading and on-going maintenance. The document is to also ensure that the responsibility and definition of maintenance within drains is clearly defined on the instruments that accompany the easement documents. This is particularly important in the rural residential areas where some residents have an expectation that council will maintain the land (easement) to a much higher standard than is needed for drainage purposes. In particular, in relation to inter-allotment drains that are not a part of the public drainage system, provision is to be made in the easement document to state that all maintenance is the owner's responsibility but with provision being made to enable the council to carry out necessary works at the cost of the defaulting owner.

SC6.4.4.4 Attachment A - Design AEPs and fraction impervious for land use zones

Development Category	**Land use**	**Fraction impervious (fi)**
Residential zones category	Low density residential	0.65
	Medium density residential	0.7
	High density residential	0.9
	Rural residential	0.6
	Character residential	0.55
Centre zones category	Neighbourhood centre	0.9
	Local centre	0.9
	District centre	0.9
	Major centre	1
	Principal centre (CBD)	1
	Specialised centre	0.9
	Mixed use	0.9
Community facilities and Open space zone category	Sport & recreation	0.2
	Open Space	0.2
	Community facilities	0.95
	Environmental management & conservation	0.4
Industry zones category	Low impact industry	0.9
	Medium impact industry	0.9
	High impact industry	0.9
Rural zones category	Rural	0.1
Other zones category	Emerging community	-
	Special purpose	-

SC6.4.4.4 Attachment B - Hydrologic and Hydraulic calculation sheets

Click here to view SC6.4.4.4 Attachment B - Hydrologic and Hydraulic calculation sheets

SC6.4.4.5 Earthworks (design)

SC6.4.4.5.1 Introduction

(1) Objectives

This sub-section provides advice, guidelines and standards for earthworks including to ensure the:

(a) efficient, sustainable and economical design;

(b) enhancement of the environmental character of the site whilst maintaining the natural features of the site;

(c) provision of safe conditions for construction commensurate with the proposed purpose of the development;

(d) equality of building conditions for residential development; and

(e) earthworks does not impact on adjoining properties and developments.

(2) Scope

(a) This sub-section sets out requirements for earthworks involved in land development and subdivision. Conceptual requirements are presented as necessary considerations when preparing designs for earthworks.

(b) The scope of this sub-section assumes that the Designer is familiar with requirements cited in the various construction specifications, specifically those related to earthworks, clearing and grubbing and erosion and sedimentation. Additionally the Designer is required to make reference to the associated design sub-sections related to stormwater drainage design, geometric road design and stormwater quality management, and any other relevant best practice documents.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

(i) Construction sub-sections
SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.11 Clearing and grubbing
SC6.4.6.10 Earthworks (construction)
SC6.4.6.26 Landscaping

(ii) Design sub-sections
SC6.4.3.8 Stormwater quality management plans for development
SC6.4.3.9 Water sensitive urban design guidelines
SC6.4.4.1 Geometric road design
SC6.4.4.4 Stormwater drainage design

(b) Australian Standards
AS3798 *Guidelines on earthworks for commercial and residential developments*
AS2870.1 *Residential slabs and footings - construction.*

(c) Qld Government Legislation
Work Health and Safety Act 2011

SC6.4.4.5.2 Earthworks concept design

(1) Areas of a site proposed for earthworks, building or recreational purposes may not be suitable in their natural state for their intended function without improvement works to:

(a) alleviate flooding of low-lying ground;

(b) fill gullies or create emergency flowpaths after underground stormwater piping has been installed;

(c) allow improved runoff from flat ground;

(d) regrade excessively steep slopes that would preclude economical construction of dwelling foundations; and

(e) allow effective recreational use or give reasonable access.

The Designer must review the natural surface contours as determined and identified on site and where

necessary must design finished surface levels that ensure the land is suitably prepared.

(2) Areas should be regraded to minimise the necessity for underground drainage systems with surface inlet pits, and allow surface water to flow naturally to roads or drainage reserves without excessive concentration.

(3) The Designer must consider the implications of earthworks in relation to the existing natural environment. Generally earthworks must be minimised in heavily treed areas.

(4) Care must be taken to provide depressions for overland flow from low points and over major drainage lines, to direct stormwater for storms up to a 1% annual exceedance probability (AEP).

(5) The design of earthworks areas in conjunction with the design of roadworks must be considered with the objective of balancing cut to fill and achieving both an economical development and minimising haulage of imported fill or spoil to and from the development site. Bulk haulage should always be considered as having an adverse effect on adjacent development and infrastructure.

SC6.4.4.5.3 Special treatment of particular areas

(1) All lots must be regraded to a minimum level at the1% AEP flood level. In doing so, the Designer must ensure that other areas are then not affected by flooding. The site must be identified on the Drawings with appropriate notation of site specific requirements.

(2) In the event that an area is known to be affected by or inundated by local stormwater flows, the Designer must investigate the existing conditions as they relate to the proposed development and advise the Developer in the preliminary design report on all data obtained in the investigation and recommend appropriate contour adjustments. The report should be accompanied by sketch plans to clarify recommendations and any other relevant data.

(3) Site constraints either natural or otherwise may be required to be identified as a burden on developed property. The Designer must take this into account when preparing the design. The property may ultimately be affected by a "restriction as to user", which may be controlled by a legal Instrument placed on title to the land and/or by a message advising prospective purchasers of any restrictions affecting the land.

(4) The finished surface of filled areas must be designed to levels allowing an adequate cover depth over the pipeline (if piped) and permitting surface stormwater flow to be guided to inlet pits if depressions are retained in the finished surface contouring.

(5) The location of such features must be clearly defined on the earthworks plans and defined by distance to corner boundaries etc. for purposes of relocation. A geotechnical report specifying the site specific preparation and compaction requirements must be incorporated in the earthworks plan. A description of the minimum acceptable quality of the fill must also be specified on the plans, supported by geotechnical recommendations. All documentation necessary from various authorities to support the filling of dams and watercourses must be supplied with the Drawings.

(6) The finished level of any building area must be designed to ensure a desirable surface grading of 0.5% minimum oriented in the direction of the drainage system designed to cater for its catchment.

SC6.4.4.5.4 General standard of lot preparation

(1) Special requirements will apply where necessary but generally lots are to be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the development. Prior consultation with council's officer responsible for tree preservation, or other authorised council officer, is necessary. Such requirements must be shown on the Drawings.

(2) All timber and other materials cleared from lots must be removed from the site. All roots, loose timber, etc. which may contribute to drain blockage must be removed. Such requirements must be shown on the Drawings.

(3) In areas to be filled over butts of trees, allowance must be made for clearing of all trees and replanting with a minimum of six advanced suitable species to each lot; planting must to be clear of probable future building location and services and utilities, and not to be commenced until filling has been completed and graded, with provision for watering and maintenance for duration of the contract. These specific requirements must be shown on the Drawings.

(4) Selected trees must be preserved by approved means to prevent destruction normally caused by placement of

conventional filling or other action within the tree drip zone. The Tree Preservation Officer, or other authorised council officer, must be consulted for advice and all specific requirements noted on the Drawings.

SC6.4.4.5.5 Standard of fill for lots

(1) The following notations are to be incorporated in the Drawings. "Filling is to be of sound clean material, reasonable standard and free from large rock, stumps, organic matter and other debris". "Placing of filling on the prepared areas shall not commence until the authority to do so has been obtained from the council".

(2) All work must be in accordance with AS3798. Fill must be placed in layers not exceeding 150mm compacted thickness. All fill must be compacted to 95% standard maximum dry density. Maximum particle size is 2/3 of the layer thickness.

(3) Fill comprising natural sands or industrial wastes or by-products may only be used after the material type and location for its use is approved by council and will be subject to specific requirements determined by prevailing conditions.

(4) It is essential that prior advice be given of intended use of such materials. It should be noted that failure to obtain council's approval may lead to an order for removal of any material considered by council or other relevant authorities as unsuitable or in any way unfit for filling.

(5) All areas where filling has been placed must be dressed with clean arable topsoil, fertilised and sown with suitable grasses. This work must be carried out in accordance with the sub section SC6.4.6.26 Landscaping.

SC6.4.4.5.6 Temporary diversion drains

(1) Where temporary drains are required to divert surface flows away from the earthworks area, the location and silt/erosion control treatment must be clearly identified on the Drawings. The scale of such works must reflect the volume of water to be diverted.

The objective will be to ensure minimal soil disturbances and material loss off the site.

The requirements identified in SC6.4.4.4 Stormwater drainage design, SC6.4.3.8 Stormwater quality management plans for development, and SC6.4.3.9 Water sensitive urban design guidelines must be addressed for technical details and any additional requirements.

SC6.4.4.5.7 Concurrence with the Department of Environment and Heritage Protection

The Designer is recommended to refer to the Department of Environment and Heritage Protection with regard to any items requiring specific consideration when preparing an earthworks plan. Such plans may need to incorporate sediment/siltation/erosion control devices with specific reference to the stage at which these are to be provided. The responsibility rests with the Developer to make enquiries with the Department of Environment and Heritage Protection and subsequently obtain council approval to proposed measures.

SC6.4.4.5.8 As-constructed drawings

The Designer must annotate on the earthworks plan, the site specific detail to be shown on the as-constructed plans. Such detail must include a geotechnical report certifying the works to be suitable for the intended purpose and any other certifications, testing and survey data, as required in this sub-section.

SC6.4.4.5.9 Cartage of soil

(1) The Designer must refer to council for acceptable haul roads with applicable load limits. This detail must be shown on the earthworks plan. The payment of a Bond, as determined by council, may be required by the Developer where council has some concern about the ability of a haul road to sustain the loads without undue damage or maintenance requirements.

(2) Unless specific application is made to council and approval obtained, the plans must be annotated as follows: "All topsoil must be retained on the development site and utilised effectively to encourage appropriate revegetation."

SC6.4.4.5.10 Effect on adjoining properties

(1) Where it is proposed to divert or direct piped stormwater into adjoining properties, drainage easement rights must be created over the adjoining lots in accordance with the SC6.4.4.4 Stormwater drainage design.

(2) A written agreement between the Developer and adjoining property owners to carry out construction work on adjoining properties must to be submitted to council prior to works commencing.

(3) Works must not cause ponding of stormwater on adjacent allotments and no stormwater formerly flowing onto the site may be diverted onto other neighboring allotments or reserves.

(4) Earthworks must be graded so that the new land forms are free draining and all stormwater naturally falling into the site is collected within the property boundaries and discharged to a lawful point of discharge as agreed with council.

SC6.4.4.7 Pathway and Cycleway

SC6.4.4.7.1 Introduction

(1) Purpose

This sub-section aims to set standards and document requirements related to the provision of pathways and cycleways for the use of pedestrians and cyclists, for both on road and off road which encourage pedestrian activities and cycling for transportation and recreational purposes. Pathways and Cycleways are to be safe and convenient and must maintain a satisfactory level of service for path users of all abilities including users with disabilities and/or limited mobility. Pathways and Cycleways should provide a clear and continuous accessible path of travel, void of tripping hazards and unsafe obstacles.

The design of a development must encourage the use of pedestrian and cycle facilities and ensure that priority is given to pedestrians with direct links between a building's main entrance and any adjoining local activities and public transport services and recreational areas.

(2) Scope

(a) This sub-section sets out requirements to be used in the design of various types of pathways and cycleways for the use of pedestrians and cyclists.

(b) All relevant design principles contained in the Austroads' Guides referenced below must be integrated in the design of all pathways and cycleways and their associated infrastructure.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
9.4.6 Transport impact, access and parking code
SC6.4.4.1 Geometric road design
SC6.4.4.8 Standard drawings
SC6.4.3.3 Footpath Treatment Policy
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscape Policy

(b) Australian Standards

AS 1428.1	*Design for access and mobility Part 1: General requirements for Access – New building work*
AS 1428.2	*Design for access and mobility Part 2: Enhanced and additional requirements-Buildings and facilities*
AS/NZS 1428.4.1	*Design for access and mobility Part 4.1: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators*
AS 2890.3	*Parking facilities Part 3: Bicycle parking facilities*

(c) Austroads
Guide to Road Design Part 3: *Geometric Design*
Guide to Road Design Part 4: Intersections and Crossings – General
Guide to Road Design Part 6A: Pedestrian and Cyclist Paths
Cycling Aspects of Austroads Guides
Guide to Traffic Management Part 11: Parking

(d) Queensland government
Department of Transport and Main Roads specifications, *Manual of uniform traffic control devices (MUTCD)*
Road Planning and Design Manual Volume 3 Part 6A TRUM Manual
Technical Standards Publications - Technical Notes
Queensland Development Code, MP 4.1 – *Sustainable Buildings*

(e) Other
Bicycle Network Victoria – www.bicyclenetwork.com.au
Institute of Public Works Engineering Australia, Queensland, *Complete Streets - Guidelines for Urban Street Design.*
Roads and Traffic Authority, *NSW Bicycle Guidelines*, Version 1.2, July 2005.

(4) Definitions

Pedestrian	A person walking, and including people in wheelchairs, on roller skates or riding vehicles such as skate boards or other vehicles, other than a bicycle, powered by effort or a motor and with a maximum speed of 7 km/h
Walking	to advance or travel on foot at a moderate speed or pace; proceed by steps; move by advancing the feet alternately to move about or travel on foot for exercise or pleasure.
Cyclist	Rider of a bicycle or human-powered vehicle. On a vehicle with one or more wheels that is built to be propelled by human power through a belt, chain or gears (whether or not it has an auxiliary motor), and includes a pedicab, penny-farthing and unicycle: but not a wheelchair, wheeled toy or pedelec.
Cycling	also called **bicycling** or **biking**, is the use of bicycles for transport, recreation, exercise or sport.[1] Persons engaged in cycling are referred to as "cyclists",[2] "bikers",[3] or less commonly, as "bicyclists".[4] Apart from two-wheeled bicycles, "cycling" also includes the riding of unicycles, tricycles, quadracycles, recumbent and similar human-powered vehicles (HPVs).
Path / Pathway	Series of links along a public way defining the connection between nodes in a network, reserved for the movement of pedestrians, motorised wheelchairs and personal mobility devices, and cyclists to chosen destinations via suitable desire lines.
Cycleway	Portion of a road or path devoted to the use of bicycles.

SC6.4.4.7.2 Consultation

The designer should consult with council, the applicant's landscape consultants and relevant authorities prior to and during the preparation of pathway and cycleway designs.

SC6.4.4.7.3 Design concepts

The Designer should be familiar with the different geometric design requirements for the various types of pathways and cycleways in terms of:

(1) width;

(2) grade;

(3) stopping sight distance;

(4) change in grade;

(5) horizontal curvature;

(6) crossfall and drainage; and

(7) sight distance on horizontal curves.

These requirements are discussed in the Austroads Guides.

SC6.4.4.7.4 Types of Pathways and Cycleways

(1) By definition pedestrian paths are "off road"in that, pedestrian facilities are usually designed adjacent to roadways, and meet the criteria outlined in Austroads Guides, SC6.4.4.8 Standard drawings, and SC6.4.4.1 Geometric road design, and to take into consideration SC6.4.3.3 Footpath treatment policy. Common pathway types include:

(a) foothpath;

(b) shared path; and

(c) separated path.

(2) Cycleways can be provided on road and off road. The Austroads Guides provide detailed descriptions, warrants, widths, pavement marking etc. for the majority of these cycleways. The Austroads Guides provide advice on the suitability of pavement conditions, drainage pit grates etc. for on road cycleways. All cycleways may diverge from the road alignment to provide a safer alternative access.

(3) Common cycleway types include:

(a) On road:

(i) bicycle lane;

(ii) bicycle awareness zone (BAZ);

(iii) cycle route; and

(iv) bicycle/car parking lane; and

(b) Off road:

(i) footpath;

(ii) shared path;

(iii) separated path; and

(iv) bicycle path.

(4) Common pedestrian path types include:

(a) footpath;

(b) shared path; and

(c) separated path.

By definition pedestrian paths are "off road" in that, pedestrian facilities are usually designed adjacent to roadways, and meet the criteria outlined in SC6.4.3.3 Footpath treatment policy and SC6.4.4.8 Standard drawings, and SC6.4.4.1 Geometric road design

All paths may diverge from the road alignment to provide a safer alternative access.

(5) Provisions for pathways and cycleways at structures.

Designers must consider the best way to provide for a safe uninterrupted movement of pedestrians and cyclists.

The reference and source documents provide information on:

(i) acceptable widths and clearances;

(ii) types of pathways and cycleways;

(iii) handrails;

(iv) bridges;

(v) approach ramps;

(vi) safety; and

(vii) crime prevention through environmental design (CPTED) principles.

(6) Developments must make appropriate provision for the safe and convenient movement and provide accessibility of pedestrians and cyclists, both on-site and to and from surrounding networks. Design should include the provision of suitable routes and end-of-trip facilities to encourage and facilitate these forms of movement.

SC6.4.4.7.5 End of trip facilities

(1) Where appropriate, consideration must be given to the provision of adequate facilities at destinations for cyclists and pedestrians, to encourage bicycle path and pedestrian path usage.

(2) Such facilities could include:

(a) seats;

(b) secure bicycle parking;

(c) toilets and showers; and

(d) picnic facilities.

(3) The provision of bicycle parking must meet appropriate criteria discussed in the *Austroads Guide to Traffic Management Part 11: Parking* and in accordance with AS 2890.3.

SC6.4.4.7.6 Signage and pavement marking

(1) Adequate signage design for pathways and cycleways must be provided.

(2) Signs and pavement marking must provide for the safe and convenient use of the facility. The signs and

pavement marking must comply with *MUTCD* and SC6.4.4.8 Standard drawings, SC6.4.6.22 Pavement markings and SC6.4.6.24 Signposting.

SC6.4.4.7.7 Design standards

(1) Notwithstanding the guidelines provided in this sub-section and referenced documents, the following minimum standards have been determined as shown in Table SC6.4.4.7.1. Where these values are less than those in the referenced documents, Table SC6.4.4.7.1 may only be used in special circumstances with separate approval.

Table SC6.4.4.7.1 Minimum design standards

	Footpath	**Shared Path**
Path width	1.5m minimum preferred 1.5m minimum for one wheelchair and pedestrian (people with disabilities) 1.8m desirable minimum for two wheelchairs	2.5m absolute minimum 3m – 4m (3.5m desirable) major recreation paths
Crossfall	2.5% maximum (1 in 40) Aids people with a disability	2.5% maximum (1 in 40)
Gradient	1:33 25 m interval* 1:20 15 m interval* 1:14 9 m interval for ramps*	1:33 25m interval* 1:20 15m interval* 1:14 9m interval for ramps*
* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction Intervals between 1:33 and 1:20 should be interpolated		
Lateral clearance beside path	0.3 m absolute minimum	1m desirable (cycling) 0.5m absolute minimum (0.3m absolute minimum fencing smooth features aligned parallel)
Vertical clearance	2.5m (pedestrians)	2.5m (cyclists)

Formation Width: During the design process allow 0.5 m minimum either side of reinstatement works. Ensure design for free draining across surface of the verge so as to not create ponding or tripping hazards.

Alternative situations

	Separated Path			**Bicycle Path**
Path width	**Two-way**			2.5m acceptable minimum 3.0m desirable for high speeds 2.0m absolute minimum very low use at all times
	Bicycle Path 2.5m desirable minimum	**Footpath** 2.0m desirable ≥1.5m absolute minimum	**Total** 4.5m	
	One-way			
	Bicycle Path 1.5m desirable 2.0m maximum	**Footpath** 1.5m	**Total** 3.0m	
Crossfall	2.5% maximum (1 in 40)			2%-4% on sealed surfaces Up to 5% on unsealed surfaces
Gradient	1:33 25m interval* 1:20 15m interval* 1:14 9m interval for ramps*			3% maximum 200m 5% maximum 20m (if 3% cannot be achieved) Steeper gradients should not be provided unless unavoidable
Superelevation for cycling	2.5% maximum			Consider horizontal radii 2.5% desirable Can go greater than or equal to 3% dependent on site and situation
* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction intervals between 1:33 and 1:20 should be interpolated				

(2) To assist with the safety of pedestrians and cyclists during night time use, illumination of the off road pathways

and cycleways may be required. The lighting must be designed in accordance with AS/NZS 1158.3.1 Pedestrian area (Category P) lighting – Performance and design requirements and SC6.4.3.20 Public lighting and utilities services

(3) Safety and good alignment should not be compromised by inappropriate landscaping. The principles of crime prevention through environmental design (CPTED) should be a key design focus.

(4) Tactile ground surface indicators (TGSI) where required must be:

(a) standard yellow Polyurethane Tactile Indicator Studs (warning tactiles) and bars (directional tactiles), drill and lock installation; and

(b) supplied and installed in accordance with AS/NZS 1428.4.1, providing correct illuminance contrast; and AS1428.1 and AS4586 Slip Resistance of Pedestrian Surfaces and as per manufacturers specifications and in accordance with AS1884.

(5) Kerb ramps must be:

(a) in accordance with the standard drawings see SC6.4.3.3.3(3)(b) - SD-025: Kerb Ramp;

(b) in accordance with AS1428.1 *Design for Access and Mobility, Part 1: General requirements for access - New Building Works*;

(c) installed facing the direction of travel and aligned parallel and perpendicular with opposite kerb ramp ;

(d) located as per requirements for the flow of pedestrian traffic and the position of the signal button;

(e) constructed of broom finished plain natural concrete;

(f) installed with sharp transitions between adjacent surfaces (top and bottom); and

(g) Installed with Tactile Ground Surface Indicators (TGSI) in accordance wtih AS/NZS 1428.4.1 *Design for Access and Mobility, Part 4.1: Means to assist the orientation of people with vision impairment - Tactile ground surface indicators*.

SC6.4.4.8 Standard drawings

(1) Introduction

This sub-section comprises the current Townsville City Council standard drawings.

Standard drawings show the minimum standard that council has adopted with regard to certain types of work. Standards have been developed for works on drainage, irrigation, roads, sewerage, transport, water and other miscellaneous activities.

(2) List of standard drawings

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage
Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation
Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks
Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage
Table SC6.4.4.8.5 Townsville City Council standard drawings for transport
Table SC6.4.4.8.6 Townsville City Council standard drawings for water

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage

Drawing No.	Title	Revision number
SD-200	Precast Grated Kerb Inlet System and Cast Insitu Stormwater Manhole	C
SD-205	Stormwater Manhole Details	C
SD-210	Precast Stormwater Manhole – Slab Top Details	A
SD-215	Raised Grate Field Inlet Manhole	A

Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation

Drawing No.	Title	Revision No.
SD-4.1	XR 1 - 4 Panel and Screw Hole Layout	-
SD-4.2	XR 1 - 4 Terminal Layout and Power Diagram	-
SD-4.3	XR 1 - 4 Control Enclosure	-
SD-4.4	XR 1 - 4 Base and Antenna	-
SD-4.5	XR 1 - 4 Preferred Equipment List – Controller and Telemetry	-
SD-5.1	AC Irrinet ACE DR 24 – 48 Panel Layout	-
SD-5.2	AC Irrinet ACE DR 24 – 48 Terminal Layout	-
SD-5.3	AC Irrinet ACE DR 24 – 48 Control Enclosure	-
SD-5.4	AC Irrinet ACE DR 24 – 48 Base and Pole	-
SD-5.5	AC Irrinet ACE DR 24 – 48 Electrical Diagram	-
SD-5.6	AC Irrinet ACE DR 24 – 48 Screw Holes	-
SD-5.7	AC Irrinet ACE DR 24 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-5.8	AC Irrinet ACE DR 24 – 48 Panel Layout Photo	-
SD-5.9	AC Irrinet ACE DR 24 – 48 Chassis Mounting Photo	-
SD-5.10	AC Irrinet ACE DR 24 – 48 Door Layout Photo	-
SD-7.1	Irrigation Design Data Example	-
SD-7.2	Irrigation Cabling Wiring Schedule Example	-
SD-8.1	Plan Conventions	-
SD-9.1	Survey Dimensions	-
SD-10.1	Water meter assembly 50MM and Above Type A	-
SD-10.2	Water meter assembly 50MM and Above Type B	-
SD-10.3	Water meter assembly 25M-32MM Type A	-
SD-10.4	Water meter assembly 25M-32MM Type B	-
SD-10.5	Water Meter Stands	-
SD-10.6	Valve Assembly Side View	-
SD-12.1	Sprinkler Installation	-
SD-12.2	Sprinkler Riser Large and Small	-

Drawing No.	Title	Revision No.
SD-13.1	Subdivision Services Allocation (figure 1, 2, 3, 4, 5, 6)	-
SD-14.1	Drip Irrigation Overview	-
SD-14.2	Drip Valve Assemblies	-
SD-14.3	Drip Valve Assembly 25MM and 40MM Internal Reg	-
SD-14.4	Drip Valve Assembly 25MM External Reg	-
SD-15.1	Drip Tube Holding Pin	-
SD-16.1	Curved Road Sprinkler Layout	-
SD-17.1	Conduit Placement in Valves	-
SD-17.2	Valve Assembly - Plan View and Electrical Pit	-
SD-18.1	Typical Pipe Trench Details	-
SD-19.1	Scheduling Co-efficient	-
SD-20.1	AC Irrinet M Slave 12 – 24 Panel Layout	-
SD-20.2	AC Irrinet M Slave 12 – 24 Terminal Layout	-
SD-20.3	AC Irrinet M Slave 12 – 24 Control Enclosure	-
SD-20.4	AC Irrinet M Slave 12 – 24 Base and Pole	-
SD-20.5	AC Irrinet M Slave 12 – 24 Electrical Diagram	-
SD-20.6	AC Irrinet M Slave 12 – 24 Screw Holes	-
SD-20.7	AC Irrinet M Slave 12 – 24 Preferred Equipment List – Controller and Telemetry	-
SD-21.1	AC Irrinet M Slave 36 – 48 Panel Layout	-
SD-21.2	AC Irrinet M Slave 36 – 48 Terminal Layout	-
SD-21.3	AC Irrinet M Slave 36 – 48 Control Enclosure	-
SD-21.4	AC Irrinet M Slave 36 – 48 Base and Pole	-
SD-21.5	AC Irrinet M Slave 36 – 48 Electrical Diagram	-
SD-21.6	AC Irrinet M Slave 36 – 48 Screw Holes	
SD-21.7	AC Irrinet M Slave 36 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-22.1	AC Irrinet M 12 – 24 Panel Layout	-
SD-22.2	AC Irrinet M 12 – 24 Terminal Layout	-
SD-22.3	AC Irrinet M 12 – 24 Control Enclosure	-
SD-22.4	AC Irrinet M 12 – 24 Base and Pole	-
SD-22.5	AC Irrinet M 12 – 24 Electrical Diagram	-
SD-22.6	AC Irrinet M 12 – 24 Screw Holes	-
SD-22.7	AC Irrinet M 12 – 24 Preferred Equipment List – Controller and Telemetry	-
SD-23.1	AC Irrinet M 36 – 48 Panel Layout	-
SD-23.2	AC Irrinet M 36 – 48 Terminal Layout	-
SD-23.3	AC Irrinet M 36 – 48 Control Enclosure	-
SD-23.4	AC Irrinet M 36 – 48 Base and Pole	-
SD-23.5	AC Irrinet M 36 – 48 Electrical Diagram	-
SD-23.6	AC Irrinet M 36 – 48 Screw Holes	-
SD-23.7	AC Irrinet M 36 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-26.1	Door Bracket	-
SD-26.2	Door Bracket Position	-
SD-26.3	Door Bracket – Irrinet M	-
SD-26.4	Door Bracket Position – Irrinet M	-
SD-27.1	Enclosure Earth Wiring	-
SD-28.1	Transceiver Interface Cable Type 1	-
SD-28.3	Aux Data Cable – RJ45 Modified Crossover Cable	-
SD-29.1	Rain Switch Installation	-
SD-31.1	Hydrometer Covers 50mm – 100mm	-
SD-31.2	Multijet Covers 25mm - 32mm	-

Drawing No.	Title	Revision No.
SD-32.1	Drinking Fountain Assembly	-
SD-32.2	Drinking Fountains Base	-
SD-33.1	Valve Nest Cover (sheet 1)	-
SD-33.2	Valve Nest Cover (sheet 2)	-
SD-33.3	Valve Nest Cover (sheet 3)	-
SD-33.4	Valve Nest Cover (sheet 4)	-

Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks

Drawing No.	Title	Revision No.
SD-001	Typical Road Cross Sections – Urban Streets	B
SD-002	Typical Road Cross Sections – Collector Roads	B
SD-003	Typical Road Cross Sections – Sub Arterial Roads	B
SD-004	Typical Road Cross Sections – Arterial Roads	B
SD-005	Typical Road Cross Sections – Industrial Roads	B
SD-006	Typical Road Cross Sections – B-Double Turning Path and Access Plan Example Drawing	B
SD-010	Typical Road Cross Sections – Rural Roads	B
SD-015	Verge Service Corridors – General Type Sections	E
SD-020	Concrete Kerbing	D
SD-025	Kerb Ramp	D
SD-030	Driveway Access Urban Residential Properties	I
SD-031	Driveway Access Industrial Properties	G
SD-032	Driveway crossovers urban residential properties	F
SD-055	Road Crossing and Footpath Reinstatement for Trench Laid Services	A
SD-060	Traffic Sign Installation	A
SD-065	Street Name Sign and Installation Details	A
SD-066	Miscellaneous Traffic Details – Shared Path Terminal Treatments Deflection Rail and Intersection at Side Road	B
SD-067	Miscellaneous Traffic Details – Pedestrian Refuge and Holding Rail	A
SD-070	Concrete Pathway Reinforced Concrete (Mesh) Alternative	D
SD-075	Concrete Pathway Reinforced Concrete (Fibre) Alternative	E
SD-080	Subsoil Drain	D
SD-085	Kerb and Channel Drainage Connections	A
SD-090	Driveway Access Rural Properties Type 1 - Access With Invert Slab H<300mm	B
SD-091	Driveway Access Rural Properties Type 2 - Conc. Access With Culvert Cast Insitu With Grate H≥300mm	B
SD-092	Driveway Access Rural Properties Type 3 - Gravel Access With Culvert Cast Insitu With Grate H≥300mm	B
SD-093	Driveway Access Rural Properties Type 4 - Conc. Access With Culvert Inverted Pre-cast Box Culvert H≥325mm	B
SD-094	Driveway Access Rural Properties Type 5 - Gravel Access With Culvert Inverted Pre-cast Box Culvert H≥325mm	B
SD-095	Driveway Access Rural Properties Type 6 – Access With Culvert Cast Insitu H≥450mm	B
SD-096	Driveway Access Rural Properties Type 7 - Conc. Access With Culvert 535mm<H<685mm	B
SD-097	Driveway Access Rural Properties Type 8 - Gravel Access With Culvert 535mm<H<685mm	B

Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage

Drawing No.	Title	Revision No.
SD-400	Sewerage Standard Drawing List	C
SD-405	Legends for Sewerage Drawings	C
SD-410	Typical Layout of Sewerage Details Example Plan	B
SD-411	Sewer Maintenance Shaft Typical Layout	B
SD-420	Small Sewerage Pump Stations Typical Plans, Sections and Details	C
SD-421	Sewerage Pump Stations Package Fibre Reinforced Plastic	B
SD-425	Small Sewerage Pump Stations Two Part Access Cover and Frame	B
SD-430	Sewerage Pump Stations Safety Grill Details	B
SD-435	Sewerage Pump Stations Washdown Service Installation	B
SD-440	Pressure Main Discharge to Maintenance Hole	B
SD-445	Overflow Maintenance Hole Arrangement	C
SD-450	Vents at Sewerage Rising Main Receiving Inspection Chambers and Pump Stations	D
SD-455	Property Connection Details Buried Interface Method	C
SD-460	Embedment and Trench Fill Typical Arrangement (sewer)	B
SD-461	Pipe Embedment Support Types	B
SD-463	Special Embedment - Piles, Concrete and Stabilised Supports	B
SD-470	Maintenance Holes - Sewers Less Than DN300 Cast In-Situ	C
SD-471	Maintenance Holes - Sewers Less Than DN300 Changes In Level Details and Channel Arrangements	C
SD-473	Maintenance Holes - Typical Channel Details	B
SD-474	Maintenance Holes - Alternative Drop Connections	D
SD-475	Maintenance Holes - Typical MH Cover Arrangements	B
SD-476	Maintenance Holes - Sewer DN375 to DN750	B
SD-480	Design Layouts - Longitudinal Sections	A
SD-481	Soil Classification Guidelines and Allowable Bearing Pressures for Bulkheads	A
SD-482	Trench Drainage Bulkheads and Trenchstop (sewer)	A
SD-483	Trench Drainage Typical Systems (sewer)	A
SD-484	Maintenance Holes - Pipe Connection Details	A
SD-485	Maintenance Holes - Connection Details DN110 to DN450 PE Pipes	A

Table SC6.4.4.8.5 Townsville City Council standard drawings for transport (21)

Drawing No.	Title	Revision No.
SD-500	Standard Bus Shelter Framing Details Sheet 1 of 2	E
SD-502	Standard Bus Shelter Slab and Footing Details Sheet 2 of 2	D
SD-505	Regional Bus Shelter Framing Details Sheet 1 of 2	C
SD-510	Regional Bus Shelter Construction Details Sheet 2 of 2	C
SD-515	Standard Bus Stop Urban Location Layout Details Type 1 and 2	D
SD-520	Regional Bus Stop Urban Location Layout Details Type 3 and 4	D
SD-525	Basic Bus Stop Layout Details Urban Location	B
SD-530	Standard Bus Stop Urban and Rural Locations Layout Details Type 7 and 8	B

Drawing No.	Title	Revision No.
SD-535	J Pole, Timetable Display Case, Rubbish Bin and Sleeve Installation Details	D
SD-540	School Bus Bus Stop Sign Details	B
SD-545	Bus Setdown – Urban Locations Layout Details	A
SD-550	Bus Setdown – Parking and Indented Details Urban Locations	A
SD-555	Bus Setdown Rural Location Layout Details	C
SD-560	Bus Setdown Rural Location Table Drain Precast Culvert Crossing	C
SD-565	Bus Setdown Rural Location Table Drain Cast-Insitu Culvert Crossing	B
SD-570	Standard-Country Bus Shelter – Framing, Slab and Footings Details	A
SD-575	Standard-City Bus Shelter Framing Details	B
SD-580	Standard-City Bus Shelter Slab and Footing	B
SD-585	Standard-City Bus Stop Urban Location Layout Details - Type 9 and 10	B
SD-590	Parking for People with Disabilities	A
SD-595	Taxi Rank	A
SD-596	Taxi sign details	A

Table SC6.4.4.8.6 Townsville City Council standard drawings for water

Drawing No.	Title	Revision No.
SD-300	Water Standard Drawing List	C
SD-305	Street Positioning of Mains, Valves, Hydrants and Domestic Water Service Connections	C
SD-310	Domestic Water Service Connections for 20mm Diameter Water Meters Rural Residential Area Only	C
SD-315	Typical Mains Construction Reticulation Main Arrangements	C
SD-320	Typical Mains Construction Connection to Existing Mains	B
SD-325	Embedment and Trench Fill Typical Arrangement (water)	C
SD-330	Standard Embedment - All Pipe Types	C
SD-335	Special Embedments - Inadequate and Poor Foundation	C
SD-340	Special Embedments - Concrete, Geotextile and Cement Stabilised Systems	C
SD-345	Valve and Hydrant Identification - Identification Markers and Marker Posts	C
SD-350	Typical Valve and Hydrant Installation Valve Arrangement	C
SD-355	Typical Valve and Hydrant Installation Hydrants and Air Relief Valves	C
SD-360	Typical Appurtenance Installation Scour Arrangements	B
SD-370	Soil Classification Guidelines and Allowable Bearing Pressures for Anchors and Thrust Blocks	A
SD-371	Thrust Block Details - Concrete Blocks	A
SD-372	Thrust and Anchor Blocks - Gate Valves and Vertical Bends	B
SD-373	Restrained Joint System DN100 to DN375 DI Mains	A
SD-374	Trench Drainage Bulkheads and Trenchstop (water)	A
SD-375	Trench Drainage Typical Systems (water)	A
SD-376	Buried Crossings Bored and Jacked Encasing Pipe Details	A
SD-377	Flanged Joints Bolting Details	A

SC6.4.5 Construction management

(1) This section outlines the standards and provides advice and guidelines for construction management of development and covers pre-construction, construction and quality management systems.

(2) All development works shall be supervised by a Registered Professional Engineer of Queensland with relevant experience. Where the owner or developer does not have such a Professional Engineer in their employ, a Registered Consulting Professional Engineer shall be retained for the purpose of supervising the development works prior to commencement of work.

(3) This section aims to clearly define the role of council, Superintendent, Consultant, Principal Contractor and the Developer. This section seeks to ensure that inherited development works are constructed to achieve a cost effective operation and maintenance asset and perform adequately for their design lives.

(4) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.2.5 Pipeline testing and restoration (Water supply sub-section)
SC6.4.6.3.4 Pipeline testing and restoration (Sewerage system sub-section)
SC6.4.6.19 Stabilisation
SC6.4.6.22 Pavement markings
SC6.4.6.29 Boundary fencing
SC6.4.6.30 Control of traffic

(b) Australian Standards

AS 1012.1	*Methods of testing concrete - Sampling of fresh concrete*
AS 1012.3.1	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test*
AS 1012.14	*Methods of testing concrete - Method for securing and testing cores from hardened concrete for compressive strength*
AS 1012.4	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Compactibility index*
AS 1012.8	*Methods of testing concrete - Method of making and curing concrete*
AS 1012.9	*Methods of testing concrete - Determination of the compressive strength of concrete specimens*
AS 1141.11	*Methods for sampling and testing aggregates - Particle size distribution*
AS 1141.12	*Methods for sampling and testing of aggregates - Materials finer than 75 micrometre in aggregates (by washing)*
AS 1141.14	*Methods for sampling and testing aggregates - Particle shape, by proportional caliper*
AS 1141.15	*Methods for sampling and testing aggregates - Flakiness index*
AS 1141.18	*Methods for sampling and testing aggregates - Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*Methods for sampling and testing aggregates - Wet/dry strength variation*
AS 1141.23	*Methods for sampling and testing aggregates - Los Angeles value*
AS 1141.24	*Methods for sampling and testing aggregates - Aggregate soundness - Evaluation by exposure to sodium sulphate solution*

AS 1141.25	*Methods for sampling and testing aggregates - Degradation factor*
AS 1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS 1141.42	*Methods for sampling and testing aggregates - Pendulum friction test*
AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289.3.2.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the plastic limit of a soil - Standard method*
AS 1289.3.3.1	*Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil*
AS 1289.3.6.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.7.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the sand equivalent of a soil using a power-operated shaker*
AS 1289.4.2.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method*
AS 1289.4.3.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the pH value of a soil - Electrometric method*
AS 1289.4.4.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials*
AS 1289.5.1.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.5.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method*
AS 1289.5.7.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1289.5.8.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture–Density gauge - Direct transmission mode*
AS 1289.6.1.1	*Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS 1477	*PVC pipes and fittings for pressure applications*

AS 1478	*Chemical admixtures for concrete, mortar and grout*
AS 1580.107.3	*Paints and related materials - Methods of test - Determination of wet film thickness by gauge*
AS 1741	*Vitrified clay pipes and fittings with flexible joints - Sewer quality*
AS 1742.3	*Manual of uniform traffic control devices - Traffic control for works on roads*
AS 2008	*Bitumen for pavements*
AS/NZS 2032	*Installation of PVC pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS 2280	*Ductile iron pipes and fittings*
AS 2150	*Hot mix asphalt - A guide to good practice*
AS 2544	*Grey iron pressure fittings*
AS 2638	*Gate valves for waterworks purposes*
AS 2758.1	*Aggregates and rock for engineering purposes - Concrete aggregates*
AS 2891.9.3	*Methods of sampling and testing asphalt - Determination of bulk density of compacted asphalt - Mensuration method*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 3439	*Low-voltage switchgear and controlgear assemblies*
AS 3582.1	*Supplementary cementitious materials for use with portland and blended cement - Fly ash*
AS 3583.1	*Methods of test for supplementary cementitious materials for use with portland and blended cement - Determination of fineness by the 45 micrometre sieve*
AS 3583.12	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of available alkali*
AS 3583.13	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of chloride ion content*
AS 3583.14	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of insoluble residue content*
AS 3583.2	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of moisture content*
AS 3799	*Liquid membrane-forming curing compounds for concrete*
AS/NZS 3905.12	*Quality system guidelines - Guide to AS/NZS ISO 9001 for architectural and engineering design practices*
AS 3952	*Water supply - Spring hydrant valve for waterworks purposes*
AS 3972	*General purpose and blended cements*
AS 4198	*Precast concrete access chambers for sewerage applications*

AS 4373	*Pruning of Amenity Trees*
AS/NZS 4455	*Masonry units, pavers, flags and segmental retaining wall units*
AS 4687	*Temporary Fencing and Hoardings*
AS 4970	*Protection of trees on development sites*
AS 5101.4	*Methods for preparation and testing of stabilized materials - Unconfined compressive strength of compacted materials*
AS/NZS ISO 9001	*Quality management systems - Requirements*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10013	*Guidelines for quality management system documentation*

(c) Department of Transport and Main Roads

Standard specifications roads

MRTS17 - Bitumen
MRTS18 - Polymer Modified Binder
MRTS21 - Bituminous Emulsion
MRTS22 - Supply of Cover Aggregate
MRTS30 - Dense Graded and Open Graded Asphalt

Materials testing manual

Q103A Particle size distribution (wet sieving)
Q104A - Liquid limit (cone penetrometer)
Q104D - One-point liquid limit (cone penetrometer)
Q105 - Plastic limit and plasticity index
Q113A - California bearing ratio (standard compactive effort)
Q115 - Unconfined compressive strength of compacted materials
Q142A - Dry density- moisture relationship (standard compaction)
Q201 - Flakiness index
Q205B - Ten percent fines value (wet)
Q205C - Wet/dry strength variation
Q208A - Degradation factor (source rock)

(d) Other

ASTM International, ASTM-D 2434-68 - *Standard Test Method for Permeability of Granular Soils (Constant Head)*
Environmental Protection (Noise) Policy (EPP (Noise))
International Erosion Control Association, *Best Practice Erosion and Sediment Control Document (BPESC)*
NSW Department of Transport, Roads and Maritime Services (RMS), *Test method T432: Rate of slaking of quicklime, October 2012*
TCC-001
Work Health and Safety Act 2011

SC6.4.5.1 Pre-construction guidelines

SC6.4.5.1.1 Pre-construction steps

The chart presented below indicates the steps required to be undertaken prior to commencement of works.

(1) Notice to commence works

The Developer must give council's Development Assessment Unit (DAU) notification of at least 5 business days (in writing) of their intention to commence construction works. Refer to SC6.4.5.1 Attachment A Development works – notice to commence works. Refer to the Development works - notice to commence works form for a list of requirements to be submitted prior to or at the pre-start meeting.

(2) Pre-start meeting

The nominated Consultant must ensure that a pre-start meeting is conducted on the premises between the contractor, supervising engineer (RPEQ), the design consultant and council representatives. This meeting represents a hold point and works may not proceed until the meeting is held and any further requirements identified during the course of the meeting have been satisfied. The pre-start meeting must be based on an agenda which includes:

(a) introduction of the principal contractor, supervising engineer (RPEQ), design consultant (including any specialist) and council representative. A statement of their respective roles and relevant personnel contact details must also be tabled and distributed at that meeting;

(b) confirmation that all relevant statutory permits/approvals have been obtained;

(c) evidence of current public liability insurance. Refer to SC6.4.5.2(21) Insurance and indemnity;

(d) review and discussion of all relevant conditions of the development approval;

(e) review and confirmation of the site establishment and access arrangements including all necessary site security fencing and signage requirements;

(f) review and discussion of the approved traffic management plan and haulage routes if applicable;

(g) review and discussion on a schedule of "hold-points" to be adopted throughout the construction phase. This schedule of "hold-points" is to be approved by council prior to construction proceeding;

(h) discussion of site specific workplace health and safety issues and an approved work method statement and safety plan in compliance with the *Work Health and Safety Act 2011*;

(i) review of the approved erosion and sediment control plan including site base stormwater management

plans and sediment controls during and post construction. Refer to SC6.4.5.2(11) Erosion and sediment control and SC6.4.3.8 Stormwater quality management plans for further details regarding this requirement;

(j) location confirmation and identification of all existing public utilities, services and council assets if applicable, including any approved demolition/rectification actions if required;

(k) scheduling and identification of all necessary responsible persons to undertake any council required works (e.g. disconnection of irrigation systems, sewer line connections etc.);

(l) review of the vegetation protection plan if applicable and confirmation that any necessary vegetation protection measures are in place;

(m) construction schedule and program and any other details that requires review before construction work commences e.g. work quality plan and/or quality manual review of quality requirements (SC6.4.5.3 Quality management system) and inspection test plan requirements;

(n) if required, a development notice (project sign in accordance with SC6.4.5.2.1(6) Development notice) is to be erected;

(o) confirmation of possession of site by the contractor; and

(p) any other relevant matters specified by the principal contractor, supervising engineer (RPEQ), consultant/s and/or council representative that may be pertinent to the successful completion of the project.

SC6.4.5.1 Attachment A Development works - notice to commence works form

Click here to view SC6.4.5.1 Attachment A Development works - notice to commence works form

Note—this form is to be completed, signed and submitted to council by the developer at least 10 working days prior to commencement of any development works.

SC6.4.5.2 Construction

SC6.4.5.2.1 General standards and guidelines

The following are general standards and guidelines during the construction of development works:

(1) Superintendent

The superintendent is to be nominated or appointed by the supervising engineer (RPEQ) and must be supervised by the RPEQ at all times throughout the construction period. The supervising engineer (RPEQ) is to take full responsibility for all construction work on the development site.

(2) Hours of work

Unless otherwise approved by council (in writing), works involving machinery of any description shall only be carried out on site from 6.30am to 6:30pm Monday to Saturday, subject to legislative requirements. No construction work is to take place on Sundays and public holidays without prior approval. Construction work includes deliveries to the site of the works and the onsite servicing of equipment.

(3) Relocation/alteration and repair to existing utility services

The location and level of all existing public utilities and services and the alignment for any new service utility or service in association are to be identifiedwith the relevant authority or council asset owner. The developer is responsible for any relocation and/or alteration to any public utility installation required as a result of any works carried out in connection with this development at no cost to council.

The contractor is to ensure that utmost care is to be exercised during the progress of the development works to prevent damage to any existing utility or service. Any damage to existing utilities or services directly resulting from the development works shall be the responsibility of the developer.

(4) Provision for traffic management

No works shall be conducted within an existing public road without approval (i.e. Road work permit). Any proposed road closure (partial or full), or traffic diversion is to be presented (with full details of proposed traffic management) for approval. Proposed traffic management is to comply with the relevant sections of SC6.4.6.30 Control of traffic.

The developer is to ensure that all appropriate approvals and permits are obtained from council for work zones, gantries and scaffolding prior to commencement of construction.

The developer shall be held responsible for implementing the approved traffic management plan including the safety of all vehicles, pedestrians and cyclists and must provide all necessary measures to prevent any accident, damage and loss.

(5) Condition of entry to adjoining properties

The developer or its representative must effectively protect all adjoining properties against any loss, damage or injury that may occur as a result of development works.

Works must not be undertaken on adjoining properties without prior written consent of the lawful owner. All adjoining property which has been disturbed as a result of the development shall be reinstated to a finish similar to its pre-development state or to an alternative state agreed to in writing by the affected property owner.

Upon completion of the development works, written approval from any affected property owners will be required by council prior to acceptance of the completed development works.

(6) Development notice

Where required, a project sign is to be erected within the site boundaries on the road frontage of the subject site or any other council approved location that is prominent and visible to the public. The developer is responsible for maintaining the signage for the duration of the construction. The signage shall have the following information (as a minimum):

(a) description of development (include an overall concept plan);

(b) name of developer;

(c) name of project;

(d) street address of the site;

(e) supervising engineer's name and phone number;

(f) consultant's name and phone number;

(g) principal contractor's name and phone number; and

(h) other specialist consultants' names and phone numbers.

(7) Signage and security

All necessary signage and site security shall be provided wholly within the site and in strict accordance with current Workplace Health and Safety (QLD) guidelines and requirements.

(8) Site access

The construction site shall be accessed via one convenient access from a public road. The location and details of this access point is to be approved by council prior to construction commencing. This access point shall be used by all vehicles, equipment and personnel during the approved construction hours of the site. Appropriate vehicle "shake-down" facilities are to be provided at the point of access in accordance with appropriate water quality management objectives for the site. The vehicle shake-down facility is to be a minimum 1.5m long by 3m wide for one-way or 6m wide for two way entrances.

(9) Site fencing

The developer must erect a temporary man-proof fence to restrict unauthorised access into the construction site. The fence is to extend around the entire perimeter of the site with access being provided as outlined above. The developer is to refer to SC6.4.6.29 Boundary fencing for details of the temporary fence.

(10) Site management

The Contractor is responsible for the management of the construction site and control of construction activities throughout the period of works, with particular attention to reducing the impact of the construction work on the public, adjacent and nearby properties and other areas of the site not part of the works. The primary objective is to eliminate the impacts of the temporary and permanent works having regard to:

(a) work health and safety;

(b) erosion control;

(c) acid sulphate soils;

(d) run-off;

(e) traffic management;

(f) disposal of all materials;

(g) gaseous discharges and odour;

(h) noise; and

(i) dust.

Adjacent waterways shall be regularly monitored for turbidity plumes, algal blooms and dead marine life which may be attributable to the construction of the works.

(11) Erosion and sediment control

During the construction phase and up until council accepts the development works or at the end of the defect liability period the contractor shall be responsible for the installation and maintenance of all erosion and sediment control measures on site.

The approved erosion and sediment control plan (ESCP) submitted as part of the operational works or compliance application must be presented during the pre-start meeting. This plan must be presented to council's nominated representative for review and "fit-for-purpose" implementation on the site. If the ESCP requires revision to suit the current conditions of the development site, the plan must be amended to achieve the approved set of water quality outcomes required by council. Upon approval of the ESCP, the procedures

and guidelines outlined in the plan for establishing, managing (inspection and monitoring) and maintaining water quality across the development site shall be the responsibility of the contractor.

At the end of the agreed period of implementation and maintenance, all identified temporary sediment control measures must be removed by the developer and the ground reinstated to council's satisfaction.

(12) Suppression of dust
At all times the Contractor shall ensure that dust resulting from the proposed works, including excavation, backfilling, grading and stockpiles is kept to an absolute minimum and to the satisfaction of council, by approved methods.

(13) Noise control
All construction work is to be undertaken pursuant to the *Environmental Protection (Noise) Policy (EPP (Noise))*. Construction works shall be carried out in accordance with the requirements and restrictions relating to hours of work specified in SC6.4.5.2.1(2); and the *Environmental Protection Act 1994*.

(14) Hazardous material
Hazardous materials are to be stored in a hazardous goods store such that it is free from flood and storm tide inundation. The hazardous goods store must ensure that materials cannot enter the environment or cause a public safety nuisance or hazard. Hazardous goods may only be kept on site for the duration of construction and are to be safely removed from site at completion of works, unless otherwise approved by council.

(15) Machinery refuelling
During construction, fuel and petroleum products shall not be stored on the site nor shall construction equipment and machinery be serviced on the site. Procedures shall be developed and implemented by the contractor for the refuelling of machinery and equipment which will minimise any potential for contamination of the site by way of spillage. The procedures shall ensure that refuelling on the site occurs within a designated area that does not drain directly into adjacent stormwater systems or waterways. Any procedures developed and implemented in this regard must include bunding of the refuelling area.

Any spillage of fuels and petroleum products during construction shall be reported to the superintendent. All steps necessary to rectify the contamination shall be undertaken by the contractor prior to the completion of the works and at no cost to council.

(16) Material storage
Materials shall not be stored on site unless approved in writing by the Superintendent or unless material storage details are shown on the drawings and approved by council.

All necessary measures shall be implemented to reduce the potential for environmental damage, which may arise from the storage of materials.

(17) Stockpiling of materials
Wherever possible, materials shall be installed directly in place or continually removed from site, eliminating the need for stockpiles. In all other cases, stockpiling of materials shall be on a temporary basis at the discretion of superintendent.

The location of approved stockpiles shall be in accordance with the ESCP and as a minimum stockpiles shall:

(a) Remain on site for as little time as practical;

(b) Be limited to a height of 2m;

(c) Not to be located within 10m of a residential boundary;

(d) Have batter slopes, covers and drainage which limit the potential for erosion and/or segregation;

(e) Be managed in accordance with SC6.4.5.2 Attachment B;

(f) The contractor is to erect and maintain a temporary sediment fence around all stockpiles for the duration

of the stockpile being on the site.

(18) Vegetation disposal

Burning or burying of waste vegetation on site is not permitted unless otherwise approved by council. Clearing and grubbing of the development site shall otherwise be undertaken in accordance with SC6.4.6.11 Clearing and grubbing.

(19) Work adjacent to trees and protection of environmentally significant vegetation

(a) Protection of trees and vegetation – general

All existing and newly planted trees and vegetation should be noted on the drawings and protected from damage during construction. The approved vegetation protection plan should be available onsite prior to commencement and during works. The vegetation protection plan will identify key stages where monitoring and certification will be required.

As specified in the vegetation protection plan, a vegetation protection zone must be established on site to ensure the required retention of existing trees and vegetation identified for protection and retention. The vegetation protection zones must be identified as *"no-go"* areas for construction traffic and meet the following requirements:

(i) For trees, the extent of the vegetation protection zone is to be determined in accordance with the tree protection zone (TPZ) requirements of AS 4970 - *Protection of trees on development sites.*

(ii) For areas of vegetation not including trees, other areas of natural heritage or hydrologically sensitive features, the extent of the Vegetation Protection Zone is to be determined by a qualified arborist, ecologist, or other approved officer.

(iii) The Vegetation Protection Zone is to be fenced or barricaded to prevent unauthorised vehicle and machinery access, as per AS4970 *Protection of trees on development sites* and AS4687 *Temporary Fencing and Hoardings*.

(iv) Signage to indicate "Vegetation Protection Zone - No Access" should be installed as per AS4970 *Protection of trees on development sites* and AS1319 *Safety signs for the occupational environment*.

(v) Where required, the tree bark is to be protected by wrapping a triple layer of hessian or rubber matting around the tree trunk.

(vi) Fixing of temporary service wires, nails, screws, stays, guys and or any other fixing device to trees should be avoided.

(vii) No fuel, oil dumps or chemicals are allowed to be used or stored within the Vegetation protection zone and the servicing or re-fuelling of equipment and vehicles must be carried out away from the vegetation protection zones.

(viii) Deposition of wind-blown materials (such as cement) into the protection area should be avoided through the attaching of cloth to the Vegetation Protection Zone fencing.

(ix) Soil compaction and removal of top soil within the Vegetation Protection Zone is to be avoided. Where compaction occurs, hand methods to de-compact the soil should be used.

(x) No vehicles are to access or be parked within the Vegetation Protection Zone. Where traffic is unavoidable within the zone, a 300 mm thick layer of mulch over a geotextile fabric should be placed in the area to protect the trees surface roots and to reduce the risk of soil compaction.

(xi) No storage of material, equipment or temporary building is to take place within the Vegetation Protection Zone, including the placing of spoil from excavation against tree trunks.

(b) Fill and excavation near trees and vegetation

(i) Any underground service installations within the Vegetation protection zone must be bored and the utility authorities must utilise a common trench where possible. Where practical, trenching is to be combined with locations where roots need to be severed for other reasons.

(ii) Within the Vegetation protection zone, all excavation must be carried out by hand digging or with the use of "air-excavation" techniques.

(iii) Where required, trees roots or branches are to be cut cleanly without tearing, with clean, sharp tools (chainsaw, secateurs or hand saw) in accordance with the AS 4373 *Pruning of Amenity Trees* and under the supervision of a qualified arborist with formal qualifications (Level 3 Australian Qualification Framework) or at least 5 years recognised experience in arboriculture.

(iv) Cutting of tree roots exceeding 50 mm in diameter should be avoided. Where roots must be cut, this should not unduly disturb the remaining root system.

(v) Any ripped or torn roots are cleanly re-cut as soon as noted.

(vi) Roots to be left exposed for any period of time are covered with wet hessian and maintained in a moist condition until recovered.

(vii) Immediately after cutting of any roots, Copper Naphthanate or an equivalent alternative solution is to be applied to the cut surface to prevent the incursion of rot or disease - as deemed necessary.

(viii) Backfill to excavations around tree roots should be with a soil mix similar in consistency and pH value to that of the existing soil.

(ix) Backfill should be placed in layers of 300 mm loose depth and be compacted to a dry density similar to that of the original surrounding soil using hand methods or light compaction equipment.

(x) Backfill layers should generally match the soil horizon of the surrounding soil.

(xi) The depth of fill within the vegetation protection zone should not exceed 200 mm from the original surface level. Immediately after placing any fill around a tree, the area should be watered thoroughly.

(c) Trees to be transplanted

(i) Trees to be transplanted shall be noted on the drawings and/or shall be marked on site by the superintendent prior to the commencement of construction.

(ii) Requirements and procedures for transplanting of trees are to be issued by council for each particular species.

(d) Damage to tree or vegetation

(i) Any unauthorised removal, damage or disturbance undertaken prior to the identification of the protected zone/s (without the required approval) or within the identified protected zone/s shall be rehabilitated by the contractor to the satisfaction of council and at no cost to council.

(ii) In the event of an unauthorised removal and that rectification works to damaged tree/s or vegetation is impractical, or the rectification work has been carried out by the contractor and is rejected by council, then council may direct the contractor to remove the trees/vegetation as part of the rectification work. The contractor will:

(A) replace the damaged tree/vegetation with a tree/vegetation of the same species and similar size to council's satisfaction; or

(B) replace the damaged tree/vegetation with a tree/vegetation of a similar size but different species to council's satisfaction; or

(C) pay for the cost of replacing the tree/vegetation with the same size and species to council's satisfaction; or

(D) replace the damaged tree/vegetation with a smaller tree/vegetation of an approved species and pay for the difference in cost between the new replacement and a specimen of the same size and species, to council's satisfaction.

(iii) The replacement value of an existing tree/vegetation will be calculated using the Revised Burnley Method under the Draft Australian Standard DR99307 *Amenity Trees – Guide to Valuation system*.

(20) Stormwater quality

Development works may cause changes to the quality, quantity and flow rate of stormwater discharged from the site. During the construction phase where soil disturbance and construction activity significantly increases the risk of soil erosion or where the development is required to implement a Stormwater Quality Management Plan (SQMP) that has been approved during the operational works approval phase. Council will then require a detailed maintenance regime to control stormwater quality during the construction phase to be presented during the pre-start meeting for review and acceptance by council unless a detailed maintenance regime has

been presented and accepted by council during the design process.

If the development works involves construction of stormwater quality device/s or is part a catchment with an existing stormwater quality device, then the developer and his contractor must ensure that no stormwater discharge will be permitted to enter such device (directly or indirectly) unless otherwise permitted by council. Refer to SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

Any temporary stormwater quality device proposed as part of the development works is to be removed and any land or existing infrastructure disturbed or damaged during the installation of any temporary stormwater quality device shall be reinstated to its former condition to the satisfaction and at no cost to council.

(21) Insurance and indemnity

From the commencement of construction until council accepts the development works or the commencement of the maintenance period, the developer or contractor must insure the works against public liability ($10 million dollar minimum cover) and other claims arising from the works, and indemnify council against that liability. Council must be included as an interested party to the insurance policy. The developer must provide council with evidence and a certificate of currency for the insurance and indemnification before commencing the construction works.

(22) Dilapidation survey

Where required by council and where development is directly adjacent to existing infrastructure and improvements, it may be prudent for the developer or his contractor to carry out a dilapidation survey of all the existing adjoining structures prior to construction commencing. This may reduce any damage claims during the construction period. Any damages to adjacent structures as a result of the development works shall be the responsibility of the developer.

(23) Fencing

While undertaking development works, and where appropriate, site fencing is to be erected for the duration of construction activities. Fencing is required to restrict unauthorised site access and to ensure the safety of persons from the subject site and any works on the adjoining road reserve and/or premises.

If existing fencing is to be altered or if there is no existing site fencing, temporary fencing, as a minimum, shall be provided and maintained for the duration of the construction to prevent unauthorised entry into the property or work area from any adjoining road reserve or property. The reinstatement of fencing and removal of temporary fencing on completion of the work shall be undertaken.

A construction site may provide any additional amount of security and/or fencing that is considered necessary that will improve the safety of the public or persons working on the site.

(24) Environment

All work shall be carried out in such a manner as to avoid nuisance and/or Environmental Harm. Development shall be planned and executed so that the works undertaken avoid contamination of the site and its surroundings by taking all reasonable and practical measures to prevent or minimise harm (general environmental duty).

Herbicides and other toxic chemicals shall not be used on the site without the prior written approval of the council or other relevant authority.

(25) Lighting

All lighting associated with the construction activity shall be installed and used so that lighting does not adversely affect the adjoining amenity of nearby sensitive uses, sensitive environmental areas or pose a safety hazard on adjacent road networks. All public road/street lighting systems must be designed in accordance with AS 1158 and must be approved by Ergon prior to construction.

(26) Blasting

Blasting will generally not be permitted. If blasting is necessary and there are no alternatives, it shall be carried out strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual.

(27) Vibration

Ground vibration levels, transmitted from the construction works, rock breaking, drilling, and piling, operating items of plant or other noisy activities shall not exceed levels that are close to the lower level of human perception nor is it to cause any unacceptable damage to any adjoining buildings or infrastructure. Acceptable practices and vibration thresholds shall be determined in accordance with current Statutory Regulations.

Acceptable practices and vibration thresholds shall be determined in accordance with current Statutory Regulations.

A complaints management system should be devised which includes corrective and preventative actions. Consultation with and information supplied to nearby residents, workers and any other sensitive noise receptors is to be undertaken when vibration is known to be generated and is considered sufficient to warrant notification.

Editor's note—the results and recommendations of reporting on noise and vibration, as detailed in SC6.4.3.15 Noise and vibration assessment guidelines, associated with a particular development will be required to be implemented.

Editor's note—the Contractor shall be responsible for any damage and compensation payments as a result of vibration.

The control of ground vibration as a result of blasting shall be strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual and will be solely at the risk and responsibility of the developer.

SC6.4.5.3 Quality management system

(1) Townsville City Council requires an emphasis on quality for the development works being delivered by developers. Where a condition for the approval of the development works requires the works to be completed as a "Quality Controlled and Assured Development", the developer must engage consultants and contractors with the necessary level of Quality Assurance accreditation to undertake and certify the development works.

(2) Quality management system – It is a requirement for a "Quality Controlled and Assured Development Contract" that the contractor shall plan, develop and maintain a documented Quality System in accordance with this section and the current requirements of AS/NZS ISO 9001.

(a) Quality manual
This is a document setting out the general quality policies, procedures and practices of an organisation. The development of this document shall cover and include the requirements as specified in the Quality System Documentation section of AS/NZS 3905.12 with guidance to preparation by AS/NZS ISO 10013. Additionally, it must include standard method statements and inspection and test plans for the activities undertaken by the Contractor. The following details shall be provided by appropriate annexures to the Company Quality Manual:

(i) Organisational Structure – this provides information regarding the management structure of the project with details of the specific responsibilities and authorities of the nominated personnel, which includes but is not limited to:

(A) a project quality management representative – is appointed by the Contractor for a specific project with the authority and responsibility for the implementation and operation of the quality plan, to ensure that Quality System requirements are not subordinated to design and productivity. Details of this person's qualifications, technical experience and present position are also to be provided;

(B) the contracted testing organisation – details of the personnel who will be conducting each type of compliance inspection of testing; and

(C) the person authorised to change construction processes on site; and

(ii) Register of Method Statements – the register shall list all Method Statements that are to be included in the project quality plan for the development contract and shall include any suitable method statements already incorporated in the Company Quality Manual.

(b) Project quality plan
The Quality System as expressed in the project quality plan shall be used throughout the course of the construction to ensure that the quality of the Contractor's and any sub contractor's work complies with all the requirements under this section. The Company Quality Manual, method statements and checklists and other project specific components shall make up the Project Quality Plan. The project quality plan must generally conform to the recommendations of AS/NZS ISO 10006. A concept illustration is shown in Figure SC6.4.5.3.1 Project quality management system documentation.

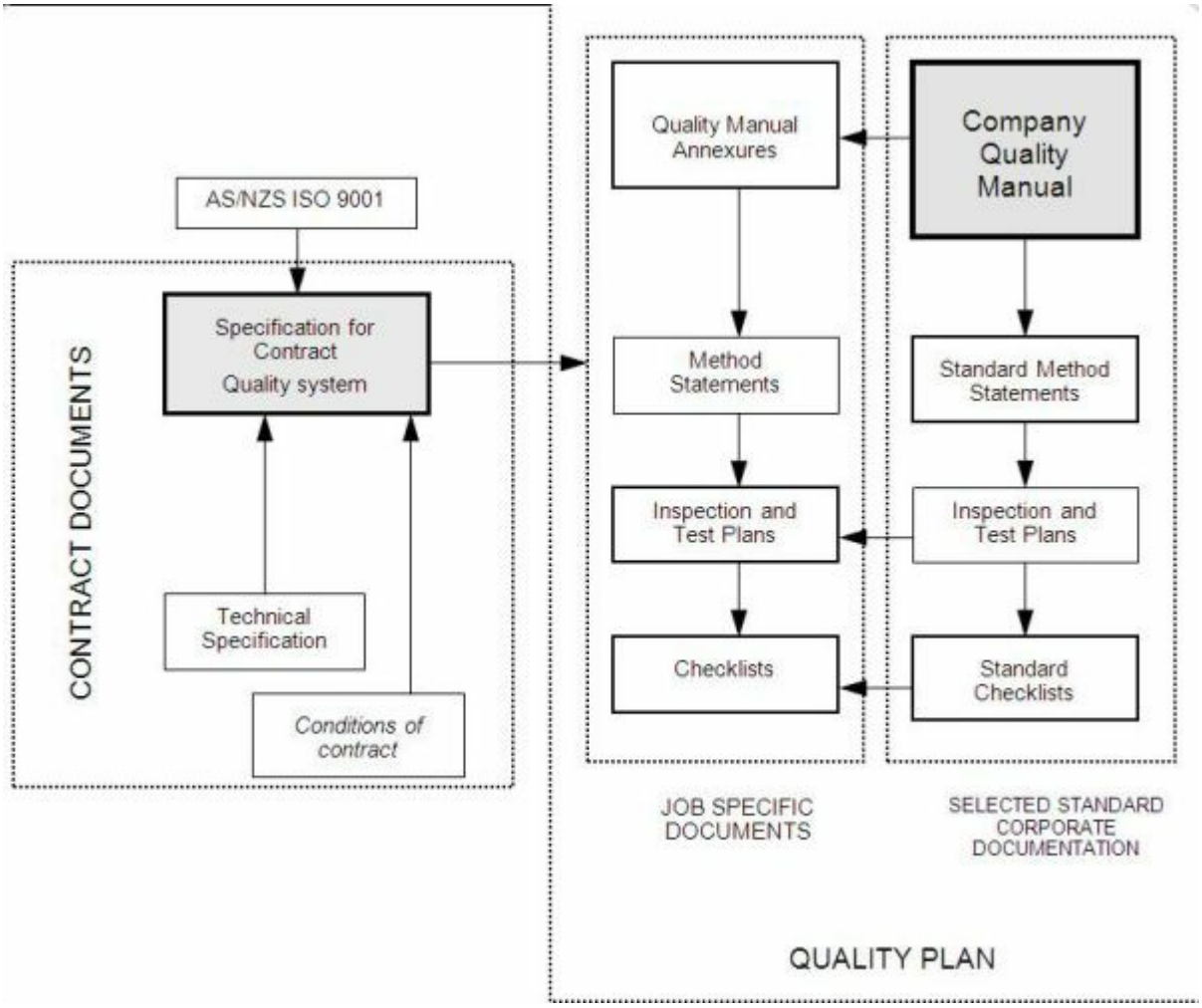


Figure SC6.4.5.3.1 Project quality management system documentation

(3) Where a "Quality Controlled and Assured Development" is not a requirement, a quality plan is not therefore required to be provided but it will be necessary as a minimum requirement that:

(a) the nominated Superintendent or Consultant are suitably and appropriately qualified and experienced;

(b) a work quality plan must be submitted to council for review and acceptance prior the pre-start meeting or commencement of works. The work plan must outline a program of inspection and testing regime that will ensure an adequate control of the progress and correctness of the work in accordance with the accepted design plans and specification;

(c) upon completion of the development works and prior to council accepting the completed development works, all records as required on the work quality plan must be submitted to council to demonstrate compliance with the accepted work quality plan; and

(d) the full cost of all required testing as per the work plan shall be the responsibility of the developer or the contractor. These tests are required to ensure that the materials and the works that were carried out conform to the accepted design specification and standard.

(4) Quality management system procedures

(a) Quality control system

(i) Lots

All items of work shall be subdivided into lots. Each lot shall be given a unique lot number and shall be chosen by the Contractor but must be within the limits given in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies. In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.

The lot numbers shall be used as identifiers on all surveys and test results. The Contractor shall determine the bounds of each lot before sampling and shall identify each lot clearly. The

boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous.

The lot identification system and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

(ii) Sampling and testing
All compliance inspections and tests shall be based on lots. The maximum lot sizes and minimum testing frequencies are listed in the Attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies.

Where no minimum frequency of testing, or maximum lot size is stated in the sub-section, the Contractor shall nominate appropriate frequencies for the Superintendent's approval. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or sub-section, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the sub-section.

Where test methods are nominated in the sub-section, sampling and testing shall be carried out by a (NATA) National Association of Testing Authorities registered laboratory accredited for those test methods and sampling procedures. Sampling shall be conducted by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and shall be supervised by the approved signatory from that laboratory. Test results shall be reported on NATA endorsed test documentation which shall include a statement by the approved signatory certifying that the correct sampling procedures have been followed.

Random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B Random sampling defines the method to be used for determining test locations of random sampling in each lot. For quality control of processes other than compaction of layers of earthworks, flexible pavement and asphalt, the sampling locations will be proposed by the Contractor and will require the approval of the Superintendent. All samples shall be each considered to be representative of the lot and all test results will be required to meet the appropriate tolerances for the lot.

The latest NATA advice of the terms of registration and current signatories for the laboratories are to be included within the quality plan shall which will be providing the compliance test reports.

The NATA registered laboratory must provide inspection, testing and measuring equipment capable of producing the precision and/or degree of accuracy specified in the referenced test methods and this shall be made available by providing evidence or records of calibration.

(iii) Surveying
The Contractor shall engage qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all Surveying Control.

(iv) Surveying Control shall include all measurement, calculation and record procedures necessary to:

(A) set out the works;

(B) verify conformance to the drawings and sub-section in relation to dimensions, tolerances and three dimensional position; and

(C) determine lengths, areas or volumes of materials or products, where required for measurement of work.

The procedures and equipment used must be capable of attaining the tolerances required in the relevant construction specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report to the Superintendent for each lot or

component where design levels, position and/or tolerances have been specified. The report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

(v) Records and quality control documentation
Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall submit all conformance records to the Superintendent for inspection and approval. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the Developer.

The Contractor shall maintain a quality register which contains all quality control records such as test results, completed check lists, certificates of compliance, and consignment dockets for materials procured.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council through the Superintendent a copy of the quality register and other required quality control documents as required in this section.

(5) Quality assurance system – is the management of actions covering planning, quality control testing, inspection and verification procedures integrated with production to provide a product fit for the purpose.

(a) Inspection and test plan (ITP) is the document which identifies the specific inspections and tests required to be carried out for on development works including hold points. The ITP is to be prepared by an appropriately experienced consultant identifying specific inspections and tests to be carried out for each item of development works. Refer to council’s minimum ITP requirement on SC6.4.5.3 Attachment D Minimum inspection and test plan.

As a minimum, the inspection and test plans must contain the following information:

- lot references;
- activity description;
- specification requirements (if not provided, referenced specification);
- sampling methodology;
- test frequency and method; and
- identify responsibilities for inspection and testing and approval.

The superintendent shall audit the contractor’s work on a regular basis and provide sufficient site presence and in particular at inspection points identified in the Inspection and testing plan as set out in the construction schedules and agreed to and accepted by council. Inspections by council shall not in any way diminish the responsibility of the consultant and the superintendent to adequately audit the works. Auditing shall include regular site inspections which will be conducted with the presence of the contractor’s representative to confirm acceptability of works as complying with the design intent and other council requirements.

Inspection and test plans will typically have an associated check list which shall require completion for each particular lot. Prior to council’s acceptance of completed development works all documentation relating to compliance to the agreed and accepted ITP are to be submitted by the Contractor and/or the Superintendent which will form part of the Consultants’ certification that the works have been carried out and inspected in accordance with the agreed and accepted ITP.

(A) Inspections
The contractor shall ensure that any particular stage of work to be inspected has been satisfactorily completed before requesting an inspection by the superintendent and/or council. A minimum of 24 hours’ notice (except for off maintenance inspection which requires a minimum of 7 days) is required to enable arrangements to be made for an

inspection. Responses to the requests within the prescribed minimums are not guaranteed, although every effort will be made by council to accommodate request where possible. All council required inspections must be carried out Monday to Friday unless other arrangements have been agreed.

Incoming inspections shall be required for deliveries of materials that will be subsequently included in one or more lots. When completing check lists for particular lots the inspection status shall be cited.

In-process and compliance inspections shall be completed by a responsible officer nominated in the check list and certified by the Contractor's Quality Management Register (QMR) indicating that the work has been completed in accordance with the contract documents.

The Contractor shall establish and maintain a system to ensure and demonstrate that all products or parts of products requiring inspection and/or testing are so inspected and/or tested. The Contractor shall also establish and maintain a system for identifying the inspection status for all lots of work.

(B) Hold points and witness points

To assure compliance with the specified standards and requirements, mandatory hold points shall apply. Hold points are those stages during the construction/manufacturing process where the technical specifications require "approval by the Superintendent" or where a non-conformance report (NCR) or notice of non-conformance (NNC) has been issued. The Contractor shall not proceed past the hold point until approval has been received from the Superintendent to proceed. For ease of identification hold points may also be annotated on the margins of technical specifications.

To obtain the approval to proceed from the Superintendent, the Contractor shall:

- provide the information required by the technical specifications;
- ensure and certify that the particular lot/process is conforming;
- ensure and certify that all underlying and adjacent lots affected by the lot in question are conforming; and
- submit the appropriate form (check list, NCR or NNC) at least 24 hours prior to the time the Contractor wishes to proceed with the placement/construction of the next lot, unless some alternative arrangements have been agreed with the Superintendent.

If the hold point has resulted from a NCR or NNC, the Superintendent's approval may be conditional on a witness point being included.

(b) Quality assurance activities

(A) Document control

In addition to the requirements of AS/NZS ISO 9001 and AS/NZS 3905.2, the quality plan shall specify the method of keeping quality registers, tracking and handling of NCRs, NCC, NNCs and other site correspondence.

(B) Method statements

A document that specifies the key steps and sequence in the manufacture/construction for an activity; what, how and by whom it shall be done; what materials and equipment shall be used to achieve the required quality standards.

Method statements shall be provided for all activities scheduled in SC6.4.5.3 Attachment C Method statement requirements. This requirement applies to both contract and subcontracted work. The documentation shall cover, as applicable, planning, methods, verification and control.

The presentation of method statements may be either descriptive, in the form of flow charts or a combination of both. In either case it must be accompanied by a check list which shall include the

relevant inspection and test points, surveying control points and Hold Points and the officer responsible to verify each check point.

A system audit of each method statement shall be carried out by the Contractor whilst the process is in effect. In the absence of a method statement for activities where it has been specified, this will automatically create a hold point.

(C) Identification of lots and traceability

All items of work shall be subdivided into lots. Lots shall be chosen by the Contractor but shall be within the limits given in SC6.4.5.3 Attachment A. lot numbers are to be used as identifiers on all quality system data. Each lot shall be given a unique lot number. The allocation of lot numbers shall be carried out by the Contractor specific to each item of work and provides a lot numbering system which conforms to these requirements:

The Quality Register must contain records of lot number which provides information such as:

- location of the lot (e.g. start and end chainage, layer and lateral location or a particular structure);
- note regarding conformance/non-conformance (e.g. NCR, CPAR Registers); and
- table of test results (summary) and their respective locations and numerical identification.

In cases where non-conforming lots are identified, a new identification number shall be allocated to the resubmitted documentation, but reference to the original lot number must be included.

The Contractor is responsible in determining the bounds of each lot before sampling and shall physically identify each lot clearly. The physical identification of a lot shall be maintained until the Contractor has ensured that the lot has achieved the specified quality.

To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor shall implement a field identification system which will clearly identify the bounds of each lot and the lot number. This identification system shall be detailed in the quality plan and shall be maintained during all stages of construction of the lot.

The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous. This will require appropriate notation in the Quality Register by the QMR.

The lot identification system, site records and sample numbering system shall allow test results to be positively identified with material incorporated in the works. Traceability is required for concrete loads, asphalt loads and steel plate as follows:

- concrete used in bridge components, cast-in-place box culverts, retaining walls, road pavement sub base and base. Asphalt used in wearing courses, intermediate courses and drainage layers;
- the trace shall start at the batch plant and finish at the location where the concrete or asphalt is incorporated in the Works. Records shall be kept of the batch quantities, mix and despatch time, testing details and location of placement; and
- steel plate in bridge girders and bridge columns. The trace shall start at the steelworks and finish at the location of the plate in the girder or column. Records shall be kept of the steel heat number, testing details and location of the plate in the girder or column.

(D) Surveying control

Surveying control shall be treated as a separate system element and shall include all measurement, calculation and record procedures necessary to:

- set out the Works;
- verify conformance to the drawings and specification in relation to dimensions, tolerances and three dimensional position; and
- determine lengths, areas or volumes of materials or products, where required for

measurement of work.

The method statements for surveying control shall address the process control parameters in AS/NZS 3905.2 for special processes which cannot be fully verified by subsequent inspection and test.

The Contractor shall appoint qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all surveying control.

The procedures and equipment used must be capable of attaining the tolerances nominated in the specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report for each lot or component where design levels, position and/or tolerances have been specified.

The survey conformance report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

Where work is to be covered up after conformance has been achieved, a hold point shall apply until the survey conformance report has been submitted.

All survey records shall be included in the quality records and recorded in the quality register. Verification field book pages shall be clearly labelled, dated and signed by the surveyor with cross indexed references to equipment used lot/component identification and associated survey conformance reports. Where automatic data recording systems are used for verification surveys, a printout of both raw (field) data and reduced data shall be retained in a similar manner as conventional field books.

(E) Sampling and testing

The inspection and test plans shall include details of the sampling methods. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or specification, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the specification.

The maximum lot sizes and minimum testing frequencies are listed in the attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A to this sub-section. Where no minimum frequency of testing, or maximum lot size is stated in the specification, the inspection and test plan(s) shall nominate appropriate frequencies for the Superintendent's approval.

The inspection and test plans shall also uphold any time limits for testing which may be imposed by the specifications. The responsibility for completion of inspections, tests and documentation shall be stated in the quality plan.

Statistical techniques - random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B defines the method to be used for determining test locations of random sampling in each lot. SC6.4.5.3 Attachment A lists the maximum lot sizes and minimum test frequencies for the specified activities.

For compaction control of processes other than layers of earthworks, flexible pavement and asphalt, the sampling procedure will be proposed by the Contractor in his method statement and will require the approval of the Superintendent. In such cases the samples shall be each considered to be representative and all test results will be required to meet the appropriate

tolerances for the lot.

Every testing agency or person providing written test reports for any and all testing undertaken shall use unique consecutive project specific serial numbering of the reports for identification and auditing purposes.

The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity. The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work.

(F) Records and quality assurance documentation

The Contractor shall keep and maintain all Quality System records in a Quality Register as required by AS/NZS ISO 9001, AS/NZS 3905.2 and this sub-section. They shall be systematically recorded, indexed and filed so as to be retrievable and accessible to the Superintendent or an appointed Quality Auditor on a job basis within 1 working day of requisition.

Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall make the quality records available to the Superintendent at all reasonable times. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the developer.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council, through the Superintendent, a copy of the quality register and other required quality assurance documents as required in this section.

(G) Non-conformance

In circumstances where there is a concern about workmanship, construction methodology or materials (e.g. variation to the approved work specification), council’s representative and/or Superintendent may require the Consultant and/ or contractor respectively to provide a non-conformance certificate (NCC) (template provided at SC6.4.5.3 Attachment E Non-conformance certificate template). The NCC will be required to be endorsed by the relevant design Consultant. A non-conformance report (NCR) (template provided at SC6.4.5.3 Attachment F Non-conformance report template) is required to be issued by the Contractor addressing intended variations to approved specifications, work method statements or standards by providing proposed disposition.

In the event that the above has not been satisfied and to ensure compliance with the required standards, Superintendent and/or council may issue a Notice of Non-Conformance (NNC) (template provided at SC6.4.5.3 Attachment G Notice of non-conformance template) to the Contractor. The NNC shall be issued within 1 working day of the non-conformance being identified during an inspection or during scheduled audit inspections, i.e. hold points and witness points. Upon issuance of the NNC, the Contractor must not continue the particular work in question unless an appropriate disposition (to be provided within five working days from issuance of the corrective and preventive action request (CPAR)) has been provided and agreed in accordance with the CPAR (template provided on SC6.4.5.3 Attachment H Corrective and preventative action request template). This is to be undertaken by the Contractor if the NNC identifies non-conforming work which has been provided by the relevant design or construction consultant (Superintendent). Similarly, for council initiated NNC, work shall commence upon council’s acceptance of the proposed disposition in accordance with the CPAR. To avoid recurrence of non-conformance issues, all CPARs shall require joint sign off by the Contractor and Superintendent, and council for a council issued NNC. This procedure will require the Contractor to record the CPAR on the relevant issued NNC. Under no circumstances will the deliberation on the disposition of a non-conformance issue be used to justify delays to the construction schedule/period.

The Contractor shall advise the Superintendent in the NCR of the proposed disposition of the particular non-conformance. This proposed disposition will constitute corrective action for the lot or lots referred to in the NCR and may comprise one of the following:

- propose additional works to bring the lot up to the specified standard; or
- replace all or part of the lot to bring it up to the specified standard; or
- request utilisation of a lot for a reduced level of service if such a clause exists in the relevant technical specification; or
- for incidental defects, request that the Superintendent accept the lot without alteration as an exception with or without alteration to the respective unit rates.

Any proposed disposition shall be subject to the approval of the Superintendent. Reworked/replaced lots shall be verified to conform to the specified requirements.

The contractor shall establish a suitable numbering and registration system for all NCRs and NNCs. All non-conformance reports and relevant documentation are required to be submitted to council prior acceptance of development works, to ensure that all departure from the originally accepted requirement and appropriate disposition has been done in accordance with the agreed CPAR.

A process flow diagram of the above processes is shown on Figure SC6.4.5.3.2.

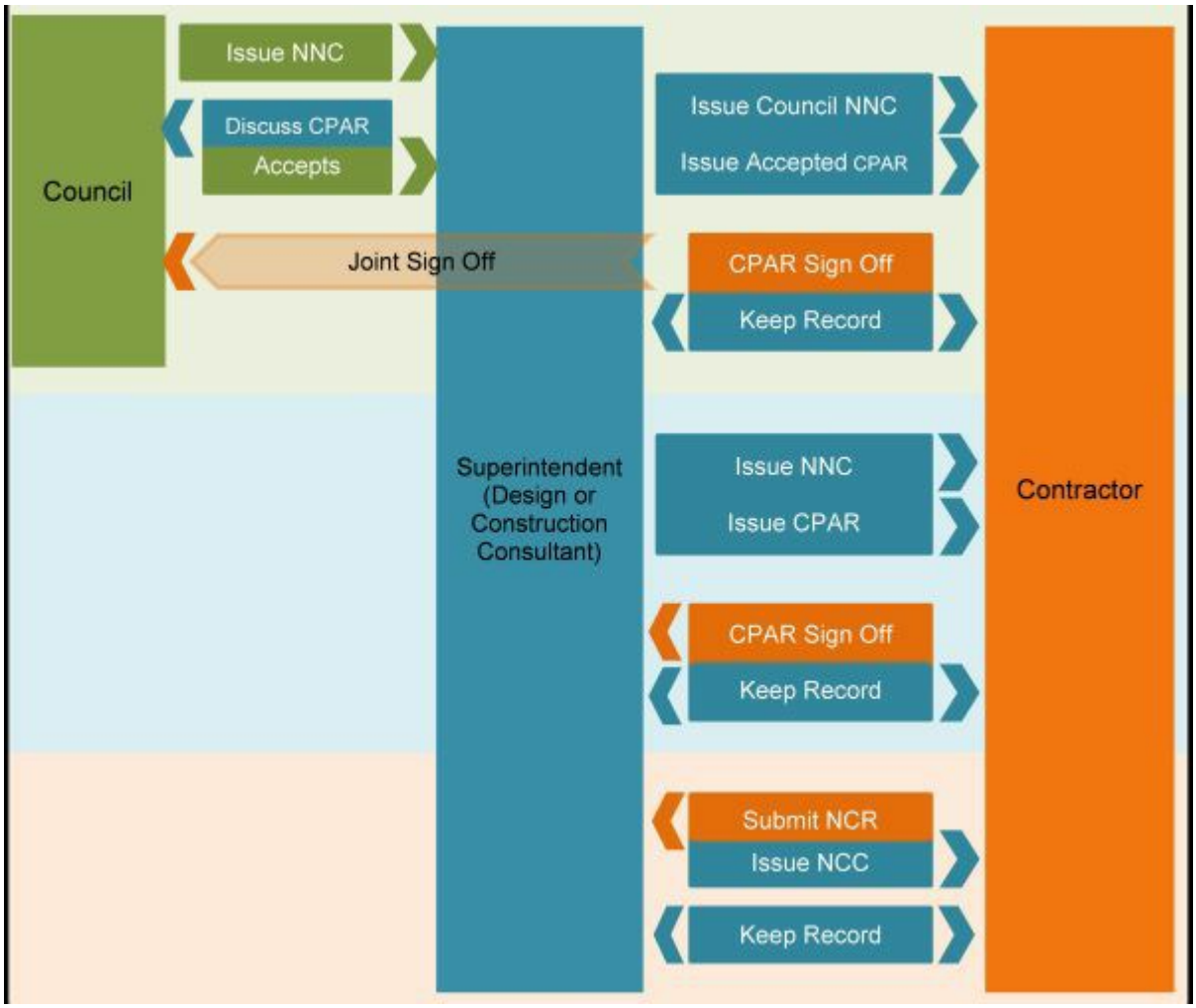


Figure SC6.4.5.3.2 Non-conformance flow diagram

(H) Inspection fees

A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the development works being accepted by council at on maintenance or final completion.

SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies

General

Where material/product quality certification can be obtained from the supplier, tests listed per contract/separable part need not be repeated and where no Queensland Department of Transport and Main Roads (DTMR) Test Methods are available, Australian Standards or NSW Roads and Traffic Authority (RTA) Test Methods are specified.

Table SC6.4.5.3.1 Earthworks (SC6.4.6.10)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Stripping Topsoil	Surface Levels	10,000m2	1 Cross Section per 25m	Survey
Excavation	Geometry	10,000m2	1 Cross Section per 25m	Survey
Floor of Cuttings	Material Quality—CBR	5,000m2	1 per 1,000m2* or Material Type	AS1289.6.1.1 DTMR Materials Testing Manual
	Compaction	10,000m2	1 per 500m2	AS1289.5.4.1
Deflection Control	Benkelman Beam Deflection or Equivalent	Per days production	4 per 1000 m2 or minimum 10 per lot	DTMR Materials Testing Manual
	No visible vertical movement under proof roll	One layer 5,000m2 or max 1 day's placement	Whole area	Visual
Foundation for Embankments	Compaction	5,000m2	1 per 500m2	AS1289.5.4.1
Embankments				
• General	Geometry	One layer 10,000m2	1 Cross Section per 25m	Survey
	Material Quality - CBR	One layer 5,000m2	1 per 800m3 or Material Type	AS1289.6.1.1
	Compaction/Moisture Content	One layer 5,000m2	1 per 250m3	AS1289.5.1.1 AS1289.5.4.1 AS1289.5.7.1
Road Carriageway Embankments				
• Select Zone	Geometry	One layer 10,000m2	1 Cross Section per 25m	Survey
	Material Quality			
	• Maximum Particle Size	10,000m2	1 per 1,000m3*	AS1289.6.1.1
	• CBR	10,000m2	1 per 500m3* or Material Type	
	Compaction/Moisture Content	One layer 5,000m2	1 per 500m2	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

Fill Adjacent to Structures: Bridges, Retaining Walls and Cast-in-Situ Culverts	Material Quality			
	• Maximum Particle Size	1 Structure	1 per 200m3	AS1289.3.3.1 AS1141.11
	• Plasticity Index	1 Structure	1 per 200m3	AS1289.3.3.1
	Compaction/Moisture Content	1 Structure	2 per lot	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.2 Stormwater drainage (SC6.4.6.4), Drainage structures (SC6.4.6.5), Pipe drainage (SC6.4.6.6), Precast box culverts (SC6.4.6.7) and Open drains (SC6.4.6.9)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Supply of Precast Units	Precast Quality— Suppliers documentary evidence and certification	1 batch	1 per type/size/class per batch	
Siting and Excavation	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Foundation	Compaction	1 drainage line/structure	1 per 40 lin m*	AS1289.5.4.1, AS1289.5.7.1 Visual
Material surrounding Steel Structures	Material Quality • pH/Electrical Resistivity	1 drainage line/structure	1 per material	AS1289.4.3.1 AS1289.4.4.1
Bedding *(Bed, haunch, sides and overlay for HS type support)*	Material Quality • Particle Size Distribution	1 contract	1 per 200m3*	AS1141.11
	Compaction/Moisture Content	1 drainage line/structure	1 per layer, per 40 lin m	AS1289.5.7.1, AS1289.5.4.1
Concrete Bedding or Lining	Geometry		1 Cross Section per 25m	Survey and 3m Straight Edge
Installation of Precast Units	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Selected Backfill *(Backfill, sides and overlay for non HS type support)*	Material Quality • Maximum Particle Size	1 contract	1 per 500m3*	
	• Plasticity Index	1 contract	1 per 500m3*	AS1289.3.3.1
	Compaction/Moisture Content	1 drainage line/structure	2 per lot	AS1289.5.7.1, AS1289.5.4.1
Rock Fill for Gabions/ Wire Mattresses	Material Quality:			
	• Wet Strength	1 contract	1 per contract	AS1141.22
	• Wet/Dry Strength Variation	1 contract	1 per contract	AS1141.22
Kerb and Gutter	Geometry	1,000 lin m	1 Cross Section per 25m and change of direction	Survey and 3m Straight Edge

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.3 Subsoil, foundation and pavement drains (SC6.4.6.20), Subsurface drainage (SC6.4.6.21), Drainage mats (SC6.4.6.8)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Material Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Pipe	1 contract/size	1 per type/size	
	Filter Material			
	• Grading (Type A, B, C, D)	1 contract/size	1 per type	AS1141.11
	• Coefficient of Permeability (Type B)	1 contract/size	1 per type	AS1289.5.5.1 ASTM-D2434-68
	• Grading Variation after Treatment (Type B)	1 contract/size	1 per type	AS1141.11
	• Wet Strength (Type C, D)	1 contract/size	1 per type	AS1141.22
	• 10% Fines Wet/Dry (Type C, D)	1 contract/size	1 per type	AS1141.22
	• Appearance (Type D)	1 contract	1 per type	Table B1 Appendix B of AS2758.1
	Geotextile - Supplier's documentary evidence	1 contract	1 per type	AS3706 (Test) AS3705
Excavation - Trench Base	Line and Grade	1 drainage line	1 per drainage line	Survey
Bedding and Backfill				
• Filter Material	Geometry	1 drainage line	Visual	Survey
	Compaction	1 drainage line	1 per line	AS1289.5.6.1
• Selected Backfill	Geometry	1 drainage line	Visual	Survey
	Compaction	1 drainage line	1 per line	AS1289.4.1
• Earth Backfill	Geometry	1 drainage line	Visual	Survey
Drainage Mat	Geometry	2000m^2	1 Cross Section per 25m	Survey

Table SC6.4.5.3.4 Stabilisation (SC6.4.6.19)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Material Supply	Material Quality - Supplier's documentary evidence and certification of (as per MRTS07A, MRTS07B, MRTS07C and MRTS08):			
	• Cement	1 contract	Type	AS3972
	• Quicklime			
	• Available Lime (CaO content)	1 contract	Type	AS3588.12
	• Slaking Rate	1 contract	1 per contract	T432
	• Particle Size Dist'n	1 contract	1 per contract	AS1141.11
	• Hydrated Lime			
	• Available Lime ($CaOH_2$)	1 contract	1 per contract	AS3583.12
	• Residue on Sieving	1 contract	1 per contract	AS3583.14
	• Ground Blast Furnace Slag	1 contract	1 per contract	AS3583.2
	• Flyash	1 contract	1 per contract	AS3583.1
	• Blended Stabilising Agent	1 contract	1 per contract	
	• Water			
	• Chloride ion content	1 contract	1 per contract	AS3583.13
	• Sulphate ion content	1 contract	1 per contract	AS1289.4.2.1
	• Undissolved solids	1 contract	1 per contract	
Mix Design	NATA certification - Supplier's documentary evidence and certification	1 mix	1 per mix	
Stationary Mixing Plant	Application rate of stabilising agent	1 day's production	1 per 100t	
	Unconfined Compressive strength of product	1 day's production	1 per 400t	AS5101.4
In-Situ Spreading	Spread rate	1 layer 1,000m^2	1 per lot or 1 per 500m^2	DTMR Materials Testing Manual
	Mix uniformity	1 layer 1,000m^2	1 per 500m^2	Visual
	Unconfined Compressive Strength of product	1 day's production	1 per 100t	AS5101.4

Trimming and Compaction	Geometry	1 layer 3,000m2, or 1day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m lane length*	3m Straight Edge
	Average Layer thickness	"	1 per lot	
	Average Width	"	1 per lot	Measure/Survey
	Compaction	1 layer 5000m2 or min. of 3 if less than 5000m2	1 per lot	As specified in SC6.4.6.19(5)

Note— or part thereof, per lot.

Table SC6.4.5.3.5 Flexible pavements (SC6.4.6.12)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Pavement Materials Supply	Material Quality - Supplier's documentary evidence and certification to meet MRTS05, MRTS07B and MRTS08 requirements - Type 2.1 for base, Type 2.3 for subbase and Type 2.4 for lower subbase.	1 contract		
	• Particle Size Distribution		1 per 1,000t	Q103A, AS1289.3.6.1
	• Fine and Particle Size Distribution Ratio			
	• Liquid Limit		1 per 1,000t	Q104A, Q104D
	• Plastic Limit		1 per 1,000t	Q105, AS1289.3.2.1
	• Plasticity Index		1 per 1,000t	Q105, AS1289.3.2.1
	California Bearing Ration (soaked)		1 per 5,000t	Q113A
	• Particle Shape		1 per 1,000t	Q201, AS1141.15
	• Ten Percent Fines Value (Wet)		1 per 5,000t	Q205B, AS1141.22
	• Wet/Dry Strength Variation		1 per 5,000t	Q205C, AS1141.22
	Degradation Factor (Source Rock)		1 per contract	Q208A, AS1141.25.1
	• Unconfined Compressive Strength (Standard Compaction)		1 per 5,000t	TCC-001, Q115, AS5101.4

	• Unconfined Compressive Strength (Bound/Modified)	1 contract	1 per mix design	Q115, AS5101.4
	Lime modified/Modified pavement materials	1 contract	1 per type	As specified in SC6.4.5.3.4 Stabilisation
Compaction Assessment	Geometry: Alignment and Level	One layer 2,000m2 or	1 Cross Section per 15m	Survey
	Width and Surface Trim	max 1 day's placement	10 per selected 200 lin m*	Measure and 3m Straight Edge
	Compaction/Moisture Content/	One layer 5,000m2 or	10 per 5,000m2 layer or	AS1289.5.1.1, Q142A,
	Dry Density Testing	max 1 day's placement	3 per lot if less	AS1289.5.4.1 AS1289.5.8.1
Deflection Control	Benkelman Beam Deflection or Equivalent	Per days production	4 per 1000 m2 or minimum 10 per lot	Q701
	No visible vertical movement under proof roll	One layer 5,000m2 or max 1 day's placement	Whole area	Visual

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.6 Sprayed bituminous surfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Suppliers documentary evidence and certification of:			
	• Class 170 Bitumen	1 contract	1 per contract	MRTS.17
	• Refinery Cutback Bitumen	1 contract	1 per contract	MRTS.17
	• Polymer Modified Binder	1 contract	1 per contract	MRTS.18
	• Bitumen Adhesion Agent	1 contract	1 per contract	
	• Cutback Oils	1 contract	1 per contract	
	• Aggregate Precoating Agent	1 contract	1 per contract	
	• Aggregate	1 contract	1 per contract	MRTS.22
Application Rates	Binder	1 day's operation	Calculate per spray run	As per spray sheet
	Aggregate	1 day's operation	Calculate per spray run	As per spray sheet

Note— one per contract or change in material.

Table SC6.4.5.3.7 Asphaltic concrete (SC6.4.6.13)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	Coarse and Fine Aggregates			MRTS 30
	• Grading	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Moisture Content	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Wet Strength	1 contract	1 per contract or material change	MRTS 30
	- Wet/Dry Strength Variation	1 contract	1 per contract or material change	MRTS 30
	- Particle Shape	1 contract	1 per contract or material change	MRTS 30
	- Fractured Faces	1 contract	1 per contract or material change	MRTS 30
	• Polishing Agg Friction Value	1 contract	1 per contract or material change	MRTS 30
	- Mineral Filler	1 contract or 1 month's production	1 per contract or material change	MRTS 30
	- Bitumen Binder	1 refinery batching	1 per contract or material change	MRTS 17
	Polymer Modified Bitumen			MRTS 18
	• Elasticity Recovery at 60ºC	1 production batch by supplier	1 per contract or material change	MRTS 30
	• Viscosity on ER at 60ºC			MRTS 30
	• Torsional Recovery at 25ºC			MRTS 30
	• Viscosity at 180ºC - Bitumen Adhesion Agent	1 contract	1 per contract or material change	MRTS 30
	• Resistance to Stripping			
	• Reclaimed Asphalt Pavement (RAP)	1 stockpile	1 per contract or material change	MRTS 30

	• Bitumen Emulsion	1 contract	1 per contract or material change	MRTS 21
Mix Design-Nominated Mix	Approval of mix and NATA certification. Supplier's documentary evidence and certification	1 mix per contract	1 per mix	
Production Mix	Temperature Moisture Content Grading Binder Content	1 per truck load SC6.4.6.13 Asphaltic concrete as included as separate table below. Additionally, max lot size one 12 hr shift's production.		Measure MRTS 30 MRTS 30 MRTS 30
Laying and Compaction	Temperature	1 day's laying per site	1 per truck load	Measure
	Levels	1 day's laying per site	1 cross section per 25m	Survey
	Shape	1 day's laying	10 per 200m* lane	3m Straight Edge
	Relative Compaction/Layer Thickness	1 day's laying	6 cores per lot or 10 nuclear density tests per lot	As per MRTS30 Compaction requirements or Nuclear Density Meter

Note—* or part thereof, per lot.

Table SC6.4.5.3.8 Minimum testing frequencies for asphalt production

Quantity of Asphalt in production lot	Minimum Frequency of Testing
Less than 100 tonnes	MRTS 30
101 to 300 tonnes	MRTS 30
301 to 600 tonnes	MRTS 30
Over 600 tonnes	MRTS 30

Table SC6.4.5.3.9 Ready-mixed concrete production and supply (SC6.4.6.14 and SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Raw Materials Supply	Material Quality—Supplier's documentary evidence and certification of:	1 contract	1 per contract or material change	
	• Cement	1 contract	1 per contract or material change	AS 3972
	• Flyash	1 contract	1 per contract or material change	AS 3582.1
	• Water	1 contract	1 per contract or material change	AS3583.13, AS1289.4.2.1
	• Admixtures	1 contract	1 per contract or material change	AS 1478
	Fine Aggregates (SC6.4.615 only)	1 contract	1 per contract or material change	
	• Grading	1 contract	1 per contract or material change	AS1141.11
	• Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B or Q102D
	• Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	• Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	• Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	• Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	• Material Finer 2µm	1 contract	1 per contract or material change	AS 2758.1
	• Deleterious Material (Impurities/Reactive)	1 contract	1 per contract or material change	AS 2758.1
	• Combined Aggregates (SC6.4.6.14 and SC6.4.6.15)	1 contract	1 per contract or material change	Q102A, Q102B or Q102D
	• Grading	1 contract	1 per contract or material change	AS1141.11
	• Moisture Content	1 contract	1 per contract or material change	

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Wet Strength	1 contract	1 per contract or material change	AS1141.22
	• Wet/Dry Strength Variations	1 contract	1 per contract or material change	AS1141.22
	• Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	• Particle Shape	1 contract	1 per contract or material change	AS1141.14
	• Fractured Faces	1 contract	1 per contract or material change	AS1141.18
	• Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	• Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	• Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	• Material Finer 75µm	1 contract	1 per contract or material change	AS 2758.1
Raw Materials Supply	• Weak Particles	1 contract	1 per contract	AS 2758.1
	• Light Particles	1 contract	1 per contract	AS 2758.1
	• Deleterious Materials (Impurities/Reactive)	1 contract	1 per contract	AS 2758.1
	• Iron Unsoundness	1 contract	1 per contract	AS 2758.1
	• Falling/Dusting Unsoundness	1 contract	1 per contract	AS 2758.1
Mix Design (kerb mix)	Compressive Strength	1 contract mix	1 per mix per contract	AS1012.1, AS1012.8, AS1012.9
	Aggregate Moisture Content	1 contract mix	1 per mix per contract	Q102A, Q102B or Q102D
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
	Consistency - Slump	1 contract mix	1 per mix per contract	AS1012.3.1
	Air Content	1 contract mix	1 per mix per contract	AS1012.4.2 (Method 4.2)
	Shrinkage	1 contract mix	1 per mix per contract	AS1012.13

Table SC6.4.5.3.10 Mass concrete subbase (SC6.4.6.14)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table SC6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4.2 (Method 4.2)
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	- Compactibility Index	50m^3	1 per load	AS1012.3.4
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
Placement	Thickness	50m^3	5m grid on plan area	Survey and check with subgrade survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS1160 (Bitumen Emulsion)
	Application Rate	1 day's work	1 per 1000m^2*	AS3799 - Liquid membrane forming curing compound for concrete
Joints	Geometry	50m^3	All joints	Survey

* **Note**—or part thereof, per lot

Table SC6.4.5.3.11 Plain or reinforced concrete base (SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table 6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4 Method 2
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	Mass per unit volume (prior crushing of 7-day specimen)	50m^3	1 per 50m^3	AS1012.12.2
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
Steel Reinforcement	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS4671
	- Splicing (welded)	1 contract		AS1554.3
Placement	Relative Compaction			
	• Machine Placed	50m^3	1 per 50m^3*	AS1012.14 AS1012.2
	• Hand Placed	Area between 2 consecutive const. joints or 50m^3 (whichever is the lesser)	2 per lot	AS1012.14 AS1012.2
	Thickness	50m^3	5m grid on plan area	Survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Ride Quality	Profile Factor	1000m^2	10/lane/lot	3m Straight Edge
Surface Texture	Texture Depth	1000m^2	2 per lot	Survey
Curing	Material Quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS1160 (Bitumen Emulsion)

	Application Rate	1 day's work	1 per 1000m²*	AS3799 - Liquid membrane
Joints	Sealant Material Quality Supplier's documentary evidence and certification	1 contract	1 per prod'n batch	
	Geometry	50m³	All joints	Survey

*** Note—**or part thereof, per lot

Table SC6.4.5.3.12 Bituminous microsurfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Bitumen (prior to emulsification)	1 contract	1 per contract or change in material	AS2008
	• Bitumen Emulsion - Residual Binder Content (Residue from Evaporation)	1 contract	2 per bulk delivery	AS1160, App.D
	• Mineral Aggregates - Degradation Factor	1 contract	1 per contract or 6 month period	AS1141.25
	- Los Angeles Value	1 contract	"	AS1141.23
	- Aggregate Wet Strength	1 contract	"	AS1141.22
	- Wet/Dry Strength Variation	1 contract	"	AS1141.22
	- Polished Aggregate Friction Value	1 contract	"	AS1141.42
	- Sand Equivalent	1 contract	"	AS1289.3.7.1
	• Mineral Filler	1 month's prod'n	"	AS2350
	• Combined Aggregate Grading	1 contract	"	AS1141.11 AS1141.12
Mix Design—Nominated Mix	Approval of mix and NATA certification—Supplier's documentary evidence and certification	1 contract	1 per mix	
Production Mix	Grading	1 day's prod'n or 50m³ (whichever is the lesser)	2 per 50m³*	AS2891.3.1
	Residual Binder Content		2 per 50m³*	AS2891.3.1
Laying	Levels	1 layer, max 200m³	1 cross section per 15m	Survey
	Surface Quality	1 layer, max 200m³	10 per 100m* lane length	3m Straight Edge

*** Note—**or part thereof, per lot

Table SC6.4.5.3.13 Segmental paving (SC6.4.6.18)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Concrete Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	• Clay Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	• Bedding Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
	• Joint Filling Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
Base	Geometry	One layer 5000m2, max 1 day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m2 or lot	3m Straight Edge
Edge Restraints	Refer SC6.4.6.28 Minor Concrete Work	1 day's placement	1 per 10 lin m	Measure/Survey
Laying Paver Units	Joint Width	1 day's placement	All joints	Measure
	Geometry	1 day's placement	One cross section per 15m	Survey
	Surface Quality	1 day's placement	10 per 200m2 or lot	3m Straight Edge

Table SC6.4.5.3.14 Minor concrete works (SC6.4.6.28)

1 per contract or material change

1 per contract or material change

1 per contract or material change

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Subgrade	Compaction	1000 lin m or 1000m^2	1 per 200 lin m or 200m^2	AS1289.5.4.1
Gravel Subbase Construction	Compaction	1 days placement	1 per 100 lin m or 100m^2	AS1289.5.4.1
	Subbase Geometry	1 days placement	1 per 25 lin m	3m Straight Edge
Steel Reinforcement	Material Quality—Suppliers documentary evidence and certification	1 delivery	1 per production batch	AS4671
Fibre Reinforcement concrete	Requirements as per SC6.4.6.28.6(1) - Reinforcement of concrete (Minor concrete works)			
Ready-Mixed Concrete Supply	Material Quality—Suppliers documentary evidence and certification	1 contract	1 per mix type	
	Consistency - Slump	15m^3	1 per load	AS1012.3.1 (Method 1)
	Compressive Strength (7 and 28 day)	15m^3	2 pairs per 15m^3	AS1012.1, AS1012.8, AS1012.9
	ALL TESTING—MINIMUM LOT SIZE 3m^3. No testing on loads less than 3m^3 if supplier can provide documentation of in production testing.			
Raw Materials Supply	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per contract or material change	
	Cement	1 contract	1 per contract or material change	AS3972
	Water	1 contract	1 per contract or material change	AS3583.13 AS1289.4.2.1
	Admixtures	1 contract	1 per contract or material change	AS1478.1

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Fine Aggregrates			
	Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B, Q102D
	Bulk Density	1 contract	1 per contract or material change	AS2758.1
	Water Absorption	1 contract	1 per contract or material change	AS2758.1
	Mineral Finer 2µm	1 cantract	1 per contract or material change	AS2758.1
	Deleterious Material (Impurities/Reactive)	1 contract	1 per contract or material change	AS2758.1
	• Coarse			
	Aggregate Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B, Q102D
	Crushing Value	1 contract	1 per contract or material change	AS1141.21
	Soundness	1 contract	1 per contract or material change	AS1141.24
	Particle Shape	1 contract	1 per contract or material change	AS1141.14
	Bulk Density	1 contract	1 per contract or material change	AS2758.1
	Unit Mass (particle density)	1 contract	1 per contract or material change	AS2758.1
	Water Absorption	1 contract	1 per contract or material change	AS2758.1
	Mineral Finer 75 µm	1 contract	1 per contract or material change	AS2758.1
	Weak Particles	1 contract	1 per contract or material change	AS2758.1
	Light Particles	1 contract	1 per contract or material change	AS2758.1

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Deleterious Materials (Impurities/Reactive	1 contract	1 per contract or material change	AS2758.1
	Iron Unsoundness	1 contract	1 per contract or material change	AS2758.1
	Fall/Dusting Unsoundness	1 contract	1 per contract or material change	AS2758.1
	Percentage Wear	1 contract	1 per contract or material change	AS1141.23
Concrete Supply (Mixing at site)	Consistency - Slump	15m^3	1 per load	AS1012.3.1
	Compressive Strength (7 days) Compressive Strength (28 days)	15m^3 15m^3	2 pairs per 15m^3 or part thereof, 1 pair for 7 day test and the other pair for the 28 day test	AS1012.1, AS1012.8
Concrete Placement	Finished Levels	15m^3	1 cross section per 15m	Survey and 3m Straight Edge
	Surface Dimensions	Single fabrication	As required to confirm design dimensions	Measure
	Finishing of unformed surfaces Geometry	15m^3	1 cross section per 15m^3	Survey and 3m Straight Edge
	Joints - Geometry	50m^3	All joints	Survey
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS3799
	Application Rate	1 day's work	1 per 1000m^{2*}	
Backfilling	Material Quality			
	• Maximum particle size	1 contract/ material type	1 per 200m^3	Q103
	• Plasticity Index	1 contract/ material type	1 per 200m^3	AS1289.3.3.1
	Compaction	1 days work or max 200m^2	1 per 200m^2	AS1289.5.4.1
Sprayed Concrete	Test Panels and Cores	1 contract	3 test panels and 4 cores per mix design	AS1012.4, AS1012.9 AS1012.14

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Compressive Strength Cores	15m^3	per 15m^3	AS1012.4 AS1012.9 AS1012.14
	Curing Material Quality— Supplier's documentary evidence and certification	1 contract	1 per production batch	

*** Note—**or part thereof, per lot

Table SC6.4.5.3.15 Pavement markings (SC6.4.6.22)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	• Paint	1 contract	1 per contract or change in material	
	• Glass Beads	1 contract	"	
	• Thermoplastic Material	1 contract	"	
	• Raised Pavement Markers (including temporary raised pavement markers)	1 contract	"	
Paint Application	Wet Film Thickness	1 contract	1 per site visit	AS 1580.107.3 Or Q513
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A
Thermoplastic Application	Cold Film Thickness	1 contract	1 per site visit	Measure by micrometer
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A

Table SC6.4.5.3.16 Signposting (SC6.4.6.24)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Sign Blanks	1 contract	1 per contract, or change in material	
	• Aluminium Extrusion Backing	1 contract	"	
	• Retro-reflective Material	1 contract	"	
	• Non-reflective Paint	1 contract	"	
	• Non-reflective Sheet Material	1 contract	"	
	• Steel Sign Support Structures	1 contract	"	
Concrete Foundations	Refer SC6.4.6.28			

Table SC6.4.5.3.17 Water reticulation (SC6.4.6.2)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• uPVC Pipes	1 contract	1 per contract	AS2977
	• Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	• Copper Pipe	1 contract	1 per contract	AS1432
	• Polyethylene Pipe	1 contract	1 per contract	AS1159
	• Stop Valves Material	1 contract	1 per contract	AS2638 and AS2129
	• Non Return Valves	1 contract	1 per contract	AS3578
	• Spring Hydrants	1 contract	1 per contract	AS2544 or AS3952
Siting and Excavation	Geometry	1 line	1 per line	Survey
Bedding	Material Quality			

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Grading	1 contract	1 per contract per source	AS2032
Thrust and Anchor Blocks	Refer to Table SC6.4.5.3.14			
Chamber Covers and Frames	Geometry	1 cover/frame	1 per cover/frame	survey
Testing of Pipelines	Pressure testing Bacteriological testing	1 line 1 line	1 per line 1 per line	As specified in SC6.4.6.2.5 As specified in SC6.4.6.2.5(3) and (4)
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1, AS1289.5.4.1
Switchgear and Control gear Assembly	Electrical function	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

Table SC6.4.5.3.18 Sewerage system (Construction specification SC6.4.6.3)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• uPVC Pipes	1 contract	1 per contract	AS1477
	• Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	• Vitrified Clay Pipes	1 contract	1 per contract	AS1741
	• Precast Access Chambers	1 contract	1 per contract	AS4198
Siting and Excavation	Geometry	1 line/structure	1 per line/ structure	Survey
Bedding	Material Quality • Grading	1 contract	1 per contract per source	Q103
Concrete Bedding	Refer Table SC6.4.5.3.14			

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Laying and Jointing of Pipes, Access Chambers, Structures	Geometry	1 line	1 per line	Survey
Thrust and Anchor Blocks	Table SC6.4.5.3.14			
Cast-in-situ Access Chambers	Material Quality			
	• Tri-Calcium Aluminate Content	1 contract	1 per contract per source	AS3972
	• Fineness Index	1 contract	"	AS3972
	• Minimum Cement Content	1 contract	"	AS3972
Acceptance Test of Gravitation Mains and Access Chambers	• Compressed Air Testing	1 line	1 per line	As specified SC6.4.6.3.4
Testing of Rising Mains	• Hydrostatic test pressure	1 line	1 per line (max 1000m)	As specified in SC6.4.6.3.4(10)
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1, AS1289.5.4.1 per SC6.4.6.3(24)
Switchgear and Control gear Assembly	Electrical Compliance	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	As specified in SC6.4.6.3.5(9)

SC6.4.5.3 Attachment B Random sampling

(1) General

Random sampling of test locations shall be used to control relative compaction of each layer of (which are generally rectangular in area):

(a) earthworks;

(b) selected material zone; and

(c) stormwater drainage.

The number of samples (n) per lot shall be as indicated in the specific sub-sections which are summarised in SC6.4.5.3 Attachment A.

(2) Locations

Sampling locations within a lot for the control of relative compaction shall be determined as follows:

(a) representing the lot as a rectangle, sub-divide the lot lengthwise into equi-area sub-lots in accordance with the number of samples selected (n) in accordance with Table SC6.4.5.3.19;

(b) establish six grid lines within the lot, as illustrated in Figure SC6.4.5.3.3;

(c) throw a die to select a number between 1 and 6. This determines which grid line to use for the sample location in sub-lot 1;

(d) throw die to select a group (1-6) in Table SC6.4.5.3.19;

(e) throw die twice to select two random numbers (between 1 and 6) for row and column in Table SC6.4.5.3.19 and obtain random fraction R;

(f) length co-ordinate for sample location in Sub-lot 1 = RL/n; and

(g) for sample location in next sub-lot:

(i) add L/n to previous length co-ordinate; and

(ii) add 1 (on a cycle of 6) to previous grid line.

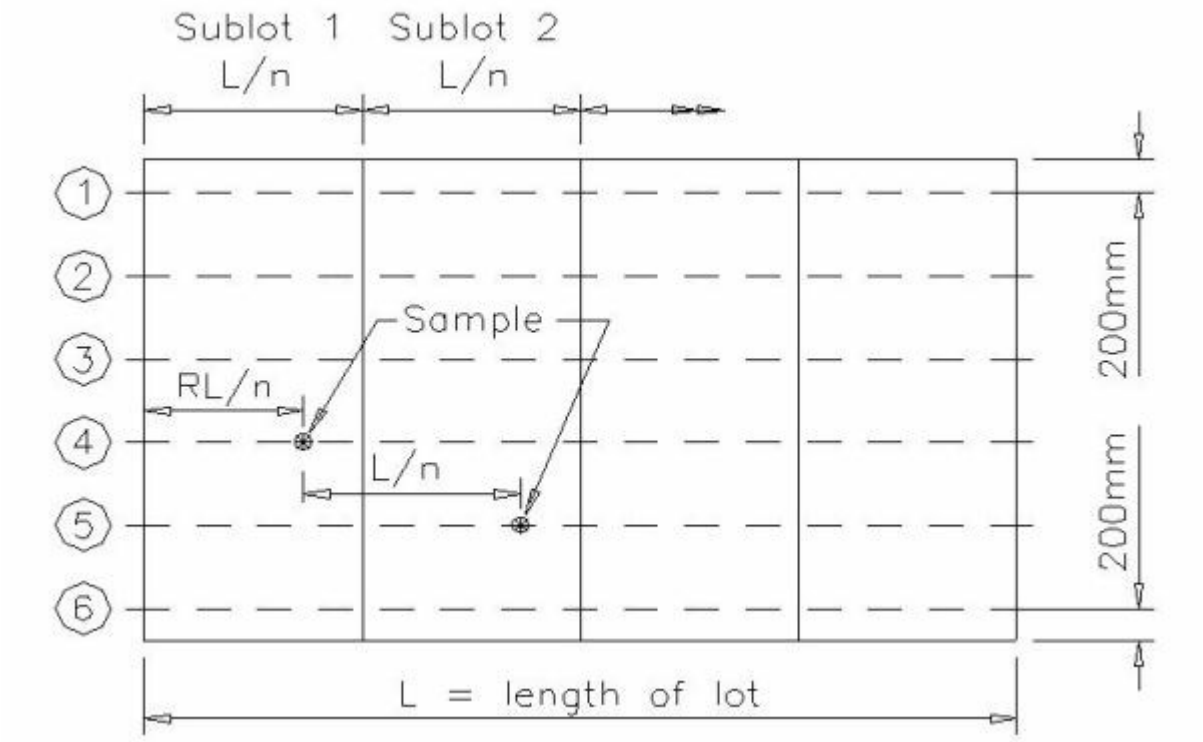


Figure SC6.4.5.3.3 Sampling locations for rectangular lot

Table SC6.4.5.3.19 Table of random fractions

GROUP	ROW	COLUMN					
		(1)	(2)	(3)	(4)	(5)	(6)
(1)	(1)	0.78178	0.45467	0.00347	0.27296	0.00020	0.36517
	(2)	0.59678	0.67931	0.25434	0.59054	0.32444	0.41504
	(3)	0.14464	0.17269	0.61154	0.18291	0.83242	0.50776
	(4)	0.89010	0.44764	0.07451	0.20428	0.49513	0.91440
	(5)	0.91941	0.47726	0.33160	0.30670	0.65114	0.36852
	(6)	0.51085	0.38148	0.22169	0.66578	0.67050	0.69559
(2)	(1)	0.81891	0.48626	0.88892	0.82994	0.16941	0.81528
	(2)	0.37410	0.60232	0.12070	0.79017	0.32981	0.34908
	(3)	0.45921	0.15648	0.58052	0.37413	0.08124	0.97145
	(4)	0.86614	0.94719	0.78872	0.91972	0.45149	0.15107
	(5)	0.26590	0.41140	0.95477	0.81267	0.24018	0.07324
	(6)	0.95205	0.39438	0.73697	0.59427	0.71146	0.00575
(3)	(1)	0.18694	0.36502	0.17828	0.84312	0.57003	0.58583
	(2)	0.91211	0.86936	0.43030	0.27672	0.47393	0.10342
	(3)	0.80714	0.34295	0.00775	0.90855	0.33368	0.21842
	(4)	0.67579	0.92686	0.18005	0.00645	0.11256	0.05278
	(5)	0.03184	0.69876	0.16676	0.43346	0.86992	0.03275
	(6)	0.15623	0.02905	0.72763	0.19095	0.80847	0.39729
(4)	(1)	0.72109	0.17970	0.22505	0.35561	0.98935	0.27818
	(2)	0.37348	0.19381	0.43331	0.75033	0.99963	0.42232
	(3)	0.12129	0.32386	0.56705	0.87165	0.84460	0.92955
	(4)	0.54948	0.08844	0.47061	0.78419	0.18731	0.93485
	(5)	0.15097	0.44967	0.48759	0.84161	0.19212	0.05146
	(6)	0.32360	0.66850	0.99382	0.94050	0.96449	0.96217
(5)	(1)	0.68091	0.54191	0.10910	0.94237	0.23161	0.15167
	(2)	0.97121	0.83626	0.70896	0.45296	0.69475	0.11264
	(3)	0.19723	0.98260	0.57429	0.94789	0.64457	0.20809
	(4)	0.84036	0.14095	0.29451	0.40256	0.34521	0.64924
	(5)	0.97500	0.98056	0.82276	0.97130	0.77329	0.89855
	(6)	0.83244	0.30828	0.06882	0.68471	0.71081	0.91649
(6)	(1)	0.75892	0.29685	0.70044	0.91238	0.53356	0.45239
	(2)	0.13229	0.19701	0.36074	0.32254	0.62045	0.26691
	(3)	0.34789	0.22179	0.91891	0.87651	0.91011	0.97469
	(4)	0.97211	0.68943	0.12831	0.50006	0.20793	0.61151
	(5)	0.24954	0.17809	0.56093	0.51524	0.69135	0.68967
	(6)	0.10062	0.11852	0.47089	0.64765	0.44644	0.35548

SC6.4.5.3 Attachment C Method statement requirements

General

(1) Method statements are required to describe the key steps and sequence in the construction activities, how and by whom each step shall be undertaken and what materials and equipment shall be used. Method statements may include a flow chart to clarify the sequence of key steps. One or more method statements may address a construction activity.

(2) Each method statement will be supported by a check list which shall identify relevant inspections, test points, materials requirements and hold points. Each requirement on the check list will have an officer responsible

identified and will require the nominated officer to sign off the requirement so indicating its satisfactory execution.

(3) Method statements and check lists shall be compatible with the appropriate Inspection and test plan. Check lists will be completed for each lot of work during construction and compiled with other documents to comprise the quality register.

(4) The Contractor shall submit method statements and check lists to describe the key steps in those construction activities listed below that are identified with a preceding asterisk (*).

Item	Enter * here if required	Activity	Sub-section Number
1		Control of Traffic	SC6.4.6.30
2		Temporary Roadways and Detours	SC6.4.6.30
3		Clearing and Grubbing	SC6.4.6.11
4		Earthworks - Cut	SC6.4.6.10
5		Earthworks - Unsuitable Material	SC6.4.6.10
6		Earthworks - Embankment	SC6.4.6.10
7		Compaction and Quality Control	SC6.4.6.10
8		Siting, Excavation, Bedding, Backfilling and Compaction of Stormwater Drainage	SC6.4.6.4
9		Installation of Pipe Drainage	SC6.4.6.6
10		Installation of Precast Box Culverts	SC6.4.6.7
11		Siting and Installation of Drainage Structures	SC6.4.6.5
12		Construction of Lined Open Drains including Kerb and Gutter	SC6.4.6.9
13		Stabilisation of Pavement or Subgrade Materials	SC6.4.6.19
14		Provision of Subsurface Drainage as subsoil drains, pavement drains or free draining layer	SC6.4.6.20-21, SC6.4.6.8
15		Construction of Flexible Pavement Layers	SC6.4.6.12
16		Construction of Concrete Pavement Layers	SC6.4.6.14-15
17		Construction of Asphaltic Concrete Pavement Layers	SC6.4.6.13
18		Sprayed Bituminous Surfacing	SC6.4.6.16
19		Bituminous Microsurfacing	SC6.4.6.17
20		Construction of Segmental Paving	SC6.4.6.18
21		Pavement Marking	SC6.4.6.22
22		Minor Concrete Works	SC6.4.6.28
23		Landscaping	SC6.4.6.28

SC6.4.5.3 Attachment D Minimum inspection and test plan

Table SC6.4.5.3.20 Water supply-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Council (Water Authority)
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Water Authority.	1 week	Council (Water Authority)
Earthworks–Excavation near existing services	Approval from relevant Authority for the excavation.	1 week	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Minimum Trench Width for Pipelines–Excavation across paved or improved surfaces	Approval from the Authority or Owner prior to commencing any excavation across paved or improved surfaces.	1 week	Superintendent
Pipe Bedding–Trench completed	Present the completed excavated trench prior to pipe laying, jointing and bedding.	2 working days	Superintendent
Laying and Jointing of Pipes–Existing asbestos cement pipe cutting and disposal	Submit method statement for approval.	2 working days	Superintendent
Pipe testing and restoration			
Testing of Pipelines	Conduct pressure testing.	7 days	Superintendent and Council
Testing of Pipelines–unsatisfactory test results, defects and leakage	Conduct pressure testing upon completion of rectification work.	3 days	Superintendent and Council
Backfill and Compaction–Completion of work	Present the laid and jointed pipes for approval prior to the commencement of trench backfilling.	2 working days	Superintendent
Restoration of Surfaces	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
Pumps	Provide written warranty from the manufacturer for approval.	2 weeks before ordering	Superintendent
Electrical Compliance–ompliance with required standard	Supply a proof of compliance**–**Test certificate.	1 week	Superintendent
Electrical Installation–oute of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Water Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Water Authority and Superintendent
Construction compliance			
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	2 weeks before operating	Water Authority and Superintendent

Table SC6.4.5.3.21 Water supply-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/ Item	Requirement	Notice for inspection
Materials		
General–Compliance with manufacturers recommendations	Contractor to inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves and Hydrants)
Pipeline construction		
Location–Set out	Confirm the set out locations prior to construction.	3 working days
Crossings–Crossings authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation.	Progressive
Laying and Jointing of Pipes–Inspection prior laying	Contractor to present to the Superintendent materials prior laying (if required).	Progressive
Pipe testing and restoration		
Disinfection and Flushing of Pipelines	Provide evidence of compliance with this requirement.	2 working days upon completion of activity.
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior spreading/disposal.	2 working days progressive

Table SC6.4.5.3.22 Sewerage systems-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Sewer Authority.	1 week	Superintendent and Council (Sewer Authority)
Earthworks–Prior Excavation	Approval from relevant Authority for the excavation.	1 week	Superintendent
Excavation near underground services–Protection of other services	Submit for approval give notice of any interference to the works caused by an existing service and submit a proposed work method statement.	1 week	Superintendent
Pipe Bedding–Foundation Condition/Water Charged Ground	Notify Superintendent and confirm method of foundation support from the designer.	Progressive	Superintendent
Wrapping Pipelines–Damage to sleeving	Rectify any damage to sleeving before backfilling trench.	Progressive	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Bedding and Backfill Compaction Requirements–Notification of pipeline laid and jointed.	Present the laid and jointed pipes for approval before the trench backfilling.	Progressive	Superintendent
Bedding and Backfill Compaction Requirements–Embankment	Submit proposal for construction of embankments.	1 week	Superintendent
Pipeline testing and restoration			
Acceptance Test of Gravitation Sewers and Maintenance Holes– acceptance Testing	Present all sewers and maintenance holes for acceptance testing.	1 week	Superintendent and Sewer Authority
Acceptance Test of Gravitation Sewers and Maintenance Holes–Hydrostatic testing	Submit proposed alternative testing regime for approval.	1 week	Superintendent and Sewer Authority
Connection to Existing Sewers	Submit request to connect to the existing sewer and give notice of works including any affected occupants.	3 weeks before connection	Superintendent and Sewer Authority
Testing of Rising Mains–Pressure Test	Present rising main for acceptance testing.	1 week	Superintendent and Sewer Authority
Restoration of Surfaces– Original condition requirement	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
General–Authorised products and materials	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pumps	Provide written warranty of the equipment.	Upon delivery on site	Superintendent
Electrical Compliance– Compliance with required standard	Supply a proof of compliance – Test certificate.	1 week	Superintendent
Electrical Installation–Route of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Sewer Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Sewer Authority and Superintendent
Practical Completion of Pump Station	Fulfil all the requirements for issuance of Certificate of Practical Completion.	2 weeks	Superintendent
Construction compliance			
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	1 week before operating	Sewer Authority and Superintendent

Table SC6.4.5.3.23 Sewerage systems-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/item	Requirement	Notice for inspection
Materials		
General–Compliance with Manufacturer's recommendations	Contractor to Inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves)
Pipeline construction		
Crossings–Crossings Authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation	Progressive
Bedding and Backfill Compaction Requirements–NATA	Provide NATA certified test results for all testing.	2 working days progressive
Thrust and Anchor Blocks for Rising Main–Verification of Bearing Pressures	Give notice if the allowable bearing pressure of the ground and the design pressure of the pipeline differ from actual pressures on site.	1 week
Pipeline testing and restoration		
General–Initial Tests (Sewers and Maintenance Holes)	Give notice prior commencement of initial testing.	2 days progressive
Ovality Test and CCTV Inspection–Deflection testing and pipeline verification	Submit proposal for deflection testing (Ovality Test). Submit CCTV Results.	1 week (Ovality Test) 2 days upon completion of inspection
Acceptance Test of Gravitation Sewers and Maintenance Holes	Submit acceptance test results.	Progressive
Visual Inspection and Measurement of Infiltration–Infiltration testing	Submit method of infiltration testing.	1 week
Testing of Rising Main	Submit acceptance test results.	Progressive
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior to spreading/disposal.	2 working days progressive
Pump stations		
General - Conformance with manufacturers recommendations	Inspect material and products at time of delivery.	2 working days
Electrical Compliance–approval of all design and materials	Submit all design drawings and materials to each Authority having jurisdiction for approval.	2 weeks before ordering

Table SC6.4.5.3.24 Stormwater drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Temporary drainage–Erosion and Sediment Control	Confirmation of accepted project ESCP and completion of erosion and sedimentation control measures.	1 week prior to site commencement	Superintendent and Council
Siting of Culverts–Survey set-out	Submit survey set-out of culvert inlets and outlets for approval.	1 week prior to proceeding	Superintendent
Siting of Culverts–Changes by Contractor	Submit proposed changes for approval.	1 week prior to proceeding	Superintendent
Excavation–Public utilities	Obtain approval for adjacent excavation with relevant authorities.	1 week prior to proceeding	Superintendent
Construction traffic–Protection measures	Submit certification and verification of protection measures.	3 working days	Superintendent

Table SC6.4.5.3.25 Stormwater drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Excavation–Notice	Identify unsuitable materials and inadequate support material for removal and disposal at the foundation level of the structure.	progressive
Backfilling–In situ concrete structures	Do not backfill against in situ concrete structures within 14 days of concrete placement.	progressive
Backfilling–Tolerance	Check shape of culvert during backfilling.	progressive
Compaction adjacent to culverts or drainage structures	Inform the Superintendent prior rectification any damage.	2 working days before proceeding

Table SC6.4.5.3.26 Drainage structures-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Precast Units–Product drawings and Quality	Submit details of precast or proprietary items for approval and Submit quality test results.	1 working day and 3 working days before delivery respectively	Superintendent
Excavation	Excavation and compaction of foundation as documented.	1 working day	Superintendent
Backfill–Commencement	Obtain approval for commencement.	1 workday day	Superintendent

Table SC6.4.5.3.27 Drainage structures-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Headwalls and Wingwalls – Batter retention	If dimensions on drawings are unable to satisfy batter retention, notify the Superintendent.	3 working days
Precast units	Give notice of installation of precast pits and junction boxes.	1 week
Construction	Submit for approval part omission of concrete lining.	3 working days

Table SC6.4.5.3.28 Pipe drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Common requirements			
General–Material Certification	Submit conformance certificate and other relevant manufacturer quality documentation.	24 hours in advance of dispatch to site	Superintendent
General–Alternative materials	Submit full product details in accordance with AS/NZS 2566.1.	4 weeks prior to commencing work	Superintendent and Council
General–Backfilling	Present the completed installation and jointed pipes for inspection.	Progressive before backfilling	Superintendent and Council
General–Protection of structures	Submit design proposal for protective measures for approval.	3 days prior	Superintendent and Council
Steel pipes and pipe arches			
Materials and Surface Treatment	Engineer's certification for the pipe materials and surface treatments.	Prior to practical completion	Superintendent
UPVC pipes			
Materials–Proprietary product with external diameter of ≥450mm	Submit for approval prior to construction.	4 weeks	Superintendent and Council

Table SC6.4.5.3.29 Pipe drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Precast reinforced concrete and fibre reinforced concrete pipes		
Excavation–Wide Trench Condition	If deemed as a wide trench, confirm appropriate pipe strength/trench support.	Progressive
Bedding	Source of bedding material -advise Superintendent.	Progressive
Bedding–Cementitious stabilisation	Provide if erosion of bedding material may occur.	1 week

Table SC6.4.5.3.30 Precast box culverts-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
Culvert Units, Link and Base Slabs	Submit certificate of conformance.	3 working days prior to dispatch	Superintendent
Proof load testing	Submit certificate and test results.	3 working days prior to dispatch	Superintendent
Construction			
Construction of coffer dams	Submit construction details for approval.	1 week prior to construction	Superintendent
Prior placement of bedding	Inspection of foundation and approval of proposed bedding.	2 days before placing material	Superintendent
Backfill—Inspection of seals	Present joints and seals for before backfilling.	1 working day	Superintendent
Construction loading on culvert —Constraint	Do not load base slab until strength has reached 20 MPa.	1 working day	Superintendent

Table SC6.4.5.3.31 Precast box culverts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Materials		
Handling, Delivery and Storage	Inspect box culvert units for conformance.	1 week prior to installation
Construction		
Coffer Dams—Timber or bracing removal	Inspect removal of bracing materials.	1 working day
Installation of Precast in situ base slabs	Attainment of concrete minimum compressive strength.	1 working day

Table SC6.4.5.3.32 Drainage mats-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Type A mats / Type B mats			
Geotextile, Damaged geotextile	Approval of condition or repair of geotextile.	1 working day before next activity	Superintendent
Filter material, Thickness	Approval of thickness and layers of filter material.	3 working days before placing filters	Superintendent

Table SC6.4.5.3.33 Drainage mats-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Type A mats /Type B mats		
Filter material, Protective layer	Inspection of placement of protective layer over mat extension.	3 working days before placing materials
Discharge, Outlets	Inspection of outlet proposals.	7 days before set-out of layers

Table SC6.4.5.3.34 Open drains-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Pre-construction planning			
Provision for traffic	Submit Traffic Guidance Scheme for approval.	2 weeks prior to site commencement	Superintendent
Temporary drainage	Submit details of procedures/devices for approval.	2 weeks prior to site commencement	Superintendent
Materials			
Proprietary Products	Submit proprietary products and manufacturer's instructions.	7 days prior to commencement on site	Superintendent
Gabions/Wire mattresses	NATA compliance certificates for proposed Gabions.	7 days prior to commencement on site	Superintendent
Rock fill material	NATA compliance certificates for proposed rock fill material.	7 days prior to commencement on site	Superintendent
Geotextile	NATA compliance certificates for proposed Geotextile material.	7 days prior to commencement on site	Superintendent
Open drains			
Excavation	Approval to divert drain to avoid trees and/or rocks.	1 working day before set-out.	Superintendent.
Excavation	Location and construction of drains to prevent salination.	1 working day before set-out.	Superintendent.
Kerb and channel (gutter)			
Foundation	Approval for shape and compaction of foundation material.	1 working day before forming	Superintendent

Table SC6.4.5.3.35 Open drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Open drains		
Excavation	Unsuitable material removal and disposal.	Progressive
Excavation	Spoil site locations.	Prior to placement
Embankment	Embankment compaction and revegetation.	Progressive
Construction	Grade and compaction of open drains.	Progressive
Construction	Proprietary items installed to manufacturers recommendations.	Progressive
Types	Maintain catch drains.	Progressive
Types	Construct minor diversion and contour drains, table drains, swales and depressed medians.	Progressive
Types	Channels preserving the existing stream bed.	Progressive
Lining		
Concrete lining	Instruction on weephole location.	1 working day before concreting.
Concrete lining	Joints and tolerances.	1 working day before concreting.
Stone pitching	Bedding material and placement.	1 working day before concreting.
Kerb and channel (gutter)		
Stormwater outlets	Positive drainage to channel.	Progressive
Vehicular or pedestrian access	Siting, location and bedding compaction.	Progressive
Backfilling and reinstatement		
Backfill behind kerbs	Backfilling timing, material and compaction.	1 working day prior to backfilling
Pavement backfill	Backfill adjacent new gutter material and location.	1 working day prior to backfilling
Rock filled wire mattresses and gabion– Completion	Inspection of rockfill material and filling method.	On completion of works

Table SC6.4.5.3.36 Earthworks-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Stockpile Sites	Approval to use any stockpile site not shown on the Drawings.	3 working days before stockpiling	Superintendent
Treatment of Floors of Cuttings–Prior ripping floors of cuttings	Present in situ material for inspection to determine suitability of pavement support.	Before ripping commences	Superintendent
Treatment of Floors of Cuttings–Compacting floors of cuttings	Inspection of compacted cutting floor.	Prior to placing any subsequent layers over the completed cutting floor	Superintendent and Council
Unsuitable material–Floor inspection	Re-present the floor of the excavation after the removal of unsuitable material.	Prior to backfilling with replacement material	Superintendent
Foundations for Embankments	Inspection of the embankment foundation area.	1 working day prior to next activity	Superintendent
Foundation for Embankments–Other Embankments (Bridging layer)	Inspection and direction for bridging layer where required	3 working days before proceeding	Superintendent
Trimming tops of embankments	Inspection of the completed surface to receive subsequent pavement layers.	Prior to placing any subsequent pavement layers	Superintendent
Selected material zone	Inspection of the completed select material zone surface prior to placing any subsequent pavement layers.	1 working day before proceeding	Superintendent
Fill adjacent to structures–General	Concrete strength required for early filling to structures.	3 working days prior to fill placement	Superintendent
Deflection monitoring or proof rolling	Present the completed work for deflection monitoring or proof rolling.	2 working days before next activity	Superintendent and Council

Table SC6.4.5.3.37 Earthworks-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Natural Surface and Earthworks Materials	Survey method and results, including any discrepancies.	At least 7 days notice
Cuttings–Floors of cuttings	Floors to be no more than 50 mm above or below the designed floor and provide suitable support.	1 working day before next activity
Batters–Excavation beyond the batter line	Minor change in the general slope of the batter to suit the site conditions.	1 working day before next activity
Transition from cut to fill–Terrace	Excavate a terrace for the width of the selected material zone to a depth of 900 mm below and parallel to the cutting floor.	1 working day before excavating terrace
Unsuitable Material	Material deemed unsuitable for embankment or pavement support in its present position.	Progressive
Placing Fill for Embankment Construction–Rock material	Modify grading of fill material to achieve compaction.	Progressive
Fill adjacent to structures–Treatment at weepholes	Proposal to use synthetic membrane geotextile.	3 working days before proposed use
Spoil–Haulage disposal	Obtain planning approval and any permits.	3 working days before commencing activity
Borrow–Requirement	Obtain planning approval and any permits.	3 working days before commencing activity

Table SC6.4.5.3.38 Clearing and grubbing-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Limits of clearing			
Survey	Decision on the removal of miscellaneous items.	7 days before proposed removal	Superintendent
Extent of clearing	Submit peg out and extent of clearing survey.	7 days before proposed commencement of clearing	Superintendent and Council
Clearing Operations			
Tagging	Confirm clearing perimeters and mark trees to be preserved.	7 days before proposed site clearing	Superintendent and Authorised Council Officer
Work near trees noted for protection	Work method statement for works within the exclusion zone.	7 days before proposed works	Superintendent
Excavation within 4m of tree trunks	Develop appropriate work methods to avoid damage to the tree for approval.	7 days before proposed excavation	Superintendent
Trees within proposed embankment areas	Direction to remove or protect trees within proposed embankments.	7 days before proposed site clearing	Superintendent
Unsound trees in road reserve	Direction on removal of trees or branches not within the clearing limits.	7 days before proposed site clearing	Superintendent
Timber falling on private property	Written consent of owner to leave in place or to enter property to remove.	Prior to carrying out works	Superintendent
Damage	Approval for any rehabilitation of vegetation or fauna habitat.	3 working days prior to carrying out works	Superintendent and Authorised Council Officer
Grubbing			
Blasting	Explosives not permitted without prior approval.	Progressive	Superintendent
Disposal of materials			
Burning of material	Approval prior to disposal of timber and other combustible materials by burning.	Prior to burning	Superintendent

Table SC6.4.5.3.39 Clearing and grubbing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Existing Utility services–Marking	Locate all underground pipe and cables.	Before commencing any earthworks
Trees to be preserved–Work near trees noted for protection	Exclusion zone around protected trees.	Progressive
Trees to be preserved–Tree protection	Trees and roots not to be cut or damaged.	Progressive
Grubbing–Backfill	Backfill and compact grub holes.	Progressive
Chipping of cleared vegetation–Stockpiling	Stockpile location approval.	Prior to stockpiling

Table SC6.4.5.3.40 Flexible pavements-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Activity plan			
Pavement construction plan	Prepare and submit pavement plan.	4 weeks before commencing site work	Superintendent
Inspection, sampling and testing			
Notification	Written notice for testing times and provide test results.	3 working days prior to testing or inspection	Superintendent
Materials			
Proposed materials	Prepare and submit schedule detailing material properties including NATA test results and certificate.	2 weeks before ordering materials	Superintendent
Bound or modified materials	Complete and submit (SC6.4.6.19 Attachment A).	2 weeks before ordering materials	Superintendent
Variations to approved materials	Submit details of changes to approved materials.	1 week before use in works	Superintendent
Lime modified base and subbase materials			
Lime modification	Submit proposals to modify materials.	2 weeks before placing	Superintendent
Stationary Plant or In-situ lime modification	Submit proposals for the in-situ use of hydrated lime or quicklime.	2 weeks before activity	Superintendent
Spreading			
Underlying layer	Inspection to determine suitability of underlying layer.	1 working day before placing next layer	Superintendent
Temperature	Submit proposal to proceed outside allowable conditions.	1 working day before placement	Superintendent
Trimming, compaction and curing			
Plant	Submit details of proposed hand operated plant.	1 week before use	Superintendent
Subsequent layers	Submit completed test results of previous layer.	1 working day before placing next layer	Superintendent
Acceptance of compaction			
Lots for acceptance	Submit compaction test results.	1 working day after testing	Superintendent
Compaction requirements and acceptance	Submit evidence that compaction is within tolerances.	1 working day after test results	Superintendent
Tolerances			
General	Submit lot survey reports.	1 working day before next activity	Superintendent
Action on rejection			
Corrective action–rejected unbound layers	Submit proposal for corrective action.	1 working day before next activity	Superintendent
Corrective action–rejected bound layers	Submit proposal for corrective action.	3 working days before next activity	Superintendent
Removal and replacement of rejected course			
Extent of removal	Submit proposal to remove less than full width.	1 working day before next activity	Superintendent

Clause title/Item	Requirement	Notice for inspection	Release by
Prior to replacement	Give notice for inspection of underlying material.	1 working day before next activity	Superintendent
Replacement	Submit proposed methods to make good.	1 working day before next activity	Superintendent
Maintenance before completion of wearing course			
Pavement condition before primerseal	Dry-back, re-prepare and give notice for inspection.	3 working days before next activity	Superintendent and Council
Opening bound pavement to traffic	Give notice of proposed opening to traffic.	3 working days before proposed opening	Superintendent

Table SC6.4.5.3.41 Flexible pavements-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Delivery to site		
Delivered materials	Give notice for inspection.	Progressive
Delivery of modified or bound materials		
Delivery of materials	Provide delivery dockets at point of delivery.	Progressive
Stockpiling of unbound materials		
Location	Give notice of proposed alternative locations.	2 weeks before stockpiling
Trimming, compaction and curing		
Compaction	Give notice of proposal to use alternative layer thickness.	2 weeks before activity
Rework	Give notice for inspection of reworked wetted up layer.	Progressive
Curing of bound materials	Give notice of water curing activities.	Progressive
Acceptance of compaction		
Nuclear density Meter testing	Give notice of proposal to use Nuclear density meter.	1 working day before use
Tolerances		
Layer width	Give notice of completion of layer width.	Progressive
Levels and Surface Trims	Give notice of completed surface layer.	Progressive

Table SC6.4.5.3.42 Asphaltic concrete-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Plant	Evidence that plant is registered and insured.	2 weeks before using plant	Superintendent
Delivery—work records	Submission for counter signing.	Each day for daily completion	Superintendent
Asphalt mix design			
Approved Mix	Submit approved mix design for Superintendent confirmation.	7 days before using mix	Superintendent
Production Mix— Production Sampling and Testing	Submission of all documented test results.	Within 7 days of delivery of material	Superintendent
Asphalt mixes incorporating RAP	Mixes containing more than 20% RAP to be submitted for assessment.	7 days before using mix	Superintendent
Placing	Present surface prior spreading.		Superintendent
Joints—General	Submit plan of joints location for approval.	7 days before commencing	Superintendent
Preparation of Pavement — Rectification of Pavement Surface	Prepare surface to the satisfaction of the Superintendent.		Superintendent
Laying—Paver	Provide notice of proposed pavers.		Superintendent
Removal and Replacement of Rejected Material	Present surface after removal of the rejected material.		Superintendent

Table SC6.4.5.3.43 Asphaltic concrete-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Plant	Superintendent to assess faulty plant.	Progressive
Production	Superintendent to access the mixing plant to verify production procedures and the supplier's compliance with the Contractor's Project Quality Manual and Quality Plan.	Progressive
Aggregate—General	Source subject to inspection and approval of Superintendent.	3 weeks before importing aggregate

Table SC6.4.5.3.44 Mass concrete subbase-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials for concrete			
Materials	Submit details of concrete mix and materials.	Submit as part of confirmation of nominated mix	Superintendent
Design and control of concrete mixes			
Nominated mix	Submit details of concrete mix and materials including NATA certificates and test results.	21 working days before using the nominated mix (Progressive)	Superintendent and Council
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials.	21 working days before implementing change	Superintendent
Conformance for concrete strength and thickness			
Sampling, curing and testing of fresh concrete	Inspection of sampling procedure.	Progressive	Superintendent
Acceptance criteria	Submit test results.	Progressive	Superintendent
Acceptance criteria for cored concrete (non-conformance)	Submit test results.	Progressive	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed work methods.	At least 21 working days before starting	Superintendent
Placing and finishing concrete subbase			
Subbase Paving plan	Submit as part of Quality plan.	21 working days before starting	Superintendent
Construction—Placing	Written notice to commence (including trial section).	7 days before starting	Superintendent
Trial Concrete Subbase —Construction	Inspection of the trial concrete subbase.	1 working day after placing trial section	Superintendent
Trial Concrete Subbase —Deficient trial section	Provide justification of the methods used in producing deficient work for assessment.	1 working day after deficiency identified	Superintendent

Table SC6.4.5.3.45 Mass concrete subbase-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Conformance for concrete strength and thickness		
Testing by specimens cut from the work	Coring witnessed by Superintendent	3 working days
Restoration after coring	Inspection of restoration work	3 working days after cutting
Placing and finishing concrete subbase		
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Average application rate	Average rate checked by the Contractor and certified by the Superintendent	Progressive
Bond breaker and spall treatment		
Treatment of Unplanned Cracks	Check for cracks and repair/reject	Progressive

Table SC6.4.5.3.46 Plain and reinforced concrete base-hold points

Clause title / Item	Requirement	Notice of inspection	Release by
Design and control of concrete mix			
Nominated mix	Submit details and certificates for nominated concrete mix and material constituents including NATA certificates and test results	21 working days before using the nominated mix	Superintendent
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials	21 working days before implementing change	Superintendent
Steel reinforcement			
Placing and cover requirements	Approval of placement and fastening of reinforcing steel	4 working hours before concrete placement	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed methods and equipment	4 weeks before starting	Superintendent
Placing and finishing concrete base			
Subbase survey	Work-as-executed survey of the subbase.	7 days before starting any works	Superintendent
Surface texture	Submit details of proposed texturing device and method of texturing	Before texturing	Superintendent
Trial of Concrete Base Construction	Obtain approval for the trial section	5 working days before main works	Superintendent
Trial of Concrete Base—Deficient trial section	Provide justification of the methods used in producing deficient work for assessment	2 working days after construction	Superintendent
Joints			
Permanent sealing—General	Submit proposed method for permanent joint sealing	4 weeks before installation	Superintendent
Slab anchors			
Excavation	Submit compacted excavated surface	1 working day before concreting	Superintendent
Testing of concrete for compressive strength			
Sampling	Inspection of sampling procedure	Progressive	Superintendent
Acceptance criteria	Submit test results	Progressive	Superintendent
Acceptance criteria for cored concrete	Submit test results	Progressive	Superintendent
Removal and replacement of base			
General	Submit proposed method of removal to preserve adjoining base and underlying subbase	7 working days before replacement works	Superintendent

Table SC6.4.5.3.47 Plain and reinforced concrete base-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Witness Points Off Site		
Clause/ subclause	**Requirement**	**Notice of inspection**
Materials for concrete		
Aggregates - Storage	Storage and handling to preserve quality of aggregate	Progressive
Steel reinforcement		
General	Provide NATA certificates and manufacturer's information.	Before delivering to site
Bar chairs	Demonstrate load bearing capacity	Before delivering to site
Joints		
Silicone Sealant	Provide NATA certificate and manufacturer's information	4 weeks before joint work
Witness Points On Site		
Joints		
Permanent Sealant	Locations as shown on drawings and change to spacing	Progressive
Placing and finishing concrete base		
Consistency	Provide slump check test results	Progressive
Protection of Work - Ambient conditions	Provide details of protection methods for cold or hot weather and rain	Progressive
Traffic considerations	Provide traffic management measures	Progressive
Rate of Evaporation and moisture loss	Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits	Progressive
Paving (Mechanical and Hand Paving)	Construction joint if hand or mechanical paving is disrupted	Progressive
Alignment and Surface Tolerances - Assessment of base thickness	Survey of base surface, edge alignment and thickness	Progressive
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Testing of concrete for compressive strength		
Testing of specimens cut from the work	Carry out coring in presence of the Superintendent	
Repair and Restore work after coring	Restore holes with non-shrink cementitious concrete	After coring
Conformance of concrete strength, compaction and thickness		
Relative Compaction	Testing conformance of required relative compaction	Progressive

Table SC6.4.5.3.48 Sprayed bitumen surfacing-hold points

Clause title/Item	**Requirement**	**Notice for inspection**	**Release by**
Design of bituminous surfacing			
Confirmation of Design and Materials Compliance	Submit the sprayed seal design and additional details for approval	2 weeks before commencing work	Superintendent
Plant	Evidence that plant is registered and insured	2 weeks before using plant	Superintendent

Table SC6.4.5.3.49 Sprayed bitumen surfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Application and rolling of aggregate		
Removal of loose aggregate, Loose aggregate particles	Completion within specified time	Various to allow inspection of performance in conformance with Tables of time limits
Removal of surplus and waste material	Demonstrate that materials are properly disposed	Progressive
Protection - New work	Demonstrate that line marking and warning signs are in place to protect new work	Progressive

Table SC6.4.5.3.50 Bituminous microsurfacing-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Mix design			
Nominated Mix—Design and control of bituminous mix	Submit details of nominated mix with NATA Certification	7 days before commencing	Superintendent
Production and paving			
Production mix Bituminous —microsurfacing	Target application rate and nominal layer thickness for approval	7 days before commencing	Superintendent
Sampling and testing of production mix	Compliance with maximum permitted variations from approved mix	During mixing	Superintendent
Weather limitations	Cease works if weather conditions are not appropriate	Progressive	Superintendent
Paving unit calibration	Documentation for detailed calibration	7 days before using paving unit	Superintendent
Preparation of Pavement	Provide cleaned surface for inspection	1 working day prior to spreading works	Superintendent
Spreading—Traffic	Capable of carring traffic in short period after slurry surfacing to the approval of Superintendent	One hour after spreading	Superintendent
Surface texture—Test run	Demonstrate surface texture	1 working day before commencing	Superintendent
Non-conformance—Materials and finished surfacing	Approval for correction or replacement	1 working day before corrective action	Superintendent

Table SC6.4.5.3.51 Bituminous microsurfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Binder—Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Mineral Aggregates—Quality	Submit NATA test results for the nominated mineral aggregates	7 days prior to commencing works
Mineral Filler—Quality Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Witness Point On Site		
Spreading—Clean up	Leave road fixtures in clean and satisfactory condition	Progressive

Table SC6.4.5.3.52 Segmental paving-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
General—Nominated materials	Submit segmental paving materials and supplier.	2 weeks before ordering	Superintendent
Construction			
Subgrade Preparation—Dimensions and specification	Present the finished subgrade for approval	1 working day before proceeding	Superintendent
Subbase—Dimensions and specification	Present finished subbase for approval	1 working day before proceeding	Superintendent
Base—Dimensions and specification	Present the finished base for approval	2 working days before proceeding	Superintendent

Table SC6.4.5.3.53 Segmental paving-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
Opening to Traffic—Inspection	Regularly inspect joints after completion	Progressive

Table SC6.4.5.3.54 Stabilisation-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials proposed for use in the work	Submit NATA certificate of compliance	14 days prior to commencement of works	Superintendent
Field Working Period —Laboratory	Nominate the specific field working period specified in the Stabilisation Mix Design	14 days prior to commencement of works	Superintendent
Materials			
Cement—Storage	Re-test cement stored in excess of 3 months	2 working days prior to usage	Superintendent
Stabilisation Process —Proposed equipment and procedures	Submit a Work Plan nominating proposed plant and work sequence	14 days prior to commencement	Superintendent
Application of stabilising agent—In situ application	Proposals for special processes of supply of stabilising agent into the mixing bowl	7 days prior to mixing	Superintendent
Mixing—In situ mixing process	Demonstration of equipment mixing efficiency in trial section	7 days prior to production stabilisation	Superintendent
Trimming and Compaction—Trimming	Work methods to exclude laminations and slurrying	3 working days prior to production stabilisation	Superintendent
Trimming and Compaction—Survey control methods	Use of trimmed material as fill or spoil	3 working days prior to disposition	Superintendent
Curing—Method statement	Submit details of proposed curing method	As directed	Superintendent
Trial section of stabilised earthworks			
General	Submit a trial section of stabilised earthworks	5 working days prior to commencement of works	Superintendent and Council
General	Any deficient sections will require to be investigated and may be directed to remove	Progressive	Superintendent and Council

Table SC6.4.5.3.55 Stabilisation-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Cement	Proof of quality and source	Progressive
Quicklime	Proof of quality and source	Progressive
Hydrated lime	Proof of quality and source	Progressive
Ground granulated blast furnace slag	Proof of quality and source	Progressive
Flyash	Proof of quality and source	Progressive
Blended stabilising agent		
Blended stabilising agent —Standard	Proof of quality and source	Progressive
Blended stabilising agent —Handling and storage	Comply with supplier's handling and storage requirements and arrange sampling of agent	Progressive
Witness Points On Site		
Quality Requirements—Compaction	Adjustment of Field Working Period for site conditions	Progressive
Application of stabilising agent —Stationary mixing plant	Monitoring application of stabilising agent at the plant	Progressive
Application of stabilising agent —Stationary mixing plant	Removal of spilled stabilising agent	Immediately upon spillage event
Application of stabilising agent —Spreading out	Actual spread to be recorded and checked	Progressive
Application of stabilising agent —Spreading out	Record average spreading rate using load cells	Progressive
Mixing—Stationary mixing plant	Test unconfined compressive strength	Progressive
Mixing—In situ mixing process	Visual inspection to ensure uniform mixing and record	Progressive
Mixing—In situ mixing process	Additional passes of mixing equipment to improve uniformity	Progressive
Trimming and Compaction—Survey control methods	Survey to confirm pavement layer thickness remains within tolerances after trimming	Progressive
Trimming and Compaction —Straight edge test	Conform to surface tolerances prior to sealing or practical completion of work component	As directed by Superintendent
Dimensions—Width	Random measurement of stabilised layer width	As directed by Superintendent

Table SC6.4.5.3.56 Subsoil, foundation and pavement drains-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Construction			
Subsoil and Sub-Pavement Drains / Foundation drains—Excavation	Inspect excavated trench	1 working day prior to filling	Superintendent
Subsoil and Sub-Pavement Drains / Foundation drains—Laying of Pipes	Present bedding of compacted filter material laid to line and grade	3 working days before next activity	Superintendent
General—Filter material	Type of filter material	3 working days before ordering material	Superintendent
Intra-pavement drains —Laying of pipe	Provide certification that drain has adequate crushing strength	3 working days before ordering	Superintendent
Intra-pavement drains —Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent
Edge drains—Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent

Table SC6.4.5.3.57 Subsoil, foundation and pavement drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
Construction		
Subsoil and Sub-Pavement Drains / Foundation drains—Pipes	Lay on compacted bed to documented line and level	1 working day before filling
Subsoil and Sub-Pavement Drains —Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Foundation drains—Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Geotextile—Installation	Placement of fabric conformance	1 working day before filling
Geotextile—Installation	Ensure exposure periods are within the constraints	Progressive
Cleanouts—Field testing	Perform flushing test	Progressive (timing depending on the construction of pavement layers)

Table SC6.4.5.3.58 Subsurface drainage-witness points

Item/Clause title	Requirement	Notice for inspection	Release by
General			
Siting of Work	Submit the proposed set-out in addition to the designed set-out	7 days before planned execution	Superintendent
Siting of Work—Proposed changes	Present the proposed new set-out for approval	3 days before planned execution	Superintendent
Excavation—Existing underground services	Submit evidence of approval of the relevant authorities.	14 days before planned excavation	Superintendent
Excavation—Trenches	Approval of completed trenches required prior to installation of drainage work	1 working day prior to installation of drainage work	Superintendent
Materials			
Subsurface drainage pipes—General	Submit compliance certificates	7 days before proceeding to provide pipes	Superintendent
Other subsurface drainage pipes	Submit details of proposed alternative pipes and evidence of conformity for approval.	7 days before proceeding to provide pipes	Superintendent
Geotextile—General	Provide documentation of conformity of geotextile and installation process	14 days before proceeding to provide geotextile	Superintendent
Recording of drainage			
Recording of subsurface drainage Information	Progressive supply of subsurface drainage details	5 working days after completion of each drain or drainage system	Superintendent

Table SC6.4.5.3.59 Subsurface drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
General		
Temporary drainage during construction	Locate materials and equipment clear of water courses	7 days prior to positioning

Table SC6.4.5.3.60 Pavement markings-hold points

Clause title/subclause	Requirement	Notice for inspection	Release by
General			
Material Quality	Submit NATA Test Reports on materials	7 days before work is scheduled to commence	Superintendent
Surface preparation—Wet Weather	Superintendent direction on suspension of work	Progressive	Superintendent
Removal of pavement markings			
General—Removal of redundant markings	Submit method for approval	1 working day before commencement of activity	Superintendent

Table SC6.4.5.3.61 Pavement markings-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/subclause	Requirement	Notice for inspection
General		
Setting Out—Net	Set out in accordance with the drawings	Progressive
Pavement marking paint		
Application of Paint Beads—Glass beads applied to other paint markings	Application method to be approved by Superintendent	Progressive
Field testing—Application Rate	Application to be checked for quality	Progressive
Thermoplastic pavement marking material		
Field testing—Application Rate	Application to be checked for quality	Progressive
Pavement marking tape		
Removal of Pavement Marking Tape	Direction to remove pavement marking tape	Progressive
Raised pavement markers		
Installation of Raised Pavement Markers	Installation to be checked for quality (allow adhesive to set)	Progressive

Table SC6.4.5.3.62 Guide posts-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Materials—Proprietary posts—Proposed supplier	Supply details of the proposed guide posts	Two weeks before manufacture	Superintendent
Construction			
Erection of Guide Posts —Proprietary guideposts	Provide manufacturers anchorage instructions	5 working days	Superintendent
Erection of Guide Posts —Guide posts on concrete pavements	Provide fixing details	5 working days	Superintendent

Table SC6.4.5.3.63 Guide posts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/ subclause	Requirement	Notice for inspection
Construction		
General—Location of guide posts and proximity to underground services	Locations shown on drawings or as specified Check for existing underground services	Two weeks before installation
Erection of Guide Posts—Backfilling	Firm embedment in ground	Progressive
Delineators—Fixing	Arrangement of delineators relative to traffic direction	Progressive

Table SC6.4.5.3.64 Signposting-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials			
General—Approved Supplier	Details of proposed suppliers provided to the Superintendent including documentary evidence	1 week prior to ordering	Superintendent
General—Documentary Evidence	Evidence that materials and parts proposed comply with the requirements of this specification	1 week prior to engaging supplier	Superintendent
Retro-Reflective Material for Background and Legend	Details of material and compatibility in application and durability	1 week prior to ordering	Superintendent
Sign Support Structures —Attachment of signs	Details of proposed attachment systems	2 weeks prior to fabricating attachment systems	Superintendent
Erection of new signs			
Setting Out	Approval of the location and alignment of the sign support structure	1 week prior to erection	Superintendent
Setting Out—Existing underground services	Locate services and protect against damage	1 week prior to erection	Superintendent
Special requirements			
Street Name, Service and Tourist Signs	Submit details of manufacturer for approval by council	1 week prior to ordering	Council

Table SC6.4.5.3.65 Signposting-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Erection of new signs		
Setting Out	Submit details of and set out for each support structure	1 week before installing signs
Clearing	Clear vegetation after set-out on advice from council	3 working days before clearing
Sign Structure Footings —Excavation	Excavation as shown on drawings and as directed, including disposal of material	1 working day before next activity
Erection—Sign Damage	Repair or replace damaged signs	1 week before installing signs
Adjustment of existing signs and support structures		
General	Conform to Drawings and Superintendent direction	1 week before adjusting signs

Table SC6.4.5.3.66 Non rigid road safety barrier system-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Materials			
Certification—Evidence of Conformance	Provide documentary evidence of conformity of steel components	1 week prior to erection	Superintendent
Construction			
General— Set Out	Set out to drawings or as directed	2 working days prior to erection	Superintendent
End Treatment of Road Safety Barriers—MELT	Submit alternative MELT locations	1 week prior to ordering	Superintendent

Table SC6.4.5.3.67 Non rigid road safety barrier system-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
General—Sequence of Construction (pavements)	Erection after pavement activities	1 week before installation – progressive
General—Underground Obstruction	Alternative method due to obstructions	1 week before setting posts
Erection of Steel Posts—Damage to posts	Assessment by Superintendent for replacement	3 working days before removal of damaged post
Erection of Road Safety Barrier Rails—Excessive damage to rails	Assessment and rejection by Superintendent	1 working day after perceived damage

Table SC6.4.5.3.68 Minor concrete works-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Excavation and Foundation General—Ground preparation—Base preparation	Inspect prepared surface or sand underlay	1 working day prior to covering	Superintendent
Excavation and Foundation General—Ground preparation—Polymeric film underlay installation	Inspect membrane or film underlay installed	1 working days prior to covering	Superintendent
Approval of Formworks Design	Formwork design certificates	3 working days	Superintendent
Erection—Formwork	Certification of installed formwork and inspection	1 working day prior to covering	Superintendent
Materials for concrete			
Nominated Mix	Submit details of nominated mix for approval	7 working days	Superintendent
Reinforcement for concrete			
Steel reinforcement placement—Approval of reinforcement before concrete placement	Inspect reinforcement placement	1 working day prior to covering	Superintendent
Cores, fixings and embedded items—General	Shop drawings for cores, fixings and embedded items	7 working days prior to commencing works	Superintendent

Clause/subclause	Requirement	Notice for inspection	Release by
Loads on minor concrete structures	Approval for early loading of the structure by design strength in situ tests	3 working days	Superintendent
Sprayed concrete general—Method statement	Submit proposal for spraying	14 days prior	Superintendent

Table SC6.4.5.3.69 Minor concrete works-witness points

Clause title/Item	Requirement	Notice for inspection
General		
Ground preparation—Mass concrete bedding on earth foundations	Inspect concrete blinding slab prior to placing forms or materials	1 working day prior to covering
Concrete quality requirements —Formwork	Check erection tolerances	1 working day
Materials for concrete		
Certificate of compliance	NATA certificates for all materials	7 days prior to commencing on site
Handling and treatment of concrete		
Mixing of concrete—Hand Mix On Site	Submit proposal for use	7 days prior
Mixing of concrete—Pre-mixed supply	Submit delivery dockets and subcontractors details	Progressive
Concrete quality requirements —Flatness	Confirm unformed surfaces	1 working day
Concrete quality requirements —Surface quality	Confirm surface quality	1 working day
Concrete curing	Certified test results for curing compound	7 days prior
Joints	Submit proposal for sawn joints	7 days prior
Concrete placing and compaction —Testing	Certified test results for compressive strength	Progressive
Reinforcement for concrete		
Steel reinforcement placement —Delivery and receipt of reinforcement	Submit notice for test inspection	7 days
Steel reinforcement placement —Placing	Submit proposed changes to reinforcement	2 days prior to commencing on site
Steel reinforcement placement —Damaged galvanising	Submit proposed repair method	2 working days prior
Steel reinforcement placement —Provision for concrete placement	Submit proposed changes to spacing, cover, splicing or welding or reinforcement	2 working days prior
Cores, fixings and embedded items—Cutting or coring	Approval for cutting or coring hardened concrete	2 working days prior
Sprayed concrete—Sprayed concrete test panel	Approval of sample panels	7 days

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Table SC6.4.5.3.70 Boundary fencing-hold points

Clause title / item	Requirement	Notice for inspection	Release by
Materials			
General—Material approval	Submit source, type, Certificate of compliance and manufacturer for each type of material	One week before ordering each type	Superintendent
Construction			
General—Clearing and grubbing	Confirm approval for tree removal	One week before next activity	Superintendent
Erection of posts			
Depth of posts	Method of installing and proposed type of posts to be used	One week before manufacture or order	Superintendent
Erection of wires—General	Approval for any proprietary fasteners	One week before manufacture or order	Superintendent
Flood gates—General	Approval to proceed with flood gates and type	One week before fabricating flood gates	Superintendent
Removal and disposal of surplus material and rubbish	Approval required for burn off for combustible materials	Prior to burning	Superintendent
Bedding—Cattle Grids	Approval for bedding requirements	One week before fabricating flood gate	Superintendent

Table SC6.4.5.3.71 Boundary fencing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Materials		
Galvanised Posts, Braces and Rails —Welded Joints	Welding sites to be cleaned and painted	Progressive
Gates—Dimensions and Fittings	Fitting alternatives	3 working days before fabrication
Construction		
Stock-Proof Fencing—Erection of posts—Depth of posts	Posts sunk to the required depths	Progressive
Crossing of Watercourses and Depressions	Secure by installing longer posts as directed	Progressive
Flood gates—Small water courses	Provide required waterway area	Progressive
Erection of Gates	Double gates to be directed	One week before ordering
Removal and disposal of surplus material and rubbish	All surplus material to be removed	Progressive

Table SC6.4.5.3.72 Control of traffic-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
General			
Traffic guidance scheme (TGS)—Approval	Approval of Traffic guidance scheme	2 weeks before proposed commencement on site	Superintendent.
Traffic guidance scheme (TGS)—Relevant Authority Approval	Provide evidence of approvals from Council and other Authorities	4 weeks before proposed commencement on site	Superintendent
Traffic Guidance Scheme (TGS)—Non-complex TGS	Carry out a risk assessment for works not involving complex TGS or staged works	4 weeks before proposed commencement on site	Superintendent.
Side Roads and Property Accesses—Proposed access	Provide Proposal for access	5 working days prior to carrying out works	Superintendent.
Side Roads and Property Accesses—Notice to property owners	Approval to deny vehicular access and provide notice to property owners	3 working days prior to carrying out works	Superintendent.
Temporary roadways and detours			
Approval	Submit design of all proposed temporary roadways and detours	5 working days prior to carrying out works	Superintendent.
Opening to Traffic	Present completed temporary roadways and detours to the Superintendent for approval prior allowing traffic	5 working days prior to carrying out works	Superintendent.
Arrangements for traffic			
Construction Under Traffic—Approval	Approval required to construct under traffic	3 working days prior to carrying out works	Superintendent.
Construction Under Traffic—Details	Submit full details of temporary signposting, traffic control devices and traffic control methods for approval	5 working days prior to carrying out works	Superintendent.
Opening Completed Work—Written Notice	Provide written notice to the Superintendent confirming date of opening of completed works.	5 working days prior to opening of completed works	Superintendent.
Traffic control devices			
Adequate Traffic Control Devices—Default by Contractor	Rectify inadequate traffic control devices	1 working day of notice	Superintendent.

Table SC6.4.5.3.73 Control of traffic-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/Item	Requirement	Notice for inspection by the Superintendent
General		
Traffic Guidance Scheme (TGS)—Site Copy	A copy of the approved Traffic Guidance Scheme must be kept on site	Progressive
Traffic Guidance Scheme—Safety Audit	For complex traffic arrangements and staged works carry out safety audits	Progressive
Traffic Controllers—Personnel	Submit names and declaration of proposed traffic controllers	Prior to commencing work
Temporary Speed Zoning—Record	Diary and method of works	Progressive
Temporary roadways and detours		
Drainage—Pavements	Pavement designed and constructed not to pond water	Progressive
Surfacing—Extent	Width of wearing surface and position of finish tying into existing works	3 working days prior to carrying out works
Traffic control devices		
Arrangement of traffic control devices	Arrangement and placement as per the approved TGS	Progressive
Temporary markings—Line Marking	Ineffective line marking, remark within 48 hours.	Progressive
Temporary markings—Old Markings Removed	Obliterate or remove old markings.	Progressive
Raised Pavement Markers—Ineffective Markers	Replace ineffective markers within 24 hours.	Progressive

SC6.4.5.3 Attachment E Non conformance Certificate (NCC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment F Non Conformance Report (NCR) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment G Notice of Non Conformance Report (NNC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment H Corrective and Preventive Action Request (CPAR) - Template

Click here to obtain a copy of the following form.

SC6.4.6 Construction standards

SC6.4.6.1 Water sensitive urban design construction and establishment requirements

SC6.4.6.1.1 Introduction

This sub-section is a supporting document to the Water by Design, 2010, *Construction and Establishment Requirements: Swales, Bioretention Systems and Wetlands* (Construction and Establishment Guidelines), South East Queensland Healthy Waterways Partnership, Brisbane. The Construction and Establishment Guidelines are adopted in whole, with the exceptions and additions as noted in this planning scheme policy.

Editor's note—the most up to date version of the Construction and Establishment Guidelines can be purchased from Water by Design.

SC6.4.6.1.2 Irrigation

Supplementary irrigation may be required to maintain system functionality during prolonged periods of dry. Water supply to bioretention and wetland systems is greatly influenced by localised residential runoff; hence council imposed water restrictions or prolonged periods of dry should be met with supplementary irrigation. Irrigation (temporary or permanent) may be requested by council during landscape installation. All irrigation plans are to be approved for use by council.

Editor's note—use Form D: Swales; Form G: Bioretention systems; Form H: Constructed Wetlands from the Construction and Establishment Guidelines.

SC6.4.6.1.3 Vegetation establishment

Throughout the sub-section, reference is made to building phase protection by temporary measures. Where 80-90% of the building phase is referred to in the text the developer should ensure upwards of 90% build out before removal of temporary measures and establishment of the approved vegetation.

SC6.4.6.1.4 Weed management

Typha spp have shown an ability to dominate systems in Townsville and disable their functionality and maintainability. Although some Typha species are native they are considered an environmental weed whose control is recommended (Queensland Government Department of Primary Industries and Fisheries, October 2010). As such Typha spp should be removed from systems early to prevent spread and actively managed to ensure that the system is free of the weed at the point of handover. This will ensure that hydrological functioning is maintained, reduce snake habitat (both real and/or perceived), increase vector control, protect desirable, approved species; and reduce fuel loads when systems dry out.

The Developer is to ensure that all waterways are free of Typha spp at the end of the defects liability period.

SC6.4.6.1.5 Dredge spoil dewatering areas

As council refuse facilities do not accept "wet waste", the developer will need to incorporate dredge spoil dewatering areas for sediment and aquatic weeds removal into their design. Any dewatering area proposed should be suitable for maintenance vehicle access. The area should be positioned as close as practical to the constructed wetland/drainage channel, be an adequate size and designed to contain the excavated material and associated runoff. The dredge spoil area will not only meet the needs of the developer during the construction and operational phases. Dredge spoil areas must be identified and approved by council prior to any excavation.

Dredge spoil areas are to be retained for the duration of the construction and operational phases of the wetland/drainage canal that is being maintained.
The developer must determine dredge spoil area locations based on the following criteria:

(1) Estimated amount and frequency of dredge material to be dewatered;

(2) Proximity to existing residential and commercial properties;

(3) Proximity to proposed wetland/drainage channel; and

(4) Potential for dredge spoil to emit offensive odours (ie high clay/weed content).

Editor's note—use Form A: Swales; Form A: Bioretention Systems; Form C: Constructed Wetlands from the Construction and Establishment Guidelines.

SC6.4.6.1.6 Saltwater intrusion

Section 4.9 of the Construction and Establishment Guidelines lists potential failures. Saltwater intrusion should be considered as an additional defect or failure.

Table SC6.4.6.1.1 Potential failure scenarios for swales and rectification actions

Defect or Failure	Causes	Rectification
Saltwater Intrusion	Physical disturbance/excavation of clay liner during routine maintenance works. Drying/cracking of clay liner during routine maintenance and system resetting works. System overtopping during Highest Astronomical Tide (HAT): (1) System should be designed for highest expected tide over lifespan of asset; and (2) Overtopping in tidal areas during storm surge and heavy rainfall typically appears manageable due to stratification of fresh on salt during high tides. This should be taken into account. Poor design/construction. No liner present. Low lying wetland encroaching water table.	Provide supplementary water to lower salinity of intruded water and/or leach accumulated salts from underlying soils. Review construction designs such as spill weir heights and clay liners for deficiencies/inefficiencies. Engage soil scientist and water sensitive urban design specialist to review soils/clay lining and species compositions if system fails.

SC6.4.6.2 Water supply

SC6.4.6.2.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the construction of water supply infrastructure including:

(a) mains up to DN600 nominal size; and

(b) small pump stations.

This sub-section excludes the construction of:

(a) reservoirs, including repainting of reservoirs;

(b) treatment plants;

(c) dams;

(d) headworks, including bores and weirs;

(e) dosing plant; and

(f) larger pump stations.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents, and, in particular, in accordance with the requirements of the *Water Supply Code of Australia* except as otherwise specified herein.

(2) Reference and source documents

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Water Supply Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub section, these references are identified by part and section numbers and enclosed in brackets thus (WSA Part, Section).

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works

Note—SC6.4.4.8 Standard drawings shall take precedence over the WSAA standard drawings. Where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards

Note—references in this sub-section or on the drawings to Australian Standards are noted by their prefix AS or AS/NZS. Where not otherwise specified in this sub-section or the drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS1112	*ISO metric hexagon nuts*
AS1152	*Specification for test sieves*
AS/NZS1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS1272	*Unsintered PTFE tape for thread sealing applications*
AS1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS1289.5.6.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Density index method for a cohesionless material*

AS1289.5.7.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid method)*
AS1349	*Bourdon tube pressure and vacuum gauges*
AS1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS1477	*PVC pipes and fittings for pressure applications*
AS1565	*Copper and copper alloys – Ingots and castings*
AS1579	*Arc welded steel pipes and fittings for water and waste water*
AS/NZS1594	*Hot-rolled steel flat products*
AS1627.4	*Metal finishing – Preparation and pre-treatment of surfaces - Abrasive blast cleaning of steel*
AS1646	*Elastomeric seals for waterworks purposes*
AS1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS1830	*Grey cast iron*
AS60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS2032	*Installation of PVC pipe systems*
AS2033	*Installation of polyethylene pipe systems*
AS2129	*Flanges for pipes, valves and fittings*
AS/NZS2280	*Ductile iron pipes and fittings*
AS2419.2	*Fire hydrant installations – fire hydrant valves*
AS2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS2566.1	*Buried flexible pipelines – Structural design*
AS/NZS2566.2	*Buried flexible pipelines – Installation*
AS2638	*Gate valves for waterworks purposes – Metal and resilient seated*
AS2837	*Wrought alloy steels – Stainless steel bars and semi- finished products*
AS/NZS3000	*Electrical installations (Wiring rules)*
AS/NZS3008	*Electrical installations – selection of cable*
AS3439	*Low voltage switchgear and control gear assemblies*
AS/NZS3518	*Acrylonitrile butadine styrene (ABS) compounds, pipes and fittings for pressure applications*
AS3571	*Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS3681	*Application of polyethylene sleeving for ductile iron piping*
AS3690	*Installation of ABS pipe systems*
AS3879	*Solvent cement and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings*
AS3862	*External fusion-bonded epoxy coating for steel pipes*
AS3952	*Water supply –Spring hydrant valve for waterworks purposes*
AS3996	*Access covers and grates*
AS/NZS4087	*Metallic flanges for waterworks purposes*
AS/NZS4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZS4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*
AS/NZS4321	*Fusion bonded medium density polyethylene coating and lining for pipes and fittings*
AS/NZS4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS4794	*Non-return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010

Water Services Association of Australia (WSAA) - *WSA 03 – 2011 - Water Supply Code of Australia*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control, 2008*

British Standard - *BS 410 - Specification for test sieves*

SC6.4.6.2.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub-section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by Townsville Water and Waste, the design drawings and this sub-section, an approval from Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M)

Unplasticised PVC (uPVC) and modified PVC (PVC-M) pipes and fittings for mains and suction pipes shall comply with AS/NZS1477 and AS/NZS4765, shall be suitable for use with rubber ring (elastomeric) seals complying with AS1646 joints and shall be of the class and size as shown on the Design drawings. (WSA 03 – 2011, Part 1, Section 4.)

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Acrylonitrile butadine styrene (ABS)

ABS pipes and fittings shall comply with AS/NZS3518 to the class, size, use, shape and colour as shown on the Design drawings and installed in accordance with AS/NZS2566.2 and AS3690.

ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS 3691.

(4) Glass reinforced plastic (GRP)

The use of this material is not permitted by council.

(5) Ductile iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS2280 and shall be of the class, size and lining, as shown on the Design drawings, and installed in accordance with AS/NZS2566.2. Jointing shall be with rubber rings (elastomeric), complying with AS1646, to the class and type as shown on the design drawings.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS4321, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline and fittings

Steel pipelines and fittings shall comply with AS1579 and AS/NZS1594 and shall be of the class, size, lining and coating as shown on the design drawings. (WSA 03 – 2011, Part 1, Section 4).

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric), complying with AS1646, unless shown otherwise on the design drawings.

The Contractor shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines.

(7) Copper pipe and fittings

Copper tube and fittings shall comply with AS1432 and shall be of the size and type as shown on the design drawings.

The Contractor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the design drawings (WSA 03).

(8) Polyethylene (PE)

Polyethylene pipe shall comply with AS/NZS4129 and AS/NZS4130 and shall be of the class and size as shown on the design drawings and installed in accordance with AS2033 (WSA 03 – 2011, Part 1, Section 4).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

Fittings up to 110mm shall comply with AS/NZS4129. Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS2280 and coated internally and externally in polyethylene in accordance with AS/NZS4129.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(9) Steelwork

Structural steelwork, including ladders, brackets, and covers, complying with AS1657, shall be abrasive blast cleaned to AS1627.4 Class 2.5 and hot dip galvanised to AS/NZS4680. (WSA 03 – 2011, Part 1, Section 4.)

SC6.4.6.2.3 Valves and hydrants

(1) General

The Contractor shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that the valves and hydrants are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer’s recommendations, the requirements shown on the design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03 – 2011, Part 2, Section 15.13.)

The type of external corrosion protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS3862 and AS/NZS4321 or thermal-bonded polymeric coating to AS/NZS4158.

Flanges shall comply with AS2129 and AS4087 and shall be of the class and size shown on the design drawings.

(2) Stop valves

Sluice valves shall be resilient seated valves manufactured in accordance with AS2638. The valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Drawings (WSA 03 - 2011 Part 1, Section 8.2).

Ball valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Butterfly valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Knife Gate valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Scour valve assemblies shall be as shown on the Design drawings.

Valves shall be operated by a removable key. The Contractor shall size “Tee Key” valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels, where specified, shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

(3) Air valves

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80, and shall be installed as shown in the Design drawings (WSA 03 – 2011 Part 1, Section 8.4).

Air valves shall be installed such that they can be maintained without affecting supply.

The Contractor shall obtain the consent of Water Authority for the use of other types of air valves.

(4) Non-return valves

Non-return valves shall be of the swing check type to AS3578 or AS4794 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway (WSA 03 – 2011 Part 1, Section 8.5). Wafer style non-return valves shall not be used.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body.

Where shown on the design drawings, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS1449, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition.

No flow switches shall have the following features:

(a) be of the eccentric cam operated limit switch type.

(b) have a minimum rating of 10 amps, 240 V AC, 50- Hz.

(c) be oil tight and dust proof to IP 65.

(d) be suitable for 25mm conduit entry.

(e) be mounted on rigid stainless steel complying with AS1449 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

(5) Spring hydrants

Spring hydrant bodies shall be manufactured in accordance with AS3952 and installed in accordance with AS2419.2 except as varied below (WSA 03 - 2011 Part 1, Section 8.8).

The top of spring hydrants shall be between 100mm and 300mm below finished surface level as detailed in SC6.4.4.8 Standard drawings SD-350. If necessary, this shall be achieved by the use of hydrant risers of various heights.

Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS4158, or equivalent protection approved by the Superintendent.

(6) Pressure reducing valves

Pressure reducing valves shall be of the type as shown on the design drawings.

Pressure reducing valves shall be installed with isolating valves to facilitate maintenance.

SC6.4.6.2.4 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent for approval prior to the release of the hold point.

The Contractor shall not change the pipeline alignment without prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the mains and pump stations, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the design drawings. The pipelines shall be laid to grades and locations shown on the design drawings and to tolerances in the Water Supply Code unless directed otherwise by the Superintendent (WSA 03 – 2011, Part 2, Section 21). The Contractor shall confirm the locations immediately prior to construction (WSA 03 – 2011, Part 2, Section 11).

(3) Cover over pipelines

The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be in accordance with SC6.4.4.8 Standard drawings SD-325:

Lesser cover may be provided where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent.

The maximum cover shall be 1200mm, however, greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

(4) Crossings

Where a pipeline crosses a road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (WSA 03 - 2011 Part 2, Section 15.16.) The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested. The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the mains. The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 03 – 2011 - Part 2, section 15.15).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1m behind the back of kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings or as directed by the Superintendent within the specified tolerances.

With excavation near existing underground services and structures, the Contractor shall be responsible in obtaining approval of the appropriate Authority and comply with all the requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners (WSA 03- 2011, Part 2, Section 13). The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense.

The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossings across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise all affected residents beforehand. All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control.*

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 - 2011 Part 2, Sections 13.1 and 13.2.)

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table SC6.4.6.2.1.

Table SC6.4.6.2.1 Minimum trench widths

NOMINAL SIZE OF PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
100	450	450
150	450	450
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved or improved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges. The Contractor is responsible in obtaining approval from the relevant Authority and/or owner before starting any excavation across paved or improved surface.

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Excavation depth

The Contractor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains to be laid on other than rock foundations or as otherwise shown on the design drawings.

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

(8) Support of excavation

The Contractor shall adequately support all excavations to statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls (WSA 03 – 2011 Part 2, Section 13.5).

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(9) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent’s approval of the excavated trench is required prior to the release of the hold point.

Crusher screenings shall only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations. (WSA 03 – 2011 Part 2, Section 14.)

Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench. The bedding material shall conform to the sands classification described in SC6.4.4.8 Standard drawings SD-370, either loose clean sand and /or medium dense clean sand.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) as shown in Figure 5.1 in AS2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Table SC6.4.6.2.2, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above provided also that the material meets the requirements for passing sieve sizes 9.5mm and 6.7mm shown in Table SC6.4.6.2.2:

Table SC6.4.6.2.2 Grading of bedding material for PVC and PE pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5 mm	3/8 inch	100
6.7 mm	1/4 inch	90 - 100
425 µm	No. 36	40 - 90
150 µm	No. 100	0 - 10

All mains laid on grades steeper than 50% shall be encased in concrete as detailed on the design drawings.

(10) Laying and jointing of pipes

Unless detailed otherwise in this sub-section, the Contractor shall install pipes in accordance with AS/NZS2032, AS2033, AS/NZS2566.1 or AS3690 as appropriate (WSA 03 - 2011 Part 2, Sections 15, SC6.4.4.8 Standard drawings SD- 315 and SD-320).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll-on or skid type or, where shown on the Design drawings, mechanical joints, either fixed flange or bolted gland type.

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Pipes may be cut as needed or directed by the Superintendent to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engined pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the

Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

The Contractor shall conform to the relevant statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes and submit a method statement for approval of the Superintendent.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2o or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface. Detectable identification tape shall be laid along the line of non-metallic mains within 150mm of the finished surface (SC6.4.4.8 Standard drawings SD-325).

(11) Trench stops

Where a pipe is laid on bedding at a grade of 5% to 14%, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed: (SC6.4.4.8 Standard drawings SD-374)

(a) at the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level; and

(b) the bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$$D = \frac{100}{G}$$, whereby

D = Distance between stops in m

G = Grade of pipe expressed in %.

(12) Concrete bulkheads

Where a pipe is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads. Where a pipe is installed at a grade 30% to 50%, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is to be installed at a grade of 50% or more the Contractor shall provide a site specific design. Bulkheads shall be of 25MPa concrete complying with SC6.4.6.28 Minor concrete works, 150mm minimum thickness as follows: (SC6.4.4.8 Standard drawings SD-374 and WSA 03 – Part 2, Section 15.10)

(a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 300mm below finished surface level or such other level as directed by the Superintendent.

(b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.

(c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick

surround of gravel 2 to 10mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula:

Concrete bulkhead (grade of 15% to 29%)

$$D = \frac{L}{G}$$

Concrete encasement (continuous) and concrete bulkhead (grade of 30 per cent to 50 per cent)

$$D = \frac{100}{G}$$, whereby

L = 80 X Pipe length, m

= 450m max

if L> 100m use intermediate trench stops at spacing < 100/G

D = Distance between bulkheads in m

G = Grade of pipe expressed in %

(13) Valve and hydrant chambers

The Contractor shall construct around each valve and hydrant a chamber of the type and to the details shown on the Design drawings (WSA 03 – 2011, Part 2, Section 15.13).

The concrete shall comply with SC6.4.6.28 Minor concrete works.

Valve chamber covers shall be painted with white pavement marking paint while hydrant chamber covers shall be painted with yellow pavement marking paint.

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Contractor shall either wrap the valve using a tape consisting of synthetic fibre open weave cloth impregnated with saturated hydro-carbons, applied in accordance with the valve manufacturer's written instructions, or apply at least one coat of corrosion preventing material to the valve body after the valve has been installed but before backfilling. The coating material shall be compatible with the coating material which has been applied to the valve prior to delivery.

(14) Chamber covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

Tolerances for the dimensions on the COVER shall be - 3mm + NIL.

Tolerances for the dimensions on the FRAME shall be - 3mm + 3mm.

Covers shall be seated as shown on the design drawings or as directed by the Superintendent.

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 25mm above the surface of the ground, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

Cast iron covers and frames shall be manufactured in accordance with AS3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

The Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

(15) Service connections

Not applicable.

(16) Thrust and anchor blocks

Thrust and anchor blocks shall be constructed where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur (SC6.4.4.8 Standard drawings SD-371 and WSA 03 – 2011, Part 2, Section 15.7).

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(17) Concrete encasement

The use of Concrete encasement shall not be permitted unless otherwise approved by the Townsville Water and Waste.

(18) Wrapping of pipelines

Where shown on the design drawings, the Contractor shall enclose a pipeline or a section thereof, in lay-flat polyethylene sleeving (WSA 03 – 2011, Part 2, Section 15.11).

The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2 mm polyethylene film approved by the Superintendent and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

For dual trenching, pipelines shall be identified by colour sleeving, blue stripe for potable water and lilac for recycled water, or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 25 0mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeving material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene sleeving before, during or after backfilling of the trench.

(19) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer’s recommendations or as directed by the Superintendent. Bolts and nuts shall be dry, clean and

free from rust immediately before wrapping.

SC6.4.6.2.5 Pipeline testing and restoration

(1) Testing of pipelines

The hydrostatic pressure testing shall be conducted in accordance with Section 6 and Appendix M of AS/NZS 2566.2.

The Contractor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled provided that:

(a) if so specified, or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall flush and clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1200 kPa.

The Contractor shall maintain the specified test pressure as long as required by the Superintendent while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing of a section shall be considered to be satisfactory if:

(a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) there is no visible leakage;

(c) the measured leakage rate for pipes other than PE does not exceed the permissible leakage rate as determined by the following formula:

$Q_1 = 0.14DLH$

where:

Q_1 = permissible leakage rate (litres per hour)

D = nominal diameter of pipe (m)

L = length of section tested (km)

H = average test head (m): and

(d) for PE pipes:

$V_2 \leq 0.55V_1 + 0.14DLH$
where:
V_1 = water volume (litres) added between Hour 2 and Hour 3 to maintain test pressure
V_2 = water volume (litres) added between Hour 4 and Hour 5 to maintain test pressure
D = nominal diameter of pipe (m)
L = length of section tested (km)
H = average test head (m)

Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the defects liability period shall be made good by the Contractor at the Contractor's expense. This constitutes a hold point.

Unless directed by the Superintendent, the maximum test length shall be 1000m.

(2) Connection to existing pipes

Connections to existing pipes carrying water shall be made at such times as will cause the least interference with the supply. The Contractor shall make arrangements with Townsville Water and Waste or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants. The Superintendent shall be given 5 working days notice of such arrangements (WSA 03 – 2011 Part 2, Section 22.).

(3) Disinfection and flushing of pipelines

The Contractor shall disinfect all water mains after satisfactory testing in accordance with this sub-section (WSA 03 – 2011 Part 2, Section 20). The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of Townsville Water and Waste. All test results submitted are required to be NATA certified.

After disinfection and testing is completed, the Contractor shall flush all water mains to ensure that the disinfected water used in the process do not enter sections of the system already in service. Flushing and disposal of disinfected water shall be in accordance with WSA 03 – 2011 Part 2, Section 20.2.

(4) Bacteriological testing

(a) General

Disinfection of a water main may be required to ensure suitable water quality parameters are maintained. When disinfection of a main is required, bacteriological testing of the disinfected water must be undertaken.

Disinfection may also be required where there is a likelihood of contamination. A bacteriological test must also be undertaken on all new disinfected mains following satisfactory completion of swabbing/flushing and pressure testing of the water main.

(b) Test procedure

Water mains shall be tested as follows:

(i) scour past the sampling point;

(ii) engage a NATA registered laboratory to collect representative water samples from the test section of the water main; and

(iii) dispose of testing water in accordance with the relevant environmental Regulator and/or Water Agency requirements.

(c) Satisfactory bacteriological test

The water main will be deemed compliant if:

(i) the test results fall within the water quality parameter limits specified in the Table SC6.4.6.2.3; or

(ii) the water quality parameter test results in the test section of water main are no worse than the water quality parameter test results measured by testing an influent sample of existing mains water, provided that the influent sample was collected by the NATA registered laboratory at the

same time as water sample from the test section of water main was collected.

Table SC6.4.6.2.3 Water quality parameter limits

Water quality parameter	Unit	Acceptable range
pH	-	6.8–8.5*
Chlorine (free)	mg/L	0.5–2.0
Total Coliform count	cfu/100mL	0
Faecal Coliform count or E.Coli count	cfu/100mL	0
Heterotrophic Plate count	cfu/mL	0–10

* for cement mortar lined mains an upper level pH of 9.2 is acceptable

For failed tests, the water main shall be swabbed, flushed and/or disinfected and then re-tested. This shall be undertaken until all test results are satisfactory.

(5) Backfill and compaction

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to the commencement of trench backfilling. The Superintendent's approval to the laid and jointed pipes is required prior to the release of the hold point. Backfill shall not be placed until the Superintendent has given approval.

Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified SC6.4.6.2.4(9) Pipe bedding. The material shall be compacted in layers of not more than 150mm to a Density Index of 70 as determined in accordance with AS1289.5.6.1 and with reference to WSA 03 – 2011, Part 2, Section 16.3.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 03 – 2011, Part 2, Section 17).

(a) where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be (WSA 03 – 2011, Part 2, Section 17):

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits detailed herein for pipe bedding, and compacted to Density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials:

(A) below 0.3m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(b) elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS1289.5.7.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor shall carry out compaction tests 75mm to 100mm below the level being tested.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above.

The Contractor may compact backfill by trench flooding only where:

(i) the ground and backfill material is cohesionless sand;

(ii) water for flooding has been sourced at the site;

(iii) the process will not create mud which would be moved off site by vehicles or construction plant. The process is closely monitored to ensure adequate volumes are added to sufficiently compact the materials to achieve the compaction requirements as specified in WSA 03 – 2011, Part 2 – Table 19.1; and

(iv) additives are not used.

(6) Valve and hydrant marking

The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with SC6.4.4.8 Standard drawings SD-345 and/or shall be consistent with the method(s) in use by Townsville Water and Waste.

Where, in the opinion of the Superintendent, a valve or hydrant is at too great a distance from any existing wall, fence, kerb face, or post, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the valve or hydrant in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions;

(b) when installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm; and

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall fix marking plates as soon as practicable after each valve or hydrant is installed. However, the Contractor shall temporarily cover marking plates for hydrants using masking tape or other approved cover which the Contractor shall remove on satisfactory completion of the pressure testing of the pipeline.

For hydrants, the Contractor shall affix blue two-way reflective raised pavement markers to the road pavement in accordance withSC6.4.4.8 Standard drawings SD-345.

(7) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with turf imported from a source approved by the Superintendent (WSA 03 – 2011, Part 2, Section 23). The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored

surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel, asphaltic concrete or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Contractor shall level trenches at the time of backfilling or otherwise as directed by the Superintendent. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.2.6 Pump stations

(1) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS1830 Gr T200
Wear rings	Cast iron AS1830 Gr T200
Impeller	316 Stainless steel AS1449
Impeller nut	Gunmetal AS 1565-905C
Shaft	316 Stainless steel AS2837
Shaft sleeve	Phosphor bronze AS1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS1565-9060
Gland	Cast Iron AS1830 Gr T200
Gland studs	316 Stainless steel AS 2837
Gland nuts	316 Stainless steel AS2837
Fixing nuts and bolts handhold	316 Stainless steel AS2837
Covers	316 Stainless steel AS1449
Fitted bolts and nuts, casing and dowels	316 Stainless steel AS2837
Forcing screws	316 Stainless steel AS2837
Water thrower and drip tray	316 Stainless steel AS1449
Pump set base plate	Cast iron AS1830 Gr T200/Fabricated steel
MOTOR	

Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	316 Stainless steel AS2837
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

The Contractor shall provide a written warranty from the Manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The Manufacturer's warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two years after the date of delivery of any piece of equipment used in Work under the Contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS1111 and AS/NZS1112 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS1449 and AS2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(2) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150mm and larger. In pipework less than 150mm, gauges and fittings shall be screwed into a tapping band. Where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(3) Electrical compliance

The Works shall be in accordance with the requirements specified in SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the Design drawings indicate otherwise. The technical requirements detailed on the Design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS/NZS3000, the service rules of the supply authority and all relevant statutory authorities.

The Contractor shall supply the Superintendent a proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(4) Switchgear and control gear assembly (SCA)

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

Starter contactors shall have the appropriate rating for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Design drawings.

The Contractor shall liaise with the electricity supply authority to supply pad locks for the metering equipment, at the Contractor’s expense. The Superintendent shall supply pad locks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current: 14kA for 1 second.
Peak Factor: 2.2
Power Factor Correction (Determined in consultation with Townsville Water and Waste)
Earthing (M.E.N. system)

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type “2” co ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to standard specification TCC24 clause 18 for starter selection requirements and functional specification

for the project.

The Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with the requirements stipulated in SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS3439.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall ensure, after approval has been given by the Superintendent, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(5) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority’s requirements, with a minimum 500mm below the finished ground level in non-trafficable areas and 600mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words “DANGER – ELECTRIC CABLES BELOW” or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read “DANGER – ELECTRICAL CABLES BELOW”. The Superintendent’s approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer’s connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers’ mains shall be sized to satisfy the following requirements:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum;

(b) be sized for a voltage drop less than 1.5% to the maximum demand as calculated;

(c) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS/NZS3000 and AS/NZS3008.

In addition to the requirements of the Supply Authority and as specified in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines) the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the Queensland Electricity Connections and Metering Manual.

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(6) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in";

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc.,

depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc.) including setting and adjustment of equipment in accordance with the requirements in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines).

The Contractor shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel.

(7) Practical completion of pump station

The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of Operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(8) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall operate automatically by control signals from the telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(9) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor's name, address and telephone number;

(ii) client's contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list;

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling - type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures: for switching and isolating the supply and distribution system;

(ii) description of operation;

(iii) maintenance procedures: recommended maintenance periods and procedures;

(iv) tools: particulars of maintenance equipment and tools provided, with instructions for their use.

(v) equipment: a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling: where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts: a list of the spare parts provided.

(10) Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

(11) Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.2.7 Construction compliance

(1) Work-as-executed details and operation and maintenance manual

The Contractor shall submit to the Superintendent work-as-executed drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals.

Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

SC6.4.6.3 Sewerage system

SC6.4.6.3.1 Introduction

(1) Scope

This sub-section is for the construction of the following:

(a) gravitation sewers up to DN600 nominal size;

(b) common effluent sewers, both gravity and pressurised;

(c) vacuum sewerage systems;

(d) rising mains up to DN600 nominal size;

(e) standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers; and

(f) small pump stations, usually limited to single wells with submersible pumps.

This sub-section excludes the construction activities for:

(a) treatment plants;

(b) headworks;

(c) dosing plant;

(d) larger pump stations; and

(e) works controlled by others, including overflow management.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents and, in particular, in accordance with the requirements of the Water Services Association of Australia publications WSA 02-2014 – *Gravity Sewerage Code of Australia*, WSA 07 – 2005 - *Sewerage Pumping Station Code of Australia*, and WSA 07-2011 *Pressure Sewerage Code of Australia*, except as otherwise specified herein. Sewerage works should be designed in accordance with SC6.4.3.21 Townsville Water planning and design guidelines in conjunction with Department of Energy and Water Supply's *Planning Guidelines for Water Supply and Sewerage.*

For the purposes of this sub-section, "access chambers" are referred to as "maintenance holes".

(2) Reference and source documents to be read and applied in conjunction with this policy is sub-section are as follows:

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Sewerage Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub-section, these references are identified by edition, part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section).

(a) Development manual planning scheme policy sub-sections:

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works
SC6.4.6.30 Control of traffic

Note—where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards:

Note—references in this sub-section or on the design drawings to Australian Standards are noted by their prefix AS or

AS/NZS. Where not otherwise specified in this sub-section or the design drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS 1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS 1112	*ISO metric hexagon nuts,*
AS 1152	*Specification for test sieves*
AS/NZS 1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS 1272	*Unsintered PTFE tape for thread sealing applications*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1	Methods of testing soils for engineering purposes – Soil compaction and density tests- *Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid Method)*
AS 1349	*Bourdon tube pressure and vacuum gauges*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS 1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 1565	*Copper and copper alloys – Ingots and castings*
AS 1579	*Arc welded steel pipes and fittings for water and wastewater*
AS/NZS 1594	*Hot-rolled steel flat products*
AS 1627.4	*Metal finishing – Preparation and pre-treatment of surfaces- Abrasive blast cleaning of steel*
AS 1646	*Elastomeric seals for waterworks purposes*
AS 1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS 1741	*Vitrified clay pipes and fittings with flexible joints – sewer quality*
AS 1830	*Grey cast iron*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 2032	*Installation of PVC pipe systems.*
AS 2033	*Installation of polyethylene pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS/NZS 2280	*Ductile iron pipes and fittings*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS 2566.1	*Buried flexible pipelines – Structural design*
AS/NZS 2566.2	*Buried flexible pipelines – Installation*
AS 2837	*Wrought alloy steels – Stainless steel bars and semi-finished products*
AS/NZS 3000	*Electrical installations (Wiring Rules)*
AS/NZS 3008	*Electrical installations –Selection of cables*
AS 3439	*Low voltage switchgear and controlgear assemblies*
AS 3518	*Acrylonitrile butadine styrene (ABS) compounds pipes and fittings for pressure applications*
AS 3571	*Glass filament reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS 3578	*Cast iron non-return valves for general purposes*
AS 3681	*Application of polyethylene sleeving for ductile iron pipelines and fittings*
AS 3690	*Installation of ABS pipe systems*
AS 3972	*General purpose and blended cements*
AS 3996	*Access covers and grates*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure)*
AS 4060	*Loads on buried vitrified clay pipes*
AS/NZS 4087	*Metallic Flanges for waterworks purposes*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS 4198	*Precast concrete access chambers for sewerage applications*

Note—read “maintenance hole” for “access chamber”

AS 4321	*Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS 4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS 4794	*Non return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010
Water Services Association of Australia (WSAA):

WSA 02-2014 - *Gravity Sewerage Code of Australia*
WSA 04-2005 - *Sewerage Pumping Station Code of Australia*
WSA 05-2013 - *Conduit Inspection Reporting Code*
WSA 07-2007 - *Pressure Sewerage Code of Australia*

British Standard - BS 410 - *Specification for test sieves*
International Erosion Control Association (IECA) - *Best Practice Erosion and Sediment Control*.

SC6.4.6.3.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the design drawings.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by the Townsville Water and Waste, the design drawings and this sub-section, an approval from the Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M) pipe and fittings

Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class and size as shown on the design drawings (WSA 02- 2014, Part 2, Section 13.).

Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings. Modified PVC (PVC-M) pipes and fittings shall comply with AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Polyethylene (PE) pipe and fittings

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the design drawings and installed in accordance with AS 2033 (WSA 02-2014, Part 2,Section 13.).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(4) Glass reinforced plastic (GRP) pipe and fittings

Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the design drawings and installed in accordance with AS/NZS 2566.1 (WSA 02-2014, Part 2, Section 13.).

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of cover.

(5) Ductile iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the design drawings and in accordance with WSA 02-2014, Part 2, Section 13.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be thermal bonded polymeric coated, in accordance with AS/NZS 4158, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design drawings or as specified in WSA 02- 2014, Part 2, Section 13.

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric) unless shown otherwise on the design drawings.

(7) Vitrified clay

Vitrified clay (VC) pipes and fittings shall comply with AS 1741 and shall be of the class of pipe, complying with the loading requirements of AS 4060, and size as shown on the design drawings and suitable for rubber ring (elastomeric) joints (WSA 02-2002, Part 2, Section10).

(8) Precast maintenance holes (MH)

Precast maintenance hole components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-2014, Part 2, Section 17.2).

If approved by the Superintendent, precast systems, complying with the drawings, may be used in lieu of cast in-situ systems (WSA 02-2014, Part 2, Section 17.2.2). Precast system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(9) Preformed maintenance shafts (MS) and terminal maintenance shafts (TMS) including cover

Preformed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-2014, Part 2, Section 17).

(10) Maintenance hole covers and frames

Cast iron maintenance hole covers and frames shall comply with AS 3996 and shall be of a type that is flush top cast cover, identifiable as SEWER, size, opening and class as shown on the design drawings. Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(11) Steelwork

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanised to AS/NZS 4680.

SC6.4.6.3.3 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent prior to the release of the hold point (WSA 02-2014, Part 2, Section 16.).

The Contractor shall not change the pipeline alignment without the prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the sewers, maintenance holes, rising mains and pump stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers and the classes of pipes shall be as shown on the design drawings. The Contractor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Superintendent. The Contractor shall lay pipelines to grades and locations shown on the design drawings unless directed otherwise by the Superintendent (WSA 02-2014, Part 2, Section 16.).

(3) Cover over pipelines

The minimum depth of cover to be provided over pipelines shall be as follows: (WSA 02-2014, Part 1, Section 5.6.3).

LOCATION	MINIMUM COVER (mm)
Private property non vehicular new developments	600
Private property non vehicular existing developments	450
Private residential property subject to vehicular loading	750
Footpaths, sealed roads (non arterial)	900
Unsealed roads	1200
Arterial roads	1200

Lesser covers may be permitted where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent (WSA 02-2014, Part 1, Section 5.6.3.)

(4) Crossings

Where a pipeline crosses a main or state road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. The Contractor shall obtain the written approval from the Authority prior to

commencement of work. Such written approval shall be supplied to the Superintendent if requested.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the sewer mains. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 02-2014, Part 2, Section 14.12).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1.0 m behind the back of the kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings, or as directed by the Superintendent, within the specified tolerances.

Prior commencement of excavation, the Contractor shall be responsible in obtaining approval from the appropriate Authorities and shall comply with all requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor’s expense. The Contractor shall give notice of any interference to the works caused by an existing service and submit a proposed work method statement.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control*.

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in Table SC6.4.6.3.1 (SC6.4.4.8 Standard drawings SD-460).

Table SC6.4.6.3.1 Minimum trench widths

Nominal size of PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
80	400	350
100	400	350
150	450	400
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting, or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges (WSA 02-2014, Part 2, Section14.7).

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Maximum trench width

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table SC6.4.6.3.2.

The Superintendent may, however, restrict the width of trench due to local conditions. The Superintendent shall not restrict the width of trench to less than as shown in column (iii) of Table SC6.4.6.3.2.

Where the depth to invert exceeds that shown in column (ii) of Table SC6.4.6.3.2 – Maximum trench widths, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in column (iii) of Table SC6.4.6.3.2.

Table SC6.4.6.3.2 Maximum trench widths

Nominal size of pipe (mm) (i)	Maximum depth to invert, unlimited width trench (m) (ii)	Maximum trench width, depths greater than in column (ii) (mm) (iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150 mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400 mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580 mm plus the outside diameter of the pipe barrel.

The Contractor shall supply a method statement of any special construction control, where shown on the design drawings, to the Superintendent's approval.

(8) Excavation depth

The Contractor shall excavate trenches to a minimum of 100 mm below the underside of the pipe barrel and socket or coupling except for rising mains to be laid on other than rock foundations or as otherwise shown on the design drawings (SC6.4.4.8 Standard drawings SD 461).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

(9) Support of excavation

The Contractor shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls.

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(10) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent's approval of the excavated trench is required prior to the release of the hold point, or where sewers are to be located in water charged ground (present or predicted to occur) will require specialist geotechnical analysis and design. The contractor shall inform the Superintendent immediately upon encountering ground water and await further direction.

Crusher screenings may only be used for pipe bedding where sand or other non- cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations.

Pipes for gravitation sewers (excluding PVC/PE pipes), shall be bedded on sand or other non-cohesive material. Pipe bedding shall consist of a non-cohesive granular material, having a minimum thickness of 75 mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table SC6.4.6.3.3.

Table SC6.4.6.3.3 Grading of bedding material for pipes other than PVC and PE

Sieve size aperture width (AS 1152)	Equivalent BS sieve size (BS410)	Percentage passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90 - 100
425 µm	No. 36	40 - 90
75 µm	No. 200	0 - 10

Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100 mm below the barrel (SC6.4.4.8 Standard drawings SD-461) and socket of the pipe, where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Superintendent. The bedding material shall be either loose clean sand and /or medium dense clean sand or as directed by the Superintendent.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100 mm below the underside of the pipe barrel (SC6.4.4.8 Standard drawings SD-461) and socket, side support and overlay to a depth of 150 mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above, provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm as shown in Table SC6.4.6.3.4.

Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5mm	3/8 inch	100
6.7mm	1/4 inch	90 - 100
425µm	No. 36	40 - 90
150µm	No. 100	0 - 10

The Contractor shall bed all gravitation sewers laid on grades of 15 per cent to 50 per cent on 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works. Such concrete bedding shall have a thickness of at least 75 mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width shown in Table SC6.4.6.3.1 Minimum trench widths.

The Contractor shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50 per cent, in concrete as detailed on the design drawings.

(11) Laying and jointing of pipes

Unless detailed otherwise in this Specification, the Contractor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate (WSA 02-2014, Part 2, Section 16).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the

The Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Contractor shall remove any temporary supports prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the design drawings, mechanical joints (either fixed flange or bolted gland type).

For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Contractor, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Contractor shall withdraw the pipe and remake the joint.

For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1 mm from the end of the socket.

Pipes may be cut as needed, or directed by the Superintendent, to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol-engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

(a) for jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Contractor shall use a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.

(b) for jointing PVC/PE to ductile iron, the Contractor shall use a rubber ring (elastomeric) joint with an adaptor coupling.

The Contractor shall conform with the relevant Statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes.
Gravitation pipelines shall be constructed to the following tolerances:

(c) the maximum horizontal deviations to either side from the design axis of a pipeline shall be 20mm for all sizes of pipes (WSA 02-2014, Part 2, Section 22.1); and

(d) the invert level shall not deviate from the design grade line by more than 10 mm (WSA 02-2014, Part 2, Section 22.2).

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer’s written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2º or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main within 150 mm of

the finished surface or as otherwise directed by the Superintendent (WSA 02-2014, Part 2, Section 16.11.2 and SC6.4.4.8 Standard drawings SD-460).

(12) Connections to maintenance holes and structures

The Contractor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600 mm long pipes such that two flexible joints are provided, the first joint being at or within 150 mm of the face of the structure. The contractor shall not core any connections into wall sections of precast or cast insitu manholes <150 mm from any joint to the closest edge of core. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300 mm of the position shown on the drawings (SC6.4.4.8 Standard drawings SD-470 and SD484).

The Contractor may vary slightly the positions of maintenance holes shown on the design drawings, subject to final approval by the Superintendent immediately prior to construction, to suit changes, such as erection of structures, growth of flora and installation of services. The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole. Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

(a) for deviations from the design levels of maintenance holes as shown on the design drawings or as directed by the Superintendent during construction, the following tolerances shall apply (WSA 02-2014, Part 2, Section 22):

(i) where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

Pipe Tolerance
Inlet - nil; + 10 mm
Outlet - 10 mm; + nil; and

(ii) where the difference in levels, as above, is greater than 100 mm:

Pipe Tolerance
Inlet - 10 mm; + 10 mm
Outlet - 10 mm; + 10 mm; and

(b) allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

(13) Junctions and property connection sewers

The Contractor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this sub-section and the design drawings. Such junctions shall be inserted along pipelines in locations shown on the design drawings or directed by the Superintendent, with the service connection, where not shown on the design drawings, provided at a depth no deeper than 1.5 m provided the property still has service to the sewer, as follows:

(a) for existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies; and

(b) for vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75 m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75 m.

Concrete support shall be provided for the full trench width in accordance with SC6.4.4.8 Standard drawings SD-455 complying with sub-section SC6.4.6.28 Minor concrete works.

Except where concrete encasement is ordered by the Superintendent, the Contractor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500 mm upstream and downstream of the riser. Compaction density shall

be as for the requirements for the trench pipeline.

All property connection sewers and junctions shall have a minimum diameter of 150 mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10 m.

(14) Marking of junctions and property connection sewers

The Contractor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by Townsville Water and Waste and to the approval of the Superintendent (WSA 02-2014, Part 2, Section 16.9).

Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50 mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Elsewhere, the Contractor shall drive into the ground, a peg, 75 mm x 50 mm x 600 mm long at that position, and left flush with the surface of the surrounding ground. The Contractor shall connect the peg to an underground identification tape as specified hereafter.

The Contractor shall tie the identification tape to the junction or end of the property connection sewer, hold the tape in a vertical position during backfilling operations and finish tape flush with finished ground level.

The identification tape shall be 75 mm wide fawn coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200 mm.

(15) Trench stops

Where a sewer or rising main is laid on bedding at a grade of 5 per cent to 14 per cent, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed. Reference shall be made to SC6.4.4.8 Standard drawings SD-482 and SD-483.

(a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300 mm below finished surface level.

(b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.
The distance between trench stops shall be determined by the following formula:

D = 100, whereby G
D = Distance between stops in m
G = Grade of pipe expressed in per centum.

(16) Concrete bulkheads

Where a gravitation sewer or rising main is installed at a grade of 15 per cent to 29 per cent, the Contractor shall construct concrete bulkheads. Where a gravitation sewer or rising main is installed at a grade 30 per cent to 50 per cent, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where any sewer line is to be installed with a grade exceeding 50 per cent, the contractor must provide a site specific design to incorporate all aspects of the site conditions including soil conditions. Bulkheads shall be of 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works, 150 mm minimum thickness as follows: (SC6.4.4.8 Standard drawing SD-482, WSA 02-2014, Part 1, Section 9.10 and WSA 02-2014, Part 2, Section 16.6)

(a) where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 150 mm below finished surface level or such other level as directed by the Superintendent;

(b) where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench; and

(c) a 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula: (WSA 02-2014, Part 1, Section 9.10.)

Concrete bulkhead

$$S = \frac{L_P}{G}$$

Concrete encasement (continuous) and concrete bulkhead S = 100/G, whereby

L_P = 80 X Pipe length, m

= 450 m max

if L_P > 100 m use intermediate trench stops at spacing < 100/G

S = Distance between bulkheads in m

G = Grade of pipe expressed in per centum

(17) Thrust and anchor blocks for rising mains

The Contractor shall construct thrust and anchor blocks where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent where it is deemed that the allowable bearing pressure of the ground and the design pressure on the pipeline are different to the actual pressures on site. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume and dimension not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(18) Rising main fittings

The Contractor shall install rising mains, air release valves and inspection pipes where shown on the design drawings or directed by the Superintendent. All rising mains shall be topped with an appropriate identification tape.

The Contractor shall provide marking plates bearing the letters "DAV" for double air valves, "SCOUR" for scour pipes and "SRM" for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter. In urban areas, the kerb adjacent to each fitting is to be painted with 2 coats of non-slip paint coloured black.

Where, in the opinion of the Superintendent, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a

minimum 80 mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions.

(b) when installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by the Superintendent, its height above the ground shall be increased to 1500 mm.

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall encase in concrete pipes in gravity sewers or rising mains, as shown on the design drawings, with less than the specified cover above the top of the pipe barrel, or where directed by the Superintendent. Concrete shall be 20 MPa complying with sub-section SC6.4.6.28 Minor concrete works and have the following minimum dimensions (WSA 02-2014, Part 1, Section 9.7 and SC6.4.4.8 Standard drawing SD-463):

(a) for trenches in other than rock: 150 mm minimum under, on both sides and on top of the pipe barrel; and

(b) for trenches in rock: 100 mm minimum under the pipe barrel, 150 mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12 mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling.

Reinforcement in concrete encasement shall be as shown on the design drawings.

(19) Wrapping of pipelines

Where shown on the design drawings or directed by the Superintendent, the Contractor shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving (WSA 02-2014, Part 2, Section 16.10).

The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2 mm polyethylene film, approved by the Superintendent, and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench. The Contractor shall present the wrapped pipeline for inspection by the superintendent prior to commencing backfilling operations.

(20) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent consisting

of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

(21) Cast-in-situ maintenance holes

For all maintenance holes concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below (WSA 02-2014, Part 2, Section 17.2.3 and SC6.4.4.8 Standard drawings SD-470 and SD-476).

Cement used in all concrete shall be Type SR to AS 3972. The Contractor may use fly ash additive to a maximum 20 per cent. Cement used shall be no older than 3 months since manufacture.

The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

(22) Covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4 mm radius.

Tolerances for the dimensions on the COVER shall be – 3 mm + NIL.

Tolerances for the dimensions on the FRAME shall be -3 mm +3mm.

Maintenance hole covers shall be seated on a layer of bitumen impregnated fibre board, having a cross-section of 25 x 25 mm. Alternatively another seating material of a cross-section and composition approved by the Superintendent may be used.

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25 mm above the surface of the ground where not shown otherwise on the design drawings, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

In locations where shown on the design drawings or directed by the Superintendent, the Contractor shall install a cast iron cover and frame. Where it is evident, or otherwise shown on the design drawings, the Contractor shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding. Cast iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

(23) Preformed maintenance hole and maintenance shaft systems

The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Generally, preformed maintenance holes shall be made up in accordance with the design drawings, with components consisting of a base section, shaft sections, converter, cover and frame. Make-up Rings (1 only) of 100-150 mm may be used between converter section and cover to make up height differentials. The wall thickness of any reinforced component below the frame shall not be less than 84 mm.

Preformed maintenance shafts shall be made with section lengths that once constructed comprise the least amount of joints as required to satisfy height parameters and unit joint/wall penetration coring clearances.

The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements.

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to the required finished surface level according to location requirements. If

necessary, the Contractor shall import and compact non-cohesive granular material.

(24) Bedding and backfill compaction requirements

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling (WSA 02-2014, Part 2, Section 19). Backfill shall not be placed until the Superintendent has given approval.

Material for the bedding, side support and overlay of the pipe shall be as for pipe bedding specified in SC6.4.6.3.3(10) Pipe bedding. The material shall be compacted in layers of not more than 150 mm to a Density Index of 70 for the material used when determined in accordance with AS 1289.5.6.1.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows:

(a) Where the trench is within a roadway, proposed roadway, the remainder of the trench shall be:

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table SC6.4.6.3.3, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1:

(A) below 0.3 m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor is to submit to the Superintendent for approval any proposal for construction of embankments in conformance with the drawings, including the method of placement and compaction and any limitations to the placement/ compaction over the top of any pipeline.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above must be undertaken by the contractor.

The Contractor may compact backfill by trench flooding only where:

- the ground and backfill material is cohesionless sand;
- water for flooding has been sourced at the site;
- the process will not create mud which would be moved off site by vehicles or construction plant; and
- additives are not used.

The contractor shall carry out compaction tests to the full depth of zone being tested and present NATA certified test results to the Superintendent.

SC6.4.6.3.4 Pipeline testing and restoration

(1) General

The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and backfilling is completed (WSA 02-2014, Part 2, Section 21).
All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

Where a vacuum system has been specified, the Contractor shall test the system in accordance with the testing schedule as shown on the design drawings.

(2) Initial test of gravitation sewers

The Contractor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipe laying on the section shall be completed, and backfill shall be compacted to at least the level of the top of overlay section of trench filling. The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required.

The initial test shall not be carried out before risers and/or property connection sewers are constructed.

Where the Superintendent approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

(3) Initial test of maintenance holes

The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted.

Maintenance holes may be tested in conjunction with both upstream and downstream sections of mains using the low pressure vacuum method for the initial testing only in accordance with WSA 02-2014, Part 2, Section 21.4.2.2. It is advised that a pressure relief valve be installed inline with a maximum setting release of 50 kPa.

Alternatively, the Contractor may request to test manholes initially using hydrostatic means. The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole. The Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(4) Ovality test and CCTV inspection

The Contractor shall carry out deflection (ovality) testing in conformance with WSA 02-2014 Part 2, Section 21.6.2 upon completion of placement and compaction of trench and embankment fill. Submit proposal for deflection testing to the Superintendent for acceptance. Carry out a CCTV inspection of the sewer system and maintenance structures to WSA 05 Attachment E and WSA 02-2014 Part 2, Section 21.7 and SC6.4.2.2.6 Conduit assessment.

The Contractor shall undertake ovality testing as follows:

(a) all sewers to DN 300 shall be tested to determine any excessive ovality using either a proving tool approved by the council or by CCTV light ring and approved measurement software. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 14 days after backfill of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested (WSA 02-2014, Part 2, Section 21.6.2 & WSA 05-2013);

(b) the proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as specified in WSA 02-2014, Appendix K;

(c) the proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size and the prover outside diameter;

(d) Maximum Allowable Deflection = 3% of Mean Outside Diameter; and

(e) the testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.

(5) Acceptance test of gravitation sewers and maintenance holes

Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained. (WSA 02-2014, Part 2, Section 21.) The Contractor shall make the acceptance test on all components in the section of the sewer in the same manner and to the same methods as the initial test. The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

The Superintendent may permit hydrostatic testing as an alternative to air testing for acceptance of gravitation pipelines and maintenance holes after approval from council.

Where the project contains a combination of precast and cast insitu maintenance holes, then each group must be regarded as a separate population and testing frequencies shall be in accordance with WSA 02-2014, Part 2, Table 21.5.

The Superintendent may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

(6) Testing with compressed air

The Contractor shall supply and keep all necessary equipment in a condition acceptable to the Superintendent.

All test gauges must have a current calibration certificate and have a range that is suitable to be able to read decimal increments. The minimum diameter of readable face shall be 100 mm.

Sewer lines may be tested by either vacuum (negative pressure) or by positive pressure. The use of inline manhole through connectors can be utilised for ease of testing multiple lines. Manholes and sewer lines shall be tested separately.

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m^3/minute at 35 kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28 kPa ± 4 kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28 kPa ± 4 kPa and a gate valve to the pipeline to be tested.

The method of setting up and carrying out the test shall be as specified in WSA 02-2014, Part 2, Section 21.4.2.

(7) Allowable pressure drop times

The time taken for the pressure to drop from 25 kPa to 18 kPa shall be greater than that specified in WSA 02-2014, Part 2, Table 21.3.

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Contractor shall apply a hydrostatic test.

(8) Hydrostatic testing

The Contractor shall not carry out hydrostatic testing unless prior approved by the superintendent.

The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:

(a) for initial test:

(i) when no property connection sewers or risers are constructed – a minimum head of 2 metres above the pipe invert at the upstream end of the line under test; or

(ii) where property connection sewers and/or risers are constructed – a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers;

(b) for acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers, or above the free standing level of ground-water in the vicinity whichever is the higher; and

(c) such other lesser head as the Superintendent, at the Superintendent's discretion, may direct.

The Contractor shall determine, at the Contractor's expense, the free standing level of groundwater, by a method acceptable to the Superintendent.

After allowing an interval for absorption, to be determined by the Superintendent, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during ten minutes thereafter.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25 mm for each standard test length of the pipeline under test including property connection sewers and/or risers.

A standard test length in metres is defined as 1370 m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

(9) Visual inspection and measurement of infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500 mm or more above the soffit of the sewer main provided that groundwater is at least 150 mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration upon request to the Superintendent.

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured (WSA 02-2014 Part 2, Section 21.5).

If the Superintendent, at the Superintendent's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Superintendent shall determine the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:

Rate of Infiltration

$$Q.I. = 0.65 (L^1d^1h^1 + L^2d^2h^2 + \ldots\ldots\ldots L^nd^nh^n) + H^a$$

Where:

Q.I. = rate of infiltration in litres/hour

L = length of pipe in metres

d = nominal size of pipe in metres

h = average head of groundwater over the invert level of the pipe in the section under test

H^a = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the

maintenance hole is included in the infiltration test.

The Contractor shall determine the head of groundwater, by a method approved by the Superintendent.

(10) Testing of rising mains

The Contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Rising mains failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained (WSA 07-2007, Part 3, Section 21). The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled, provided that:

(a) if so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than 7 days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves. A maximum length of 1000 m can be tested in one continuous section unless otherwise approved by the superintendent.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to 1.25 times the maximum operating pressure of the pipeline but do not exceed 1.25 times the maximum operating pressure rating of the lowest rated pipe/fitting. The test procedure shall be in accordance with WSA 07-2007, Part 3, Section 21.4.

The Contractor shall maintain the specified test pressure for as long as required by the Superintendent, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing (pipes other than PE) of a section shall be considered to be satisfactory if:

- there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- there is no visible leakage; and
- the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

  $Q_1 = (0.14 \times D \times L \times H)$

  where:

  Q_1 = permissible leakage rate (litres per hour)

  D = nominal internal diameter of pipe (m)

L = length of section tested (km)
H = average test head (m)

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the defects liability period shall be rectified by the Contractor at the Contractor's expense. Where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the design drawings, and the failure is not, in the opinion of the Superintendent, the fault of the Contractor, the thrust or anchor block shall be strengthened or reconstructed as directed by the Superintendent. The cost of strengthening or reconstruction of such thrust or anchor block and the cost of retesting shall be paid as a Variation to the Contract, at such rates as are determined in accordance with the provisions of the General Conditions of the Contract.

For PE rising mains, testing shall be in accordance with WSA 07-2007, Part 3, Section 21.5.

Alternatively, the rising main may be tested by the use of compressed air. In this case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(11) Connection to existing sewers

The Contractor must request approval (request for private works quotation) for connection to existing sewers from Townsville Water and Waste. Works shall be either performed by the Sewer Agency or delegated to the contractor at the discretion of the Sewer Agency. Approval must only be requested upon satisfactory completion of all backfilling and testing. All necessary works required in completing connections to "live" maintenance holes (that is, accesses to sewer system that is currently in service), including all works undertaken by the Sewer Agency at "live" maintenance holes in delivering the works shall be the responsibility of the Contractor (WSA 02-2014, Part 2, Section 23).

(12) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by the Superintendent. (WSA 02-2014, Part 2, Section 24.) The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration. The Contractor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out in accordance with SC6.4.4.8 Standard drawings SD-055 to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would

not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Superintendent may order the Contractor to level trenches at the time of backfilling. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.3.5 Pump stations

(1) General

Provide only products and materials authorised by Townsville Water and Waste, the drawings and this specification. The Contractor shall submit for approval any alternative or not authorised products and materials.

The Contractor must conform to manufacturer's recommendations for handling, transport and storage of materials and in a manner to prevent damage or deterioration or excessive distortion. Inspect all products and materials at the time of delivery and reject products and materials not in conformance with this specification and the manufacturers' recommendations. Maintain protective crating or packaging until immediately before use.

Damaged or defective materials are not to be installed or used, including coatings and linings, outside the manufacturer's recommended limits.

(2) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	Cast iron AS 1830 Gr T200
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	316 Stainless steel/AS 1449
Impeller	Gunmetal AS 1565-905C
Impeller nut	316 Stainless steel/AS 2837
Shaft sleeve	Phosphor bronze AS 1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS 1565-9060
Gland studs	Cast Iron AS1830 Gr T200
Gland nuts	316 Stainless steel/AS 2837
Fixing nuts and bolts handhole	316 Stainless steel/AS 2837
Covers fitted bolts and nuts, casing and dowels	316 Stainless steel/AS 2837
Forcing screws	316 Stainless steel/AS 1449
Water thrower and drip tray	316 Stainless steel/AS 2837
Pump set base plate	316 Stainless steel/AS 2837
	316 Stainless steel/AS 1449
	Cast iron AS 1830 Gr T2000/Fabricated steel
MOTOR	Cast iron/Mild steel
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Mild steel
Motor fan cover	Metal
Motor fan	
HOLDING DOWN BOLTS	316 Stainless steel/AS 2837
MECHANICAL SEALS	Tungsten carbide or equal
Seal faces	Nickel chrome steel
Springs	Fluoro carbon or nitrile rubber
Secondary seal	

The Contractor shall provide a written warranty from the manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The manufacturer's warranty shall require the manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within 2 years after the date of delivery of any piece of equipment used in work under the contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS 1449 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(3) Preformed pump stations and package pump stations

Preformed components or systems, complying with the design drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided:

(a) preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units;

(b) joints shall be internal flush; and

(c) the Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Package pump stations may be supplied and installed provided:

(a) The proposed packaged system has been appraised and recommended by WSAA;

(b) all components comply with the requirements of this sub-section; and

(c) the units are at least equivalent to the requirements of this sub-section and the design drawings.

(4) Electrical compliance

The Works shall be in accordance with the requirements contained in clause SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the design drawings indicate otherwise. The technical requirements detailed on the design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where clause SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority and all relevant statutory authorities.

The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material, to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the Works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(5) Switchgear and control gear assembly (SCA), controls

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

The Contractor shall provide an effective barrier to prevent gases from the wet well entering the SCA.

Starter contactors shall have appropriate ratings for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design drawings.

The Contractor shall liaise with the electricity supply authority to supply padlocks for the metering equipment, at the Contractor's expense. The Superintendent shall supply padlocks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current:
14kA for 1 second. Peak Factor: 2.2
Power Factor Correction (determined in consultation with the Superintendent)
Earthing (M.E.N. system)
Characteristics

All cables shall enter the SCA from below:

The Contractor shall supply data from the switchgear supplier confirming Type “2” co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to Standard Specification TCC24 clause 18 for starter selection requirements and functional specification for the project.

The Contractor shall carry out of factory tests in the presence of the Superintendent's Representative and in accordance with clause SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS 3439. The Superintendent shall be given 7 days notice of the proposed date of such tests.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall pack the equipment for transport after satisfactory final factory inspection and tests, and after approval has been given by the Superintendent. The Contractor shall ensure that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

Automatic control of the pump station pumping equipment shall be by way of hydrostatic level sensor providing single pump duty operation unless shown otherwise on the drawings. The level sensor will be compatible with those in use in the system. A float switch shall be used to provide a HIGH HIGH(overflow) level alarm. Refer to TCC24 clauses18.2, 18.2, 19.1 and 19.2.

The following wet well levels shall be used in the automatic control of the pump operation system:

(a) STOP level;

(b) Duty Start level;

(c) Standby Start level; and

(d) High level.

Pump operation requirements are described in TCC24 clause 18.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(6) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read "DANGER – ELECTRICAL CABLES BELOW". The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers mains shall be sized to satisfy the following:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 per cent minimum;

(b) be sized for a voltage drop less than 1.5 per cent to the maximum demand as calculated;

(c) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS 3000 and AS 3008.

In addition to the requirements of the Supply Authority and clause SC6.4.3.21.4 Electrical and mechanical, the Contractor shall run the main earthing conductor in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the *Queensland Electricity Connections and Metering Manual.*

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(7) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS 1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band. On rising mains, where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(8) Valves

The Contractor shall ensure that the valves supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that valves are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer’s recommendations, the requirements shown on the design drawings, the type of connection, and lubrication of connecting bolts.

Flanges shall comply with AS 2129 to the class shown on the design drawings.

Unless shown otherwise on the design drawings, all valves shall be anti-clockwise closing.

The Contractor shall size “Tee” Key valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

One “Tee” key operator per pump station, of suitable length for operating the respective valve from the surface level, shall be provided for each size of valve installed in each pump station.

Non-return valves shall be of the swing check type to AS 3578 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve.

Each non-return valve shall have an extended spindle, minimum grade 316 stainless steel, fitted with an adjustable counterweight.

The knife gate valve shall be constructed in accordance with the following:

(a) the design shall include an enclosed bonnet;

(b) the spindle shall be of the non-rising type;

(c) valves shall be anti-clockwise closing;

(d) the gland around the spindle shall be adjustable or formed by a double O-ring;

(e) flange jointing shall be rubber O-rings; and

(f) seating shall be achieved by flexible seats which shall be designed in a manner that will allow easy replacement. The material of the seat is to be nominated.

All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required.

Each valve spindle shall be fitted with a cast steel or forged steel spindle guard secured to the valve spindle with a gun metal set screw or a handwheel secured to the spindle with gun metal set screw and washer.

Valves shall be drilled and threaded, where required, in accordance with AS 2129.

(9) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for “running in”;

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc., depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare, schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in accordance with SC6.4.3.21 Townsville water and planning design guidelines.

The Contractor shall arrange for all testing, commissioning and any adjustments.

(10) Practical completion of pump station

The Contractor shall fulfill the following requirements before the Certificate of Practical Completion can be issued which constitutes a hold point:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(11) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(12) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor’s name, address and telephone number;

(ii) client’s contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list; and

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling – type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures - for switching and isolating the supply and distribution system;

(ii) comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures);

(iii) maintenance procedures - recommended maintenance periods and procedures;

(iv) tools - particulars of maintenance equipment and tools provided, with instructions for their use;

(v) equipment - a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling - where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts - a list of the spare parts provided.

Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.3.6 Construction compliance

(1) As-constructed details and operation and maintenance manuals

The Contractor shall submit as-constructed drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals in accordance with SC6.4.7. Refer to SC6.4.3.21.3(5)(n) for the pump station documentation requirements.

Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details. The Contractor shall record on as-constructed drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.

The Contractor shall ensure that a registered surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

(2) Video records

Unless advised otherwise by the Superintendent, the Contractor shall provide a video recording of the internal condition of all mains. The video recording shall be undertaken at the time of practical completion of the Contract.

SC6.4.6.4 Stormwater drainage

SC6.4.6.4.1 Introduction

(1) Introduction

Drainage works shall form a complete system carrying water through and away from the Works.
This is the general sub-section common and applicable to all types of drainage lines, open drains, kerb and channel, and drainage structures and shall be read in conjunction with drainage specifications:

(a) SC6.4.6.6 Pipe drainage;

(b) SC6.4.6.7 Precast box culverts;

(c) SC6.4.6.5 Drainage structures; and

(d) SC6.4.6.9 Open drains.

(2) General scope

The work to be executed under this sub-section consists of:

(a) preparation for stormwater drainage construction;

(b) temporary drainage during construction;

(c) siting of pipes, pipe arches and box culverts;

(d) all activities and quality requirements associated with excavation and backfilling; and

(e) all concrete work associated with stormwater drainage.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(3) Extent of work

Details of the work are shown on the drawings. The extent of works under this specification is summarised as follows:

(a) pipe culvert stormwater drainage;

(b) precast box culvert stormwater drainage;

(c) drainage pits, headwalls, wingwalls and aprons;

(d) kerb and channel;

(e) open concrete dish drains;

(f) scour protection of open drains at outlets to drainage structures; and

(g) demolition and removal of existing redundant pipe culverts, headwalls and pits.

(4) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1597 - *Precast reinforced concrete box culverts*
AS/NZS2566.2 - *Buried flexible pipelines installation*
AS/NZS3725 - *Design for installation of buried concrete pipes*

(c) other:
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.4.2 Construction

(1) Temporary drainage during construction

(a) For each part of the drainage system, complete the erosion and sedimentation control measures before commencing the drainage works (except those parts of the drainage system forming part of the control measures). Measures for erosion and sedimentation control must be provided in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.

(b) The Contractor shall make adequate provision for runoff flows at drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities.

(c) The Contractor shall not implement any proposals to dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of council by way of approved drawings or written instruction.

(d) The Contractor's material and equipment shall be located clear of all watercourses.

(2) Siting of culverts

(a) Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the drawings, and shall present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the inlet or outlet locations or designed levels or the culvert length to suit actual site conditions. Any such amendments must ensure no negative impacts on neighbouring land parcels and existing properties. Prior approval must be sought from council.

(c) Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit the construction procedures, the Contractor shall present the proposed culvert set-out in addition to the designed set-out for consideration by the Superintendent and council. No changes shall be made unless prior written approval from council is obtained.

(3) Excavation

(a) Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with SC6.4.6.10 Earthworks (construction).

(b) In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(c) Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(d) Excavation by blasting, if permitted by council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert or drainage structure does not exceed 25mm per second. The Contractor shall comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(e) Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed by the Contractor.

(f) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable and inadequate to support the proposed drainage structure shall be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section and the sub-sections for particular culvert types. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert.

(g) The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(4) Backfilling

Backfilling shall be carried out in accordance with the requirements of the relevant culverts or drainage structures sub-sections and to the compaction requirements specified in SC6.4.6.4.2(5) Compaction.

In situ concrete structures are not to be backfilled in accordance with Clause 6.4.6.5.2 8(a) unless otherwise directed by the Superintendent.

The shape of the culvert must be checked by the Contractor during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure do not vary from the manufacturer's specified dimensions by more than ± 2% for pipes and pipe arches.

(5) Compaction

Foundations, bedding (other than for pipe drainage) and backfilling shall be compacted to the following requirements when tested in accordance with AS 1289.5.4.1 or AS 1289.5.7.1 for standard compactive effort.

Refer to Table SC6.4.6.4.3 for details of compaction and moisture tolerances.

Compaction requirements adjacent to pipe drainage for concrete, steel or UPVC pipes are set out in sub-section SC6.4.6.6 Pipe drainage.

(6) Concrete work

For all concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

(7) Sprayed concrete

If sprayed concrete has been specified, shown on the drawings or directed by the Superintendent, it shall comply with requirements in sub-section SC6.4.6.28 Minor concrete works.

(8) Construction traffic

If proposing to move heavy construction plant or vehicles over pipe or box culverts structures, provide verification and certification of protective measures to the Superintendent for confirmation and approval of protection measure proposed.

SC6.4.6.4.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.4.3 below:

Table SC6.4.6.4.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting**		
	(a) peak particle velocity	≤25mm/sec	SC6.4.6.4.2(3)
2.	**Relative Compaction (Standard)**		
	(a) Foundations or trench base to a depth of 150mm below foundation levels.	95%	SC6.4.6.4.2(5)
	(b) Material replacing unsuitable material.		
	(c) Bedding material.		
	(d) Selected backfill and ordinary backfill material: • other than sub-grade (sand 70% Density Index) • other than sub-grade (other than sand) • at sub-grade level to 300mm below • in a pavement zone		
	(e) Backfill material within the selected material zone.		
3.	**Backfill**		
	(a) Layers	≤ 150mm	SC6.4.6.4.2(5)
	(b) Moisture Content	>60%, <95%	SC6.4.6.4.2(5)

SC6.4.6.5 Drainage structures

SC6.4.6.5.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction of drainage structures and shall be read in conjunction with the sub-section SC6.4.6.4 Stormwater drainage, and other drainage specifications as applicable:

(i) SC6.4.6.6 Pipe drainage;

(ii) SC6.4.6.7 Precast box culverts; and

(iii) SC6.4.6.9 Open drains.

(b) This sub-section details the construction of headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators, batter drains and other supplementary structures.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editors note - A reference to drawings is a reference to construction drawings.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.4 - Stormwater drainage
SC6.4.6.6 - Pipe drainage
SC6.4.6.7 - Precast box culverts
SC6.4.6.9 - Open drains
SC6.4.6.28 - Minor concrete works

(b) Australian Standards
AS 3996 - *Access covers and grates*

SC6.4.6.5.2 Construction

(1) General

(a) Drainage structures shall be constructed in concrete and in accordance with sub-section SC6.4.6.28 Minor concrete works.

(b) All structures shall be constructed as soon as practicable and shall be completed not later than 28 days after the construction of the associated culverts, unless otherwise approved by the Superintendent.

(2) Alignment

(a) Unless otherwise shown on the drawings, headwalls and pits shall be constructed parallel to the road centreline and wingwalls at 120º to the headwall or as shown on the drawings.

(b) Where the culvert is laid skew to the road, the wingwalls and headwalls shall be splayed so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.

(c) Energy dissipaters shall be constructed in accordance with the drawings and with centreline on the axis of the culvert.

(3) Headwalls and wingwalls

(a) The wingwalls shall be constructed to retain the batters effectively. Where the dimensioned drawings do

not satisfy this requirement the Superintendent shall be notified before the headwalls and wingwalls are constructed. The Superintendent shall direct the Contractor as to the action to be taken. Where rock is encountered at the bottom of excavations for wingwalls and headwalls, and after approval is given by the Superintendent, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown in the drawings, but must be not less than 150 mm into sound rock.

(4) Pits

(a) All new pits, including access covers, gully grates and frames complying with AS 3996, shall be constructed to the details shown on the drawings. Modification of existing pits is only to be carried out if shown on the drawings.

(b) Where the full depth of the excavation is in sound rock, and the Superintendent approves, part of the concrete lining of gully pits and sumps may be omitted, provided that a neatly formed pit of the required dimensions is constructed. In all such cases the wall of the pit adjacent to and parallel to the road shall be constructed of concrete

(c) Inlet and outlet pipes shall be integrally cast into the pit at the time of pouring the concrete for the pit walls.

(d) Step irons are not required.

(e) A subsoil drain where required shall be installed into the pit or headwall in accordance with the general requirements in sub-section SC6.4.6.6 Pipe drainage.

(5) Precast units

(a) Where precast units including kerb inlet lintels, are provided in the design they shall be handled and installed in accordance with the manufacturer's instructions.

(b) If the Contractor proposes to use precast units, detailed drawings and complete details of installation procedures shall be submitted for the approval of the Superintendent.

(c) The Superintendent is required to adopt pre-cast units which are in accordance with council’s standard drawings and specifications unless otherwise agreed by council.

(6) Jointing

Where drainage structures abut concrete paving, kerb and channel or other concrete structures, a 10 mm wide joint shall be provided between the structure and paving, or kerb and channel or other concrete structures. The joint shall consist of preformed jointing material of bituminous fibreboard.

(7) Mass concrete bedding

(a) Mass concrete bedding for reinforced concrete bases shall not be placed on earth or rock foundations until the foundations have been inspected and approved by the Superintendent. Following such approval, the surface of the foundation shall be dampened and a layer of concrete not less than 50 mm thick, shall be placed over the excavated surface and shall be finished to a smooth even surface.

(b) Unreinforced concrete bases may be cast on earth or rock foundations without the mass concrete bedding.

(8) Backfill

(a) Backfilling shall not commence until the compressive strength of concrete has reached at least 15MPa unless otherwise approved by the Superintendent.

(b) Selected backfill shall be placed against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure.

(c) Selected backfill shall consist of a granular material in accordance with the requirements in sub-section SC6.4.6.6 Pipe drainage.

(d) Special care shall be exercised to prevent wedge action against vertical surfaces during the backfilling. Where the sides of the excavation are steeper than 4 horizontally to 1 vertically they shall be cut in the form of successive horizontal terraces at least 600 mm in width, as the backfill is placed.

(e) Backfill on both sides of the structure shall be carried up to level alternately in layers so as to avoid wedge action or excessive horizontal forces. Backfilling and compaction shall commence at the wall. Compaction shall be in accordance with sub-sections C6.4.6.4 Stormwater drainage and SC6.4.6.6 Pipe drainage.

(9) Tolerances

(a) On the completed works shall be as detailed in subsection SC6.4.6.28 Minor concrete works.

SC6.4.6.5.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.5.1 below.

Table SC6.4.6.5.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Cut-off Walls**		
	Depth into sound rock	>150mm	SC6.4.6.5.2(3)
2.	**Mass Concrete Bedding**	>50mm	SC6.4.6.5.2(7)

SC6.4.6.6 Pipe drainage

SC6.4.6.6.1 Introduction

(1) Scope

(a) This sub-section covers the supply and installation of pipe culverts and pipe arches for stormwater drainage.

(b) This sub-section should be read and applied in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(c) The work to be executed under this sub-section consists of supply of pipes and pipe arches, bedding, installation and backfilling.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS 1141.11 - *Particle size distribution –sieving method.*
AS 5101.4 - *Unconfined compressive strength of compacted materials.*
AS/NZS 1254 – *PVC-U pipes and fittings for stormwater or surface water applications.*
AS 1289.3.3.1 - *Calculation of the plasticity index of a soil.*
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.4.3.1 - *Determination of the pH value of a soil - Electrometric method.*
AS 1289.4.4.1 - *Determination of the electrical resistivity of a soil – Method for sands and granular materials.*
AS 1289.5.6.1 - *Compaction control test - Density index method for a cohesionless material.*
AS 1397 – *Continuous hot-dip metallic coated steel sheet and strip – coatings of zinc and zinc alloyed with aluminium and magnesium.*
AS 1646 - *Elastomeric seals for waterworks purposes.*
AS 1762 - *Helical lock-seam corrugated steel pipes - Design and installation.*
AS/NZS 2032 - *Installation of PVC pipe systems.*
AS/NZS 2041 - *Buried corrugated metal structures.*
AS/NZS 2566.1 - *Buried flexible pipelines - structural design*
AS/NZS 2566.2 – *Buried flexible pipelines - Installation*
AS/NZS 2666.1 - *Buried flexible pipes*
AS/NZS 3725 – *Design for installation of buried concrete pipes*
AS/NZS 3750.9 – *Paints for steel structures - Organic zinc-rich primer.*
AS/NZS 3750.15 - *Paints for steel structures - Inorganic zinc silicate paint.*
AS 4058 - *Precast concrete pipes (pressure and non-pressure).*
AS/NZS 4131 - *Polyethylene (PE) compounds for pressure pipes and fittings*.
AS 4139 - *Fibre reinforced concrete pipes and fittings.*
AS/NZS 4680 - *Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.*
AS/NZS 5065 - *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.*
AS/NZS ISO 9001:2008 *(as amended) - Quality management systems - Requirements*.

(c) Department of Transport and Main Roads Technical Standards:

MRTS 25 - Manufacture of pre-cast concrete pipes
MRTS 26 - Manufacture of fibre reinforced concrete drainage pipes

(d) Other:
AASHTO Standard, *M190 - Bituminous coated corrugated metal culvert pipe and pipe arches.*
ASTM F2562/F2562M-08 - *Specification for steel reinforced thermoplastic ribbed pipe and fittings for non-pressurised drainage and sewerage*
Safety in Design CWPHESS

SC6.4.6.6.2 Common requirements

(1) General

(a) Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent, that the manufacture of the products to be used in the works has complied with the Manufacturer's Quality Plan in accordance with ISO 9001.

(b) Documentation shall comprise a conformance certificate to AS 4058 or AS 4139 as appropriate for each batch of pipes or pipe arches to be included in the works, including manufacturer's installation recommendations. The above documentations certificates are to be supplied at least 24 hours in advance of dispatch to site.

Note—Table 3.6 of AS 4058 shall be replaced by Table 7A of *MRTS 25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(c) Each unit shall be marked at time of manufacture with:

(i) class and size;

(ii) manufacturer's name; and

(iii) date of casting.

(d) Where a Contractor wishes to use drainage pipe other than the pipes described in SC6.4.6.6.3(1) to (5) inclusive, the Contractor shall submit, for agreement by the Superintendent, full details in accordance with AS/NZS 2566.1 of the characteristics of the pipe materials and embedment and design loads, together with certification from the manufacturer of its suitability and quality for use in each particular application. Certification of the suitability of any pipe will address the bedding requirements, deflection, strength, buckling and any other considerations appropriate to the particular application. Upon agreement, the Superintendent must submit an application for a variation to the development consent for approval by council.

(e) The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.

(f) Culverts shall be installed within 10mm of the grade line and within 50mm of the horizontal alignment specified on the drawings. The Contractor shall relay any culvert which is not within these tolerances. Where longitudinal gradients are less than 0.5 per cent, culverts shall be installed within +/- 6mm of the grade line.

(g) Where shown on the drawings at the discharge end of culverts terminating at pits and headwalls a 3m length of 100mm diameter subsurface drain shall be laid in the trench 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert or headwall. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with SC6.4.6.21 Subsurface drainage.

(h) Excavation and backfilling for pipe drainage shall be undertaken in a safe manner and in accordance with all statutory requirements. The Contractor must present to the Superintendent the installed pipe drainage upon completion of backfill to the top side of the side zone for inspection prior completion of backfill.

(i) Where the Contractor proposes to travel construction plant in excess of 5 tonnes gross mass over pipe drainage structures, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to the Superintendent for prior approval.

(j) Upon completion of installation of pipe drainage, the Contractor shall submit relevant test results to demonstrate compliance to the requirements indicated on clauses.

SC6.4.6.6.3 Precast reinforced concrete

(1) Pipes

(a) Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the drawings.

Note—Table 3.6 of AS 4058 shall be replaced by Table 7A of *MRTS25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(b) Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the drawings.

(c) Unless specified otherwise, joints shall be flush type with external elastomeric bands complying with AS 1646 and as recommended by the manufacturer.

(d) Where precast pipes are to be installed into a marine or saline environment, the contractor is to ensure and provide documentation that the supplied pipes are “fit for purpose” and are suitable for the intended site application.

(2) Excavation

(a) Unless otherwise indicated on the drawings, or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

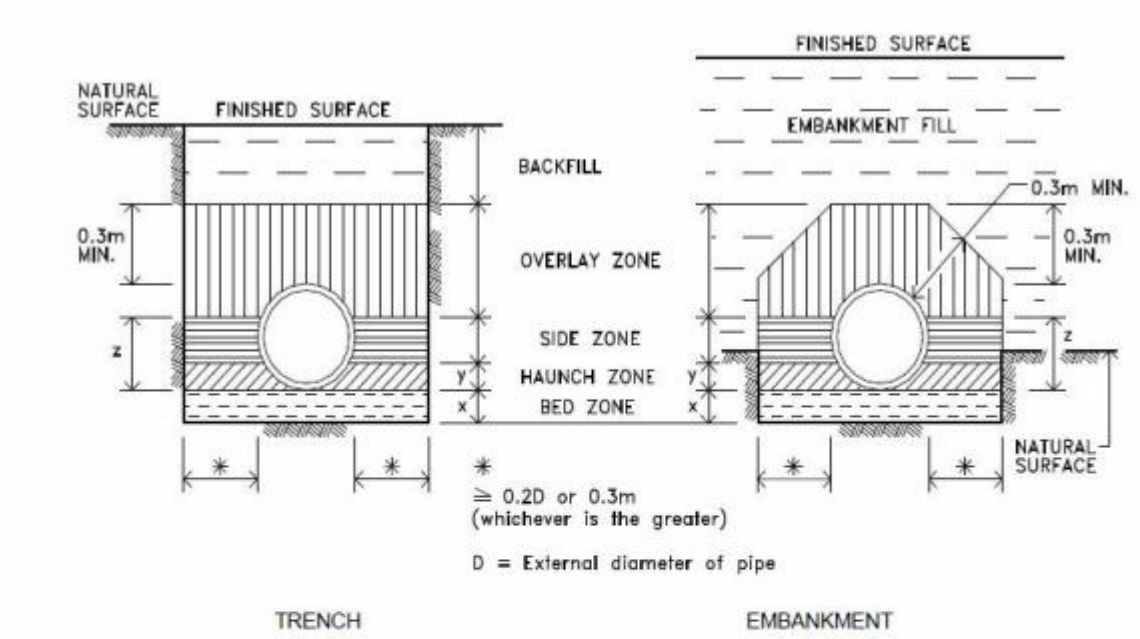
(b) For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in SC6.4.6.6.2(3). The trench shall be excavated to a width as specified in Figure SC6.4.6.6.1.

(c) Care is necessary to avoid laying pipe drainage in trenches excavated to excessive width. Pipes laid in wide trench conditions will be deemed to be in embankment conditions (positive projection). Wide trench conditions apply when, for a single pipe, the width of trench, $W \geq D + 0.6$ metre where D is the pipe diameter. For multi-cell pipes wide trench conditions apply when the width of trench, $W \geq \sum D + \sum S + 0.6$ metre where S is the square spacing between the pipelines. This definition of wide trench conditions as equivalent to embankment conditions relates to the size and geometry of the excavation utilised at construction. Pipes shown on the drawings to require trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength and trench support requirements in accordance with AS 3725.

(3) Bedding

(a) Bedding shall be in accordance with this sub-section, AS 3725 and AS 3725 Supplement 1 for the pipe support types as shown on the drawings. Where the pipe support type is not shown on the drawings, the support type shall be HS3 within road reserves (HS3 is recommended for high embankment fill) and H2 elsewhere.

(b) Figure SC6.4.6.6.1 below and Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions for all AS 3725 pipe support types.



		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Dimension (minimum)	x	75 on rock Nil on soil	100 for D ≤ 1500 150 for D > 1500		0.25 D but >100	100 for D ≤ 1500 150 for D > 1500		
	y	—	0.1D	0.3D	0.3D	0.1D	0.3D	0.3D
	z	—	—	—	—	≥ 0.7D		

D = External diameter of pipe

Figure SC6.4.6.6.1 Pipe installation conditions

(c) Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table SC6.4.6.6.1 Bedding Material Grading Limits, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6. Select fill material in the side zones, for pipe support type HS, shall also comply with Table SC6.4.6.6.1.

Table SC6.4.6.6.1 Bedding material grading limits

Sieve size mm	Weight passing %	
	Bed and Haunch Zones	Side Zones/Overlay Zones
75.0	-	100
19.0	100	-
9.5	-	50 - 100
2.36	50 -100	30 - 100
0.60	20 - 90	15 - 50
0.30	10 - 60	-
0.15	0 - 25	-
0.075	0 - 10	0 - 25

(d) The Contractor shall advise the Superintendent of the source of bedding material.

(e) All material shall be compacted in layers not exceeding 150mm compacted thickness except where explicitly approved by the Superintendent, for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage. Each layer shall be compacted to the relative compaction specified before the next layer is commenced. Cohesionless materials can be

compacted in one operation by saturation and vibration to achieve the minimum Density Index (DI) specified.

(f) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(g) Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725, when tested in accordance with AS 1289.5.6.1. H3 Pipe Support includes concrete bedding. Concrete shall be grade N20 to AS 3600. Pipe shall be suitably reinforced in accordance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 Pipe Support. Unless specifically selected pipes are nominated for use with H3 bedding, a design check shall be required to confirm the suitability of the proposed pipes.

(h) The top 0.1Dmm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

(i) Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.

(4) Installation

(a) General

Pipes shall be laid with the socket (female) end placed upstream. Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m.

The contractor is to ensure that all trenching is to conform to the requirements of Workplace Health and Safety (WHS) Act and regulations and Excavation Work Code of Practice 2013.

Pipes can be stiffened temporarily by the use of timber structs, erected before filling is placed. Struts shall be of hardwood measuring at least 100mm by 100mm or 125mm diameter. One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200mm. Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe. Both the sill and the cap shall be continuous throughout the length of the pipe. Struts shall be made to bear tightly against the pipe by the use of wedges between the top of the struts and the cap. Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the Superintendent, or a 3:1 sand:cement mortar, before the commencement of backfilling.
Bulkheads shall be constructed in accordance with SC6.4.6.5 Drainage structures on all lines where the pipe gradient exceeds 5 per cent.

The Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling.

(b) Joints in reinforced concrete pipes

(i) Rubber Ringed Joints

Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the Superintendent.

The joint shall be tested to ensure that the rubber ring has rolled evenly into place.
Where wedge shaped “skid” rubber rings are prescribed the Manufacturer’s instructions, which include the use of lubricants, shall be followed.

(ii) Flush or butt jointsThe ends of the pipes shall be butted together so as to be as tight and as even as possible.

The joints shall be sealed externally with proprietary E.B bands, supplied and installed in accordance with the manufacturer's recommendations, care being taken that the bands are not twisted.

(c) Joints in fibre-reinforced cement pipes

(i) New Pipes
Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in SC6.4.6.6.3(4) Installation.
Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

(ii) Direct Side Connections to Other Pipes
Direct side connections to other pipes shall be as detailed on the drawings.

(5) Backfill

(a) Select fill material to the side zones shall be compacted to the requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

(b) Ordinary fill to the side zones and overlay zones, for all pipe support types, except type HS shall consist of Selected Backfill as defined in SC6.4.6.10 Earthworks (construction) or alternatively cohesionless material in accordance with Table 6.4.6.6.1 Bedding material grading limits. It shall be placed around the pipe to the dimensions shown in Figure SC6.4.6.6.1 Pipe installation conditions.

(c) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725.

(d) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(e) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(f) When compacted adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any culvert or drainage structure. Any damage caused shall be rectified by the Contractor. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

SC6.4.6.6.4 Steel pipes and pipe arches

(1) Nestable steel pipe and drainage units

(a) Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings.

(b) The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250

and a minimum coating Class of Z600.

(c) Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by the Superintendent, to a thickness of 400 microns.

(d) Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

(2) Helical lock-seam corrugated steel pipe

(a) Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the drawings.

(b) The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600.

(c) Unless otherwise approved by the Superintendent, no part of the pipe shall incorporate steel strips which have been joined by welding. Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of organic zinc-rich primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15. Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing.

(3) Bolted steel pipes, pipe arches and special shapes

(a) Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings. The corrugated pipe or plate shall be hot-dip galvanised on both sides after fabrication in accordance with the requirements for coating thickness and mass for articles in AS/NZS 4680.

(b) Also, after assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by the Superintendent. Invert plates shall be coated on the outside before they are placed on the pipe bed. The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer. The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns. Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns.

(4) Materials and surface treatment of steel pipes and pipe arches

All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading, as well as corrosion protection for a satisfactory design life of 100 years, unless indicated otherwise on the drawings. Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified SC6.4.6.6.4(5).

(5) Materials against steel structures

(a) The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.

(b) Besides meeting the normal requirements of the bedding, selected backfill materials and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure SC6.4.6.6.2 will determine the level of corrosion protection required.

(c) Notwithstanding the height of fill, embankment material within 6m of the structure shall conform to these requirements.

(d) The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.4.3.1 and AS 1289.4.4.1.

(e) The Contractor shall nominate the sources of the various materials and submit documentary evidence

from a NATA registered laboratory that the representative samples conform to the requirements of this clause and the protective treatment provided. The samples shall be pre-treated if necessary so as to represent the condition and grading when compacted and in service.

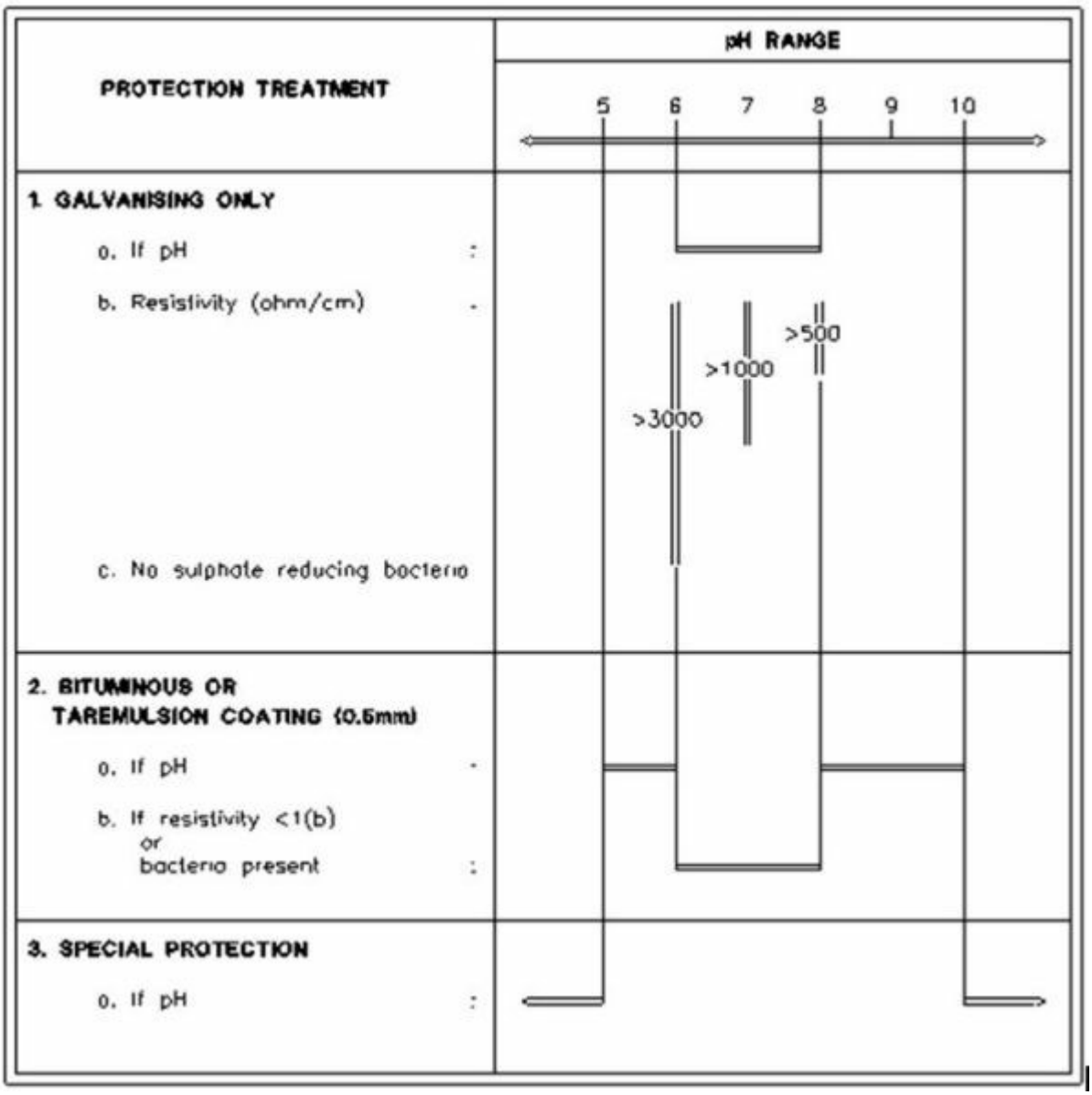


Figure SC6.4.6.6.2 Corrosion protection requirements for steel structures

(6) Excavation and foundation preparation

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) The trench shall be excavated to a level 75mm below the design invert and for a minimum width of 600mm on each side of the structure.

(c) Where unsuitable material, as determined by the Superintendent, is encountered at the foundation level, it shall be removed to a depth approved by the Superintendent. The additional excavation shall be backfilled with material complying with, selected material as per SC6.4.6.10 Earthworks (construction).

(d) Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure. The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in SC6.4.6.6.3 3(b).

(7) Bedding

Bedding shall meet the requirements of SC6.4.6.6.3(3)(f). The thickness of uncompacted bedding material

between the foundation and the outer surface of corrugation shall not be less than 75mm. The uniform blanket of loose material which provides the minimum 75mm thick bedding, shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.

(8) Installation

(a) General
The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations. These recommendations shall be submitted to the Superintendent before assembly or laying of the culverts is commenced.

If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.

(b) Joints
Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2041.

Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68mm. Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands. Rubber ring joint seals shall be used in conjunction with the coupling bands except where specifically indicated otherwise in the drawings.

All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of non-woven geotextile material, of minimum 250mm width and of minimum mass 270 grams per square metre in accordance with the requirements for geotextile in SC6.4.6.20 Subsoil, foundation and pavement drains, to prevent loss of sand backfill or bedding into the pipe.

(9) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of clause SC6.4.6.6.3(5) except that the required relative compaction in the side support and overlay zones shall be 95 per cent (AS 1289.5.4.1 standard compaction). Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width, on both sides.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(e) The Contractor shall check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2 per cent for pipes and pipe arches.

(10) Invert protection of corrugated steel pipes and pipe arches

(a) Where shown on the drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

(b) The sprayed concrete shall be placed to a thickness of not less than 100mm over the crest of the

corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

(c) All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

(d) The production, application and curing of sprayed concrete shall be in accordance with sub-section SC6.4.6.28 Minor concrete works.

(e) The sprayed concrete shall be reinforced with a fabric of hard drawn steel wire 4mm diameter with 200mm square mesh. The fabric shall be securely supported at a central location within the sprayed concrete by non-metallic supports.

(f) Laps in fabric shall be 300mm and a cover of 50mm of sprayed concrete shall be provided to the fabric at all edges.

(g) Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

(h) No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

SC6.4.6.6.5 UPVC pipes

(1) Materials

(a) Unplasticised PVC (UPVC or similar material) Pipes and Fittings shall be manufactured in accordance with AS/NZS 1254 and shall be of the type and size as shown on the drawings. Where pipes with extreme external diameter are equal to or greater than 450mm (375mm nominal internal diameter) are proposed, a separate approval from the Superintendent and council is required.

(b) Embedment material in the bedding, side support and overlay zones shall be in accordance with bed and haunch zone material in SC6.4.6.6.3(3).

(c) Trench backfill material shall satisfy the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction).

(2) Excavation and bedding

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) Figure SC6.4.6.6.3 and Table SC6.4.6.6.2 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the drawings.

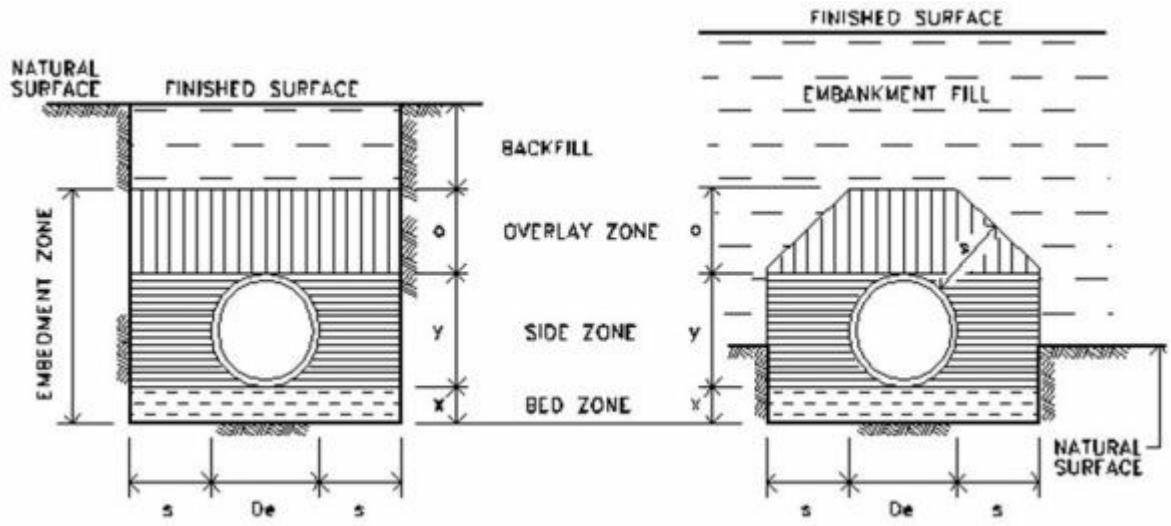


Figure SC6.4.6.6.3 Pipe installation conditions

Table SC6.4.6.6.2 Trench and embedment dimensions

Extreme External	Minimum Dimensions (mm)			
Dia (De)mm	x	s	o	y
[3]75≤150	75	100	100	Pipe dia.
>150≤300	100	150	150	Pipe dia.
>300≤450	100	200	150	Pipe dia.

Note—Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension "s" for the larger of adjacent pipes.

(c) Bedding zone material shall be placed and compacted in accordance with the requirements in Table 5.5 of AS/NZS 2566.2.

(3) Installation

(a) Embedment of the UPVC pipe shall be in accordance with the requirements of AS/NZS 2566.2 and to the dimensions shown in Figure SC6.4.6.3.

(b) Pipe laying shall be in accordance with Part 7 of AS 2032 and solvent-cement pipe jointing shall be in accordance with Part 3 of AS 2032. Jointing may be performed with the pipes either in the trench or at ground level. All pipes, or jointed pipelines, shall be lowered into the trench without being dropped. Pipelines shall be placed so that joints are not strained.

(4) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of SC6.4.6.6.3(5) for HS3 support type.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5.5 of AS/NZS 2566.2 – Buried Flexible Pipelines – Installation.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content, which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

SC6.4.6.6.6 Limits and tolerances

The limits and tolerances for materials and product performance related to the various clauses in this sub-section are summarised in Table SC6.4.6.6.3 Summary of Limits and Tolerances below:

Table SC6.4.6.6.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
	Culvert Position	± 10mm	SC6.4.6.6.2(1)
	(a) Grade Line	± 6mm	
	(b) Grade line <0.5%		
	(c) Horizontal Alignment	± 50mm	SC6.4.6.6.2(1)
	Bedding		
	(a) Bed and Haunch Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(3)

Backfill - Concrete Pipes (a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(5)
Backfill - Steel Pipes		
(a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725, HS3	SC6.4.6.6.4(9)
(b) Pipe/Structure		
(i) Horizontal and Vertical Variation	< 2% of specified dimensions	SC6.4.6.6.4(9)
Sprayed Concrete		
(a) Over crest of corrugations over bottom third of pipe circumference	> 100mm	SC6.4.6.6.4(10)
Bedding Zone Compaction	DI 70	SC6.4.6.6.5(2)
Backfill - UPVC Pipes		
(a) Side and Overlay Zone Compaction	³95%, DI 70	SC6.4.6.6.5(4)

SC6.4.6.7 Precast box culverts

SC6.4.6.7.1 Introduction

(1) Scope

(a) This sub-section covers the installation of precast concrete box culverts and should be read in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(b) The work to be executed under this Specification consists of:

(i) preparation of foundations;

(ii) provision of bedding;

(iii) construction of base slabs;

(iv) installation of precast culvert units;

(v) headwalls and wingwalls;

(vi) backfilling against structures;

(vii) provision and removal of coffer dams; and

(viii) excavation of inlet and outlet channels.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.9 Open drains
SC6.4.6.12 Flexible pavements
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS1597.1 - *Precast reinforced concrete box culverts - Small culverts*
AS1597.2 - *Precast reinforced concrete box culverts - Large culverts*
AS/NZS ISO 9001:2008 - *Quality management systems - Requirements.*

(c) Other:
Austroads, *Guide to Geotextiles*
Department of Transport and Main Roads
MRTS05 - *Unbound Pavements*
MRTS24 - *Manufacture of precast concrete culverts*

SC6.4.6.7.2 Materials

(1) Culvert units, link and base slabs

(a) The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS1597 with the following alterations or additional requirements:

(i) proof load testing must be arranged by the Contractor in batches as specified in either AS1597.1 or AS 1597.2 as appropriate;

(ii) proprietary lifting anchors must be provided in the culvert units, link and base slabs;

(iii) delivery and unloading is the Contractor's responsibility; and

(iv) the supplier must implement and maintain a Quality System in accordance with ISO 9001 to ensure materials, manufacture and proof load testing conform to the appropriate Standards.

(b) A conformance certificate, to AS1597 must be submitted to the Superintendent at least 3 working days prior to dispatch.

(c) Each unit must be marked at time of manufacture with:

(i) type and size;

(ii) casting date;

(iii) manufacturer's name; and

(iv) inspection pass and date.

(2) Handling, delivery and storage

(a) Ensure adequate equipment and load shifting machineries are available for safe handling and unloading.

(b) Upon delivery of precast units, ensure that the following criteria have been achieved:

(i) 70% of the minimum concrete strength;

(ii) small culvert units: Cured to AS 1597.1 clause 2.6.3; and

(iii) large culvert units: Cured to AS 1597.2 clause 2.7.

(c) Prior inspection of the stored precast box culvert units is to be undertaken for dimensional accuracy and defects following delivery. Results of the inspections must show that the units conform to the following:

(i) small culvert unit: To AS 1597.1; and

(ii) large culvert unit: To AS 1597.2.

(3) Concrete

The concrete and reinforcement for cast-in-situ base slabs shall comply with sub-section SC6.4.6.28 Minor concrete works.

(4) Selected backfill

The quality of selected backfill shall comply with the requirements in AS 1597.2, or alternatively comply with the requirements of side/overlay zone materials in Table SC6.4.6.6.1 *Bedding material grading limit* of sub-section SC6.4.6.6 Pipe drainage.

(5) Ordinary backfill

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which are in accordance with the requirements for the upper 0.3 m of embankment construction as detailed in SC6.4.6.10 Earthworks (construction).

SC6.4.6.7.3 Construction

(1) Coffer dams

(a) At some sites it may be expedient for the Contractor to construct a coffer dam. The construction of coffer dams shall be the responsibility of the Contractor.

(b) Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Coffer dams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure.

(c) A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the Superintendent, but the Contractor shall be responsible for the successful construction of the work.

(d) Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide the clearances specified. This work will be at the Contractor's expense.

(e) No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Coffer dams, including temporary piles, shall be removed at least to the level of the invert after completion of the

structure. Upon completion of works, remove coffer dams, including temporary piles, at least to the level of the culvert invert after completion of the structure. Ensure that no material associated with the coffer dam or dewatering can enter the culvert.

(2) Excavation

Excavation shall be carried out in accordance with the provisions in sub-section SC6.4.6.4 Stormwater drainage.

(3) Foundations

(a) Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed.

(b) Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material.

(c) Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock.

(d) Earth foundations shall be finished to line and level to the underside of bedding shown on the drawings. Care shall be taken to avoid disturbing material below this level.

(e) All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Superintendent and backfilled in accordance with sub-section SC6.4.6.4 Stormwater drainage.

(4) Bedding

(a) Cast-in-situ base slabs

No bedding material shall be placed until the foundations have been inspected and approved by the Superintendent.

Bedding shall be either mass concrete or lightly bound paving material which complies with the requirements of at least a Type 3, Subtype 3.3 material as defined in the Specification MRTS05 (04/11), whichever is shown on the drawings.

Mass concrete bedding blinding layer shall be 20 mpa compressive strength and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ±10mm in level and ±50mm in line. The bedding shall be finished to a smooth surface. Where longitudinal gradients are less than 0.5 per cent, concrete blinding layers shall be installed with +/- 6mm of the grade line.

(b) Precast base slabs

Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bed zone of selected backfill of minimum compacted depth 150mm in accordance with AS 1597.2.

If suitable compaction of the trench subgrade cannot be achieved, it will be the responsibility of the developer to recommend an alternate solution to council to achieve the desired bearing capacity for the structure prior to construction.

(5) Cast-in-situ base slabs

(a) Cast-in-situ base slabs shall be constructed to the dimensions shown on the drawings and in accordance with the requirements of sub-section SC6.4.6.28 Minor concrete works. The invert levels shall be within -10mm to +10mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position ±50mm. Where longitudinal gradients are less than 0.5 per cent cast insitu base slabs shall be installed within +/- 6mm of the grade line.

(b) Recesses or nib walls to accommodate the walls of the precast crown units shall be formed in the base

slab to the dimensions shown on the drawings.

(6) Installation of precast units

(a) Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa.

(b) Precast crown units shall be placed on a bed of mortar either on the slab or in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout or flexible joint filler.

(c) Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit.

(d) Lifting anchor recesses shall be filled to the surface with cement mortar.

(e) In the case of multi-cell culverts, a nominal 50mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.

(f) All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

(g) All external surfaces of vertical joints between precast crown units, shall be covered full length, and minimum 100mm width, with strips of denso tape or similar as an alternative to joint filling.

(7) Backfill

(a) All bracing and formwork shall be removed prior to backfilling. Prior to backfill placing, present to the Superintendent for inspection all seals, joints and levels.

(b) Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. Alternatively cohesionless materials can be compacted in one operation by saturation and vibration to achieve a minimum Density Index of 70. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with SC6.4.6.10 Earthworks (construction).

(c) Backfill shall be placed against wingwalls, headwalls and retaining walls in accordance with SC6.4.6.28 Minor concrete works.

(d) Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

(e) Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m width before the backfill is placed.

(8) Excavation of inlet and outlet channels

(a) Excavation of inlet and outlet channels shall be carried out as shown on the drawings and shall extend to join the existing stream bed in a regular manner as detailed SC6.4.6.9 Open drains.

(9) Construction loading on culverts

(a) Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32 MPa.

(b) Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

SC6.4.6.7.4 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.7.1 Summary of Limits and Tolerances below:

Table SC6.4.6.7.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clauses
1.	**Mass Concrete Correction**		
	a) Over highest points of rock	50mm	SC6.4.6.7.3(3)
2.	**Mass Concrete Bedding**		
	a) Level	± 10mm	SC6.4.6.7.3(4)
	b) Level where grade line <0.5%	+/- 6mm	
	c) Line	± 50mm	SC6.4.6.7.3(4)
3.	**Culvert Location**		
	a) Invert Level	±10mm	SC6.4.6.7.3(5)(a)
	b) Invert where grade line is <0.5%	+/- 6mm	
	c) Grade	5mm in 2.5m (1 in 500)	SC6.4.6.7.3(5)(a)
	d) Plan Position	±50mm	SC6.4.6.7.3(5)(a)

SC6.4.6.8 Drainage mats

SC6.4.6.8.1 Introduction

(1) Scope

(a) The purpose of this policy sub-section is to provide standards advice and guidelines for the use and installation of drainage mats.

(b) Drainage mats shall be constructed where and as shown on the drawings or as directed by the Superintendent.

(c) This sub-section should be read in conjunction with SC6.4.6.21 Subsurface drainage.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the SC6.4.5 Supervision and construction guidelines

(2) Terminology

Type A drainage mats	are intended to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.
Type B drainage mats	are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section one as follows:

SC6.4.6.21 Subsurface drainage
SC6.4.6.20 Subsoil, foundation and pavement drains

(b) Australian Standards:

AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*

(4) Order of construction

(a) Type A drainage mats shall be constructed after the site has been cleared and grubbed and before commencement of embankment construction.

(b) Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

SC6.4.6.8.2 Construction

(1) Type A mats

(a) Type A drainage mats shall be constructed under embankments as and where shown on the drawings or as directed by the Superintendent.

(b) After the embankment foundation has been trimmed and any necessary trench drains installed, a geotextile complying with the requirement of SC6.4.6.21 Subsurface drainage, shall be laid on the embankment foundation. The area of geotextile laid shall be sufficient to cover the area of the Type A drainage mat and an additional amount for enclosing the sides of the drainage mat after the filter material has been placed. Laps of minimum width of 500 mm shall be provided at each join in the geotextile.

(c) Type C filter material or Type D filter material, as shown on the drawings or as determined by the Superintendent, shall be placed on the geotextile and compacted to the satisfaction of the Superintendent. The minimum thickness of the compacted filter material shall be 300 mm plus an allowance for the expected consolidation of the embankment foundation under the embankment load or 500 mm if the amount of the expected total consolidation of the embankment foundation is not known.

The filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250 mm.

(d) After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat.

(e) An additional layer of geotextile shall be placed on the drainage mat under the base of any rock facing which may be placed as part of the embankment construction. The additional layer of geotextile shall extend beyond the outside and inside faces of the bottom layer of rock.

(f) Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent layers of filter material, earth filling or rock facing. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of the Superintendent. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

(g) Type A drainage mats shall extend 2 m beyond the toes of embankments and such extensions shall be covered by a 300 mm thick layer of Type C filter material or Type D filter material, as determined by the Superintendent. This protective layer shall be placed immediately after completion of construction of each drainage mat.

(h) Outlets from Type A drainage mats may be surface outlets at the toes of embankments or piped outlets connected to other drainage systems. Where piped outlets are constructed they shall conform to the requirements of SC6.4.6.21 Subsurface drainage.

(2) Type B mats

(a) Type B drainage mats shall be constructed in cuttings as and where shown on the drawings or as directed by the Superintendent. Type B drainage mats shall be constructed for the full width of cuttings and for the pavement width in other locations.

(b) After the subgrade material has been compacted and trimmed, a geotextile complying with the requirements of SC6.4.6.21 Subsurface drainage, shall be laid on the subgrade. Laps of minimum width of 500 mm shall be provided at each join in the geotextile.

(c) Slotted thick walled unplasticised PVC pressure pipe complying with AS 1477, shall be laid on the geotextile at a distance of 200 mm from and parallel to the longitudinal edges of the drainage blanket as shown in the drawings. Details of slot sizes and spacings are shown in SC6.4.6.20 Subsoil, foundation and pavement drains.

(d) Type A filter material shall be placed on the geotextile and compacted to achieve a relative compaction, determined by AS 1289.5.4.1, of at least 100 per cent (standard compaction). Alternatively, the Superintendent may approve the use of a coarser filter material having a maximum particle size of 75 mm and a maximum D90/D10 ratio of three.

(e) The thickness of the compacted filter material shall be as shown on the drawings or as directed by the Superintendent. If the required thickness of compacted filter material is greater than 250 mm, the filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250 mm.

(f) After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing pavement layers over the drainage mat.

(g) Outlets from Type B drainage mats shall conform to the requirements of SC6.4.6.21 Subsurface drainage.

Table SC6.4.6.8.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Filter Material**		
	(a) Layer thickness	250 mm max	SC6.4.6.8.2(1) SC6.4.6.8.2(2)
	(b) Compaction (Relative) Type A filter material	100% Standard	SC6.4.6.8.2(2)
2.	**Type B Mats**		
	(a) Design level at top of mat	+0, -40 mm	SC6.4.6.8.2(2)

SC6.4.6.9 Open drains

SC6.4.6.9.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions associated with stormwater drainage infrastructure.

(b) This sub-section should be read in conjunction with SC6.4.6.4 Stormwater drainage, and other drainage sub-sections as applicable:

(i) SC6.4.6.6 Pipe drainage;

(ii) SC6.4.6.5 - Drainage structures; and

(iii) SC6.4.6.7 Precast box culverts.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editors note - A reference to drawings is a reference to construction drawings.

(2) Terminology

Open drains	are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerb and channel.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.4 Stormwater drainage
SC6.4.6.6 Pipe drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works
SC6.4.6.7 Precast box culverts
SC6.4.6.26 Landscaping

(b) Australian Standards:

AS 1141.22 - *Wet/dry strength variation*
AS 1289.5.4.1 - *Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*
AS 2758.4 - *Aggregate for gabion baskets and wire mattresses*
AS 2876 - *Concrete kerbs and channels (gutters) – Manually or machine placed*
AS/NZS 4534 - *Zinc and zinc/aluminium-alloy coatings on steel wire.*
AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other:

Austroads, *Guide to Pavement Technology, Part 4B – Asphalt (AGPT04B)*
Austroads, *Guide to Pavement Technology, Part 4G – Geotextiles and Geogrids (AGPT04G)*
ASTM International, ASTM A975 - *Standard specification for double-twisted hexagonal mesh gabions and revet mattresses (metallic coated steel wire or metallic coated steel wire with PVC coating)*
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.9.2 Unlined open drains general

Open drains shall be designed and constructed in accordance with the relevant clauses in Chapter 9 of QUDM 2013. Locate and construct open drains to avoid recharging groundwater, a shallow water table and salinity degradation of

adjacent land.

Any unsuitable material must not be used for the bed and banks of the drain and must be removed from the site. Where a tree is marked for preservation, any drain must be diverted around it with sufficient clearance to avoid damage to the tree's root system.

Where open drains pass through private property, drainage easements of sufficient width to contain the flow and vehicular access for maintenance must be provided and registered as an encumberance on the title of the land through which the drain passes.

Prior to works commencing, temporary drainage measures must be implemented in accordance with the requirements of Best Practice Erosion and Sediment Control.

(1) Types

Catch drains shall be provided above the top and at the toe of embankments as part of the construction of the adjacent roadway. The edges of catch drains shall be positioned not less than 2 m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains unless otherwise approved.

Minor diversion and contour drains shall be constructed where shown on the construction drawings. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain unless otherwise approved by the Superintendent.

Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the drawings. Their construction is deemed to be part of the earthworks.

(2) Inlet, outlet and diversion drains shall extend to join the existing stream bed and be of sufficient size to accommodate the design flows from the upstream catchment. The drain shall be excavated to the full width of the structure and care must be taken to ensure the stream bed can accommodate the additional flow with only minimal disturbance.

(3) Construction material excavated from drains shall be placed on the lower sides of the drains and formed as banks with slopes graded in accordance with QUDM Third edition 2013 – Provisional. This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 per cent for standard compactive effort.

The Contractor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site. Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally.

Any excess material shall be legally and responsibly disposed of by the Contractor.
Unlined drains and areas adjacent to open drains shall be treated and revegetated immediately after the drains are complete, in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.9.3 Lined open drains general

(1) The Contractor must only use proprietary products which are suited to the terrain and have been approved for use by council. This would include the use of

(a) organic fibre and vegetation mats installed in accordance with the manufacturer's instructions;

(b) rock filled wire mattresses; or

(c) concrete where there is insufficient width to accommodate the required water way area, or the flow velocity in the drain will exceed the non-scouring velocities or where the trail is likely to be used as a bikeway of footpath during dry periods. Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.

Before placing any lining material, the foundation material shall be shaped and compacted to not be less than 95 per cent for standard compactive effort as determined by AS 1289.5.7.1 or AS 1289.5.4.1

This section does not include kerb and channel.

(2) Concrete lining

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed to a minimum thickness of 100 mm measured at right angles to the surface of the lining in accordance with sub-section SC6.4.6.28 Minor concrete works.

Polyfibres must not be used in marine environments, or where there is risk of fibres escaping into the environment, without approved controls to capture loose polyfibre strands.

Weepholes shall be provided in the concrete at intervals of 2 m spacing with non-horizontal elements or as determined by the Superintendent.

Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 5-10 mm in width, 20 mm deep, shall be formed neatly in the surface of the freshly placed concrete at intervals of 3 m unless otherwise specified by the Superintendent.

Expansion joints shall be placed at intervals not more than 15 m with a minimum width of 15 mm and shall consist of preformed jointing material of bituminous fibreboard or alternate approved material and shall be of sufficient depth to fill the joint.

(3) Stone pitching

Stone pitching shall consist of sound durable rock not less than 100 mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface. The exposed surface of each stone or block shall be generally flat and not less than 0.05 square metres in area. Spaces between adjacent stones or blocks shall not exceed 20 mm in width.

(4) Batter drains

Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the drawings.

The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0 mm to –50 mm from the batter line at the underside of topsoil.

Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the rim of the batter drain.

When topsoil is placed it shall be tapered over a width of 1 m to zero thickness at the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 1 m and pinned down as provided in SC6.4.6.26 Landscaping.

(5) Proprietary products

Unless shown on the drawings, proprietary products may only be used with the approval of the Superintendent. Where specified, they must be used strictly in accordance with the manufacturer’s instructions.

SC6.4.6.9.4 Rock filled wire mattresses and gabions general

(1) Prior to installation of rock filled wire mattress or gabion excavate so the mattresses finish flush and level with the surrounding ground. Rock-filled wire mattresses and gabions shall be placed at the locations shown on the drawings. Installation shall be in accordance with the manufacturer's instructions. A geotextile, as shown on the drawings, shall be placed between the wire cage and the material being protected.

Foundations of floors of gabions should ideally be within cut material, however if in fill areas or embankments then material must be compacted in layers not greater than 150 mm thick, to a relative compaction of 95 per cent when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

(2) Materials

For wire mattresses and gabions, the galvanising requirements for wire of circular cross section cited in this Clause as "heavily galvanised", shall comply with the coating mass requirements for round wire, Class W10, in AS/NZS 4534. The contractor must submit for approval the type of mattress/gabion proposed along with confirmation of compliance to ASTM A975 and a schedule of installation locations.

(a) Gabions

The gabions shall be of the sizes shown on the drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the drawings. Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100 mm. Gabions shall have a nominal mesh size of 80 mm x 100 mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

(b) Wire mattresses

Unless specified otherwise, the wire mattresses shall be supplied in units having dimensions of 6 m x 2 m x 230 mm, and shall be cut to suit areas as shown on the drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600 mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the drawings.

Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

(c) Geotextile

A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with Guide to Pavement Technology Part 4G Geotextiles, shall be used.

Samples, manufacturer's specification and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile.

(d) Rock Fill Material

The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.
Rock fill for gabions shall have particle sizes between 100 mm and 250 mm. Rock fill material should be placed by hand and only when approved by the superintendent shall they be placed using a suitable mechanical device to ensure fill is tightly packed with a minimum of voids. Fill material shall be levelled off 25 mm to 50 mm above the top of the mesh to allow for settlement.
When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled slightly overfull by 25 mm to 50 mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

(3) Assembly and erection

Before laying out the gabions or wire mattresses, geotextile shall be placed on the founding material and against any surface that will be in contact with either drainage course or earth backfill.

Adjust the position of the diaphragms so that the sides hinge up on the thicker wire woven in the mesh. Lace the gabion boxes along all diaphragm points and edges at to all adjacent boxes. Internal bracing wires 4 per metres at 330 mm centres to prevent distortion. Face bracing wires 4 per metres of face.

Ensure star pickets are either driven or cut off level with the top of the mattress.

After tying diaphragms and adjacent units of mattresses/gabions on all three adjacent corners(rear, floor and front face), leave top edge untied to allow for securing along with the lid section. The end corners of wire mattress/gabion tied sections shall be firmly tied after galvanised star pickets are driven and stretched in place a minimum of 900 mm into the surrounding ground in the final location at one end.

Carefully secure the opposite end of the gabions without damaging or distorting the dimensions of the units to a

suitable mechanical device and apply a stretching force to the assembled mattress/gabion section to be filled. Whilst under tension, secure each corner of each unit using galvanised star pickets driven into foundation ensuring each unit is stretched tight in all directions.

(4) Filling

Fill whilst the gabion boxes are under tension. Place the rocks at the front face and other exposed faces by hand to produce a neat face free of excessive bulges, depressions and voids.

Redistribute the filling materials by hand to ensure that all diaphragm compartments are fully filled to produce a neat and level top surface. Overfill by 25 to 50 mm to allow for subsequent settlement.

Mechanical filling equipment may be used with caution ensuring to protect any PVC or galvanized coatings from abrasion. Release the tension on the mattress/gabion boxes only when fully laced so as to prevent any slackening.

The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300 mm and filled with rock fill. This edge shall be tied to star pickets.

Final lacing should be undertaken as soon as practicable after filling particularly if there is a storm or flood expected. Stretch lids tightly over the filling and lace down securely. The works should be inspected upon completion of lacing.

SC6.4.6.9.5 Summary of limits and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.9.1 below.

Table SC6.4.6.9.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Open Drains - General**	Grade - QUDM 2013 Table 9.5.2	SC6.4.6.9.2(3)
	(a) Grading		
	(b) Depth	Based on hydraulic capacity of the channel	SC6.4.6.9.2
	(c) Freeboard	QUDM 2013 table 9.3.1 & Fig 9.8	SC6.4.6.9.2
	(d) Channel Side Slopes	QUDM 2013 Section 9.5.3	SC6.4.6.9.2(3)
	(e) Compaction	>95% (standard compaction)	SC6.4.6.9.2(3)
2.	**Open Drains - Lining**	>95% (standard compaction)	SC6.4.6.9.3(1)
	(a) Compaction of Foundation		
3.	**Stone Pitching**	>100mm thickness	SC6.4.6.9.3(3)
	(a) Rock Dimensions		
	(b) Exposed Surface Area	>0.05 sq m	SC6.4.6.9.3(3)
	(c) Spaces between Stones	<20mm width	SC6.4.6.9.3(3)
4.	**Batter Drains**	+0, -50 from batter line	SC6.4.6.9.3 (4)
	(a) Rim line		
5.	**Kerb and channel**		
	(a) Compaction of foundation	To AS 2876	SC6.4.6.9.3(6)
	(b) Level of gutter surface	Level ≤ ±6mm of design level	SC6.4.6.9.3(6)
	(c) Alignment	Level ≤ ±50mm of design alignment	
	(d) Surface uniformity	Deviation of kerb and channel surface from 3m straight edge ≤5mm	SC6.4.6.9.3(6)
	(e) Contraction Joints		
	(i) Area	≥50% of CS area	SC6.4.6.9.3(6)
	(ii) Groove Width	≥5mm	SC6.4.6.9.3(6)
	(f) Expansion Joint Interval	at all gully pits and associated structures	SC6.4.6.9.3(6)
	(g) Backfill behind Kerb		
	(i) Layer thickness	≤150mm	SC6.4.6.9.3(6)
	(ii) Compaction	>95% (standard compaction)	SC6.4.6.9.3(6)

Item	Activity	Limits/Tolerances	Clause
6.	**Rock Fill for Gabions and Wire Mattresses**	>100kN	SC6.4.6.9.4(2)(d)
	(a) Wet Strength		
	(b) Wet/Dry Strength variation	<35%	SC6.4.6.9.4(2)(d)
	(c) Particle size for Gabions	>100mm <250mm and preferably not greater than 200 mm	SC6.4.6.9.4(2)(d)
	(d) Fill Level	>25mm <50mm above top of mesh	SC6.4.6.9.4(2)(d)
	(e) Particle size for Wire Mattresses	Between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser	SC6.4.6.9.4(2)(d)
7.	**Erection of Gabions and Wire Mattresses**	Depth in ground >900mm Spacing <1m	SC6.4.6.9.4(3)
	(a) Star pickets for ties		
	(b) Trench Depth for upstream edge	Depth >300mm	SC6.4.6.9.4(3)

SC6.4.6.10 Earthworks (construction)

SC6.4.6.10.1 Introduction

(1) Scope

(a) This sub-section provides standards, advice and guidelines for earthworks and associated construction, including:

(i) removal of topsoil;

(ii) all activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the drawings and sub-section;

(iii) removal and replacement of any unsuitable material;

(iv) any spoil or borrow activities associated with earthworks; and

(v) any additional processing of selected material for the selected material zone.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.30 Control of traffic
SC6.4.6.11 Clearing and grubbing
SC6.4.6.4 Stormwater drainage

(b) Australian Standards:

AS1141.11 - *Soil classification test – Determination of the particle size distribution of a soil – Standard method of analysis by sieving*
AS1289.3.3.1 - *Calculation of the plasticity index of a soil.*
AS1289.5.1.1 - *Determination of the dry density/moisture content relation of a soil using standard compactive effort.*
AS1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*
AS1289.5.7.1 - *Compaction Control Test Hilf density ratio and Hilf moisture variation (Rapid Method).*
AS1289.6.1.1 - *Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.*
AS1289.7.1.1 - *Soil reactivity tests – Determination of the shrinkage index of a soil*
AS2187.0 - *Explosives - Storage, transport and use - Terminology*
AS2187.1 - *Explosives - Storage, transport and use - Storage*
AS2187.1 - *Explosives - Storage, transport and use - Use of explosives*

(c) QLD Government Legislation:

Environmental Protection Act 1994
Environmental Protection (Noise) Policy 2008
Explosives Act 1999
Explosives Regulation 2003
Sustainable Planning Act 2009
Work Health and Safety Act 2011

(d) Other:

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

Workplace Relations Ministers' council, *Australian Code for the Transport of Explosives by Road and Rail*
MRTS55 Use of Explosives in Roadworks

(3) Natural surface and earthworks materials

(a) Natural surfaces

The Contractor must verify the accuracy of the model by field surveys. If the Contractor considers any areas of the model not to be representative of the approved plans, the Contractor shall give not less than seven days' notice, prior to commencement of Works to the Superintendent to allow checking. If the subsequent check survey reveals the ground model to be incorrect, any plans that are affected are to be resubmitted for approval.

(b) Earthworks materials

The Contractor shall be responsible for any assumptions made by the contractor in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.
Where material from excavations is acceptable for use in embankments, but the Contractor elects to:

(i) spoil it; or

(ii) use it for the Contractor's own purposes; or

(iii) use it as a source of pavement materials; or

(iv) construct embankments with dimensions in excess of those specified.

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in clause SC6.4.6.10.6(2). The cost of making good such deficiency of material shall be borne by the Contractor.

(4) Protection of earthworks

The Contractor's responsibility for care of the Works shall include the protection of earthworks.
The Contractor shall install effective erosion and sedimentation control measures in accordance with accepted *Best Practice Erosion and Sediment Control* procedures, prior to commencing the earthworks, and shall maintain these control measures for the duration of the contract.

Details of the proposed sediment and erosion control measures and procedures are to be documented by a suitably qualified person in accordance with council's soil and sediment erosion control standards. The proposed measures and procedures are to be approved by council prior to implementation on site.

Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface.

Should insitu or stockpiled material become wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

(5) Setting out of earthworks

Before earthworks operations commence and after survey controls are in place, batter profiles shall be established by the Contractor and the necessary pegs driven at 25m intervals, at each cross section shown on the drawings or at each change in batter slope, whichever is the lesser. The chainage/station, offset from-control line and slope distance to finished surface level, shall be clearly marked on each peg.

The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at

intervals of not more than 5m of vertical height.

All pegs and batter profiles shall be maintained in their correct positions. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes.

The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses SC6.4.6.10.3(5) and SC6.4.6.10.6(3).

(6) Stockpile sites

The Contractor shall obtain the written consent of the Superintendent to the use of any stockpile site which is not shown on the drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile.

Any clearing and grubbing required for these sites shall be carried out in accordance with SC6.4.6.11 Clearing and grubbing. Temporary erosion and sedimentation control measures shall be taken in accordance with *Best Practice Erosion and Sediment Control.*

Restoration of stockpile sites following completion of the work shall be carried out in accordance with IECA *Best Practice Erosion and Sediment Control.*

SC6.4.6.10.2 Removal of topsoil

(1) Scope

Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones.

Removal of topsoil from any section of the Works shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the works in accordance with relevant parts of *Best Practice Erosion and Sediment Control* and SC6.4.6.11 Clearing and grubbing.

Topsoil throughout the length of the Work shall be removed and stockpiled separately clear of the Work with care taken to avoid contamination by other materials. The work shall include the following:

(a) Cuttings

Removal of the topsoil to a depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information shall be removed to its full depth as directed by the Superintendent.

(c) Other locations

Removal of topsoil as directed by the Superintendent.

(2) Topsoil stockpiles

The maximum height of stockpiles shall not exceed 2.5m and the maximum batter slope shall not exceed 2h:1v.

Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.

Keep topsoil and underburden stockpiles separate.

Stabilise stockpiles and batters that will remain bare for more than 28 days by covering with mulch or anchored

fabrics or seeding with sterile grass.

Establish sediment controls around unstabilised stockpiles and batters. Locate stockpiles away from drainage lines, at least 10m away from natural waterways and where they will be least susceptible to wind erosion.

To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent.

Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.10.3 Cuttings

(1) Scope

Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

(2) Excavation

Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to clauses SC6.4.6.10.5 Unsuitable material, SC6.4.6.10.6(1) Scope and SC6.4.6.10.6(2) Embankment material.

Cuttings shall have batter slopes as shown on the drawings or as redetermined by the Superintendent on the basis of site inspection and investigation during the excavation.

The tops of all cuttings shall be neatly “rounded”.

In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material.

Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds.

Where, after the removal of topsoil as specified in clause SC6.4.6.10.2(1) Scope, material of variable quality or moisture content is encountered, the Contractor shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of clause SC6.4.6.10.6(2) Embankment material.

(3) Batter tolerances

If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the batter to suit the convenience of

the Contractor, but such a change shall not be regarded as a redetermination of the batter slope under clause SC6.4.6.10.3(2) Excavation. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the Superintendent's approval.

For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, the Superintendent may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock.

The tolerances for the excavation of batters, measured at right angles to the design grade line, are given in Table SC6.4.6.10.1 Excavation tolerances for batters.

Table SC6.4.6.10.1 Excavation tolerances for batters

Location	Tolerance (mm)	
	Slope 1:1 or flatter	Steeper than 1:1
Toe of batter and level of table drain	+ 0 - 150	+ 0 - 200
2m above table drain and higher	+ 300 - 300	+ 300 - 600
Between level of table drain and 2m above table drain	pro rata basis	pro rata basis

Note—tolerances are measured normal to the batter surface with (+) measured towards the roadway.

(4) Benching in cuttings

Cut batters shall be benched as shown on the drawings to provide drainage and erosion control. Notwithstanding the tolerances permitted under clause SC6.4.6.10.3(3) Batter tolerances, bench widths shall not be less than those shown on the drawings.

Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Contract period. The cost of such maintenance and cleaning of benches shall be borne by the Contractor.

(5) Subgrade of cuttings

The subgrade of cuttings shall be excavated, parallel to the designed grade line, to a designed subgrade level. The subgrade must then be trimmed to a level of not more than +0mm, -50mm from the designed subgrade level. Prior to ripping or removal of the cut material, the Contractor shall determine the CBR of the material in at the subgrade level in accordance with AS1289.6.1.1, Plasticity Index AS1289.3.3.1 and Shrink-Swell Index AS1289.7.1.1. Sufficient tests shall be taken to represent all the various materials which may exist within the subgrade.

Adequate sampling and testing shall be undertaken to satisfy all necessary requirements to verify the intended pavement design. Where the Superintendent considers that any underlying material is unsuitable for pavement support, the Superintendent may direct that it be removed in accordance with clause SC6.4.6.10.5 Unsuitable material.

The Contractor shall rip or loosen all material in the subgrade to a minimum depth of 200mm below the designed subgrade level for the width of the selected material zone (or subbase layer, where no selected material zone), including areas of rock. The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm.

After recompaction, the subgrade within cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than +0mm, -50mm from the designed subgrade level. It shall be recompacted in accordance with Clause SC6.4.6.10.7(1).

Horizontal tolerance – the width of the cutting at subgrade level for support of the pavement shall not be less than that specified.

Prior to placing any subsequent layers over the completed subgrade level, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects to relevant specifications.

In placing subsequent layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the subgrade surface.

(6) Transition from cut to fill

After the removal of topsoil and before the excavation of any cutting commences the contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of

the selected material zone or pavement subbase.

The contractor is to ensure that the transition from cut to fill is undertaken in accordance with best practice geotechnical procedures and guidelines.

SC6.4.6.10.4 Blasting general

(1) When explosives are permitted to be used by council, the contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all government and council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187.1 and AS2187.2. The transport of explosives shall be in accordance with the *Australian Code for the Transport of Explosives by Rail and Road. The requirements of the Explosives Act 1999* and *Explosives Regulation 2003* and Local laws, if applicable, shall be complied with.

The contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Before the start of blasting operations, the contractor, in the presence of the superintendent, shall conduct a dilapidation survey to determine and record the existing condition of all structures likely to be affected by any blast.

The survey shall include all structures including public utilities within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure, to the superintendent and council before blasting commences.

The contractor shall advise the superintendent of the proposed maximum instantaneous charge and the contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The superintendent may direct amendments to the scope of the survey as a result of blast monitoring during the work. All costs associated with the surveys and reports shall be borne by the contractor.

Before each blasting operation, the contractor shall submit to the Superintendent written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures.

Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table SC6.4.6.10.2 Limiting peak particle velocity.

Table SC6.4.6.10.2 Limiting peak particle velocity

Point of Potential Damage (within 1 km of blasting site)	**Peak Particle Velocity**
Completed and cured bridge structures or sub‐structures (e.g. completed abutment).	25mm/sec
Bridgeworks and structural retaining walls under construction.	20mm/sec
Residential premises, schools, hospitals and other buildings.	5mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance.	2mm/sec

The contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations

commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result.

Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.

When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with the sub-section SC6.4.6.30 Control of traffic. A standard warning procedure such as that given in the AS2187.2 shall be established and observed at all times.

(2) Presplitting

Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre.

(3) Blasting records

The Contractor shall maintain accurate records of each blast showing the details listed below:

(a) date and time of blast;

(b) location, number and diameter of holes loaded;

(c) depth of each hole loaded;

(d) inclination of holes;

(e) maximum and minimum burden;

(f) types of explosives used;

(g) charge distribution in each hole;

(h) maximum instantaneous charge;

(i) delay periods and sequence;

(j) total amount of charges in the blast; and

(k) length and type of stemming in each hole.

The records shall be prepared as holes are loaded and signed by the Powder man. A copy shall be provided to the Superintendent on the day of the blast.

(4) Control of air blast over-pressure

This clause shall apply only where a noise sensitive location exists within 1km of the blasting site.

The Contractor's attention is drawn to the recommendations given in the *Environmental Protection (Noise) Policy 2008* or as amended - for the reduction of air blast over-pressure.

The noise emanating from blasting operations shall not exceed an over-pressure level of 115dB (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120dB is not exceeded at any time.

The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this sub-section. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

In the event that the measured air blast over-pressure exceeds the specified limits, the Contractor shall suspend further blasting work and shall submit to the Superintendent proposals detailing any additional steps and precautions the Contractor shall take to ensure that for any future blast, the limiting over-pressure shall not be exceeded. The Contractor shall not resume any blasting until such proposals have been submitted.

(5) Control of ground vibration

The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table SC6.4.6.10.2 Limiting peak particle velocity. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this part of the sub-section. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge.

For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

$$MIC = 0.5\left[\frac{D}{\left[\frac{PPV}{1140}\right]^{-0.625}}\right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms
D = Distance in metres from charge to the point of potential damage
PPV = limiting peak particle velocity from Table SC6.4.6.10.2.

A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Superintendent, if so requested.

SC6.4.6.10.5 Unsuitable material

Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Superintendent deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings which the Superintendent deems to be unsuitable for embankment construction.

Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable, as directed by the Superintendent, shall be incorporated in embankments in accordance with SC6.4.6.10.6(2) Embankment material or spoiled in accordance with clause SC6.4.6.10.6(13) Spoil.

After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with SC6.4.6.10.8(1) Compaction and moisture requirements.

The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with clause SC6.4.6.10.6(14) Borrow, of the quality specified in clause SC6.4.6.10.6(2).

Embankment materials. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with clause SC6.4.6.10.6(5) Placing Fill for embankment construction and compacted in accordance with clause SC6.4.6.10.8(1) Construction management.

Reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor.

Excavate and dispose of all contaminated material in an environmentally responsible manner including the following:

(1) assay material uncovered on-site prior to disposal. If the wastes include putrescibles wastes, then also analyse leachate and landfill gases;

(2) excavate material in a manner which avoids off-site environmental problems;

(3) seal remaining contaminated material or wastes, where only part of the tip has been excavated, to ensure than there is no off-site effect now or in the future;

(4) transport odorous wastes in covered vehicles; and

(5) dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

SC6.4.6.10.6 Embankment construction

(1) Scope

Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with clause SC6.4.6.10.5 Unsuitable material, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the drawings. It also includes any pre-treatment such as breaking down or blending material or drying out material containing excess moisture.

(2) Embankment material

Material for embankment construction shall be obtained from the cuttings within the Works in accordance with clause SC6.4.6.10.3(2) Excavation supplemented by borrow in accordance with clause SC6.4.6.10.6(14) Borrow and from other sources as approved by the Superintendent if necessary. The material shall be free of tree stumps and roots, clay, topsoil, steel, organic material and other contaminants and shall be capable of being compacted in accordance with clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The work shall be programmed so that material of the quality specified in clause SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.6(9) Selected material zone for the upper zones of the formation is available when required.

(3) Foundations for embankments

(a) Following removal of topsoil in accordance with clause SC6.4.6.10.2 Removal of top soil, the embankment foundation area shall be made available for inspection by the Superintendent.
Where the Superintendent considers that any underlying material is unsuitable, the Superintendent may direct that it be removed and replaced in accordance with clause SC6.4.6.10.5 Unsuitable material.

(b) Foundations for Shallow Embankments
Shallow embankments are those embankments of a depth less than 1.0m from the top of pavement to natural surface. After removal of topsoil the Contractor shall survey and work out the extent of the area of shallow embankments.

Material in the foundations for shallow embankments which does not meet the requirements specified in SC6.4.6.10 Attachment A Earthworks – supplementary information, shall be deemed unsuitable in

accordance with clause SC6.4.6.10.5 Unsuitable material and shall be replaced by material of the specified quality.

Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements. The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

(c) Other embankments

For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The bridging layer shall consist of free-draining granular material with or without geofabric interlayer as specified on the drawings. The granular material shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements shall not apply to the bridging layer.

A bridging layer may also be employed, subject to the approval of the Superintendent, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in clause SC6.4.6.10.8(1) Compaction and moisture requirements. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design. As an alternative to a bridging layer, approval of a working platform created by the chemical stabilisation of in situ material to conform with sub-section SC6.4.6.19 Stabilisation may be required.

(4) Hillside embankments

Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction, shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1m in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

(5) Placing fill for embankment construction

The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.
The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with clause SC6.4.6.10.8(1) Compaction and moisture requirements. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25% by volume of the filling consists of rock with any dimension larger than 150mm, the Superintendent may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements is attained.

The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.

Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material

must be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Superintendent considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.
Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer.

In placing embankment layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.
After compaction, embankment material in the zone(s) below the selected material zone (or subbase layer, where no selected material zone) shall have a CBR value not less than that quoted in and for the depth(s) specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information.

For the purpose of this clause, the CBR value of the material shall be determined by Test Method AS1289.6.1.1.

The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements.

(6) Embankment batters

The batter slopes shown on the drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Superintendent according to the Superintendent's assessment of the materials encountered.

When completed, the slope of embankment batter shall conform to those shown on the drawings and conform to the following tolerances:

(a) for a vertical distance to 1m below the shoulder, no point on the completed batter to vary from the specified slope line by more than 150mm when measured at right angles to the slope line;

(b) at distances greater than 1m vertically below the shoulder, no point on the completed batter to vary from the specified slope line by more than 300mm when measured at right angles to the slope; and

(c) in no case is the edge of the formation at the underside of the pavement to be nearer to the roadway than shown on the drawings and the batter slope at no point be steeper than the specified slope.

However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the drawings.
Undulations in the general plane of the batter shall not be permitted.

(7) Rock facing of embankments

Where shown on the drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.

The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced.

The Contractor shall adjust its working methods and programme the work so as to obtain hard and durable rock of the specified dimensions as it is required. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter.

The Contractor shall exercise extreme caution whilst placing the rock facing. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage down the batter.

The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use.

(8) Trimming tops of embankments

The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

The tops of embankments at these levels shall be compacted to meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements and trimmed so that they do not vary by more than ±50mm from the calculated level. The width of the embankment at subgrade level shall not be less than that specified.

Prior to placing any subsequent pavement layers over the completed top of embankment filling, the contractor shall present the completed surface to the superintendent for inspection. The contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of the relevant specifications.

(9) Selected material zone

A selected material zone must be provided in accordance with the following quality requirements:

(a) it shall be free from stone larger than 75mm maximum dimension and have no less than 50% passing the 19mm AS sieve;

(b) a CBR value not less than the specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information for the fraction passing AS 19mm sieve; and

(c) Plasticity Index of 15 maximum.

If chemical stabilisation is specified these requirements must apply to the selected material immediately prior to incorporating the stabilising agent.

The Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this clause.

The Contractor shall ensure that any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled at locations approved by the Superintendent for future use by the Contractor in the selected material zone until at least sufficient material is reserved to complete the selected material zone over the whole work. Should the Contractor fail to conserve material of the specified quality, the Superintendent may direct that material of equivalent quality be provided.

The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. The selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material which does not comply with the specified requirements of this clause and compaction shall be as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in SC6.4.6.10 Attachment A Earthworks – Supplementary Information.

Prior to placing any subsequent pavement layers over the completed select material zone surface, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of relevant Specification.

(10) Fill adjacent to structures

For the purpose of this clause, structures shall include bridges, precast and cast-in-situ box culverts and

retaining walls. Fill adjacent to other culverts and drainage structures to be provided in accordance with SC6.4.6.4 Stormwater Drainage, SC6.4.6.6 Pipe Drainage, SC6.4.6.7 Precast Box Culverts and SC6.4.6.5 Drainage Structures.

No filling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the contractor can demonstrate that 85% of the design strength of the concrete has been achieved. This includes concrete in bridge decks and fill placement that impacts the position, stability and serviceability of bridge deck member bearings.

(11) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50 mm to 10 mm such that:

(a) the maximum particle dimension shall not exceed 50mm; and

(b) no more than 5% by mass shall pass the 9.5mm A.S. sieve.

The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend from 200mm below to at least 450mm vertically above the level of the weepholes, where practicable.

Alternatively the Contractor may provide a synthetic membrane (geotextile) of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane (geotextile) shall be subject to the Superintendent's approval.

(12) Selected backfill

(a) Selected backfill shall be placed adjacent to structures in accordance with Table SC6.4.6.10.3 Selected backfill, width and height. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS1289.3.3.1, neither less than 2 nor more than 12.

Table SC6.4.6.10.3 Select backfill, width and height

Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-situ Box Culverts and Precast Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining Walls	H/3	H

(Where H = height of structure)

The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1m in width, and the selected backfill shall be placed in accordance with clause SC6.4.6.10.6(5) Placing fill for embankment construction.

Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within 21 days after placing concrete in the bridge deck, unless approved by the Superintendent.

In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by individual placement around or against such structures.

In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm.

(13) Spoil

Spoil is surplus material from excavations which is not required to complete the Works as specified or other material from excavations whose quality the Superintendent deems to be unacceptable for incorporation in the Works.

Where there is surplus material the Superintendent may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in clauses SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments.

Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent within the specified working area for the Works or be removed and disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments or to such lesser extent as may be approved by the Superintendent.

(14) Borrow

Borrow will only be authorised by the Superintendent if, in constructing cuttings and embankments to the batter slopes specified or directed by the Superintendent or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock facing of embankments, SC6.4.6.10.6(8) Trimming tops of embankments or SC6.4.6.10.6(10) Fill adjacent to structures, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Where borrow material is required to complete the Works as specified, the location of borrow sites shall be as approved by the Superintendent, and the quality of material shall be acceptable to the Superintendent in accordance with clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock Facing of Embankments or SC6.4.6.10.6(10) Fill Adjacent to Structures as appropriate. The edges of borrow sites must be no closer than 3m from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Superintendent, cut batter slopes not steeper than 4h to 1v, and shall be left by the Contractor in a tidy and safe condition (i.e. stabilising disturbed areas).

For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with SC6.4.6.11 Clearing and grubbing and clause SC6.4.6.10.2 Removal of top soil. Restoration of borrow sites shall be carried out by Contractor in accordance with Best Practice Erosion and Sediment Control.

If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses SC6.4.6.10.3(2) Excavation, SC6.4.6.10.3(3) Batter tolerances and SC6.4.6.10.3(5) Treatment of floors of cuttings as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

The Contractor shall be responsible for obtaining any permits required for entry on land and for the payment of any royalty for such borrow material. The Contractor shall also comply with any requirements of the *Planning Act 2016* – as amended, Townsville City Plan, Local laws and land owners, as appropriate.

SC6.4.6.10.7 Acid sulfate soils

(1) Objective

To minimise disturbance to areas of potential acid sulphate soils (PASS) and/or actual acid sulphate soils (ASS). If disturbance of PASS/ASS cannot be avoided, appropriate treatment is required to minimise the

potential for environmental harm.

PASS and ASS are soils that have the potential to generate acid through oxidation of iron sulphides when exposed to air. ASS and PASS are generally found in coastal areas, and generally in soils at an elevation of 5m AHD or lower.

(2) References

Dept of Environment and Resource Management, *Nov 2002*
Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines
State Planning Policy
EF006: Daily Dredging Checklist Form
CE020: Regulated Waste Transport Procedure
QAF004 Incident, Hazard, Improvement reporting form

(3) Safety requirements

Works shall comply with provisions of the Work Health and Safety Act 2011 and subsequent regulations. Personnel are responsible for their own Personal Protective Equipment (PPE) and the safety of the surrounding workplace during works.

Care is to be taken when using hydrogen peroxide, including gloves and eye protection.

(4) Environmental Requirements

Compliance with Environmental Protection Act 1994 and subordinate legislation.
Compliance with *Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines*
Compliance with the State Planning Policy.
Compliance with all other environmental legislation.
Compliance with TCC Environmental Policy.

(5) Equipment and materials

Testing should be undertaken by a suitably qualified laboratory.

(6) Method

(a) Identifying ASS/PASS on site

The following points can assist in determining if soil has a likelihood of containing ASS/PASS. Affirmative answers to the following questions may indicate the presence of ASS/PASS. Field observations and tests should be complemented by laboratory testing.

(i) Is the site elevation 5m AHD or less?

(ii) Are mangroves, she-oaks or melalueca species (i.e. paper barks) present on site?

(iii) Is there other vegetation that is stunted or dying?

(iv) Does the soil have a dark grey to grey appearance?

(v) Is there a rotten egg smell (hydrogen sulphide) to disturbed soil?

(vi) Is there a mottled-yellow mineral present in the soil (Jarosite)?

(vii) Is there water bodies nearby that have a very clear blue-ish appearance, or does it appear to be reddish (rust) in colour?

(viii) Is the pH of the excavated sediment, or water, below 4?

(b) Managing and treating ASS and PASS

(i) Determine if works can be undertaken without disturbing ASS/PASS material.

(ii) If ASS/PASS is to be disturbed as a result of project activities then undertake testing to determine the severity of the potential acidification and extent of ASS/PASS material.

(iii) ASS/PASS material excavated on site must either be treated on site or transported to a treatment location. A treatment pad should be set up as per the *Queensland Acid Sulfate Soil Technical*

Manual, Soil Management Guidelines.

(iv) ASS material should be transported as regulated waste as it has the potential to be generating acid while exposed to the atmosphere.

(v) All treatment of PASS/ASS must be undertaken in compliance with the *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines.*

(vi) ASS/PASS treatment must be undertaken as per the laboratory recommendations.

(c) Corrective/Emergency Actions

If PASS and/or ASS are identified through site inspection and confirmed through lab testing, follow procedure outline in (6) above.

If corrective actions are identified, an Incident, Hazard, Improvement Report is to be completed and subsequent review of this procedure undertaken in accordance with these guidelines.

(d) Waste Control

Treat PASS and ASS in accordance with guidelines (State Policy)

Ensure wastes generated as a result of field testing or work activities are disposed of correctly.

(e) Responsibilities

(i) Site foreperson/works controller is responsible for:

(A) monitoring and testing soils; and

(B) Minimising disturbance to PASS/ASS.

(ii) The Environmental Engineer is responsible for ensuring any environmental non-compliances are reported.

(iii) The Executive Manager Engineering Services is responsible for:

(A) notifying relevant personnel of changes to this procedure; and

(B) delivering training to personnel (if required).

(f) Monitoring and reporting

The foreperson will monitor and test soils prior to commencement of works and record results of field tests on daily dredging checklist.

SC6.4.6.10.8 Compaction and quality control

(1) Compaction and moisture requirements

In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

(a) The following areas shall be compacted to provide a relative compaction, determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort, of not less than 95%.

(i) each layer of material replacing unsuitable material as detailed in clause SC6.4.6.10.5 Unsuitable material

(ii) each layer of material placed in embankments, up to 300mm from the top of the sub-grade;

(iii) fill placed adjacent to structures up to 300mm from the top of sub-grade;

(iv) material in unsealed verges and within medians up to the level at which topsoil is placed;

(v) spoil (excluding unsuitable material); and

(vi) all other areas except those where a higher relative compaction is specified.

Unsuitable material shall be stockpiled as directed by the Superintendent and compacted by track rolling.

(b) The following areas shall be compacted to provide a relative compaction of not less than 97% as determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort:

(i) foundations for shallow embankments;

(ii) foundations other than shallow embankments;

(iii) the whole area on the floors of cuttings;

(iv) each layer of the embankment or cutting within 300mm from the top of sub-grade;

(v) each layer of the selected material zone as specified in clause SC6.4.6.10.6(9) Selected material zone;

(vi) any areas of material of specified quality which may be shown on the drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements; and

(vii) the fill material placed adjacent to structures as specified in clauses SC6.4.6.10.6(10) Fill adjacent to structures and SC6.4.6.10.6(12) Selected backfill in each layer within 300mm from the top of the sub-grade.

Where the vertical alignment design is such that a substantial portion of the road is required to be built at or close to the natural surface, cut the prepared subgrade to a depth below natural surface of less than 0.5m. Approval is required when shallow cutting conditions occur, the specified transition from cut to fill may be modified such that the depth of terrace excavation at the transition from cut to fill is reduced from 900mm to 250mm.

Treat the floor of shallow cutting as specified in clause SC6.4.6.10.3(5) Treatment of floors of cuttings and clause SC6.4.6.10.3(6) Trasition from cut to fill and compact to provide a relative compaction of not less than 100% for a depth of 200mm determined by AS1289.5.4.1, for standard compactive effort.

At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is within the range set out in SC6.4.6.10 Attachment A Earthworks Supplementary Information of the optimum moisture content as determined by AS1289.5.1.1 or AS1289.5.7.1. Material which becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Superintendent, by the use of hydrated or quick lime. Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained.

Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

Any material placed by the Contractor that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS1289.5.4.1, shall be dried out and uniformly recompacted to the required relative compaction in accordance with this clause before the next layer of material is placed. Alternatively, the Contractor may remove the layer of wetted material to a stockpile site for drying and later re-use.

(2) Test locations

The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the Contractor shall work the lot to ensure uniform moisture content and compaction of all material within the lot.

The test(s) then taken shall be considered to represent the total volume of material placed within the lot.

Where the Superintendent considers that the material which is present has not achieved uniformity required by this clause or clause SC6.4.6.10.6(5) Placing fill for embankment construction, the Superintendent may take or

direct further testing. The Superintendent shall nominate the area represented by the additional testing.

If such testing confirms that material not conforming to the Specification, the Contractor shall carry out remedial work as necessary to achieve conformance to the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

(3) Deflection monitoring

Following completion of the formation to the underside of the selected material zone in accordance with clause SC6.4.6.10.6(3) Foundations for embankments and SC6.4.6.10.6(5) Placing fill for embankment construction, completion of the selected material zone in accordance with clause SC6.4.6.10.6(9) Selected material zone and SC6.4.6.10.3(5) Treatment of floors of cutting, the Contractor shall make the work available in lots, for the Superintendent or council to carry out deflection monitoring.

A lot for deflection testing shall consist of a continuous length of formation, in compliance with council requirements, and a single carriageway width which is generally homogeneous with respect to material and appearance. The contractor shall identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent.

Prior to the release of the lot, a proof roll is to be performed with a single drive axle truck with an axle load of 8.2 t covering all lanes of carriage way including parking bays having no evident movement.

(4) Widening of formation

Road shoulders and formation shall be widened to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the drawings.

(5) Subgrade testing and treatment

Refer to SC6.4.4.2.4

SC6.4.6.10.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.10.4 Summary of limits and tolerances below.

Table SC6.4.6.10.9 Summary of limits and tolerances

Item	Activity	Limits/Tolerances
1.	**Batter Slopes**	± 300mm
	a) Excavation	
	b) Embankment	± 300mm
2.	**Subgrade**	Parallel to designed grade line. Tolerance is to be within +0mm - 50mm of the levels specified.
	Vertical Tolerance	
	Horizontal Tolerance	The width of the cutting at subgrade level for support of the pavement shall not be less than that specified on the drawings or documentation.
3.	**Tops of Embankments**	Parallel to the designed grade line. Tolerance is to be within, ±50mm from the levels specified
	Vertical Tolerance	
	Horizontal Tolerance	The width of an embankment at subgrade shall not be less than that specified on the drawings or documentation.
4.	**Selected Material**	SC6.4.6.10 Attachment A: Earthworks – Supplementary Information

Note—tolerances are measured at right angles to design surfaces.

SC6.4.6.10.10 Attachment A: Earthworks - supplementary information

Clause	Description	Value
SC6.4.6.10.2(1)	The depth below natural surface up to which the removal and measurement of top soil shall apply: (a) Cutting area; and (b) Embankment area	75mm
SC6.4.6.10.3(5)	Minimum CBR value in cutting floors used for design of pavement	3%
SC6.4.6.10.6(3)	Requirements of material in foundations for shallow embankment Moisture Content - within the range of 60% to 90% of optimum	
SC6.4.6.10.6(5)	Upper Zones of Formation and SC6.4.6.10.6 (9) Select Material Zone Material within each zone shall have a CBR value of not less than the following, under the nominated test conditions:	

Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)
a. Select Material Zone	10	200	4
b. Material below Selected Material Zone to 1.5 metre from top of pavement	3	N/A	4

SC6.4.6.10.6(9) Construction tolerances for selected material zones is to be ±50mm of the designed grade and crossfall profile

SC6.4.6.10.8(1) Moisture content of material placed in embankments:

(a) Material in upper zones of formation - within the range of 60% to 90% of optimum

(b) All other embankment material - within the range of 60% to 90% of optimum

SC6.4.6.11 Clearing and grubbing

SC6.4.6.11.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the clearing of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards), all rubbish and other materials, including the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees stumps from the area. The work also includes the disposal, in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation and SC6.4.6.11.3(3) Disposal of materials, of all materials that have been cleared and grubbed.

(2) General requirements

Site works shall take all measures to prevent damage to existing underground and overhead utility services.

Before commencing earthworks, locate and mark existing underground services in the areas to be affected by the works including clearing, excavating and trenching.

All existing utilities, natural landscape features, including natural rock outcrops, natural vegetation, trees to be preserved, soil and watercourses are to remain undisturbed.

Explosives shall not be permitted to be used in clearing, grubbing or other demolition activities.

Editor's note—DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, through which underground pipes and cables are located (possible within two working days). For more information go to the Dial 1100 Before you Dig website.

SC6.4.6.11.2 Clearing

(1) Clearing operations

The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards), all rubbish and other materials which, are unsuitable for use in the works with the exception of certain trees marked for preservation. The contractor shall plan clearing operations such that wherever possible, clearing is carried out progressively and only the minimum area of land is left disturbed at any time.

The contractor shall give the superintendent written notice of seven days of the intention to clear any area of the work. The superintendent shall mark or indicate to the contractor the trees that shall be preserved. The contractor shall arrange for an inspection by an authorised council officer and shall obtain council's approval to proceed with clearing and grubbing. The contractor must conform to the requirements of SC6.4.5.2(18) when protecting identified trees and bushland within or adjacent to the construction site.

The erection of structures, excavation and filling, changes to soil profiles, stockpiling of spoil, storage of other materials and driving or parking of any vehicle or machinery within 4m of the trunks of trees to be retained shall not be permitted unless they form part of the works as approved by the council.

The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or directed by the Superintendent. No growing trees shall be destroyed or damaged by the Contractor other than those specified and those indicated by the Superintendent.

Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Superintendent, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation, subject to prior approval of council.

If directed by the Superintendent, any branch, which overhangs the road formation, shall be cut back to within 0.5 m of the tree trunk and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation.

(2) Fallen timber and tree damage

Every precaution shall be taken to prevent timber from falling onto private property. The Contractor shall dispose of any timber that has fallen onto private property or produce written consent from the property owner to its remaining there.

The cost of disposal of such fallen timber shall be borne by the Contractor. Prior to entering the private property, the Contractor shall obtain consent from the Superintendent and the property owner. Damage of any kind, including damage to trees, fencing, occurring during clearing operations shall be made good by the Contractor. The cost of making good such damage shall be borne by the Contractor. Any damage to trees or vegetation which in councils opinion, will require its removal, is to be in rectified in accordance with SC6.4.5.2.1(19)(d).

SC6.4.6.11.3 Grubbing

(1) Grubbing

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing.

Grubbing operations shall be carried out to a depth of 0.5m below the natural surface or 1.5m below the finished surface level, whichever is the lower.

Holes remaining after trees and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground.

(2) Chipping of cleared vegetation

The Contractor shall produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this sub-section. The wood-chip mulch produced shall be stockpiled for subsequent use or for use at other locations as appropriate.

The wood-chip mulch shall be produced from branches having a maximum diameter of 100mm and the chipped material produced shall not have two orthogonal dimensions exceeding 75mm and 50mm.

(3) Disposal of surplus materials

Unless otherwise specified elsewhere, all surplus materials cleared and grubbed in accordance with this sub-section shall either be removed from the site or used for landscaping within the site in accordance with the approved plans and any conditions set by council.

Unless otherwise approved by council in writing, disposal of timber and other combustible materials by burning shall not be permitted.

SC6.4.6.12 Flexible pavements

SC6.4.6.12.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply, spreading, compaction and trimming of base and subbase courses of flexible pavements.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Pavement structures

Flexible pavement material types and layer thicknesses must be as per design requirements.

(3) Activity plan

Prior to commencement of work, the Contractor must provide the Superintendent a Pavement construction plan and detail the following activities:

(a) allocation of plant and personnel for the contract period;

(b) work programming to meet the constraints of all inspection points; and

(c) prepare and submit a Pavement construction plan for the flexible base and subbase construction consistent with the drawings and subject to direction by the Superintendent. Include the following:

(i) a time based program;

(ii) a drawn sectional plan showing lots and sequence;

(iii) site availability, assumptions on weather, plant and materials;

(iv) a list of activities requiring approvals or notification of local authorities, statutory bodies, and local residents; and

(v) off-site storage of plant, personnel and maintenance facilities.

(4) Inspection, sampling and testing

Inspection, sampling and testing of the pavement must be undertaken by the Contractor in accordance with the requirements of this sub-section before, during and after the construction of the pavement. Testing must be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

The Contractor must provide the Superintendent with written notice when testing is being carried out and copies of all test reports for approval to proceed.

Field density tests must be carried out in accordance with AS 1289.5.3.1, or, with the Superintendent's concurrence, with a Nuclear Density Meter in accordance with Clause SC6.4.6.12.6(3).

(5) Terminology

Base material	materials designated as Base are of a suitable quality that form the uppermost structural element of a pavement and on which the surfacing may be placed.
Bound material	bound material incorporates binder/s to produce structural stiffness (UCS > 1.5MPa at 28 days in accordance with TMR Test Method Q115).

Flexible pavement	a flexible pavement consists of a base and a subbase constructed of unbound granular materials or modified material, obtaining its load spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
Modified material	modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness. A modified material must have sufficient stabilising binder to achieve a UCS range of 0.8MPa - 1.5MPa at 28 days in accordance with TMR Test Method Q115.
Subbase material	materials designated as Subbase are laid on the subgrade (or selected material), below the base, either for the purpose of making up additional pavement thickness, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Unbound material	unbound materials are granular materials with no significant capacity to resist tensile stresses.

(6) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.16 - Sprayed bitumen surfacing
SC6.4.6.19 - Stabilisation
SC6.4.4.2 - Pavement design

(b) Queensland Department of Transport and Main Roads specifications:
MRTS05 - Unbound Pavement

(c) Queensland Department of Transport and Main Roads Test Methods:
Q142A - Dry Density - Moisture Relationship (Standard Compaction).
Q115 - Unconfined Compressive Strength of Compacted Materials.
Q701 - Benkelman Beam Deflections.

(d) Australian Standards:

AS 1141.14 *- Particle shape, by proportional calliper*
AS 1141.22 *- Wet/dry strength variation*
AS 1289.3.1.1 *- Determination of the liquid limit of a soil - Four point Casagrande method*
AS 1289.3.3.1 *- Calculation of the plasticity index of a soil*
AS 1289.3.6.1 *- Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.6.3 *- Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer*
AS 1289.5.1.1 *- Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.3.1 *- Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus*
AS 1289.5.4.1 *- Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.8.1 *- Determination of field density and field moisture content of a soil using a nuclear surface moisture - density gauge - Direct transmission mode*
AS 1289.6.1.1 *- Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 5101.4 *- Methods for preparation and testing of stabilized materials. Method 4: Unconfined compressive strength of compacted materials*

SC6.4.6.12.2 Materials

(1) General

The Contractor must submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any binder including targeted 28 days unconfined compressive strength (UCS). These details must be submitted to the Superintendent, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this sub-section.

If the proposed base or subbase is a bound material, the Contractor must submit a completed SC6.4.6.19 Attachment A Stabilisation mix design contained in the sub-section SC6.4.6.19 Stabilisation.

No material may be delivered until the Superintendent has approved the source of supply.

If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor must inform the Superintendent in writing of the proposed changes. No delivery of material produced under the altered proposal must take place without the approval of the Superintendent.

At least 2 weeks before placement of the material on site, the Contractor must submit a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this sub section.

Ongoing testing of materials during delivery and construction must be undertaken on samples taken from the site.

(2) Unbound base and subbase

Base materials must comply with the requirements of type 2.1 materials as per clause 7.2 of MRTS05, grading B or C.

Sub-base materials must comply with the requirements of type 2.3 materials as per clause 7.2 of MRTS05, grading B or C.

Lower sub-base must comply with the requirements of type 2.4 materials as per clause 7.2 of MRTS05, grading B or C.

Unbound materials, including blends of two or more different materials, must consist of granular material which does not develop significant structural stiffness when compacted. Material produced by blending must be uniform in grading and physical characteristics.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the Contractor.

(b) **Layer Thickness**

Unbound pavement material must be laid at a minimum thickness of 125mm and a maximum thickness of 250mm.

(c) **Longitudinal Joins**

Longitudinal joins for paving runs for the top layer of the base courses must be aligned to coincide with the position of the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**

Segregation is the uneven distribution of particle sizes. The construction process must minimise segregation. There must be no visible signs of segregation on each lot. Samples must be taken from each lot to check that segregation of the material in the lot has not occurred. Additional samples must be taken from any areas which show visible signs of segregation. Each sample must be tested in accordance with Test Method Q103A.

(3) Lime modified base and subbase materials

Modification of unbound base and subbase materials to meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase by the addition of hydrated lime or quicklime is subject to approval by the Superintendent and to the additional requirements of this clause. After modification, the material must meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase.

Modification of materials must be by means of blending either hydrated lime through a stationary mixing plant or by hydrated lime or quicklime utilising in-situ operations.

Material requirements of hydrated lime and quicklime must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The method of incorporating lime through the stationary mixing plant must ensure that the lime is mixed uniformly through the material.

In-situ operations must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The proportion of lime must be not less than 1.5% nor more than 4% by mass. The material prior to lime treatment must contain no added pozzolanic material.

The lime treated material must yield an unconfined compressive strength not exceeding 1MPa, when tested in accordance with Test Method Q115 where sampling is undertaken within 24 hours of adding the lime and testing is after 28 days curing.

(a) **Curing Final Layer**

Moist curing process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non-cohesive, soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, wherever possible the completed pavement should not be moist cured within 48 hours of placing. Moist curing must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 48 hours.

(4) Bound base and subbase materials (Including Modified Material)

Bound material for a UCS>1.5MPa (28 days) to be used as subbase generally or base layer may be supplied as a pugmill quarry product with stabilising agent and laid using a paving machine or grader laid. Alternatively it may be produced by the in-situ stabilisation of natural or blended gravel where stabilisation is undertaken by mobile plant at the site.

Prior to stabilisation, the layer to be stabilised must meet the appropriate requirements for subbase material.

Material requirements for the stabilising agent must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The stabilisation process must meet the requirements of sub-section SC6.4.6.19 Stabilisation.

The unconfined compressive strength (UCS) of the material after 28 days curing as determined by Test Method Q115 must be not less than 2.5MPa for stabilised pavements and not less than 0.8MPa for modified pavements. Sampling and test specimen compaction of the material must be undertaken within one hour of the incorporation of the stabilising agent.

The maximum period (working time) between mixing cement with the gravel material and the completion of compaction must be 3 hours. Council reserves the rights to reject the work if working time is not achieved and the material must be removed from site.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the contractor.

(b) **Layer Thickness**
Bound pavement material (including Modified Material) must be laid at a minimum thickness of 150mm and a maximum thickness of 250mm. If bound layers are placed with a paving machine, Council may approve thinner layers.

(c) **Longitudinal Joins**
Longitudinal joins for paving runs for the top layer of the base courses must be aligned to coincide with the position with the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**
Segregation is the uneven distribution of particle sizes. The construction process must minimise segregation. There must be no visible signs of segregation of the material in the lot has not occurred. Additional samples must be taken from any areas which show visible signs of segregation. Given the presence of cement additive in the material, the relevant test for segregation must be as specified in AS 1289.3.6.1.

(e) **Curing Final Layer**
Moist curing process has the potential to “wash” the cementitious paste from the upper surface, which leaves an unbound, non-cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement must not be moist cured within 48 hours of placing. After 48 hours, moist curing must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 48 hours.

SC6.4.6.12.3 Delivery, stockpiling and processing of pavement material

(1) Delivery to site
Materials must be supplied sufficiently damp to avoid segregation and loss of fines during transit.

(2) Stockpiling of unbound materials
Stockpile sites must be located as shown on the drawings or as approved by the Superintendent.

Stockpile sites, which must be cleared of all vegetation and extraneous matter, must be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by AS1289.5.4.1 for standard compactive effort, of not less than 95%.

Stockpiles and stockpile sites must be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.

The total height of any stockpile must not exceed 3m.

Stockpiles must be of uniform shape with side slopes neither steeper than 1.5h to 1v nor flatter than 3h to 1v.

The worked face of any stockpile must be the full face of the stockpile. The stockpiled material must be maintained at a moisture content sufficiently damp to avoid loss of fines.

At the completion of the works, stockpile sites must be cleared of all surplus material and left in a clean and tidy condition.

(3) Delivery of modified or bound materials
Modified or bound materials must be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport.

The time between mixing and conveyance by delivery trucks to the site, must be such as to allow incorporation into the works including trimming and compaction within the nominated field working period.

Each truck load of bound material must be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets must be made available to the Superintendent at the point of delivery.

Bound materials must comply with the requirements of sub-section SC6.4.6.19 Stabilisation.

SC6.4.6.12.4 Spreading pavement materials

The contractor must present the underlying layer to the Superintendent prior to placement of subsequent layers and must ensure that moisture content of the underlying layer does not exceed 90% of the laboratory optimum moisture content as determined by AS1289.5.1.1. If the underlying layer has become rutted or mixed with foreign matter, it must be corrected to comply with this Sub-section before spreading of the next layer of pavement.

Where the underlying layer was constructed by the Contractor, or where the Contractor's activities caused the underlying layer constructed by others to become non-complying with this sub-section, correcting the underlying layer to comply is the responsibility of the Contractor.

Each layer of material must be deposited and spread in a concurrent operation and, after compaction, the finished surface levels on the base and subbase courses must be within the permitted tolerances stated in Clause SC6.4.6.12.6(6)(c) Levels and surface trim without subsequent addition of material. The thickness of each compacted layer must be neither less than 125mm nor more than 250mm for all pavement layer types, unless otherwise approved by the Superintendent.

At all work boundaries in bound materials the Contractor must provide vertical faces to provide for transverse and longitudinal joints.

When spread for compaction processes the moisture content of the unbound and bound base materials must be in the range of 60-90% and subbase materials must be in the range of 75-100% of laboratory optimum moisture content in accordance with AS1289.5.1.1.

Bound materials with UCS > 1.5MPa (28 days) must not be spread with a self-propelled paver when the ambient air temperature in shade is either below 5°C or above 35°C. Where the materials are to be spread outside the required ambient air temperature range, the Contractor must submit a work proposal to the Superintendent for approval.

SC6.4.6.12.5 Compaction

(1) General requirements

Each layer of the base and subbase courses must be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in clauses SC6.4.6.12.6(3) Relative compaction and SC6.4.6.12.6(4) Compaction requirements and acceptance.

On sections of pavement with one way crossfall, compaction must begin at the low side of the pavement and progress to the high side. On crowned sections, compaction must begin at the sides of the pavement and progress towards the crown. Each pass of the rollers must be parallel with the centreline of the roadway and uniformly overlap each preceding pass. The outer metre of both sides of the pavement must receive at least two more passes by the compaction plant than the remainder of the pavement.

At locations where it would be impracticable to use self propelled compaction plant, the pavement material must be compacted by alternative hand operated plant approved by the Superintendent.

Watering and compaction plant must not be allowed to stand on the pavement being compacted.
If any unstable areas develop during rolling, the unstable material must be rejected. The rejected material must be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. This operation will be at cost to the Contractor.

The placement of subsequent layers must not be allowed until the requisite testing has been completed and the test results for each layer have been accepted by the Superintendent and correct curing times for bound

layers has been attained.

Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up must be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.

(2) Curing of bound materials
The curing of the surface layer of a lot must commence after compaction is completed and must be in accordance with the SC6.4.6.19 Attachment A Stabilisation mix design.

The stabilised work must be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal. Also refers to the requirements of SC6.4.12.2 (5) (e) Curing of final layer.

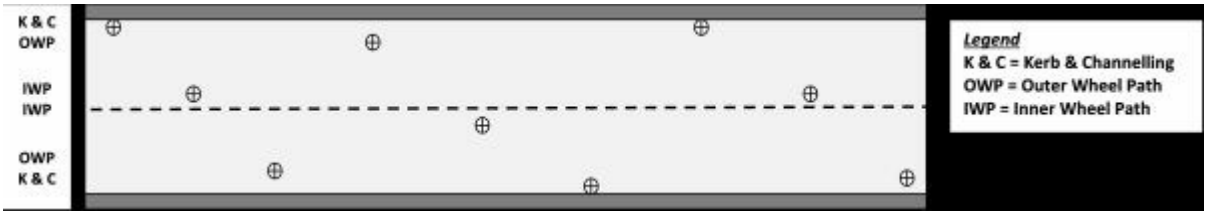
SC6.4.6.12.6 Acceptance of compaction

(1) Lots for acceptance
Acceptance of work, as far as compaction is concerned, must be based on density testing of the work in lots. A lot must be nominated by the Contractor, but must conform to the following:

(a) cover only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints; and

(b) for unbound materials, it may equal a day's output using the same material.

(2) Compaction assessment
The Superintendent must assess compaction for each lot based on arranged test locations for in-situ dry density testing in line with the following diagram. The intention is that one in every three density tests must be positioned against the inner line of the kerb and channel on either side. This arrangement must be repeated or truncated as appropriate depending on the number of tests required per lot.



Similar arrangement must be adopted for roads with no kerb and channel or edge constraint, with the test locations at the edge shifted to the OWP position. A random arrangement for test locations at intersection is acceptable, provided that one in every three density test is positioned along the inner kerb and channel / edge line.

The Contractor must arrange for testing to assess compaction on the basis of a pro rata testing frequency of 10 tests per 5,000sqm with a minimum of three tests per lot.

The elastic rebound deflection must be taken as the maximum deflection in accordance with Test Method Q701 utilising the Benkelman Beam or equivalent. The average maximum deflection for any lot must not exceed 1mm, and the co-efficient of variation (CV) in recorded deflections must not exceed 30%.

Measurements must be taken at the rate of 4 per 1,000sqm, with a minimum of ten measurements per lot.

Proof rolling must be undertaken with the use of a single drive axle truck with a rear single axle/dual wheels load of 8.2t or tandem rear axle/dual wheels carrying a load of 13.8t. Proof rolling cover all lanes of the carriage way including parking bays and must show no evident movement.

(3) Relative compaction
The relative compaction of pavement material at each location tested for in-situ dry density must be calculated

in accordance with AS 1289.5.4.1 as follows:

Relative Compaction (per cent) = $\frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$

Note—the comparative dry density must be the maximum dry density determined in the laboratory.

The council Superintendent may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1. Council reserves the right to request additional testing at the discretion of the Inspector.

Each day that material is produced for placement in a layer or layers, a sample of the material must be taken by the Contractor for maximum dry density testing to represent that day's production.

For unbound layers, the sample must be tested in accordance with AS 1289.5.1.1 to determine the maximum dry density (standard compactive effort) for the material.

For bound layers the sample must be tested within two hours after the addition of stabilising agent to the mix in accordance with Test Method Q142A to determine the maximum dry density (standard compactive effort) for the material. This test method must also be used to determine the standard optimum moisture content.

The maximum dry density so determined must be used as the comparative dry density in relative compaction calculations for all like material from that lot or day's production placed in a single layer of work whichever is the lesser.

(4) Compaction requirements and acceptance

All compaction test results must exceed the minimum requirements in accordance with:

(a)	Unbound pavement	MRTS05
(b)	Insitu stabilised subgrade using lime	MRTS07A
(c)	Insitu stabilised pavement using cement	MRTS07B
(d)	Insitu stablised pavement using foam bitumen	MRTS07C
(e)	Plant mixed stabilised pavement	MRTS08

(5) Reworking of rejected unbound layers

Lots or areas of pavement that have been rejected in regard to compaction must be reworked before resubmission for compaction assessment.

Material that has become degraded, segregated or otherwise reduced in quality by reworking must be rejected. The rejected material must be removed, disposed of and replaced with fresh material complying with this Sub-section in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. When a lot or area of pavement is resubmitted for compaction assessment, testing must be carried out in accordance with clauses SC6.4.6.12.6(2) Compaction assessment and SC6.4.6.12.6(3) Relative compaction.

All corrective work must be carried out by the Contractor before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking. All costs associated with corrective work carried out before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking must be borne by the Contractor. Reworking of rejected modified or stabilised material is not accepted.

(6) Tolerances

(a) General

The tolerances stated are the acceptable limits of departure from the dimensions shown on the drawings, which may occur during construction.

Areas for assessment of conformity with tolerance requirements must be divided into lots and presented to the Superintendent together with survey reports covering line and level.

(b) Width

At any cross section without kerb and /or guttering channel or a dish drain, and for pavement layers extending under the kerb and channel or dish drain/or guttering , the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface must be neither less than 50mm less than the dimension nor more than 300mm greater than the dimension shown on the drawings.
The average width of the layer determined from measurements at three sites selected at random by the Superintendent over any 200m road length, or part thereof, must be not less than the specified width.

(c) Levels and surface trim

The levels of the finished surface of the top of the unbound subbase course must not vary from the design levels by more than ±15mm.

Level tolerances at the top of the unbound base course must not exceed those stated above for subbase. In addition, where kerb and channel exists or is being constructed, the level of the top of the base course adjacent to the kerb and channel must not vary by more than ±5mm from the lip level of the gutter minus the design thickness of the wearing surface.

The design level of the top of the subbase course must be determined from the design level of the finished road surface less the thickness of the base course and the wearing course, including an allowance for any flush seal layer in the pavement design.

The pavement surface after trimming and immediately prior to sealing must be of a quality such that the deviation under a 3m straight edge placed in any direction does not exceed 12mm. Measurements for conformance must be taken in accordance with the maximum lot size and minimum test frequencies in SC6.4.5 Construction management.

(7) Action on rejection

(a) Unbound materials

A lot that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6)(c) Levels and surface trim respectively must be rejected except as otherwise provided in this clause. Rejected lots must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

Notwithstanding the above, where the rejected lot can be corrected by further trimming, the Superintendent may allow the surface to be corrected without complete removal and replacement with fresh material. Such trimming must be undertaken in a manner that produces a uniform, hard surface and must be achieved by cutting only without filling. After any such cutting, the level tolerances in clause SC6.4.6.12.6(6)(c) Levels and surface trim must apply.

The required surface correction or replacement work ordered in accordance with this clause including removal of material, disposal and supply and transport of replacement material, must be borne by the Contractor.

(b) Bound materials

An area of bound material that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6) Levels and surface trim respectively must be rejected except as otherwise provided for in this clause. Rejected areas must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

The removal and disposal of rejected material and its replacement with fresh material must be borne by the Contractor.

Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

(i) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.

(ii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20mm above the original design level. Approval by the Superintendent must be subject to the following requirements:

(A) the rate of change of grade from the original finished design surface level must be less than 3mm per metre;

(B) the regrading must not interfere with the proper design functioning of the drainage system;

(C) the regrading must not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond council's allowable design limits; and

(D) the regrading must not interfere with clearances.

(iii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a base course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course. Approval by the Superintendent is subject to the requirements of this clause in (ii) above.

(8) Removal and replacement of rejected courses
Sections of work that have been rejected by the superintendent are to be removed from the work site and replaced with fresh material.

Any rejected pavement sections are to be removed and replaced over the full length of the rejected lot for a minimum length of 20m of the pavement layer. Any damage to underlying or abutting layers or structures must be made good by the Contractor using methods approved by the Superintendent.

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction. In this case, the new longitudinal cold joint must be formed and located along the centreline of the road pavement.
After removal of rejected base or subbase course material, the section must be presented for inspection by the Superintendent before replacement work is commenced.

Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, must comply with the requirements of this sub-section.

The removal, replacement and correction of base and subbase courses required under this clause must be the responsibility of the Contractor in respect of delays caused by such removals, replacements and corrections must be borne by the Contractor.

All costs associated with the corrective work must be borne by the Contractor.

(9) Maintenance before completion of wearing surface
Following the Superintendent's acceptance of any section of the work, the Contractor must maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The preparation work must be carried out in a manner which will promote the adhesion of the bituminous material to the surface of the pavement. Preparation work must include:

(a) Removal of all foreign and loose material from the surface; and

(b) Light watering on dry and dusty surface

Ball Penetration testing on inner and outer wheelpaths must be carried out on all pavements before application of bituminous material. Where a ball penetration result exceeds 4.0mm the surface must not be sprayed until Council is advised and approval to proceed granted.

The base course of sections of the accepted work must be covered with a primerseal over the full width of pavement in accordance with sub-section SC6.4.6.16 Sprayed bitumen surfacing within 7 days of the date of the acceptance of such sections, unless otherwise approved by the Superintendent.

Should the pavement condition deteriorate before the application of the primerseal and consent to proceed with the bitumen surfacing work is withdrawn by the Superintendent, the Contractor must re-prepare the pavement and re-present the pavement for inspection by the Superintendent.

The maintenance and re preparing areas of the deteriorated pavement is the responsibility of the Contractor.

The Contractor must maintain adequate drainage of the pavement, and remove any ponded water within 12 hours of its creation if free drainage cannot be achieved, prior to the completion of the wearing course.

SC6.4.6.12.7 Opening pavement to traffic

General requirements

For unbound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work must not be permitted to use the pavement until the primerseal has been applied, unless otherwise approved.

For bound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work should not use the pavement until the primerseal has been applied and seven days have elapsed since placement of the base. In any case only vehicles registered for legal road usage and loaded within legal limits will be allowed to use the pavement.

SC6.4.6.12.8 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.12.1 below.

Table SC6.4.6.12.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Stockpile Sites**	(i) Relative Compaction >97% (ii) Stockpile height <3m (iii) Stockpile batter <1.5:1 and >3:1	SC6.4.6.12.3(2) SC6.4.6.12.3(2)
2.	**Spreading Pavement Materials**		
	(i) Compacted Layer Thickness	≥150mm (modified material) ≥125mm (unmodified material) ≤250mm (all material)	SC6.4.6.12.4
3.	**Compaction Acceptance**		
	Minimum value of all calculated relative compaction results	All compaction test results must exceed the minimum referenced requirements	SC6.4.6.12.6(4)
4.	**Width of Pavement**	-50mm to +300mm of dimensions on drawings	SC6.4.6.12.6(6)(b)
	(i) Design centre-line to edge of constructed pavement		
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, must be not less than the specified width.	SC6.4.6.12.6(6)(b)
5.	**Surface Level**		
	(i) Subbase levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(ii) Base levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)

(iii) Base levels adjacent to kerb and channel	<±5mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	SC6.4.6.12.6(6)(c)
(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing must be less than 12mm	SC6.4.6.12.6(6)(c)
(v) Ball Penetration	>4.0mm	SC6.4.6.12.6(9)

SC6.4.6.13 Asphaltic concrete

SC6.4.6.13.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt. The extent of the policy sub-section includes:

(i) manufacture/supply of the production mix;

(ii) provision of a testing laboratory;

(iii) preparation of the surface on which asphalt is to be placed;

(iv) transport of asphalt;

(v) laying and compaction of asphalt; and

(vi) sampling and testing.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Plant

The Contractor must provide all the plant, equipment and labour necessary for carrying out the work in accordance with this sub-section.

All plant and equipment used on the work must be in accordance with the submitted quality documentation and kept in good operating condition. The Contractor must not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant must be registered and insured as appropriate to its use on a public road and must comply with statutory environmental regulations.

(3) Protection of services and road fixtures

The Contractor must take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor must clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

(4) Control of traffic

The Contractor must provide for traffic control in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

(5) Work records

Particulars of the work performed must be recorded by the Contractor on the Asphalt Work Record at SC6.4.6.13 Attachment A Asphalt Work Record or as per the Contractor's own procedures where equivalent. The Contractor must complete the Asphalt Work Record, which must be countersigned by the Superintendent each day as a true record of the work performed.

Delivery dockets stating the mass of each truck load of asphalt must be attached to the Asphalt Work Record.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1141.11	*- Particle size distribution by dry sieving*
AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.17	*- Voids in dry compacted filler*
AS 1141.18	*- Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*- Wet/dry strength variation*
AS 1141.42	*- Pendulum friction test (PAFV)*
AS 1160	*- Bitumen emulsions for the construction and maintenance of pavements*
AS 2008	*- Residual bitumen for pavements*
AS 2150	*- Hot mix asphalt*
AS 2734	*- Asphalt (hot-mixed) paving - Guide to good practice*
AS 2758.5	*- Asphalt aggregates*
AS 2891.1	*- Sampling of Asphalt (AS2891.1.1 Methods of Sampling and testing asphalt Loose asphalt)*
AS 2891.3.1	*- Bitumen content and aggregate grading - Reflux method*
AS 2891.5	*- Determination of stability and flow - Marshall procedure*
AS 2891.8	*- Voids and density relationships for compacted asphalt mixes*
AS 2891.10	- Water and volatile oils content

(c) Queensland Department of Transport and Main Roads Specifications:

MRTS17	*- Bitumen*
MRTS18	*- Polymer Modified Binder*
MRTS21	*- Bituminous Emulsion*
MRTS30	*- Dense Graded and Open Graded Asphalt*

(d) Austroads:

AGPT03-2009 *Guide to Pavement Technology Part 3 – Pavement surfacings*
AGPT04B-2007 *Guide to Pavement Technology Part 4B - Asphalt*

SC6.4.6.13.2 Materials

Materials and mix ingredients must be in accordance with MRTS30. Binder must be in accordance with MRTS17 and polymer modified binder in accordance with MRTS18.

SC6.4.6.13.3 Asphalt mix design

(1) Approved mix

The supply only of an approved mix in accordance with MRTS 30.

The Contractor may not make any changes to the approved mix, or constituent materials without the prior written approval of the Superintendent.

Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor is responsible for producing asphalt which satisfies all requirements of this policy sub-section.

Asphalt produced in the plant and delivered to the site must be known as the "production mix".

(2) Production

(a) Asphalt production must comply with the requirements of MRTS30.
The Superintendent, upon provision of notice to the asphalt supplier or the supplier's representative, must have access to the mixing plant for purposes of inspection to verify production procedures and the supplier's compliance with the Contractor's Quality Management Manual and Project Quality Plan. The Superintendent must have the right to declare any non-conformance and be entitled to request correction

of either the Contractor's Quality Management Manual or the Project Quality Plan or both.

(b) Storage of asphalt
Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt which has been stored for more than twenty four hours or is below the minimum temperature specified must not be used. Binder manufacturer's instructions must be followed when polymer modified asphalt is stored.

(c) Contractor's laboratory
The Contractor must maintain and operate an appropriately registered NATA testing laboratory at or near the mixing plant to control the quality of the asphalt produced.

The Contractor will make the laboratory available for inspection by the Superintendent at any time during the course of the works.

All documented test results must be submitted to the Superintendent for inspection and approval in a format and to a timetable suitable to the Superintendent.

The Contractor is responsible for taking samples and must supply all facilities, equipment and labour for that purpose. The samples must be taken by the Contractor.

(d) Frequency of sampling
For the purpose of testing production mix the Contractor must sample production lots at the minimum frequencies set in MRTS30. This testing frequency requirement must apply to each asphalt mix type. The test results must be related to production intervals with samples representing the full lot of production of the relevant mix for the production interval.

Test results from this production control sampling are acceptable as representative of deliveries made under this contract subject to the traceability of production from specific production intervals to the location at the paving site.

Such traceability shall include registration of lot number and time of production on the delivery docket system. The size of any production lot shall be limited to production from a 12 hour "shift".

Sampling shall be performed in accordance with Test Method Q301. Samples shall be identified so as to allow traceability of the mix to the paving site. Each sample or sample portion as appropriate sampled as a referee sample shall be stored in an airtight container labelled so as to be traceable to the job and paving site location.

Testing required shall be arranged by the Contractor at an appropriately registered NATA laboratory. Test reports will be made available to the Superintendent as soon as they are available and always within 7 days of delivery of material.

Dense graded asphalt that does not include modified bitumen may include a proportion of RAP up to but not exceeding 20% by mass. The resultant asphalt shall meet all requirements for the Nominated Mix.

The RAP to be utilised shall be nominated by source and/or stockpile. Testing of the Nominated Mix shall include RAP sampled from the stockpile and of similar physical properties as that to be utilised for the contract. Any change in RAP supply shall be brought to the attention of the Superintendent prior to proposed usage in asphalt under this contract.

(3) Delivery
The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

During transport asphalt shall be covered with a canvas or other suitable cover which is held down securely.

When transported to site until delivery to the hopper, the mix must be covered with a heavy duty canvas or similar waterproof cover which shall overlap the sides of the truck body by at least 250mm and shall be tied down securely. The bodies of all trucks shall be suitably insulated.

Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment.

The mass of all truck loads of asphalt shall be measured on a registered weighbridge.

(4) Placing

Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of the Superintendent, spreading and compaction will be adversely affected. The Superintendent may order work to cease temporarily on account of adverse weather, unsatisfactory pavement surface condition, or other circumstance which the Superintendent feels may adversely affect the subsequent operations.

(5) Preparation of pavement

The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent.

Surface preparation shall be in accordance with AS 2734. Thermoplastic linemarking or other linemarking, where indicated necessary by the Superintendent will be removed prior to paving. Raised pavement markers shall be removed prior to paving.

The Contractor, when paving over existing road pavement, shall be responsible for the recording of lane marking positions including the extent of barrier line. After paving the Contractor will mark up the pavement to re-establish such positions using conventions agreed with the Superintendent and to a standard adequate to allow accurate re-establishment of line marking.

The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's activities. Affected areas designated by the Superintendent shall be removed and reinstated to the Superintendent’s satisfaction.

A corrector course shall be used to correct irregularities in an existing surface and/or modify the shape of an existing surface. Any surface depressions greater than 25mm in depth and any uneven surface shall be brought to the general level of the surrounding pavement/deck surface. Where a corrector course is used to modify the shape of an existing surface, the course shall be laid to the reduced levels and/or shape specified in the documents.

The Contractor shall mark out, in the presence of the Superintendent, the areas where corrector course is to be applied and shall not lay corrector course prior to receiving acceptance of the proposed areas from the Superintendent.
The asphalt in these patches shall be compacted to comply with the general level of the existing surface to the Superintendent’s satisfaction.
Back filling and stress absorbing fabric strips is to be carried out in accordance MRTS30 where indicated on the drawings or directed by the superintendent.
Preparation of the prepared surface is to be to the satisfaction of the Superintendent. Subsequent inspection and Superintendent’s approval of surface condition shall be required prior to the release of the hold point.

(6) Tack coat

Only on multiple courses shall tack coat be used between each course unless directed otherwise by the Superintendent. The whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion. Bitumen emulsion shall comply with the requirements of MRTS21.

The bitumen emulsion shall be applied at a rate of between 0.1 litres per square metre and 0.2 litres per square metre of undiluted bitumen unless otherwise specified.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.

The bitumen emulsion may be warmed or diluted with water to facilitate spraying. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Over application of tack coat, due to surface depressions, shall be removed or dispersed by brushing.

All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat, any services or exposed fixtures including concrete kerbs, guardfence or bridge handrails. Appurtenances susceptible to overspray shall be protected with suitable paper.

When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the Superintendent may require that the finished surfaces be suitably protected from carryover of bituminous material.

In locations of heavy pedestrian traffic, such as shopping areas, the Contractor shall take appropriate precautions in accordance with sub-section SC6.4.6.30 Control of traffic to keep pedestrians off tack coated areas.

(7) Laying

(a) Paver
The paver(s) shall be expected to have a minimum spreading capacity of 50t of asphalt per hour and be capable of spreading a width of at least 3.7m to the requirements of this sub-section. It shall be expected to have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam. The Contractor shall provide the Superintendent with notice of proposed pavers without these capabilities and obtain Superintendent's agreement to their use.

(b) Laying operations
The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80 °C by the time the following paver matches the longitudinal joint.

In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

Unless otherwise approved by the Superintendent, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

The Superintendent may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers.

Asphalt shall not be placed when the surface of the pavement is wet or while rain appears imminent.

AS 2734 shall constitute a valid reference of good practice for asphalt laying practice.

(c) Laying temperature

Weather restrictions and minimum asphalt temperatures at the time of discharge into the paver shall be in accordance with MRTS30. Measurement may be made by calibrated infra-red thermometers when accepted by both Contractor and Superintendent.

The Superintendent may reject that part of any truck load which contains lumps of cooled asphalt which are liable to affect the quality of the finished surface.

The laying temperature shall be measured in the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2 °C with a range from at least 0 °C to 200 °C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200mm at a location at least 300mm from the side of the paver. The average of two readings shall be adopted as the temperature of the mix. Measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause shall be recorded on the Asphalt Work Record Sheet.

(d) Level control

The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties.

Corrective courses shall be automatically controlled by programmed computer control of the paver, joint matching shoe or stringline sensor. Where the correction is only minor, the Superintendent may allow the use of levelling beams at least 10m long.

Intermediate courses shall be automatically controlled by programmed computer control of the paver or a joint matching shoe.

The wearing course shall be controlled by levelling beams at least 10m long and, as required by the Superintendent or a joint matching shoe. When identified in the Project Quality Plan and/or approved in writing by the Superintendent, small areas (as defined) may be paved as wearing course without the use of levelling beam to achieve target levels.

(e) Layer thickness

The compacted thickness of each course shall be as shown on the drawings. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance MRTS30.

(8) Joints

(a) General

The location of longitudinal and transverse joints shall be as approved by the Superintendent and at the spacing nominated in the drawings. All joints shall be compacted and finished with a smooth, planar surface coinciding with, and being of similar appearance to the remainder of the layer.

(b) Longitudinal joints

An automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Longitudinal joints shall be:

(i) continuous and parallel;

(ii) coincident within 150mm of line of change in crossfall;

(iii) offset by at least 150mm from joints in underlying layers;

(iv) located away from traffic wheel paths; and

(v) located beneath proposed traffic linemarkings in the case of a wearing course.

Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

A joint shall be considered “cold” when the temperature of the asphalt has dropped below 60ºC for dense graded mix. Cold joints will require tack coating.

(c) Transverse joints

When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1m between successive layers and between adjacent runs.

Runs shall end either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full layer thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds.

When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses requirements.

SC6.4.6.13.4 Compaction

(1) Plant and equipment

The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish.

The minimum number of rollers used for compaction of asphalt laid at various rates should be as shown in Table SC6.4.6.13.1 Minimum roller combinations for compaction.

For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used.

Table SC6.4.6.13.1 Minimum roller combinations for compaction

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
	Dense Graded Asphalt		
Tonnes per hour per paver	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		

Note— 1. At the discretion of the Superintendent, the minimum number of rollers may be decreased for layer thicknesses in excess of 60mm.

2. Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.

(2) Dense graded asphalt

(a) Initial rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift asphalt, pneumatic tyred rollers may be used.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

The transverse and longitudinal joints and edges shall be compacted first.

The minimum asphalt temperature at the commencement of rolling shall be as detailed in MRTS30.

(b) Secondary rolling
Secondary rolling shall immediately follow initial rolling. In secondary rolling, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers should equal or exceed 550 kilopascals.

Rolling shall commence at the longitudinal joint side of the run.

Secondary rolling shall be completed before the mix temperature falls below 80 °C.

(c) Final rolling
Final rolling shall be carried out by a pneumatic tyred roller to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

Final rolling shall be completed before the asphalt temperature falls below 60 °C.

(3) Acceptance criteria for compaction
The acceptance for compaction shall be on a lot by lot basis where each day's work in one layer is generally one lot. Any defective areas which show cracking, bony material or exhibiting excessive binder shall be excluded from the lot and shall be rectified by the Contractor before being tested.

When directed by the Superintendent the Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

The acceptance for compaction on a lot shall be on the basis of characteristic value of relative compaction in accordance with MRTS30.

(4) Finished pavement properties
Each course of asphalt shall be finished parallel to the finished surface of the wearing course.

(5) Thickness
The thickness of asphalt shall be specified and/or measured in one of the following ways:

(a) No finished surface levels specified
When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in MRTS30.

(b) Finished surface levels specified
When asphalt is placed to specified levels, vertical tolerances and thicknesses shall be in accordance with MRTS30.

(6) Shape
The surface shall not deviate from the bottom of a 3m long straightedge laid in any direction by more than 5mm.

(7) Removal and replacement of rejected material
The sections of work that have been rejected under the preceding clauses of this sub-section or as otherwise determined by the Superintendent shall be removed within 15 days from the work and replaced with fresh asphalt mix material corresponding in grade and quality to that material specified in the Approved Mix unless otherwise approved by the Superintendent.

If removal of the single nonconforming pavement strata is impossible, the affected area as determined by the Superintendent shall be removed to subbase or subgrade depth as appropriate to provide a smooth level

surface on which to found the reinstated base and/or subbase course.

The perimeter of the nonconforming area shall be prepared in accordance with the practice pertaining to longitudinal and transverse cold joints (AS 2734).

In rejected sections the material is to be removed over the full length of the affected area except that a minimum length of 5m and a minimum width equal to the paver width shall be removed.

The Superintendent shall have the right to alter the constitution, quality, grading, or other parameters of the "reinstatement pavement" if it is felt that reconstruction of the affected area with the Approved Mix would produce nonconforming pavement as a result of non-continuous pavement structure.

After removal of the rejected base or subbase course the area shall be made available to the Superintendent for inspection and approval to proceed with the works. Superintendent inspection and approval is required prior to release of hold point.

All materials used in the reinstatement of the nonconforming area shall comply with the requirements of this sub-section unless otherwise directed by the Superintendent.

SC6.4.6.13.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.13.2 below:

Table SC6.4.6.13.2 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Materials and mix ingredients and manufacture	AC Asphalt - MRTS 30 and current TMR supplementary specifications. Bitumen - MRTS 17 Polymer modified binder - MRTS 18	SC6.4.6.13.2
2.	**Preparation of Pavement** (a) Cleaning of Surface	>300mm beyond the edge of proposed layer	SC6.4.6.13.3(1)
3.	**Tack Coat** (a) Bitumen Emulsion	Application Rate > 0.10 and < 0.20 litres per square metre	SC6.4.6.13.3(1)
4.	**Laying** (a) Paver Capacity	>50 tonnes asphalt per hour	
	(b) Spread Width	>3.7m	
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80˚C when following paver matches the longitudinal joint.	
	(d) Laying Temperature		
	(i) Dense Grade AC	As per MRTS30	
	(e) Level Control	>10m length	SC6.4.6.13.3(7)(d)
	(i) Levelling Beam for Corrective Course		
	ii) Levelling Beam for Wearing Course	>10m length	SC6.4.6.13.3(7)(d)
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per MRTS30.	
5.	**Longitudinal Jointing** (a) Change in Crossfall	Within 150mm of line of change.	
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	
6.	**Transverse Jointing** (a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	

Item	Activity	Limits/Tolerances	Clause
7.	**Compaction**	Initial Rolling:	SC6.4.6.13.3(2)(c)
	(a) Dense Graded Asphalt	To be commenced before asphalt temperature falls below 115ºC for layer ≤40mm. Refer to MRTS30	
		Secondary Rolling:	SC6.4.6.13.3(2)(d)
		Tyre pressures on pneumatic rollers to be≥550kPa.	
		Rolling to be completed before the asphalt temperature falls below 80ºC.	
		Final Rolling:	SC6.4.6.13.3(2)(d)
		Rolling to be completed before asphalt temperature falls below 60ºC.	
	(b) Acceptance Criteria for Compaction	On bases of characteristic value of relative compaction as per MRTS30 AC7 90% AC10 90% AC14 91% (92% > 50mm) AC20 93%	SC6.4.6.13.3(4)
8.	**Finished Pavement**	Max. compacted thickness tolerance as for	
	(a) Thickness	Table 12.3.3.2 of MRTS30 AC7 ± 5mm AC10 ± 5mm AC14 ± 7mm Where finished surface levels are specified, thickness and level shall comply with requirements of MRTS30. Reduced level primary tolerance ± 10mm.	
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than 5mm	SC6.4.6.3(6)

SC6.4.6.13 Asphalt Work Record

Click here to obtain a copy of the following form.

SC6.4.6.14 Mass concrete sub-base

SC6.4.6.14.1 Introduction

(1) Scope

This policy sub-section provides standards advice and guidelines for the construction, by mechanical or hand placement of mass concrete sub-base including trial sections and sub-grade beams.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Thickness and levels of subbase

The sub-base thickness and levels shall be as per design requirement.

(3) Provision for base slab anchors

During construction of the sub-base, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the design. Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with sub-sectionSC6.4.6.15 Plain and reinforced concrete base as part of the concrete base construction.

(4) Reference and source documents

Documents referenced in this Sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.15 - Plain and reinforced concrete base

SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:

AS1012.1 - *Sampling of fresh concrete*

AS1012.3.1 - *Determination of properties related to the consistence of concrete - Slump test*

AS1012.4.2 - *Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete*

AS1012.8 - *Method of making and curing concrete – Compression and indirect tensile test specimens*

AS1012.8 - *Method of making and curing concrete – Flexure test specimens*

AS1012.9 - *Determination of the compressive strength of concrete specimens*

AS1012.13 - *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*

AS1012.14 - *Securing and testing cores from hardened concrete for compressive strength*

AS1141.11.1 - *Particle size distribution – Sieving method*

AS1141.14 - *Particle shape, by proportional calliper*

AS1141.22 - *Wet/dry strength variation*

AS1160 - *Bitumen emulsions for the construction and maintenance of pavements*

AS1379 - *Specification and manufacture of concrete*

AS1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*

AS2758.1 - *Concrete aggregates*

AS3582.1 - *Supplementary cementitious materials for use with portland and blended cement - Flyash*

AS3799 - *Liquid membrane-forming curing compounds for concrete*

AS3972 - *General purpose and blended cements*

(c) Other:

Austroads, *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*

SC6.4.6.14.2 Materials for concrete

(1) Cement

Cement shall be Type GP Portland cement or Type GB blended cement complying with AS3972. Cement shall be from a source approved under the Queensland Government's State Purchasing Policy.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the Superintendent, the contractor shall use only the nominated cement in the work.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent may require a retest to ensure the cement complies with AS3972, before the cement is used in the work.

Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash

Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and the quality of flyash shall comply with AS3582.1.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(3) Water

Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures

Chemical admixtures and their uses shall comply with AS1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air entraining agent may be included in the mix. If an air entrainer is used, the air content of the fresh concrete shall comply with Clause SC6.4.6.14.3(5) Air content.

Fresh concrete with an air content not complying with Clause SC6.4.6.14.3(5) Air content shall be rejected.

During the warm season (October to March inclusive), a lignin or lignin based ("ligpol") set retarding admixture approved by the Superintendent, shall be used to control slump within the limits stated in Clause SC6.4.6.14.3(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS1478.1 shall be submitted to the Superintendent, together with the proposed `dosage chart' in accordance with SC6.4.6.14.4(1) General.

If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause SC6.4.6.14.4(2) Variations to approved mixes.

When submitting details of the nominated mix in accordance with Clause SC6.4.6.14.4(1) General, the Contractor shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

(ii) Aggregates shall all pass the 37.5mm AS sieve and shall comply with AS2758.1 in respect of bulk density, water absorption (maximum 5%), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS1141.14 shall not exceed 35%.

(iii) When submitting details of the nominated mix, the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

(iv) If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

(b) Grading

(i) The grading of the combined aggregate used in the work, determined by AS1141.11, shall not deviate from that of the proposed grading by more than the amounts shown in Table SC6.4.6.14.1 Aggregate grading deviation limits.

Table SC6.4.6.14.1 Aggregate grading deviation limits

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5mm	-5
19.0mm	+ or -10
4.75mm	+ or -10
1.18mm	+ or -5
600mm	+ or -5
150mm	+ or -2

(c) Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

(i) Wet Strength AS1141.22 Shall not be less than 50kN; and

(ii) 10 per cent Fines Wet/Dry Variation AS1141.22 Shall not exceed 35%.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the

Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

SC6.4.6.14.3 Quality requirements of concrete

(1) Cement and flyash content
When a cement and flyash blend is nominated the minimum acceptable range is 40 – 75% by mass of the total cementitious material (cement and fly ash) in accordance with AS3582.1.

(2) Compressive strength
The compressive strength of concrete shall be determined in accordance with AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted.

(3) Shrinkage
The drying shrinkage of the nominated mix, determined by AS1012.13 shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10mm shall be taken as the average of the reading or readings within 5% of the median of the three readings obtained in accordance with AS1012.13.

(4) Consistency
The Contractor's nominated slump, determined in accordance with AS1012.3.1, shall be neither less than 25mm nor more than 40mm for mechanically placed concrete and shall be neither less than 50mm nor more than 65mm for hand placed concrete. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4.

(5) Air content
If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS1012.4.2, shall be neither less than 3% nor more than 7% when discharged from the transport vehicle ready for placement.

SC6.4.6.14.4 Design and control of concrete mixes

(1) General
The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1MPa of the median.

These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes
The Contractor shall not make any changes to the approved mix, its method of production or source of supply

of constituents without the prior written approval of the Superintendent.

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.14.4(1) General. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10kg for Portland cement, 20kg for other cementitious material and 5% by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

Notwithstanding these tolerances, the minimum cement content shall be 90kg per yielded cubic metre of concrete, the minimum flyash content shall be 100kg per yielded cubic metre of concrete.

SC6.4.6.14.5 Conformance for concrete strength and thickness

(1) Concrete cylinders

(a) Test specimens

Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS1012.8.1. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.

Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

The method of making and curing specimens shall be in accordance with AS1012.8.1 with compaction by internal vibration.

The Contractor shall mark the specimens for identification purposes.

Specimens shall be inspected, capped and crushed in accordance with AS1012.8.1 and AS1012.9.

(b) Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

(i) For the determination of the compressive strength at twenty eight days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(ii) For the determination of the compressive strength at seven days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens.
At the time of approving the mix design, the Superintendent shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.14.2 - Concrete age conversion factors.

For intermediate ages the factor shall be determined on a pro rata basis.

Table SC6.4.6.14.2 Concrete age conversion factors

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for compressive strength
If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause SC6.4.6.14.3(2) Compressive strength, the lot represented by the test cylinders shall be removed and replaced.

In case of non-conformance the Contractor may request permission of the Superintendent to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

(3) Specimens cut from the work

(a) Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS1012.14 with the following amendments:

(i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.

(ii) The preferred dimension for cores shall be 100mm diameter but in no case shall the diameter be less than 75mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.

(iii) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5mm from the mean diameter.

(iv) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table SC6.4.6.14.3 Core strength factor.

(v) Wet Conditioning only shall be used.

Table SC6.4.6.14.3 Core strength factor

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

Note—for intermediate form ratios, the factor shall be determined by interpolation.

Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.

The cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be the responsibility of the Contractor. The method of restoration shall be approved by the Superintendent.

(4) Acceptance of cored concrete for compressive strength
Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.
If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.

(5) Conformance for thickness

(a) General
No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in Clause SC6.4.6.14.7(5)(b) Surface tolerances.
If scabbling is required to achieve the level tolerance limits, the Superintendent may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. Thickness measurements shall be rounded off to the nearest 5mm.

(b) Thickness below specification
After making due allowance for the tolerances, subbase which is more than 20mm below the theoretical thickness shall be rejected and removed from the site. The removal and disposal from the site shall be the responsibility of the Contractor.

Subbase which is 20mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot.

SC6.4.6.14.6 Productions, transport and consistency of concrete

(1) Production and transport of concrete
At least 3 weeks before commencing work under this sub-section, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(2) Handling, storage and batching materials
The methods of handling, storing and batching materials for concrete shall be in accordance with AS1379, with

the following additional requirements:

(a) certificates of calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales;

(b) cementatious material shall be weighed in an individual hopper, with the cement weighed first;

(c) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water; and

(d) where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Superintendent, except for liquids which may be measured by volume or flow rate meter.

(3) Mixers and agitation equipment

Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS1379, with the following additional requirement that in Appendix A of AS1379 the maximum permissible difference in slump shall be 10mm.

(4) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS1379, with the following additional requirements:

(a) The mixer shall be charged in accordance with the manufacturer's instructions.

(b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15% and 85% along the length of the tray.

(c) For truck mixed concrete, addition of water in accordance with the batch production section of AS1379 shall be permitted only within ten minutes of completion of batching and within 200m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

(d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non agitating trucks.

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

(e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80% of the gross volume of the drum of the mixer.

(5) Maximum mixing time

Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of 10 minutes except for split drum mixers where the maximum shall be 5 minutes.

For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(6) Consistency

The consistency of the concrete shall be such as to allow the production of a dense, non segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its

shape and shall not sag or tear.

The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent.

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3.1. The test shall be made on concrete samples obtained in accordance with AS1012.1. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4. Check tests shall be done on each truckload of concrete or as directed by the Superintendent.

SC6.4.6.14.7 Placing and finishing concrete subbase

(1) General

At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of the Superintendent, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

The Contractor shall give the Superintendent 7 days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause SC6.4.6.14.11.

The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.

Submit the work-as-executed survey of the subgrade to the full extent of the works to the Superintendent for confirmation, and highlight any locations where the actual level is higher than the design levels. If the underlying layer is required to be spray sealed, take levels on the top of the seal and after removal of foreign or loose material such as aggregate. Report levels to the nearest millimetre and survey on 5.0m grid on a plan area. In the case of non conforming levels, locally redesign the pavement levels as directed by the Superintendent.

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C.

(2) Rate of evaporation

When the value of Rate of Evaporation, determined from the graph in Figure SC6.4.6.14.1 Rate of evaporation, exceeds 0.5kg per square metre per hour the Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50kg per square metre per hour.

Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull floating, are complete.

The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.

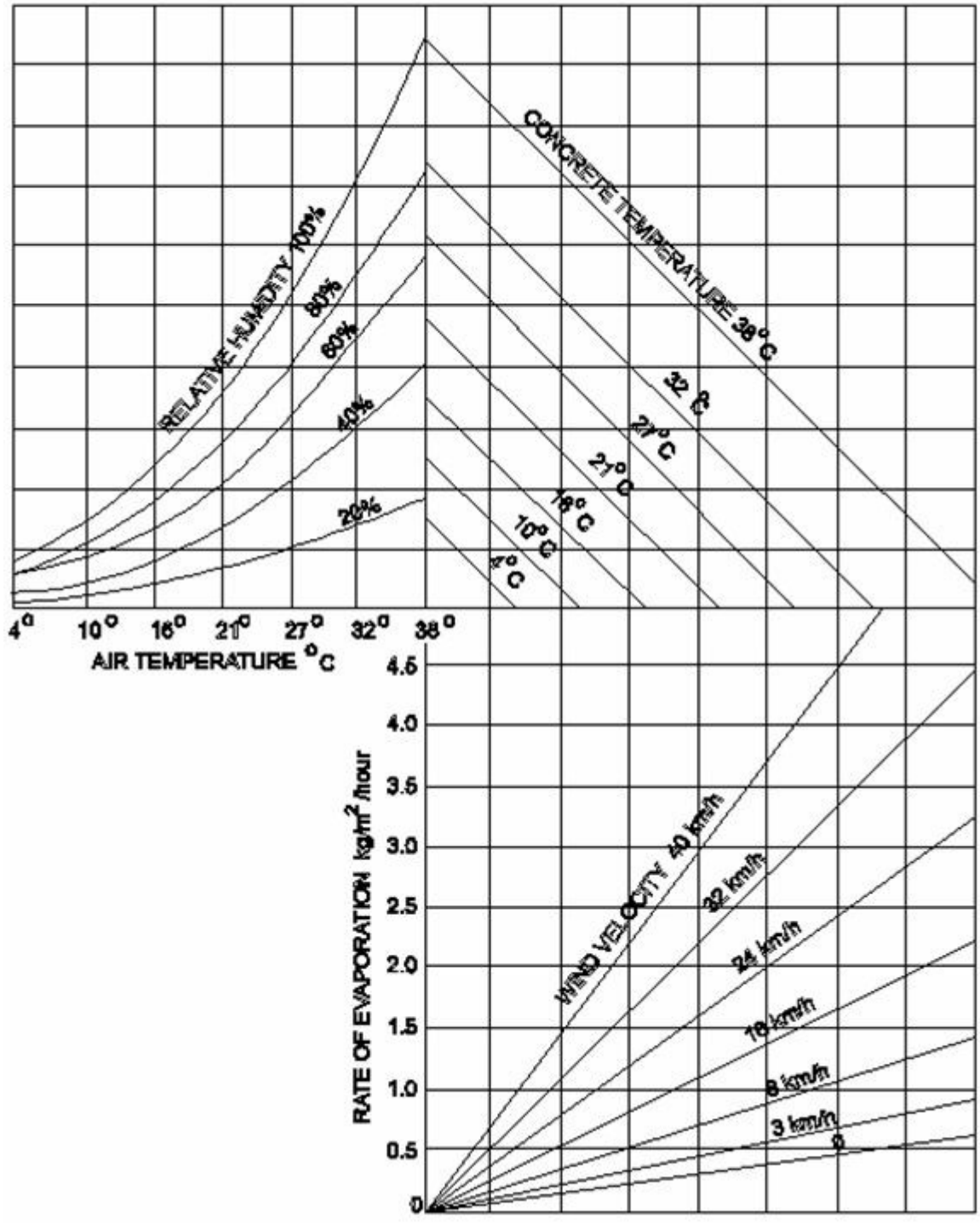


Figure SC6.4.6.14.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

The mechanical paver shall be a self propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(a) an automatic control system with a sensing device to control line and level to the specified tolerances;

(b) means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components;

(c) internal vibrators capable of compacting the full depth of the concrete;

(d) adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(e) capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(4) Hand placing

Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non adhesion of concrete to the forms.

Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of 25mm.

Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with clause SC6.4.6.14.8(2) Longitudinal construction joints.

(b) Surface tolerances

The level at any point on the top of the subbase shall not vary by more than 0mm above or 20mm below

that shown on the drawings or as directed by the Superintendent. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

The top surface of the subbase shall also not deviate from a 3m straightedge, laid in any direction, by more than 5mm.

(6) Curing

The subbase shall be cured by the use of one of the following:

(a) chlorinated rubber curing compound complying with AS3799 Class C Type 1D or resin-based curing compound complying with AS3799 Class B, Type 1D or Type 2, if an asphalt base is used; or

(b) white pigmented wax emulsion curing compound complying with AS3799 Class A Type 2, if a concrete base is used; or

(c) bitumen emulsion Grade CRS/170 complying with AS1160 for either asphalt or concrete base.

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90% when tested in accordance with Appendix B of AS3799.

The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.35 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25%.

The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(7) Protection of work

The Contractor shall ensure that the temperature of the concrete does not fall below 5ºC during the first twenty four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5ºC and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals for procedures and equipment to be used for such protection.

Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4.0MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:

(a) bond-breaker and spall treatment;

(b) concrete or asphalt paving; and

(c) Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction.

SC6.4.6.14.8 Joints

(1) Transverse construction joints

Transverse construction joints shall:

(a) be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations;

(b) be constructed normal to the edge line and to the dimensions shown on the drawings;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm; and

(d) cut back the edge of the previously placed concrete by sawing the concrete, to at least 1/3 the slab depth to expose an even, clean, sound, vertical surface, without disturbing the concrete that is to remain in place.

(2) Longitudinal construction joints
Longitudinal construction joints shall:

(a) be formed no closer than 300mm of the base longitudinal joints as shown in the drawings, unless directed otherwise by the Superintendent;

(b) not deviate from the plan or nominated position at any point by more than 20mm;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm, having made due allowances for any planned curvature; and

(d) be smooth across the joint.

SC6.4.6.14.9 Bond breaker and spall treatment

(1) General
Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS3799 Class A Type 2.

Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted.

Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete.

(2) Preparation of subbase
Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Superintendent of all loose, foreign and deleterious material.

(3) Treatment of spalling
Where directed by the Superintendent, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches.

A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor.

(4) Application of bond breaker
The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete.

The method of application shall conform to the requirements of Clause SC6.4.6.14.10(6) Curing.

(5) Treatment of unplanned cracks
The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width geotextile backed polymer modified bitumen strip

(reference Guide to Pavement Technology Part 4G: Geotextiles and Geogrids) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.

The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

SC6.4.6.14.10 Subgrade beams

(1) General
Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the drawings.

(2) Excavation
Excavation for subgrade beams shall be to the dimensions shown on the drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. Excavated material shall be legally disposed of by the Contractor.

(3) Concrete
Concrete in subgrade beams shall comply with the requirements of sub-section SC6.4.6.28 Minor concrete works. The minimum compressive strength at 28 days shall be 32MPa.

(4) Steel reinforcement
Steel reinforcement shall be of the type and size shown on the drawings and shall be supplied and installed in accordance with sub-section SC6.4.6.15 Plain and reinforced concrete base.

(5) Construction and protection
Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompacted to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.

A steel float shall be used to produce a smooth surface finish, free of any texture.

The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Contractor.

(6) Curing
The top surface of the subgrade beam shall be cured in accordance with clause SC6.4.6.14.7 Curing before placing the subbase.

(7) Bond breaker
The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty four hours nor more than seventy two hours before placing of subbase concrete.

SC6.4.6.14.11 Trial concrete subbase

Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the sub-section. This section shall be constructed so that it may be incorporated in the finished work.

The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

A trial length of between 100m and 200m or lesser length in compliance with council requirements for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation.

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this sub-section, the Contractor may proceed with placing concrete subbase from a time five working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this sub-section.

SC6.4.6.14.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.14.4 below:

Item	Activity	Limits/Tolerances	Clause
1.	**Materials for Concrete**		
	a. Misshapen Particles	2 : 1 ratio < 35%	SC6.4.6.14.3(5)(a)
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	SC6.4.6.14.2(5)(b)
	c. Durability	Wet Strength > 50kN 10% Fines < 35%	SC6.4.6.14.2(5)(c)
2.	**Concrete**	Drying Shrinkage <450 microstrain	SC6.4.6.14.3(3)
	a. Shrinkage		
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	SC6.4.6.14.3(4)
	c. Air Content	≥3, ≤7%	SC6.4.6.14.3(5)
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	SC6.4.6.14.5(5)
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non agitating trucks.	SC6.4.6.14.6(4)

Item	Activity	Limits/Tolerances	Clause
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5ºC or >38ºC. Temperature of concrete shall be >10ºC but <32ºC.	SC6.4.6.14.7(1)
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	SC6.4.6.14.7(2)
3.	**Alignment and Surface Tolerances** a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	SC6.4.6.14.7(5)
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	SC6.4.6.14.7(5)
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	SC6.4.6.14.7(5)
4.	**Joints** a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	SC6.4.6.14.8(1)
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm. (ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	SC6.4.6.14.8(2)
5.	**Bond Breaker** a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	SC6.4.6.14.9(4)

SC6.4.6.15 Plain and reinforced concrete base

SC6.4.6.15.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction, by mechanical or hand placement of plain or reinforced concrete, including trial sections, slab anchors and terminal slabs.

(b) The work also includes the construction of reinforced concrete approach slabs for bridge abutments and traffic signal approach slabs.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Thickness and levels of slab

The base thickness and levels shall be detailed on design and construction drawings.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.9 - Open drains - kerb and channel
SC6.4.6.20 - Subsoil, foundation and pavement drains
SC6.4.6.14 - Mass concrete sub-base

(b) Australian Standards:
AS 1012.1 - *Sampling of fresh concrete*
AS 1012.3.1 - *Determination of properties related to the consistence of concrete - Slump test*
AS 1012.4.2 - *Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete*
AS 1012.8 – *Method of making and curing concrete*
AS 1012.9 - *Determination of the compressive strength of concrete specimens*
AS 1012.12.2 - *Determination of mass per unit volume of hardened concrete - Water displacement method*
AS 1012.13 - *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*
AS 1012.14 – *Method for securing and testing cores from hardened concrete for compressive strength*
AS 1141.11.1 - *Particle size distribution – Sieving method*
AS 1141.14 - *Particle shape, by proportional calliper*
AS 1141.18 - *Crushed particles in coarse aggregate derived from gravel*
AS 1141.22 - *Wet/dry strength variation*
AS 1141.24 – *Aggregate soundness – Evaluation by exposure to sodium sulphate solution*
AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*
AS 1379 - *Specification and supply of concrete*
AS 1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS/NZS 1554.3 - *Welding of reinforcing steel*
AS 2758.1 - *Concrete aggregates*
AS 3582.1 - *Supplementary cementitious materials for use with Portland and blended cenemt – Fly ash*
AS 3799 - *Liquid membrane-forming curing compounds for concrete*
AS 3972 – *General purpose and blended cements*
AS/NZS 4671 - Steel reinforcing materials.

(c) Queensland Department of Transport and Main Roads technical standard:
MRTS40 - *Concrete Base in Pavements: Jointed unreinforced, Jointed Reinforced, Continuously Reinforced and Steel Fibre Reinforced Pavements (10/10).*

(d) Queensland Department of Transport and Main Roads Materials Testing Manual:

Q461 - *Durability of Sealant*
Q462 - *Resistance of Vulcanised Rubber to the Absorption of Oil*
Q463A - *High Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals*
Q463B - *Low Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals*

(e) ASTM Standards:
D792 – *Standard test methods for density and specific gravity (relative density) of plastics by displacement*
C793 – *Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants*
C794 – *Standard test method for adhesion-in-peel of elastomeric joint sealants*
D2240 – *Standard test method for rubber property - durometer hardness*
D2628 – *Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements*
D2835 – *Standard specification for lubricant for installation of preformed compression seals in concrete pavements.*

(f) US Military Specification:
MIL-S-8802 - *Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion*

SC6.4.6.15.2 Design and control of concrete mixes

(1) General - design and control of concrete mixes

(a) Details of the concrete mix (or mixes) and the materials, including source, to be used for each of any mechanically placed and/or hand placed base, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

(b) Also, a certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this specification. All relevant test results shall accompany the certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the superintendent.

(c) In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS 1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 2.0 MPa of the median. The compressive strength for 28 days shall not be less than 36.0 MPa.

(d) These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes

(a) The contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the superintendent.

(b) Where changes to an approved mix are proposed, the contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.15.2(1) General – design and control of concrete mixes. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10 kg for portland cement and flyash and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

(c) Notwithstanding these tolerances the minimum portland cement content shall be 270 kilograms per yielded cubic metre of concrete and the maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

SC6.4.6.15.3 Materials for concrete

(1) Cement

(a) Cement shall be Type GP Portland cement complying with AS 3972 and shall be from a source approved under the Queensland Government’s State Purchasing Policy.

(b) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1) General – design and control of concrete mixes the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the superintendent, the contractor shall use only the nominated cement in the work.

(c) Documentary evidence of the quality and source of the cement shall be furnished by the contractor to the superintendent upon request at any stage of the work.

(d) If the contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, a re-test shall be required to ensure the cement still complies with AS 3972, before the cement is used in the work.

(e) Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash

(a) Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and quality of flyash shall comply with AS 3582.1.

(b) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the Contractor shall nominate the powerhouse source of the flyash. The Contractor shall use only flyash from the nominated powerhouse.

(c) Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent.

(3) Water

Water used in the production of concrete shall be potable, free from materials that may be deterimental to the production of concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures

(a) Chemical admixtures and their use shall comply with AS 1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used. An air entraining agent shall be included in the mix and the air content of the concrete shall comply with clause SC6.4.6.15.4(5) Air content. Fresh concrete with an air content not complying with clause SC6.4.6.15.4(5) will be rejected.

(b) The dosage of admixtures shall be varied to account for air temperature and haulage times in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478.1 shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with clause SC6.4.6.15.2(1).

(c) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the contractor shall nominate the proprietary source, type and name for each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) At least 40 per cent by mass of the total aggregates in the concrete mix shall be quartz sand. Quartz sand is aggregate having a nominal size of less than 5 mm and shall contain at least 70 per cent quartz, by mass. Where present, chert fragments will be regarded as "quartz" for the purpose of this specification, but the ratio of chert to quartz shall not exceed unity.

(ii) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the contractor shall nominate the sources of aggregate to be used in the concrete and shall submit details of the geological type of each aggregate.

(b) Fine aggregate

(i) Fine aggregate shall consist of clean, hard, tough, durable, uncoated grains uniform in quality.

Fine aggregate shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), with material finer than 2 micrometres and impurities and reactive materials. The sodium sulphate soundness, determined by AS 1141.24, shall not exceed the limits in Table SC6.4.6.15.1 Sodium sulphate soundness limits

Table SC6.4.6.15.1 Sodium sulphate soundness limits

Australian Standard Sieve	Per Cent Loss by Mass
4.75mm to 2.36mm	4
2.36mm to 1.18mm	6
1.18mm to 600µm	8
600µm to 300µm	12

(ii) In the case of a blend of two or more fine aggregates, the above limits shall apply to each constituent material.

(iii) The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table SC6.4.6.15.2 Fine aggregate grading.

(iv) When submitting details of the nominated mix the contractor shall submit to the superintendent a NATA certified laboratory test report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "proposed fine aggregate grading".

(v) If the contractor proposes to blend two or more fine aggregates to provide the proposed grading then test reports for each constituent material shall be submitted separately and the superintendent advised of the proportions in which the various sizes and constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(vi) The grading of the fine aggregate used in the work shall not deviate from that of the proposed grading by more than the amounts in Table SC6.4.6.15.2 Fine aggregate grading.

(vii) Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table SC6.4.6.15.2 Fine aggregate grading.

Table SC6.4.6.15.2 Fine aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	± 3
4.75mm	90 - 100	± 10
2.36mm	65 - 95	± 10
1.18mm	40 - 80	± 10
600µm	24 - 52	± 5
300µm	8 - 25	± 2
150µm	1 - 8	
75µm	0 - 3	

(c) Coarse aggregate

(i) Coarse aggregate shall consist of clean, crushed, hard durable rock, metallurgical furnace slag or gravel. Coarse aggregate shall comply with AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this sub-section. If required, coarse aggregate shall be washed to satisfy these requirements.

(ii) The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table SC6.4.6.15.3 Coarse aggregate grading.

(iii) When submitting details of the nominated mix the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "proposed coarse aggregate grading".

(iv) If the contractor proposes to blend two or more coarse aggregates to provide the proposed grading

then test reports for each constituent material shall be submitted separately and the superintendent advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) The grading of the coarse aggregate used in the work shall not deviate from that of the proposed grading by more than the amounts in Table SC6.4.6.15.3 Coarse aggregate grading.

Table SC6.4.6.15.3 Coarse aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
26.50 mm	100	± 2
19.00 mm	95 - 100	± 5
13.20 mm	(accepted design mix)	± 5
9.50 mm	25 - 55	± 3
4.75 mm	0 - 10	
2.36 mm	0 - 2	

(vi) Notwithstanding these tolerances, the coarse aggregate used in the work shall comply with the limits shown in Table SC6.4.6.15.3.

(vii) The coarse aggregate shall also conform to the following requirements:

(A) Wet Strength - AS 1141.22.
Shall not be less than 80 kN for any fraction and/or constituent;

(B) 10 per cent Fines Wet/Dry Variation - AS 1141.22.
Shall not exceed 35 per cent for any fraction and/or constituent;

(C) Soundness - AS 1141.24
The loss in mass when tested with sodium sulphate shall not exceed 9 per cent for any constituent;

(D) Particle Shape - AS 1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35 per cent;

(E) Fractured Faces - AS 1141.18.
At least 80 per cent by mass of the particles shall have two or more fractured faces; and

(F) Material finer than 75 micrometres – AS 1141.12
Shall not exceed 1 per cent for any fraction and/or constituent.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the superintendent.

SC6.4.6.15.4 Quality requirements of concrete

(1) Cement and flyash content
The minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete. The maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

(2) Compressive strength
The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at 28 days shall be 36 MPa.

(3) Shrinkage

The drying shrinkage of the nominated mix, determined by AS 1012.13, shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS 1012.13.

(4) Consistency

The Contractor's nominated slump, determined in accordance with AS 1012.3.1, shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.

(5) Air content

The air content of the concrete, determined in accordance with AS 1012.4.2, shall be neither less than 4 per cent nor more than 7 per cent, when discharged from the transport vehicle ready for placement.

(6) Relative compaction

The minimum relative compaction, determined in accordance with AS 1012.12.2, shall be 98 per cent.

SC6.4.6.15.5 Steel reinforcement

(1) Material

(a) The type and size of bars shall be as shown on the drawings.

(b) Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but is not to be brought to a smooth polished condition.

(c) The Contractor shall supply evidence satisfactory to the superintendent that steel reinforcement complies with AS 4671 *Steel reinforcing materials*. Test certificates shall show the results of mechanical tests and chemical analysis of the reinforcing steel to be used.

(d) Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length.

(e) Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for 1 hour at 23 ± 5ºC without malfunction. The Contractor shall demonstrate that the proposed chairs conform with these requirements.

(2) Bending

Reinforcement shall be formed to the dimensions and shapes shown on the drawings. Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the drawings shall not be used. Heating of reinforcement for the purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450 ºC and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

(3) Splicing

(a) All reinforcement shall be furnished in the lengths indicated on the drawings. splicing of bars shall only be permitted with the approval of the superintendent and as shown on the drawings. The information shown on the drawings is to detail the location and method of splicing.

(b) The length of lapped splices not shown on the drawings shall be as follows for unhooked bars:

Plain bars, Grade 250	40 bar diameters;
Deformed bars, Grade 400	35 bar diameters; and
Hard-drawn wire	50 bar diameters.

(c) Splices in reinforcing fabric shall be measured as the overlap between the outermost wire in each sheet of fabric transverse to the direction of splice. This overlap shall not be less than the pitch of the transverse wires plus 25 mm.

(d) In welded splices, bars shall only be welded by an approved electrical method. Grade 400 deformed bars

shall not be welded.

(e) Welding shall comply with AS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

(4) Storage

Reinforcement, unless promptly incorporated into the concrete, shall be stored under a waterproof cover and supported clear of the ground, and shall be protected from damage and from deterioration due to exposure.

(5) Placing

(a) Reinforcing bars and wire reinforcing fabric shall be accurately placed to the dimensions and details shown on the drawings. They shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs or metal hangers, as approved by the superintendent, and by wiring together where required using annealed iron wire not less than 1.25 mm diameter. These supports shall be in a regular grid not exceeding 1 m and steel shall not be supported on metal supports which extend to any surface of the concrete, on wooden supports, nor on pieces of aggregate.

(b) Tack welding instead of wire ties may be used on reinforcing steel. Cold worked reinforcing bars shall not be tack welded. Tack welding must conform to AS 1554.3.

(c) The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the drawings.

(d) Tie bars shall be placed in the pavement such that after placement they remain in their specified location. Tie bars shall not be placed through the finished upper surface of the pavement. Tie bars shall be placed either ahead of paving or by a bar vibrator into the edge of the joint or by an automatic tie bar inserter on the mechanical paver. Irrespective of the method of placement, tie bars extending from any side face of base concrete or gutter shall be anchored in a manner which will develop 85 per cent of the yield strength of the bar in tension.

(e) Placing and fastening of all reinforcement in the work shall be approved by the superintendent before concrete is placed and adequate time shall be allowed for inspections and any corrective work which the superintendent may require. Notice for the superintendent's inspection shall not be less than four working hours before the intended time of commencement of concrete pour or such time as determined by the superintendent. Council is to be advised no later than (48) hours before hand.

(f) Dowelled joints shall be provided as directed by the superintendent, parallel to the pavement surface and normal to the line of the joint, or as shown on the drawings. The dowels are to be installed ahead of paving by an approved dowel support assembly. One end of the dowel is to be sleeved which is to be placed on the same side of the joint for a distance of (L/2 + 25 mm) to make sure free movement of the concrete base slab (including temperature variations). The contractor is to check each dowels before placement and make sure the dowels are straight and free of irregularities including burrs and protrusions.

SC6.4.6.15.6 Production, transport and consistency of concrete

(1) Production and handling of concrete

(a) At least 4 weeks before commencing work, the Contractor shall submit, for the information of the superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(b) The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:

(i) certificates of calibration issued by a recognised authority shall be made available for inspection by the superintendent, as evidence of the accuracy of the scales;

(ii) cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first; and

(iii) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.

(c) Details of the proposed mixers and agitation methods shall be in accordance with the plant and

equipment sections of AS 1379, with the additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10 mm.

(2) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:

(a) the mixer shall be charged in accordance with the manufacturer's instructions;

(b) for the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray;

(c) for truck mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200 m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location;

(d) admixtures shall be separately pre-diluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs;

(e) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non-agitating trucks.

(f) the size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity for the vehicle nor shall it exceed 80 per cent of the gross volume of the drum of the mixer; and

(g) concrete delivery dockets must be provided for each batch of mix. The docket must record the following delivery information:

(i) supplier name and location;

(ii) volume of material supplied;

(iii) product constituents; and

(iv) dispatch time and date.

(3) Mixing time

(a) Minimum mixing time will be as determined for the approved mix and verified when trial concrete base is constructed.

(b) Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum time shall be five minutes.

(c) For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(4) Consistency

(a) At all times between mixing and discharge, the slump of the concrete is to be within 10 mm for mechanically placed concrete and is to be within 15 mm for hand placed concrete.

(b) The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1. The test shall be made on concrete samples obtained in accordance with AS 1012.1.

(c) The consistency of the concrete shall be checked within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, the consistency shall also be checked immediately prior to discharge. Concrete which is non-conforming in relation to consistency shall not be incorporated into the work. Check tests shall be done on each truck load of concrete.

SC6.4.6.15.7 Placing and finishing concrete base

(1) General

(a) At least 4 weeks before commencing work, the Contractor shall submit as part of the quality plan, to the superintendent, full details of the equipment and methods proposed for placing and finishing the concrete base together with a paving plan showing proposed paving widths, sequence, proposed jointing locations and estimated daily outputs.

(b) The Contractor shall give the superintendent seven days written notice of the intention to commence construction of the base on any section of work (including the placement of the trial concrete base in accordance with clause SC6.4.6.15.7(11) Trial concrete base. Submit work-as-executed survey details of the sub-base to the full extent of the works to the superintendent for confirmation of the constructed based. The survey should detail the locations where the constructed level is higher than the design levels. If the underlying layer is required to be spray sealed, the surveyor is to take levels on the top of the seal and after removal of foreign or loose material such as aggregate. The survey is to report as constructed levels to the nearest millimetre and survey on 5.0 m grid on a plan area that has been certified by a licensed surveyor. In the case of non-conforming locations and levels, the contractor is to locally reconstruct the pavement levels as directed by the superintendent and to the satisfaction of council.

(c) The sub-base surface shall be clean and free of loose or foreign or vegetative matter and is to be prepared in accordance with sub-section SC6.4.6.14 Mass concrete sub-base.

(d) Concrete shall not be placed either during rain or when the air temperature in the shade is below 5 ºC or above 38 ºC.

(e) The temperature of the concrete at the point of discharge from the transport vehicle shall be neither less than 10 ºC nor more than 32 ºC.

(f) Where required, slab anchors shall be constructed prior to construction of the base.

(2) Rate of evaporation

(a) When the value of rate of evaporation, determined from the graph in Figure SC6.4.6.15.1 Rate of evaporation, exceeds 0.50 kilograms per square metre per hour the contractor shall take precautionary measures to the superintendent's satisfaction, for the prevention of excessive moisture loss. If, in the opinion of the superintendent, such precautionary measures prove to be unsatisfactory, the contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour.

(b) Should the contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except for minor manual bull floating.

(c) The contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement and for continuously measuring and recording air temperature and relative humidity at the site throughout the course of the work. The contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording to accurately take place.

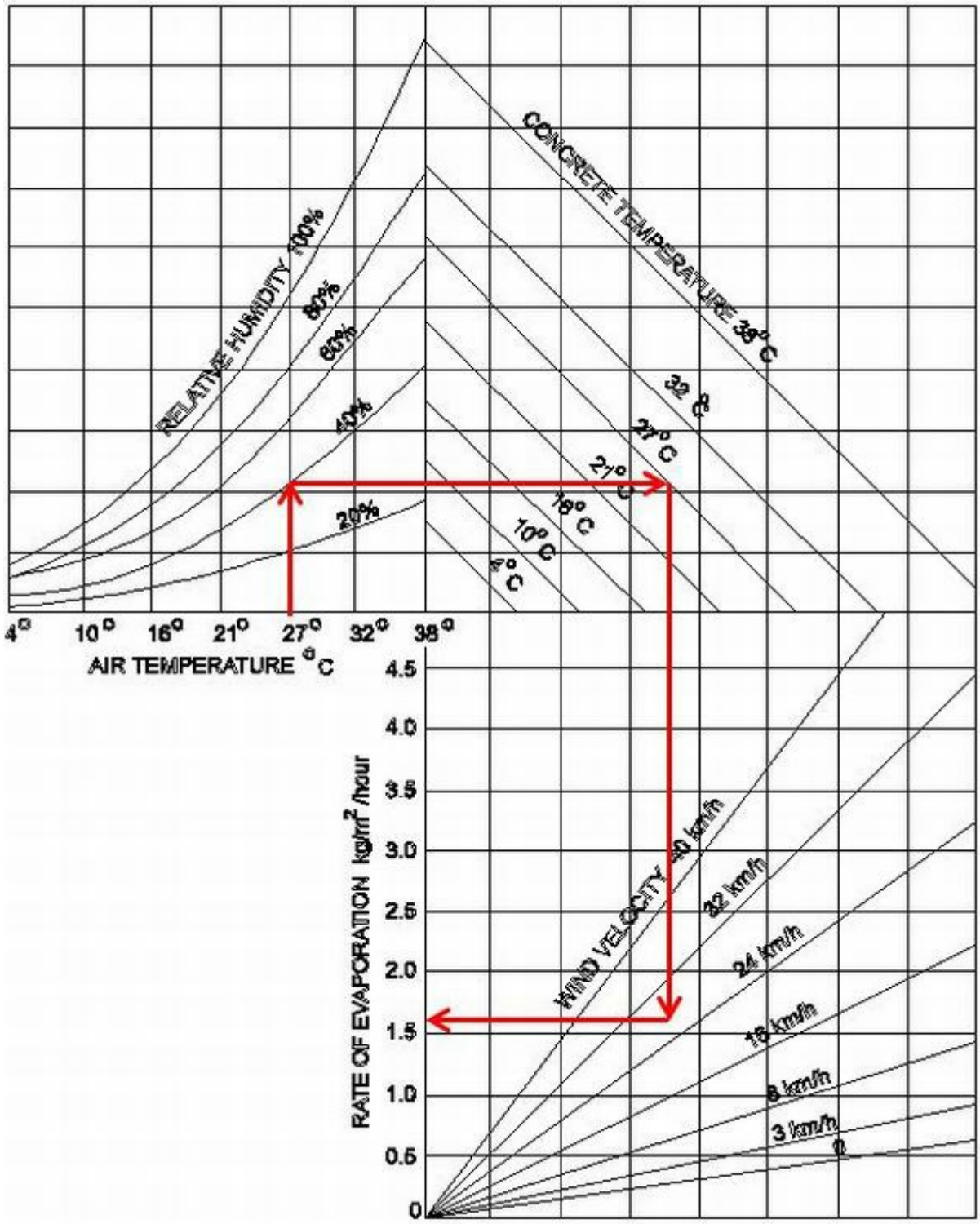


Figure SC6.4.6.15.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together with the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

(a) The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(i) an automatic control system with a sensing device to identify the control line and level – within the specified tolerances;

(ii) can spread the concrete mix uniformly and can regulate the flow of mix to the vibrators without segregation of the components;

(iii) has internal vibrators capable of compacting the full depth of the concrete;

(iv) has adjustable extrusion screeing and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(v) has the capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

(b) The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that any finishing by hand is kept to a minimum. A dense and homogeneous concrete with a surface exhibiting low permeability is to be provided. It shall be textured in accordance with clause SC6.4.6.15.7(6) Texturing of surface.

(c) The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

(d) Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(e) Where an interruption to paving occurs, which is likely to result in a non-monolithic concrete mass, the contractor shall form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(f) Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(4) Hand placing

(a) Hand placement shall only be used in areas where mechanical placement is impracticable or where it has been approved by the superintendent prior to commencement of work.

(b) Forms shall be so designed and constructed so that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and de-bonded to ensure non adhesion of concrete to the forms.

(c) Concrete shall be delivered in agitator vehicles and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any build-up of concrete between the forms and vibratory screed shall be removed.

(d) If disruptions occur for any reason, the superintendent may direct that a construction joint to be formed before the recommencement of paving operations. The cost of forming such construction joints shall be borne by the Contractor.

(e) A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with clause SC6.4.6.15.7(6) Texturing of surface.

(f) Where an interruption to placing of concrete occurs, which is likely to result in a non-monolithic concrete mass, the contractor shall form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(g) Should subsequent testing at the location of an interruption indicate the presence of non-monolithic

concrete, such concrete shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

(i) The outer edges of the concrete base shall be square to the sub-base and shall not deviate from the plan position at any point by more than 10 mm.

(ii) Where an edge of a slab is to form a longitudinal joint line, the allowable horizontal alignment tolerances shall comply with clause SC6.4.6.15.8(7) longitudinal isolation joints.

(b) Tolerances and ride-ability

(i) The tolerance on thickness of the concrete base shall be zero below the specified thickness and in accordance with clause SC6.4.6.14.7(5)(b) for excess thickness.

(ii) The top surface of the base shall also not deviate at any measurement from a 3 m straightedge, laid in any direction, by more than 5 mm. Measurements for conformance shall be taken in accordance with the maximum lot size and minimum test frequencies in accordance with SC6.4.5 Construction management. Notwithstanding this requirement, the surface shall not pond water.

(6) Texturing of surface

Texturing of the concrete surface may be effected by use of a fine broom or hessian drag. The contractor shall submit to the superintendent details of the proposed texturing method and equipment.

(7) Curing

(a) The base shall be cured by the use of one of the following:

(i) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt wearing surface is used, or

(ii) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or

(iii) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.

(b) The contractor shall submit, for the information of the superintendent, a current certificate of compliance from an Australian laboratory, approved by the superintendent, showing an efficiency index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.

(c) The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the certificate of compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with a hand lance the rates shall be increased by 25 per cent.

(d) The average application rate shall be checked by the contractor and certified to the superintendent by calculating the amount of curing compound applied to a measured area which is representative of a lot - and nominated by the Superintendent.

(e) The curing membrane shall be maintained intact for 7 days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

(f) Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(8) Protection of work

(a) The Contractor shall protect the work from rain damage and shall provide, for the information of the superintendent, detailed proposals for procedures and equipment to be used for such protection.

(b) Neither traffic nor construction equipment, other than that associated with testing, sawcutting, groove cleaning or joint sealing, shall be allowed on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached a

compressive strength of at least 20 MPa.

(9) Odd-shaped and mismatched slabs

(a) A slab is a portion of concrete base bounded by joints or free edges. A slab shall be considered to be odd shaped if the ratio of the longer dimension to the shorter dimension exceeds 1.6 or if the joint pattern produces an angle of less than 80 degrees between two adjacent sides. Slab dimensions shall be taken as the average dimension measured normal and parallel to the longitudinal joints. Slabs containing block-outs for drainage structures shall be considered as odd shaped.

(b) Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

(c) Unless otherwise shown on the drawings, odd shaped and mismatched slabs shall be reinforced with F82 reinforcing fabric placed with 50 mm to 60 mm cover to the surface of the base. Fabric shall be clear of all transverse and longitudinal joints by 50 mm to 100 mm.

(10) Terminal slabs

Terminal slabs shall be constructed adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Terminal slabs shall be constructed to the dimensions and details shown on the drawings.

(11) Trial concrete base

(a) Before the commencement of paving, the contractor shall construct a trial section of concrete base on the carriageway to demonstrate to the superintendent the contractor's capability of constructing the concrete base in accordance with the specifications. This section shall be constructed so that it may be incorporated in the finished work.

(b) The trial base shall be constructed using the same materials, concrete mix, equipment and methods the contractor intends to use for the remaining base work. The contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound, the construction and sawing of joints and the placement of tie bars and dowels.

(c) The trial shall also be used to demonstrate that the contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

(d) A trial length of between 20 m and 100 m for mechanical paving equipment or between 10 m and 30 m for hand placement is required. The maximum width proposed to be laid, shall be constructed in one continuous operation.

(e) Unless advised by the superintendent of any deficiencies in the trial concrete base, due to failure to comply with this sub-section, the contractor may proceed with placing the concrete base from a time ten working days after the completion of the trial concrete base or such earlier time as the superintendent may allow. In the event of deficiencies in the trial concrete base, the superintendent may order the contractor to construct a further length of trial concrete base which shall be treated as the first. If, after three trials, the base still is deficient in some way, the superintendent may require the contractor to justify to the satisfaction of the superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

(f) The superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the contractor in the equipment, materials, mix, plant or rate of paving are deemed by the superintendent to warrant such a trial or when concrete as placed does not comply with this sub-section.

SC6.4.6.15.8 Joints

(1) General - joints

Joints shall be provided at locations indicated on the drawings or as approved by the superintendent.

(2) Transverse construction joints

(a) Transverse construction joints shall:

(i) be provided only at discontinuities in the placement of concrete determined by the contractor's paving operations;

(ii) not be placed closer than 1.5 m to a transverse contraction joint. Where necessary, the superintendent shall authorise a change in the spacing and/or skew of transverse contraction joints to ensure that sufficient clearance is obtained;

(iii) be constructed normal to the control line and to the dimensions and details shown on the drawings. The tie bars shall comply with clauses SC6.4.6.15.5(1) Material and SC6.4.6.15.5(5) Placing;

(iv) be smooth across the joint before texturing; and

(v) not deviate from a 3 m straightedge placed along the joint by more than 10 mm.

(b) Prior to the placement of adjacent concrete, the surface of the concrete shall be roughened to expose coarse aggregate. The roughened surface and the projecting reinforcement shall be washed clean and all excess water and loose material removed.

(3) Transverse contraction joints

(a) General

(i) Transverse contraction joints shall be continuous across the full width of the concrete base and shall be sawn unless otherwise approved by the superintendent.

(ii) Where the concrete base is to be overlaid with asphalt wearing course, the superintendent may approve the joint to be formed with a suitable plastic joint inducing system.

(iii) Transverse contraction joints shall be constructed normal to the control line and to the dimensions and details shown on the drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.

(b) Saw-cutting

(i) The Contractor shall ensure that saw-cutting be conducted between 6 and 24 hours after initial paving so as not to cause excessive ravelling of aggregate adjacent to the cut and so as to prevent cracking of the concrete baseother than at the bottom of the 3 mm saw-cut. The contractor shall use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn and shall have sufficient standby equipment available on site to maintain continuity of sawing.

(ii) The line of the transverse contraction joint shall be without any discontinuities. No edge shall deviate from a 3 m straight edge by more than 10 mm.

(iii) The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300 mm in any 1m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

(iv) Saw-cuts, which do not conform to the requirements of this clause, shall be rejected by the superintendent. Rejected saw-cuts may be repaired by a method approved by the superintendent.

(c) Cleaning

Immediately after any sawing, the saw-cut shall be cleaned of all debris. The cleaning method used shall not damage the saw-cut nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants. The method shall incorporate a pressurised liquid or liquid/air jet. Cleaning liquid shall not be gravity fed from tanks.

(d) Temporary sealing

(i) Immediately after cleaning following the second saw-cut, if the transverse contraction joint is produced by a two cut operation, the joint shall be temporarily sealed by a continuous closed cell polyethylene backer rod of diameter shown on the drawings or as required by the superintendent.

(ii) The top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface. The backer rod shall pass over any longitudinal joint seal already in place.

(iii) The temporary sealant shall be maintained by the contractor until the joint is sealed permanently.

Damaged or disturbed temporary sealants shall be removed, the transverse contraction joint is to be re-cleaned to the satisfaction of the superintendent and a new temporary sealant inserted.

(e) Permanent sealing

(i) General – permanent sealing

(A) Within 10 days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint.

(B) The permanent sealant shall be either a neoprene compression seal or an in situ cast silicone sealant. The contractor shall submit for the approval of the superintendent, a full technical description of the proposed sealant, including its operating parameters and the method of installation recommended by its manufacturer.

(ii) Neoprene compression sealants

(A) Neoprene compression sealants shall comply with all the requirements of ASTM 2628. Test methods used to determine compliance with these requirements shall include test methods Q462, Q463A and Q463B.

(B) At least four weeks before installation of the sealant, the contractor shall submit to the superintendent a certificate of compliance from a NATA registered laboratory showing that the sealant meets all the requirements of ASTM 2628.

(C) At the time of installation, the sides of the neoprene sealant shall be coated with a clear or concrete coloured lubricant compound approved by the superintendent and complying with ASTM D 2835. The sealant shall be inserted into the joint by using appropriate equipment and procedures which shall not damage the sealant during its insertion. The maximum increase in length of the sealant after installation shall be 5 per cent of original length. Any sealant exceeding 5 per cent extension shall be rejected. The sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle.

(D) The sealant shall be continuous between formed longitudinal joints. Where such a discontinuity occurs, the sealant shall be angle butt jointed by a method approved by the superintendent. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base and shall overlay any longitudinal sealants.

(iii) Silicone Sealants

(A) Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table SC6.4.6.15.4 Silicone joint sealant requirements. At least 4 weeks before the installation of the sealant, the contractor shall submit to the superintendent a certificate of compliance, from a NATA registered laboratory, showing that the sealant meets all the requirements of Table SC6.4.6.15.4.

(B) The silicone joint sealant shall be grey in colour and shall be stored and installed in accordance with the manufacturer's written instructions. Installation of a silicone sealant shall take place only when the side walls of the groove have been grit blasted and are surface dry.

(C) Immediately before introducing the silicone sealant into the groove, any foreign or disturbed material shall be cleaned from the joint and from the top of the backer rod by dry air jet. The backer rod shall then be depressed to the depth such that the bottom of the silicone sealant shall be at the planned location and of the correct shape.

(D) If the backer rod is damaged in any way it shall be replaced for the full length of the joint.

(E) The method to be used for permanent sealing with silicone sealant shall be approved by the superintendent before permanent sealing commences. Notwithstanding any approval given by the Superintendent to a proposed method, the contractor shall be responsible for producing a permanent seal complying with all requirements of this specification.

Table SC6.4.6.15.4 Silicone joint sealant requirements

Test Method	Test	Requirements
ASTM-D-792	Specific Gravity	1.1 to 1.55
MIL-S-8802	Extrusion Rate	90 to 250 g per min
MIL-S-8802	Tack Free Time	30 to 70 min
ASTM D 2240	Durometer	10 to 25
Q461	Durability	Extension to 70% Compression to 50%
ASTM C794	Adhesion to Concrete	35N minimum average peel strength
ASTM C 793-7	Accelerated Weathering at 5,000 hours	No cracks, blisters or bond loss

(4) Transverse isolation joints

(a) Transverse isolation joints shall be provided at bridge approach slabs and at slab anchors where shown on the drawings and where directed by the superintendent.

(b) Transverse isolation joints shall be continuous across the full width of the concrete base normal to the control line and shall be constructed in accordance with the drawings.

(c) Transverse isolation joints shall not be placed closer than 2 m to other transverse joints. Where necessary, the superintendent shall authorise a change in the spacing and/or skew of adjacent transverse contraction joints to ensure that sufficient clearance is obtained.

(d) Joint filler shall consist of preformed jointing material of bituminous fibreboard and the joint sealant shall comply with the silicone sealant requirements of clause SC6.4.6.15.8(3) Transverse contraction joints. They shall be installed in accordance with the drawings and in a manner conforming to the manufacturers recommendations except that any reference to backer rods will not apply.

(e) The line of the isolation joint shall not deviate from a 3 m straightedge more than 10 mm.

(5) Longitudinal tied joints

(a) General – Longitudinal tied joints

(i) Longitudinal tied joints shall be provided at the locations shown on the drawings or where directed by the superintendent. The joints shall be parallel to the control line and/or to the dimensions and details shown on the drawings.

(ii) Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.

(iii) The ties shall be 12 mm diameter deformed steel bars Grade 400Y, 1 m long and shall be inserted in accordance with clause SC6.4.6.15.5(5) Placing. Tie bars shall be located and spaced as shown on the drawings. All parts of any tie bar shall lie within 50 mm of its designed position. Tie bars shall be omitted within 500 mm of a transverse joint. The epoxy to be used when installing tie bars in existing concrete shall be hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar.

(iv) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10 mm. The line shall also not deviate from a 3 m straight edge by more than 10 mm having made due allowance for any planned curvature.

(v) Where the longitudinal tied joint is formed or slip-formed, the joint face shall be corrugated in accordance with the details shown on the drawings.

(vi) Where the multi-lane width is greater than 18 m, a longitudinal isolation joint shall be constructed at each location shown on the drawings and in accordance with clause SC6.4.6.15.8(7) Longitudinal isolation joints.

(b) Sawn-induced joints

(i) Sawn longitudinal tied joints shall be provided to the dimensions shown on the drawings. Saw-cutting shall comply with clause SC6.4.6.15.9(3)(b) Saw-cutting.

(ii) Within 24 hours of sawing, the longitudinal tied joint shall be thoroughly cleaned of all debris and a neoprene backing rod, shall be inserted in accordance with the details shown on the drawings.

(iii) The sealant shall be coated with a lubricant adhesive compound approved by the superintendent. The compound shall have a colour compatible with the pavement colour. The sealant shall be inserted into the groove by means of suitable equipment which shall not damage the sealant during insertion. The maximum increase in length of the sealant after installation shall be 10 per cent of the original length, otherwise the sealant shall be rejected.

(iv) Joints in the sealant shall be kept to a minimum and shall be cemented together by an adhesive recommended by the manufacturer. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the concrete base, except where the sealant is depressed to lie under the transverse joint sealant.

(c) Ribbon-Induced Joints

(i) Ribbon induced longitudinal tied joints shall be provided to the dimensions and details shown on the drawings. The inducer ribbon shall be machine inserted so that the top of the ribbon does not protrude above the surface of the base, nor shall it lie below the surface of the base by more than 3 mm.

(ii) The inducer ribbon shall be a minimum of 0.5 mm thick. When placed, it shall be within 5º of the vertical plane. Any inducer ribbon that curls on placement when cut into the concrete base and is found to be curved in the transverse section by more than 3 mm its straight alignment, will be rejected.

(iii) At transverse construction joints, the inducer ribbon shall be carried through the joint sufficiently to allow a connection using strong stapling, or another method as approved by the superintendent. When a join, during paving, is necessary within the inducer ribbon - the inducer ribbon on the new spool shall be similarly joined to the tail of the inducer ribbon on the old spool.

(d) Treatment of sawn longitudinal tied joints prior to asphalt overlay

Where asphalt surfacing over sawn longitudinal tied joints is specified, the sealant shall be depressed to a depth below the concrete surface of not less than 10 mm and, following thorough cleaning, the joint shall be sealed flush with the concrete surface with a bituminous rubber compound, approved by the superintendent, which is to be compatible with the narrow groove.

(6) Longitudinal joint with kerb and/or channel

(a) Where kerbs and/or channel are to be constructed within the shoulder of a concrete base, they shall be formed directly onto the concrete sub-base and they may be cast either integrally with the concrete base or separately.

(b) Where constructed separately, they shall be tied to the concrete base by 12 mm diameter deformed steel tie bars grade 250S or 400Y, 1000 mm long at 1 m centres.

(c) The longitudinal joint shall be constructed parallel to the control line (parallel to the centre line for kerb ramps) and to the dimensions shown on the drawings. The tie bars shall be inserted in accordance with the drawings and clause SC6.4.6.15.5(5) Placing.

(d) The face of the longitudinal joint need not be scabbled however the joint does not need to be sealed.

(e) The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with clause SC6.4.6.15.8 Longitudinal tied joints.

(f) The construction of kerb and/or channel shall be in accordance with kerb and channel sub-section SC6.4.6.9 Open drains regardless of method of construction except that the strength of the concrete used in the kerb and/or channel shall be 36 MPa.

(7) Longitudinal isolation joints

(a) Longitudinal isolation joints shall be provided where shown on the drawings and where directed by the superintendent.

(b) The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10 mm. The line of the joint shall not deviate from a 3 m straight edge by more than 10mm.

(c) The joint filler shall consist of pre-formed jointing material of bituminous fibreboard and the joint sealant shall comply with the silicone sealant requirements of clause SC6.4.6.15.8(2) Transverse construction joints. They shall be installed in accordance with the drawings and in a manner conforming to the manufacturer's recommendations except any reference to backer rods will not apply.

SC6.4.6.15.9 Slab anchors

(1) General

(a) Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the drawings.

(b) Slab anchors shall extend over the full width of the concrete base and the associated transverse expansion joint shall not be placed closer than 2 m to other transverse joints. Where necessary, the superintendent shall authorise a change in the spacing of transverse contraction joints to ensure that this minimum clearance is obtained.

(2) Excavation

(a) Excavation of trenches for slab anchors shall be to the dimensions and details shown on the drawings.

(b) All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be re-compacted, where required, to the degree of consolidation of the adjacent undisturbed material.

(c) The Contractor shall dispose of excavated material at locations approved by the superintendent.

(d) Where a slab anchor is required at the junction of an existing flexible pavement, a straight saw-cut to the full depth of the asphaltic concrete or bituminous seal shall be made in the flexible pavement along the joint line. Excavation of the trench shall then take place as described above without disturbance or damage to the existing flexible pavement. Any disturbance or damage to the flexible pavement shall be made good as directed by the superintendent.

(e) A subsoil drain shall be provided at the bottom of the trench, in accordance with subsection SC6.4.6.20 Subsoil, foundation and pavement drains and details shown on the drawings.

(3) Concrete

(a) Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand placed concrete base.

(b) Slab anchors shall be poured separately from the concrete base slabs and to the dimensions and details shown on the drawings - up to the top surface of the sub-base.

(c) A transverse isolation joint shall be provided on the downhill side of the slab anchor.

(d) Steel reinforcement in slab anchors shall be of the type and size shown on the drawings and shall be supplied and fixed in accordance with clauses SC6.4.6.15.5(1) Material and SC6.4.6.15.5(5) Placing.

(e) Bridge approach slabs, if not in the bridge contract, shall be constructed at bridge abutments to the dimensions and details shown on the drawings and in accordance with the requirements for the concrete base.

SC6.4.6.15.10 Conformance of concrete strength, compaction and thickness

(1) Concrete cylinders

(a) Test specimens

(i) Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The contractor shall supply a sufficient number of moulds to meet these requirements for the frequency of testing specified in this clause. The contractor will also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the superintendent.

(ii) Samples of concrete for testing shall be taken in accordance with AS 1012.1. The selection of the

batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

(iii) The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.

(iv) The contractor shall mark the specimens for identification purposes.

(b) Frequency of moulding of test specimens

Test specimens shall be moulded at 7 days and 28 days or as directed by the superintendent - for the determination of the compressive strength. Each test specimen shall be moulded as follows:

(i) for each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens;

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed.

(c) Inspection, capping and crushing of specimens

(i) Specimens required by this sub-section shall be tested at the NATA registered laboratory nominated by the contractor.

(ii) Specimens shall be inspected, capped and crushed in accordance with AS 1012.9.

(iii) Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS 1012.12.2, so that the relative compaction of cores taken from the same lot of concrete base can be determined.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens unless the two results differ by more than 3 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.15.5 Concrete age conversion factors. For intermediate ages the factor shall be determined by interpolation.

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for Compressive Strength

(i) If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa or greater than 45 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(ii) In case of non-conformance the contractor may elect to core the in situ concrete base for testing

of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method approved by the Superintendent. Testing shall be carried out at the request of the contractor. Base concrete failing to reach the required in situ compressive strength shall not be re-tested for at least 72 hours after the determination of the value of the in situ compressive strength.

(iii) After testing for compressive strength of the sample concrete cores, as required, the superintendent shall consider the test results and shall, at his absolute discretion determine the compressive strength of the concrete to be either:

(A) The average of the 28 day compressive strength of the pair of specimens moulded at the time of placing; or

(B) The equivalent 28 day compressive strength of the core.

(iv) A lot is defined as a continuous pour of up to 50 cubic metres of base represented by a set of test specimens cast from a sample of the concrete used in its construction.

(v) Thickness measurements of the concrete base shall be determined and certified by a licensed surveyor. Measurements are to be taken at the edges or by coring. Audit checks using a suitable probe may be carried out whilst the concrete is being placed. The readings shall be rounded off to the nearest 5 mm.

(vi) Concrete base which is below the specified thickness shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3) .

(vii) Base which is thicker than the design thickness will be acceptable provided the finish satisfies the requirements of Clause SC6.4.6.15.7 Placing and Finishing Concrete Base and that the finished surface base level complies with clause SC6.4.6.14.7 (5) (b)

(3) Relative compaction of concrete

(a) Test specimens

(i) Test specimens for determining the relative compaction of the concrete placed in the work shall be cores cut from the work. Cores shall be cut from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions:

(A) the requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However concrete must be not less than 3 days old in the warm season and 6 days old in the cool season, before removal; and

(B) the nominal diameter of the cores shall not be less than 75 mm.

(ii) The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars from the core. The locations are not intended to be random, but are intended to ensure that the whole of the concrete base conforms to the minimum requirements of this sub section. Cores shall be marked for identification by the contractor.

(iii) Cores shall be placed immediately either in a tank of lime saturated water or in an individual plastic bag and sealed to prevent water loss. Cores stored in plastic bags shall be kept in the shade.

(iv) Cores shall not be subjected to temperatures in excess of either ambient temperature or 23 ºC whichever is the higher and they shall not be subjected to temperature less than 10 ºC, until delivered to the testing laboratory.

(b) Frequency of coring

(i) The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with clause SC6.4.6.15.10(1) Concrete cylinders.

(ii) In the case of hand placed concrete base, two cores shall be taken to represent a section of work. A section of work shall be confined between construction joints. Hand worked or placed base that is cast with machine placed concrete and not separated from the machine placed concrete shall be deemed to be part of the machine placed concrete, and be cored and tested as part of the

machine placed concrete base.

(c) Repair of core holes

(i) The Contractor shall clean and restore all core holes taken in the base with non-shrink cementitious concrete having a compressive strength of not less than that in the base and a maximum nominal aggregate size of 10 mm.

(ii) The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

(d) Testing of cores for compaction

(i) The core specimens shall be wet conditioned in accordance with AS 1012.14 for not less than 24 hours immediately prior to testing for compaction. Testing to determine mass per unit volume shall be carried out on specimens at age seven days.

(ii) The relative compaction of a core specimen shall be the ratio, expressed as a percentage, of the mass per unit volume of the core specimen to the average mass per unit volume of the standard cylinders used to determine the seven day compressive strength from the same lot of concrete base. The mass per unit volume of both standard cylinders and cores shall be determined in accordance with AS 1012.12.2.

(e) Conformance for Compaction

(i) If the relative compaction is less than 97 per cent, the lot represented by the core shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3).

(ii) Core specimens for compressive strength testing shall be wet conditioned, prepared and tested in accordance with AS 1012.14. Cores obtained for compaction shall not be re used for compressive strength testing.

(iii) The test strength shall be adjusted for age in accordance with clause SC6.4.6.15.10(2) Compressive strength and for length/diameter ratio in accordance with Table SC6.4.6.15.6 Correction factors by multiplying by the correction factor in Table SC6.4.6.15.6 Correction factors.

(iv) If the 28 day compressive strength of the core is less than 33 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3).

Table SC6.4.6.15.6 Correction factors

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

SC6.4.6.15.11 Removal and replacement of base

(1) General – Removal and replacement of base

(a) Where directed by the superintendent, rejected base shall be removed and replaced in accordance with this clause. Rejected base, which extends more than 25 m longitudinally, shall be replaced by mechanical means unless the slabs are odd shaped or mismatched. Replacement shall be in full slab widths between longitudinal joints and/or external edges.

(b) At least 7 days before the commencement of concrete base removal, the contractor shall submit, for the approval of the superintendent, details of the proposed methods of carrying out the work which shall be such as to prevent damage to the adjoining concrete base and the underlying sub-base.

(2) Removal and disposal of base

(a) At each end of the section of concrete base to be removed, a transverse saw-cut shall be made for the full depth of the base layer. Such transverse saw-cut shall be normal to the control line and not closer

than 1.5 m to an existing contraction joint in the base. No over-sawing into the adjoining concrete base or underlying sub-base shall be permitted.

(b) Longitudinal saw-cuts shall be made along the existing longitudinal joints to define the edges of the base section to be removed. Such longitudinal saw-cuts shall not extend more than 250 mm past the transverse saw-cut at each end of the section to be removed and shall not extend into the underlying sub-base.

(c) No over-sawing shall be permitted on any internal saw-cuts made by the contractor to aid in the removal of the concrete base.

(d) The contractor shall dispose of the removed concrete base slabs at sites acceptable to the superintendent.

(e) Any slab, adjoining the removed slabs, damaged by the contractor's operations shall also be removed and replaced in accordance with this clause.

(3) Replacement of base

(a) Before construction of the replacement base, the sub-base shall be prepared and de-bonded in accordance with sub-section SC6.4.6.14 Mass concrete sub-base.

(b) All work involved in the replacement of the concrete base shall comply with this sub-section, including the following additional requirements:

(i) The joint faces on the adjoining slab at the transverse saw-cuts shall be deeply scabbled below the top 25 mm which shall be left smooth. Tie bars shall be provided to form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(ii) Transverse contraction joints shall be continuous across the full width of the base containing the replaced section. The length of the joint across the full width of the base shall be sealed with the same sealant as in adjacent work and in accordance with clause SC6.4.6.15.8(3) Transverse contraction joints.

(iii) The lower two thirds of the depth of the longitudinal joint faces shall be deeply scabbled and any concrete considered to be unsound by the superintendent shall be removed. A crack inducer ribbon shall be attached to the surface of any formed longitudinal joint in the replacement concrete base and tie bars provided to form a longitudinal tied joint in accordance with clause SC6.4.6.15.8(5) Longitudinal tied joints.

(iv) Tie bars placed into hardened concrete shall be set by the use of a hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar.

(v) Neither traffic nor construction equipment other than that associated with testing, saw-cutting, groove cleaning or joint sealing shall be allowed on the section of replaced concrete base until the joints have been permanently sealed and at least 10 days have elapsed since placing the replacement concrete base or it has reached a compressive strength of at least 20 MPa.

SC6.4.6.15.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.15.7 below:

Table SC6.4.6.15.7 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Aggregates** a. General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	SC6.4.6.15.3(5)(a)
	b. Fine Aggregate (i) Grading	To be within the limits as per Table SC6.4.6.15.2 and shall not deviate from Proposed Grading by more than amounts in Table SC6.4.6.15.2	SC6.4.6.15.3(5)(b)

Item	Activity	Limits/Tolerances	Clause
	(ii) Wet Strength	Not less than 80kN for any fraction and/or constituent	SC6.4.6.15.3(5)(c)
	(iii) 10% Fines Wet/Dry Variation	Not to exceed 35% for any fraction and/or constituent	SC6.4.6.15.3(5)(c)
	(iv) Soundness	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	SC6.4.6.15.3(5)(c)
	(v) Particle Shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	SC6.4.6.15.3(5)(c)
	(vi) Fractured Faces	At least 80% by mass of the particles shall have two or more fractured faces	SC6.4.6.15.3(5)(c)
2.	**Concrete Quality** a. Cement Content	At least 270kg per yielded cubic metre of concrete	SC6.4.6.15.4(1)
	b. Flyash	Not greater than 50kg per yielded cubic metre of concrete	SC6.4.6.15.4(1)
	c.Compressive Strength	The minimum 28 day compressive strength shall be 36.0 Mpa	SC6.4.6.15.4(2)
	d. Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	SC6.4.6.15.4(3)
	e. Consistency	Nominated slump shall be neither less than 30mm nor more than 40mm for mechanically placed concrete. It shall be neither less than 55mm nor more than 65mm for hand placed concrete.	SC6.4.6.15.4(4)
	f. Air content	Shall not be less than 4% nor more than 7% when discharged from the transport vehicle ready for placement	SC6.4.6.15.4(5)
3.	**Concrete Mixing and Transport**	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non-agitating trucks.	SC6.4.6.15.6(2)
4.	**Concrete Placing**	Concrete shall not be placed when the air temperature in the shade is above 38ºC. The temperature of the concrete shall be neither less than 10ºC nor more than 32ºC.	SC6.4.6.15.7(1)
		Where the value of Rate of Evaporation exceeds 0.50kg per square metre per hour, the Contractor shall cease work.	SC6.4.6.15.7(2)
5.	**Alignment and Surface** a. Horizontal Alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10mm.	SC6.4.6.15.7(5)(a)

Item	Activity	Limits/Tolerances	Clause
	b. Surface Level	The level at any point on the top of the base shall not vary by more than +10mm or -0mm from that shown on the drawings or as directed by the superintendent. The top surface of the base shall not deviate from a 3m straight edge, laid in any direction, by more than 5mm.	SC6.4.6.15.7(5)(b)
6.	**Joints** a. Transverse Construction	The line of the transverse construction joints shall not deviate from a 3m straight edge placed along the joint by more than 10mm.	SC6.4.6.15.8(2)
	b. Transverse Contraction	(i) May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors. (ii) No edge shall deviate from a 3m straight edge by more than 10mm. (iii) The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300mm in any 1m length of joint on each edge. (iv) Temporary sealing - the top of the sealant shall be neither higher than nor more than 10mm below the concrete surface. (v) Permanent Sealing The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.	SC6.4.6.15.8(3)
	c. Transverse Isolation	The line of the transverse expansion joint shall not deviate from a 3m straight edge more than 10mm.	SC6.4.6.15.8(4)
	d. Longitudinal Tied Joints	(i) All parts of any tie bar shall be within 50mm of its designed position. (ii) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10mm. The line shall also not deviate from a 3m straight edge by more than 10mm having made due allowance for any planned curvature. (iii) For sawn-induced joints, the maximum increase in length of the sealant after installation shall be 10% of the original length. The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base. (iv) For ribbon-induced joints, the inducer ribbon shall be a minimum of 0.5mm thick and when placed it shall be within 5 of the vertical plane.	SC6.4.6.15.8(5)

Item	Activity	Limits/Tolerances	Clause
	e. Longitudinal Isolation Joints	The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10mm. The line of the joint shall not deviate from a 3m straight edge by more than 10mm.	SC6.4.6.15.8(7)
7.	**Slab Anchors**	Not placed closer than 2.0m to transverse joints (other than associated transverse expansion joints).	SC6.4.6.15.9(1)

SC6.4.6.16 Sprayed bituminous surfacing

SC6.4.6.16.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply of all materials and the application of any or all of the following types of sprayed bituminous surfacing:

(a) prime
The application of a primer of field or refinery prepared cutback bitumen without aggregate to provide penetration of the surface (preferably from 5 to 10mm) and waterproofing;

(b) primerseal
The application of a primerbinder of field or refinery prepared cutback bitumen to provide surface penetration (preferably from 2mm to 5mm) and incorporation of a light cover of aggregate to provide a temporary wearing surface;

(c) seal or reseal
The application of a bituminous binder into which aggregate is incorporated to provide a durable wearing surface (including bitumen emulsion or polymer modified seals); and

(d) slurry surfacing
The application of a bituminous emulsion binder with or without polymer modifier and with or without continuous aggregate, mineral fillers, additives and water, properly proportioned to enrich the binder content and refresh the existing wearing course material. This is a preventive maintenance treatment and shall not be used in new construction.

The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, shall be as shown on the construction drawings and/or as detailed in SC6.4.6.16 Attachment A Details of work.

For multiple application treatments, the binder and aggregate may be required to be laid in one or more separate applications indicated in SC6.4.6.16 Attachment B.

Requirements for adhesion agent in the bitumen and tolerances for binder application rates are set out in SC6.4.6.16 Attachment B Binder details.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:
SC6.4.6.30 - Control of traffic

(b) Australian Standards:
AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*
AS 2008 - *Residual bitumen for pavements*
AS 2157 - *Cutback bitumen*
AS 2758.2 - *Aggregate for sprayed bituminous surfacing*
AS 3568 - *Oils for reducing the viscosity of residual bitumen for pavements*

(c) Queensland Department of Transport and Main Roads Technical Standards:
MRTS11 - *Sprayed Bituminous Surfacing (excluding Emulsion)*
MRTS12 - *Sprayed Bituminous Emulsion Surfacing*
MRTS13 - Bituminous Slurry Surfacing
MRTS17 - *Bitumen*

MRTS18 - *Polymer Modified Binder*
MRTS19 - *Cutter and Flux Oils*
MRTS20 - *Cutback Bitumen*
MRTS21 - *Bituminous Emulsion*
MRTS22 - *Supply of Cover Aggregate*

(d) Queensland state legislation:
Fire and Rescue Service Act 1990

(e) Other:
Austroads, *Guide to Pavement Technology Part 4K: Seals*
Austroads, *Bituminous Materials Sealing Safety Guide*

(3) Control of traffic
The Contractor shall provide for the control of traffic in accordance with the requirements of policy sub-section SC6.4.6.30 Control of traffic while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate.

Where early use of the new seal is required to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no lateral displacement of aggregate occurs. Where necessary, the Contractor shall use patrol vehicles to ensure that traffic travels at an acceptable speed.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.

If facilities for the diversion of traffic are not available, the Contractor may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work shall cease. Traffic shall not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.

SC6.4.6.16.2 Materials

(1) Sampling and testing of materials
Sampling and testing of materials shall be arranged by the Contractor and carried out by a laboratory with appropriate NATA registration in accordance with the requirements of the relevant Queensland Department of Transport and Main Roads (DTMR) Specification.

(2) Bituminous materials and additives
Bituminous materials shall be in accordance with the relevant DTMR Specifications.

(3) Bitumen adhesion agent

(a) Bitumen adhesion agents.
Adhesion agents must conform to the following requirements:

(i) adhesion agent is to be added to bitumen at the rate of 5kg for every 1,000 Litres of bitumen CL170 and 10kg for every 1,000 litres of polymer modified bitumen; and

(ii) adhesion agents approved for use are Diamintol, or Bitumite EXP3995 if Diamintol is unavailable.

(4) Oils for reducing viscosity of bitumen
Cutter Oil shall conform to MRTS 19.

Delivery and storage procedures for cutter oil delivered in drums or in bulk shall ensure that all containers are free from any deleterious material prior to filling with cutter oil, and all drums are stored to ensure that entry of water through seals or welds in the drums is prevented.

(5) Aggregate

Aggregate shall conform to MRS22.

The Contractor shall obtain test results for each lot/stockpile of aggregate and certification of compliance from a laboratory with appropriate NATA accreditation, before aggregate from the lot is incorporated in the works.

SC6.4.6.16.3 Design of bituminous surfacing

(1) Before commencing sprayed bituminous surfacing work, the Superintendent will confirm the approved details of the proposed bituminous surfacing design for the work. Additional details are required to be submitted to the Superintendent prior to carrying out the work for check with the proposed bituminous surfacing design. These additional details include:

(a) test results for all nominated materials;

(b) aggregates source, geological type, nominated grading, average least dimension (ALD);

(c) pre-coating agent and bitumen adhesion agent types, proportions and manufacturer (if applicable);

(d) bitumen refinery source and certification of compliance;

(e) cutback bitumen refinery source of bitumen, type of cutter, source of cutter, cutter oil fraction, certification of compliance;

(f) polymer modified bitumen – refinery source of bitumen and manufacturer, class of polymer and fraction, certificate of compliance; and

(g) bitumen emulsion – refinery source of bitumen and manufacturer, grade of emulsion, certificate of compliance.

Design rates of application of binder and aggregate for bituminous surfacing shall be in accordance with *Guide to Pavement Technology Part 4K: Seals*. Design application rates shall be known as “nominated application rates” and materials as “nominated materials”.

SC6.4.6.16.4 Pre-coating of aggregate general

The aggregate pre-coating agent shall be applied to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

Pre-coating of aggregate shall not be carried out when rain is imminent. If aggregate has been pre-coated and rain appears imminent, the aggregate shall be adequately covered to prevent the pre-coating material being washed from the aggregate particles.

The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the pre-coating agent on the stockpiled aggregate.

Stockpiles pre-coated more than 14 days in advance of use shall be retreated unless otherwise approved by the Superintendent and shall not be used if less than 3 days old.

SC6.4.6.16.5 Application of sprayed bituminous surfacing

(1) General

The Contractor shall carry out sprayed bituminous surfacing to:

(a) provide a uniform application of binder with adequate adhesion to the underlying surface;

(b) provide a complete cover of interlocking aggregate particles; and

(c) achieve effective bond between binder and aggregate.

Details of equipment and methods to be used for sprayed bituminous surfacing shall be submitted to the Superintendent for approval prior to their use on the works.

(2) Plant

A mechanical sprayer shall be used to apply primer, primerbinder and binder. The sprayer shall have a current Sprayer Certificate issued by the Queensland Department of Transport and Main Roads.

The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times.

Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform and accurate spreading rate.

Rollers shall be utilised in accordance with Clause SC6.4.6.16.4(9) Application and rolling of aggregate.

The Contractor shall remove from the site any plant or equipment considered by the Superintendent to be not fully operational or not in a satisfactory condition for carrying out work in accordance with this sub-section.

(3) Preparation of pavement surface

Before the application of primer, primerbinder or binder, the pavement surface shall be swept by the use of a mechanically operated rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff brooms. Sweeping shall, where possible, extend at least 300mm beyond each edge of the area to be sprayed.

Adherent patches of foreign material shall be removed from the surface of the pavement.

For the spraying of primer or primerbinder, the pavement surface shall be slightly damp to impede dust interfering with initial adhesion except where explicit instructions are provided with the seal design.

(4) Surface defects must be repaired prior to laying the wearing course. This may include crack filling, pothole repairs and repair of failed pavements.

Rut-filling and corrector must be applied where necessary to rectify any ruts and uneven surfaces prior to placing the wearing course.

Review of nominated application rates

The Contractor shall select the locations where each lot of aggregate is to be incorporated in the works.

The Superintendent shall review the bituminous surfacing design at each location based on the actual average least dimension (ALD) test result for the lot of aggregate instead of the nominated ALD value of the aggregate adopted at design. Due consideration must also be given to the surface texture of the prepared pavement surface and the likely degree of stone embedment, to establish if any additional minor adjustments to bitumen spray rates should be applied. The revised application rates shall be known as "target application rates".

The Contractor shall give the Superintendent notice of the Contractor's intention to commence sprayed bituminous surfacing. This notice shall confirm spray rates, aggregate size and ALD.

(5) Bitumen temperature requirements

Bitumen temperature requirements are as per MRTS 17, 18, 19, 20 and 21.

Table SC6.4.6.16.2 Cutback bitumen spraying temperatures

Grade	Temperature Range (ºC)
AMC 00	10 - 35
AMC 0	35 - 55
AMC 1	60 - 80
AMC 2	75 - 100
AMC 3	95 - 115
AMC 4	110 - 135
AMC 5	120 - 150
AMC 6	135 - 160
AMC 7	150 - 175

(6) Pavement temperature and weather conditions

The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work. For this purpose, a spirit or mercury in glass thermometer or other suitable type of thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. When a spirit or mercury in glass thermometer is used to measure pavement temperature, the bulb of the thermometer shall be covered from direct sunlight with a small heap of grit or similar material. Suitably calibrated infra-red thermometers may be used.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

Spraying primers, primerbinders and binders shall be undertaken only if the pavement temperature has been at or above 20ºC, 25ºC for PMB, 10ºC for emulsion for spraying for at least one hour before commencement of spraying and does not fall below 20ºC, 25ºC for PMB, 10ºC for emulsion for spraying during the period of spraying.

Spraying shall not be carried out on a wet pavement, while rain appears imminent or during high winds or dust storms.

(7) Incorporation of cutter oil, flux oil and adhesion agent

(a) Cutting back bitumen

The Contractor shall determine and record the proportion of cutter oil added to each sprayer load, using MRTS11 and based on the measured pavement temperatures.
The cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of cutback bitumen shall be circulated at a rate of at least 700 litres per minute for 20 minutes to ensure that the mixture is homogeneous.

If a part sprayer load of field cutback bitumen is unused on the date of mixing, and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter shall be added to the returned cutback bitumen unless the tank is fitted with an effective mechanical mixing system. When the returned cutback bitumen is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned cutback bitumen.

(b) Fluxing bitumen

Where flux oil is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres per minute for at least 20 minutes before spraying.

(c) Bitumen adhesion agent

Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated twice at a rate of at least 1,000 litres per minute for at least twenty minutes before spraying. Spraying shall occur within 4 hours.

(8) Application of primer, primerbinder and binder

(a) General
The area to be sprayed with primerbinder or binder shall be limited to the area which can be covered with aggregate at the target application rate within ten minutes of spraying bitumen or cutback bitumen.

(b) Primer and primerbinder
Nominated and target application rates and quantities of primer and primerbinder shall apply to the whole material, including cutter oil, measured at 15ºC. Primer, Primerbinder and Binder application rates outside the tolerances indicated in SC6.4.6.16 Attachment B Binder details constitute a non-conformance.
After application of a primer, a period of at least forty eight hours, or such longer period as determined to be necessary for the primer to become completely dry, shall elapse before the binder for a seal is applied. All traffic shall be kept off the primed surface.

After application of a primerbinder, a period of at least fourteen days shall elapse before the binder for a seal is applied.

(c) Binder
The class of bitumen or grade of cutback bitumen shall be as specified in SC6.4.6.16 Attachment A Details of work.

Nominated and target application rates and quantities of binder shall be based on the volumes of bitumen measured at a temperature of 15ºC and shall not include any bitumen adhesion agent and/or cutter oil. If flux oil has been added to the bitumen, the quantity of flux oil shall be included as part of the binder. Binder application rates outside the tolerances provided in SC6.4.6.16 Attachment B Binder details shall constitute a non conformance.

Where bitumen adhesion agent and/or cutter oil have been added to the binder, the application rate of the total binder at 15ºC shall be adjusted to allow for the quantities of bitumen adhesion agent and/or cutter oil in the mixture.

The Contractor shall determine the hot application rate of total binder, including bitumen adhesion agent and/or cutter oil, using MRTS11.

Where refinery cutback bitumen is used as the binder, the target application rate of binder shall be increased by the Contractor to allow for the cutter oil in the mixture.

(d) Operation of the sprayer
Where the longitudinal edges of spray runs are not required to overlap, special type end nozzles must be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs shall be in the range 50-100mm for special type end nozzles. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays the nozzles shall be set in the normal manner for intermediate nozzles and the overlap shall be in the range 250-350mm.

The spraying of primer, primerbinder or binder for each run of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120g per square metre laid across and held securely to the pavement surface beforehand by addition of cover aggregate. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application and correct alignment is attained at the commencement of spraying.

The sprayer shall maintain a uniform rate of application throughout the length of each sprayer run.

The spraying for each run shall terminate on a protective strip of paper laid across and held securely to the pavement surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate.
Spraying shall cease immediately if any defect develops in the spraying equipment and spraying shall not recommence until the fault has been rectified.

Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. If the blockage is due to the condition of the binder being sprayed and is likely to re-occur, that load together with any binder from the same bulk tanker or supply unit shall not be used in the works.

Where a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, such areas shall be sprayed by means of the hand spray equipment attached to the sprayer. The work shall be planned to minimise the area sprayed by hand spray equipment.

After each sprayer run, the quantity of binder sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder after three runs differs by more than 5% from the target application rate, the sprayer shall not be used until a new Sprayer Certificate has been obtained.

Areas not within 5% of the target application rate of primer, primerbinder or binder shall constitute a “non-conformance”.

(9) Application and rolling of aggregate

The application of aggregate shall proceed immediately after spraying is commenced and shall be completed within ten minutes of spraying bitumen or cutback bitumen. For polymer modified binder spreading and rolling shall start immediately after spraying and continue until adhesion is complete.
Wet aggregate shall not be used.

The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. Sufficient loaded and measured trucks of dry aggregate shall be at the site to provide full cover for the area sprayed.
The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Any bare or insufficiently covered areas shall be re run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Any aggregate spread in excess of the target aggregate application rate shall be removed before rolling is commenced if it is localised and can be efficiently removed by hand brooming.
After the aggregate has been applied to each section of the work, initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi wheel rollers of minimum load of 1t per tyre and minimum tyre pressure of 550 kPa. A roller with a rubber surface drum providing equivalent compactive effort may be used in lieu of a multi-wheeled roller. Initial rolling shall continue until the aggregate is firmly embedded in the primerbinder or binder. Roller speed shall be 15-25 km/h subject to safe working conditions.

If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primerbinder or binder, the Contractor shall defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor shall substitute light hand brooming.

Backrolling shall then be carried out for a minimum period of 1 hour per 1,000 square metres sprayed for roads having a traffic volume of less than 500 vehicles per lane per day and 1 hour per 1,500 square metres sprayed for other roads, up to a maximum of 24 hours after the aggregate has been applied.

Where a bituminous surfacing is specified with separate applications of coarse and fine aggregate on a single application of binder, the coarse aggregate shall be applied first, rolled and any necessary brooming carried out as described above, before application of the fine aggregate and its subsequent rolling and brooming. In this case, the time limits for incorporation of aggregate shall apply only to the application of the coarse aggregate.

After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10mm, or larger, aggregates not to exceed the values specified in Table SC6.4.6.16.3.

Table SC6.4.6.16.3 Maximum loose aggregate particles

Road type	Loose stones (particles/m²) max
Urban areas	20
Other medium to high traffic (> 250v/l/d)	30
Low traffic (< 250v/l/d)	40

Any remaining loose particles of aggregate shall be removed by light sweeping and/or vacuumed from the pavement and disposed of responsibly by the Contractor as per Table SC6.4.6.16.4 below or as directed to by the Superintendent.

Table SC6.4.6.16.4 Maximum time limits for sweeping or vacuuming

Traffic volume (vehicles/lane/day)	Maximum time limits
> 2,000	Within 8 hours of sealing
1,000 to 2,000	Within 24 hours of sealing
250 to 1,000	Within 48 hours of sealing
< 250	Within 5 days of sealing

Prior to leaving the work site, ensure that all services are uncovered and cleaned, if necessary. Remove from site all waste paper and rubbish arising from the sprayed sealing operations. Clean the stockpile site and store any excess material in a tidy heap or remove, depending on the requirements of the Superintendent.

(10) Work records

Particulars of the work performed shall be recorded by the Contractor on a spray record sheet. Details of primer, primerbinder, binder and aggregate applied shall be recorded immediately after every sprayer run. Each form shall be signed by the Contractor's representative as a true record of the work performed. The Contractor shall supply to the Superintendent a copy of each completed form.

(11) Protection

(a) New work

Protect the new work by providing warning signs as follows:

(i) provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers;

(ii) maintain signs until loose aggregate has been removed and linemarking reinstated; and

(iii) if linemarking is to be undertaken by others, erect warning signs indicating the absence of linemarking to be maintained by the organisation responsible for linemarking.

(b) Services and road fixtures

The Contractor shall take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures.

Immediately after aggregate has been spread over the binder, the Contractor shall clean off or remove any sprayed surfacing material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

SC6.4.6.16.6 Nonconformance of materials and work

If any materials supplied or any section of sprayed bituminous surfacing work fail to conform to the requirements whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted, or any other cause then such failure or failures shall constitute a “non-conformance”.

The nonconforming section of sprayed bituminous surfacing work shall be either replaced or corrected as proposed by the Contractor, subject to the approval being obtained.

The rectified nonconformances, including any restoration work to any underlying or adjacent surface or structure,

which becomes necessary as a result of such replacement or correction, shall be the responsibility of the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this sub-section.

SC6.4.6.16.7 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.16.5 below.

Table SC6.4.6.16.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Design of Bituminous Surfacing**	Contractor to provide details of design to Superintendent before proposed commencement of work.	SC6.4.6.16.3
2.	**Commencement of Work**	Contractor to give notice to the Superintendent of intention to commence work.	SC6.4.6.16.5(1)
3.	**Sweeping of Pavement Surface**	Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed.	SC6.4.6.16.5(3)
4.	**Bitumen Heating** (a) Bitumen Temperature	When incorporated with cutter oil, bitumen shall be in temperature ranges as per MRTS.17 and 18 (06/09).	SC6.4.6.16.5(5)
	(b) Refinery Cutback Bitumen Temperature	At the time of spraying shall be in temperature range as per MRTS 20 (06/09).	SC6.4.6.16.5(5)
	(c) Retention of Temperature	Bituminous materials shall not be held at temperatures within the ranges of MRTS17,18 and 20 for periods in excess of 10 hours.	SC6.4.6.16.5(5)
5.	**Spraying Temperature** (a) Pavement Temperature	Bituminous surfacing shall not be undertaken if the pavement temperature has not been at or above 20°C, 25°C for PMB, 10°C for emulsion for at least one hour before commencement of spraying or if the pavement temperature falls below 20°C, 25°C for PMB, 10°C for emulsion during the period of spraying.	SC6.4.6.16.5(6)
6.	Cutting Back Bitumen	Circulation of hot bitumen and cutter oil mixture in the sprayer shall be at the rate of at least 700 litres per minute for 20 minutes.	SC6.4.6.16.5(7)
7.	Fluxing Bitumen or adding Bituminous Adhesion Agent	Circulation of fluxing oil or bituminous adhesion agent with hot bitumen shall be at the rate of at least 1,000 litres per minute for 20 minutes. Spraying to occur within 4 hours.	SC6.4.6.16.5(7)
8.	**Application of Bituminous Material** (a) Spray Area	Area to be sprayed shall be limited to area which can be covered by aggregate at target application rate within 10 minutes of spraying.	SC6.4.6.16.5(8)
	(b) Application Rates	Application rates and quantities shall apply to a temperature of 15ºC and have T1 tolerances of ±5% as set out in clause SC6.4.6.16.6 and T2 tolerances as set out in SC6.4.6.16 Attachment B.	SC6.4.6.16.5(8)
	(c) Primer	At least a 48 hour period shall elapse after spraying of primer before binder for a seal is applied.	SC6.4.6.16.5(8)
	(d) Primerbinder	At least a 14 day period shall elapse after spraying of primerbinder before application of binder.	SC6.4.6.16.5(8)

Item	Activity	Limits/Tolerances	Clause
9.	**Application of Aggregate** (a) Spreading Time	Application of aggregate shall be completed within 10 minutes of spraying bitumen or cutback bitumen on each section.	SC6.4.6.16.5(9)
10.	**Rolling** (a) Roller Numbers and Type	Initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheeled rollers. Minimum load of 1t per tyre and minimum tyre pressure 550KPa.	SC6.4.6.16.5(9)
	(b) Backrolling	(i) For traffic volume of <500 vehicles per lane per day, backrolling for minimum of one hour per 1,000 square metres sprayed.	SC6.4.6.16.5(9)
		(ii) For traffic volume >500 vehicles per lane per day, backrolling for minimum of one hour per 1,500 square metres sprayed.	SC6.4.6.16.5(9)

SC6.4.6.16 Attachment A: Details of work

Section Road Name From To	Prime Binder Type	Primer Seal		Seal or Reseal	
		Binder Type	Aggregate Nom. Size	Binder Type	Aggregate Nom. Size

Note —prime and primer seal binder type shall be indicated in this Attachment using the descriptive terms as follows:

Very Light Prime or Primer - equivalent cut back bitumen to grade AMCOO.
Light/Medium Prime or Primer - equivalent cutback bitumen to grade AMCO or AMC1.
Heavy Prime or Primer - equivalent cut back bitumen to grade AMC1 or AMC2.

Click here to obtain a copy of the following form.

SC6.4.6.16 Attachment B: Binder details

BINDER TYPE	**ADHESION AGENT** (At 0.5% of binder) **(YES/NO)**

Primer, Primerbinder and Binder Application Tolerance Thresholds T2

(Refer to clause SC6.4.6.16.6)

Nominal Aggregate Size (mm)	**Tolerance Thresholds T2 expressed as ± percentages**

SC6.4.6.17 Bituminous micro-surfacing

SC6.4.6.17.1 Introduction

(1) Scope

The work to be executed under this sub-section consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carparks, cycleways and footpaths; or as a preventative maintenance treatment on roads with the objective of enriching the existing wearing course. The treatment must not be used in new road construction.

Bituminous microsurfacing must consist of a mixture of emulsified polymer modified bitumen binder, mineral aggregate, mineral filler, additives and water proportioned and mixed to form a slurry which is placed and spread evenly on the road surface. It must be capable of being spread in variably thick layers for surface correction and for wearing surface applications.

The size, nominal thickness, and extent of bituminous microsurfacing must be as shown on the drawings or as directed by the Superintendent.

For all new works on road and carpark pavements, this sub-section should be read in conjunction with sub-section SC6.4.6.16 Sprayed bitumen surfacing. For new works on road and carpark pavements, bituminous mircrosurfacing must be preceded by the application of a sprayed bituminous seal a minimum of 2 weeks prior to the application of the bituminous microsurfacing wearing course.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Terminology

Users of this specification should be aware that where terms are not specifically defined in the following section, AS1348 should be the default standard.

Bituminous microsurfacing	Is one of two types of bituminous slurry surfacing. It is distinguished from the other type, slurry seals, by the incorporation of polymer and other additives to the bituminous binder to improve the performance of the slurry surfacing. Bituminous microsurfacing is also commonly known under various proprietary names such as “cold overlay”, “microsealing”, “paveseal”, “microasphalt”, etc. The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this sub-section, the size must be either Size 5 or Size 7.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy subsections to be read and applied in conjunction with this subsection are as follows:

SC6.4.6.16 Sprayed bitumen surfacing

SC6.4.5 Construction management

(b) Australian Standards:

AS1141.11.1	*Particle size distribution – Sieving method*
AS1141.12	*Material finer than 75 micrometre in aggregates (by washing)*
AS1141.22	*Wet/dry strength variation*
AS1141.23	*Los Angeles value*
AS1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS1141.25.2	*Methods for sampling and testing aggregates - Degradation factor - Coarse aggregate*
AS1141.25.3	*Methods for sampling and testing aggregates - Degradation factor - Fine aggregate*

AS1141.42	*Pendulum friction test*
AS1160	*Bitumen emulsions for the construction and maintenance of pavements*
AS1289.3.7.1	*Determination of the sand equivalent of a soil using a power-operated shaker*
AS1348	*Glossary of terms - Roads and traffic engineering*
AS2008	*Residual bitumen for pavements*
AS2350	*Methods of testing Portland and blended cements*
AS2891.3.1	*Binder content and aggregate grading - Reflux method*

(c) International Slurry Surfacing Association Tests:
ISSA TB 100 - *Test method for wet track abrasion of slurry surfaces*
ISSA TB 109 - *Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester*
ISSA TB 114 - *Wet stripping test for cured slurry seal mixes*
ISSA TB 139 - *Method of classified emulsified asphalt/aggregate mixtures by modified cohesion test measurement of set and cure characteristics*
ISSA TB 144 - *Classification compatibility by Schulze-Breuer and ruck procedure*

SC6.4.6.17.2 Materials

(1) Sampling and testing of materials
Sampling and testing of materials must be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods.

(2) Binder
The binder supplied and used in the works must be an emulsified polymer modified bitumen, formulated to meet the performance requirements of the mix specified in clauses SC6.4.6.17.3(1) Mix properties and SC6.4.6.17.4(6) Surface texture.

Prior to emulsification, incorporation of polymer and additives, the bitumen must comply with AS2008.

The Contractor must provide the Superintendent with sufficient information to verify that the binder supplied is the same as that nominated in the mix design.

(3) Mineral aggregates
Mineral aggregates must consist of crushed rock or crushed gravel, or a mixture of crushed rock or crushed gravel and natural sand. It must consist of clean, hard, angular, durable particles, and free form clay, dirt, organic material or other deleterious matter.

The aggregate from each source must comply with the requirements given in Table SC6.4.6.17.1 Aggregate properties.

Table SC6.4.6.17.1 Aggregate properties

Property	Test Method	Requirement
Degradation Factor	AS1141. 25.1	50 minimum
Los Angeles Value	AS1141.23	30 maximum
Aggregate Wet Strength	AS1141.22	150kN minimum
Wet/Dry Strength Variation	AS1141.22	30% maximum
Polished Aggregate Friction Value	AS1141.42	45 minimum
Sand Equivalent	AS1289.3.7.1	60 minimum

When tested in accordance with AS1141.11 and AS1141.12, the aggregate (including mineral filler) must conform with the grading limits given in Table SC6.4.6.17.2 Grading limits for combined aggregate/filler.

Table SC6.4.6.17.2 Grading limits for combined aggregate/filler

Sieve Size	Percent Passing by Mass	
	Size 5	Size 7
13.2mm	100	100
9.5mm	100	100
6.7mm	100	85-100
4.75mm	90-100	70-90
2.36mm	50-70	45-70
1.18mm	30-50	28-50
600µm	20-35	19-34
300µm	12-25	12-25
150µm	7-18	7-18
75µm	4-10	5-15

The Contractor must nominate the source/s of aggregates to the Superintendent, and must submit NATA certified test reports on the quality and grading of the combined aggregate proposed to be used.

The Contractor must submit test results to the Superintendent for each lot/stockpile of aggregate a minimum of seven days prior to incorporation in the works.

(4) Mineral filler

Mineral filler must consist of hydrated lime, flyash, portland cement, or other material approved by the Superintendent.

The mineral filler must be dry, free from lumps and any deleterious material, with a minimum of 85% passing a 75µm sieve. In all other respects, the mineral filler must comply with the requirements of AS2350.

The quantity of filler added to the bituminous microsurfacing during placement must not vary by more than 1% of the total aggregate (by mass) from the filler content nominated in the mix design.

(5) Water

Water added to the bituminous microsurfacing must be potable and must be compatible with the component materials.

(6) Additives

Details of the type, source and nominal proportions of additives must be submitted to the Superintendent with the mix design.

SC6.4.6.17.3 Mix design

(1) Mix properties

The nominated mix design must satisfy the properties given in Table SC6.4.6.17.3 Mix properties.

Table SC6.4.6.17.3 Mix properties

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 6 day	800 g/m^2 maximum
Traffic Time	ISSA TB 139 30 minutes 60 minutes	12kg.cm minimum 20kg.cm minimum
Adhesion	ISSA TB 114 or ISSA TB 144	≥90% or 11 grade points minimum (AAA, BAA)

(2) Nominated mix

At least 7 days before commencing bituminous microsurfacing work, the Contractor must submit to the Superintendent for approval, details of the nominated bituminous mircrosurfacing mix design for the work including the target application rate (m^3 of mix/m^2 of road surface) and the corresponding nominal layer thickness, together with NATA certification and test results demonstrating that the nominated mix and its constituents meet the requirements of the specification.

The details of the nominated mix design must include the following:

(a) bitumen emulsion content of the mix, and the residual binder content of the emulsion;

(b) target combined aggregate/filler grading;

(c) proportions of constituent materials used;

(d) type and sources of aggregates, filler and binder; and

(e) all relevant compliance certificates.

(3) Approved mix

When a nominated mix has been approved by the Superintendent, it must be known as the “approved mix”. Work must not commence until a bituminous microsurfacing mix has been approved.

The combined aggregate/filler grading and the binder content of the approved mix will be termed the "approved grading" and the "approved binder content" respectively.

Any changes to the approved mix, its method of production or source of supply of constituents require written approval 21 days prior to proposed implementation.

SC6.4.6.17.4 Production and paving

(1) Requirements of production mix

Bituminous microsurfacing produced in the paving unit at the site must be known as the "production mix".

The production mix must comply with the requirements given in Table SC6.4.6.17.4 Maximum permitted variations from approved mix and must be confirmed by the Contractor as required in SC6.4.6.17.4(2) Sampling and testing of production mix.

The Contractor is responsible for taking samples for testing at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4.

Table SC6.4.6.17.4 Maximum permitted variations from approved mix

Production Mix Properties	Maximum Permitted Variations from Approved Mix (by mass)	
	Size 5	Size 7
Grading*	Nil	Nil
Passing 9.50mm AS sieve and larger	Nil	± 7%
Passing 6.70mm	± 6%	± 6%
Passing 4.75mm	± 5%	± 5%
Passing 2.36mm and 1.18mm	± 4%	± 4%
Passing 0.600mm	± 3%	± 3%
Passing 0.300mm	± 2%	± 2%
Passing 0.150mm	± 1.5%	± 1.5%
Passing 0.075mm		
Residual Binder Content	- 0.5% + 1.0%	- 0.5% + 1.0%

Note—*these allowable variations must not fall outside the limits for design of nominated mix as given in Table SC6.4.6.17.2 Grading limits for combined aggregate/filler.

(2) Sampling and testing of production mix

(a) Lot definition

Compliance sampling and testing of bituminous microsurfacing must be undertaken on a lot by lot basis. For this purpose, 50m^3 or one day's production (whichever is the lesser), or such smaller quantity which is considered as representative of consistent production of the paving unit, will be considered as representative of consistent production of the paving unit.

(b) Responsibility of sampling

The Contractor is responsible for taking samples and must supply all facilities, equipment and labour for that purpose.

(c) Frequency of Sampling

For the testing of production mix, two 1.5kg representative samples of bituminous microsurfacing mustbe taken from each lot at random intervals. The samples must be taken from the discharge of the paving unit and the sample containers immediately sealed.

For the testing of the binder, two 2L samples of bitumen emulsion must be taken from each bulk delivery in accordance with AS1160.

(d) Testing

The samples of bituminous microsurfacing must be treated and tested at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4 Maximum permitted variations from approved mix. Prior to testing for Residual Binder Content and Aggregate Gradation, as determined by AS2891.3.1, the samples must be dried to constant weight in an oven at 60ºC for a minimum of 15 hours.

Each delivery of emulsion must be tested for residual binder content in accordance with AS1160 Appendix D and accompanied by a certification of specification compliance traceable to the relevant batch at the supplier's storage tank.

The paving unit to be used must be calibrated for the component materials of the approved mix prior to the commencement of paving. Previous calibration documentation covering the same materials and approved mix must be acceptable provided that calibration has been carried out within the previous 12 months.

The documentation must include an individual calibration for each component material at various settings which can be related to the paving unit's metering devices.

No paving unit must be allowed on the work until the calibration has been verified and approved by the Superintendent.

(3) Preparation of pavement

The existing surface must be clean and free from any loose stones, dirt, dust and foreign matter. The surface must be swept beyond the edge of the area to be surfaced by at least 300mm. Any foreign matter adhering to the pavement and not swept off must be removed by other means. Any areas significantly affected by oil contamination must be cleaned to the satisfaction of the Superintendent.

The Contractor must take all necessary precautions to prevent the bituminous microsurfacing or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, bridge or culvert decks or other road fixtures. After the bituminous microsurfacing has been spread the Contractor must clean off any such material and leave such gratings, access chamber covers and other road fixtures, in a clean and satisfactory condition.

(4) Weather limitations

Bituminous microsurfacing must not commence if either the pavement or air temperature is below 10ºC and falling.

Bituminous slurry may be applied when both pavement and air temperatures are above 7ºC and rising, or above 10ºC.

Spreading must not proceed during rain or when rain appears imminent.

The Superintendent must require cease of works, if weather conditions are not appropriate.

(5) Spreading

The surface may be pre-dampened if necessary by fogging ahead of the spreader box. Water used for pre-wetting the surface must be applied so that the entire surface is damp with no apparent flowing water ahead of the spreader box. The application rate of the fog spray must be adjusted to suit temperature, surface texture, humidity and dryness of the surface being covered.

Bituminous microsurfacing must be mixed and applied using a purpose built paver. The mix must be of the desired consistency when deposited in the spreader box, and nothing more may be added other than minor amounts of water for the purpose of overcoming temporary build-up of microsurfacing in the corners of the spreader box.

The mixing time must be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture must be conveyed into the moving spreader box at a sufficient rate to always maintain an ample supply across the full width of the strike-off.

The strike-off must be adjusted to provide an application rate which will completely fill the surface voids and provide the nominal application rate of bituminous microsurfacing as scheduled.

After the bituminous microsurfacing has been spread, the Contractor must ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, etc. are uncovered and left in a clean and satisfactory condition.

After the emulsion has broken and the mix is sufficiently stable, rolling must be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface where there is insufficient local traffic to achieve satisfactory compaction across the mat.

Bituminous microsurfacing must be capable of carrying slow moving traffic (<40 km/h) within 1 hour of application without permanent damage occurring, such as rutting or ravelling. When the time before the microsurfacing is capable of carrying traffic exceeds 1 hour, work must cease unless specifically approved by the Superintendent.

(6) Surface texture

The resulting surface after spreading must be uniform in appearance, and free of areas exhibiting segregation or

excessive or insufficient binder.

The surface texture must be demonstrated on a short test run for approval by the Superintendent. If the surface texture is acceptable to the Superintendent, then all subsequent work must be finished to an equivalent surface texture.

Where increased surface texture is required, a fabric skirt may be trailed behind the spreader box.

(7) Joints

Longitudinal joints in the wearing course must be straight and placed at either the edge or the centre of a traffic lane. If necessary, the edges and joints must be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material.

(8) Shape and levels

Where a correction and wearing course have been placed, the finished surface level may not vary from the design level at any point by more than ±10mm. Additionally immediately adjacent to any kerb and/or gutter the finished surface level is not be below nor more than 10mm above the level of the lip of the adjacent gutter.

Notwithstanding the above, the deviation from a 3m long straight edge placed anywhere on the top of the finished surface may not exceed 10mm when assessed within 24 hours of work completion.

(9) Non-conformance of materials and finished surfacing

If any materials supplied fail to conform to the requirements in this sub-section or if any section of bituminous microsurfacing fails to conform to the requirements of this sub-section - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures will constitute a “Notice of Non Conformance”. Such non-conforming sections of bituminous microsurfacing work must be either replaced or corrected.

The rectification of nonconformances, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, is the Contractor’s responsibility. Materials removed from the site by the Contractor must be replaced with materials which conform to this sub-section.

(10) Control of traffic

The Contractor must provide for traffic in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work and must take all necessary precautions to protect the work from damage until such time as the new work has developed sufficient strength to carry normal traffic without damage.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic must be temporarily diverted while the work is in progress.

SC6.4.6.17.5 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.17.5 below.

Table SC6.4.6.17.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clause
1.	**Mineral Aggregate**	As per Table SC6.4.6.17.1	SC6.4.6.17.2(3)
2.	**Combined Aggregate/filler**	As per Table SC6.4.6.17.2	SC6.4.6.17.2(3)
3.	**Mineral Filler**	> 85% passing a 75 µm Sieve	SC6.4.6.17.2(4)
4.	**Mix Properties**		
	(a) Design properties	As per Table SC6.4.6.17.3	SC6.4.6.17.3(1)
	(b) Permitted variations	As per Table SC6.4.6.17.4	SC6.4.6.17.4(1)
5.	**Surface Preparation**	Sweeping must extend at least 300mm beyond edge of area to be surfaced	SC6.4.6.17.4(3)
6.	**Weather Limitations**	Microsurfacing must not commence if either air or pavement temperature is below 10°C and falling, and may only commence if both air and surface temperature is above 7°C and rising or above 10°C	SC6.4.6.17.4)4)
7.	**Shape and Levels**		
	(a) Finished Levels	Must not vary at any point by more than ± 10mm from design levels. Immediately adjacent to kerb and/or gutters, levels must not be below nor more than 10mm above design level	SC6.4.6.17.4(8)
	(b) Finished Shape	Deviation from the bottom of a 3m straight edge must not vary by more than 10mm	SC6.4.6.17.4(8)

SC6.4.6.18 Segmental paving

SC6.4.6.18.1 Introduction

(1) Scope

(a) This sub-section covers the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.

(b) The work covered under this sub-section consists of the supply, placement and compaction of segmental pavers including the provision of a sand or crusher dust bedding course and joint filling sand, over bound or unbound base and/or subbase layer/s.

(c) This sub-section should be read in conjunction with the appropriate specifications for the construction of the base and subbase layers beneath the segmental paving, ie. SC6.4.6.12 Flexible pavements, SC6.4.6.14 Mass concrete subbase.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Choice of paver type, shape, class and laying pattern

(a) The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern must be as per decision requirement for each area of application.

(b) Unless otherwise specified, concrete pavers for road pavements must be placed in herringbone laying pattern and must be in accordance with the requirements for the appropriate road application shown in Table SC6.4.6.18.1.

(c) Unless otherwise specified, clay pavers for road pavements must be Class 4, minimum 65 mm nominal thickness, and placed in a herringbone laying pattern.

(d) Paving for cycleways and other pedestrian areas must be carried out in accordance with SC6.4.3.3 Footpath treatment and SC6.4.4.7 Pathways and cycleways.

(e) Paving for road pavements, medians and traffic islands must be carried out in accordance with SC6.4.4.1 Geometric road design and SC6.4.4.2 Pavement design.

(f) Paving for driveways must be carried out in accordance with SC6.4.3.5 Driveways and SC6.4.4.8 Standard drawings.

(3) Terminology

Concrete segmental pavers are units of not more than 0.1sqm in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges. Concrete pavers are identified by shape as being one of the following types:

(a) **Shape Type A** - Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units; or

(b) **Shape Type B** - Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces; or

(c) **Shape Type C** - Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

Clay pavers are manufactured from clay, shale or argillaceous materials which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.

Laying patterns of pavers are identified as being either Herringbone, Basket-weave, or Stretcher as shown in SC6.4.6.18 Attachment A Laying patterns. Each of these may be laid at either 90º or 45º to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in SC6.4.6.18 Attachment A.

(4) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.9 - Open drains kerb and channel
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.14 - Mass concrete subbase
SC6.4.6.19 - Stabilisation
SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:
AS1141.11.1 - *Particle size distribution - Sieving method*
AS/NZS4455 - *Masonry units, pavers, flags and segmental retaining wall units*
AS/NZS4456.0 - *Methods of test - General introduction and list of methods*
AS/NZS4456.3 – *Methods of test - Determining dimensions*
AS/NZS4456.5 – *Methods of test - Determining the breaking load of segmental pavers and flags*
AS/NZS4456.9 – *Methods of test - Determining abrasion resistance*
AS/NZS4586 - *Slip resistance classification of new pedestrian surface materials.*

(c) Concrete Masonry Association of Australia specifications:
CMAA MA56-2010 - *Guide to permeable interlocking concrete pavements*
CMAA MA57-2010 - *Concrete segmental and flag pavements - guide to specifying*
CMAA T45-1997 - *Concrete segmental pavements - Design guide for residential access ways and roads*
CMAA T46-1997 - *Concrete segmental pavements - Detailing guide.*

(d) Clay Brick and Paver Institute specification:
CBPI Manual 1: 2003 - *Clay Paving Design and Construction.*

SC6.4.6.18.2 Materials

(1) General

(a) The Contractor must submit details of all proposed segmental paving materials, including bedding sand or crusher dust and joint filling sand. These details must be submitted to the Superintendent for approval supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this sub-section.

(b) No pavers may be delivered until the Superintendent has approved the type and quality of the pavers and noted the source of supply as compliant to the requirements of this sub-section.

(c) All pavers must have suitable “slip resistance” for pedestrian traffic and vehicular traffic with a classification “W” according to AS/NZS4586 for the Wet Pendulum Test. Where specific localities or levels of usage require a higher slip resistance classification, this classification must be indicated on the drawings. Such approval does not relieve the Contractor of any responsibility for supplying materials that comply with this sub-section.

(2) Concrete segmental pavers

(a) Concrete segmental pavers must comply with the requirements of relevant Concrete Masonry Association of Australia Specifications and AS/NZS4455 for each area of application.

(b) The material requirements for concrete pavers for each application, derived from CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying*, are shown in Table SC6.4.6.18.1.

Table SC6.4.6.18.1 Material requirements for concrete segmental pavers

Pavement application		Minimum characteristic breaking load *kN	Work size minimum thickness mm	Dimensional deviation category (See Table SC6.4.6.18.3)	Maximum abrasion resistance (mean abrasion index) †		
Relevant Australian Standard		AS/NZS 4455.2 AS/NZS 4456.5	AS/NZS 4455.2	AS/NZS 4455.2 AS/NZS 4456.3	AS/NZS 4455.2 AS/NZS 4456.9		
Residential	Pedestrians only (eg paths, patios and outdoor areas)	2	40	DP0	§		
	Pedestrian and light vehicles only (eg driveways, parking spaces and the like)	3	40	DPB1	§		
	Pedestrian and commercial vehicles	5	60	DPB1	§		
					Pedestrian traffic volume		
					Low	Medium	High
Public space	Pedestrian only**	2	40	DPB1	7‡	5.5	3.5
	Pedestrian and light vehicles only	3	50	DPB2	7‡	5.5	3.5
	Pedestrian and commercial vehicles	5	60	DPB2	7‡	5.5	3.5
Trafficked segmental pavers	Minor and residential	6	60	DPB2	NA		
	Local access	6	60	DPB2	NA		
	Collector M	6	76	DPB2	NA		
Industrial	M	10	80	DPB2 or DPB3	7		

(Source: CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying* - Table 1: Minimum Requirements for Dimensions, Breaking Load and Abrasion Resistance).

Note—

* At 28 days

† At 90 days

** where cleaning of pavers and flags is undertaken by mechanical means or where prevention of vehicle entry cannot be guaranteed, the minimum recommended pavers and flags are the 'Pedestrian and light vehicles only' for such pavement applications.

§ No abrasion criteria are specified for residential pavers. Abrasion resistance requirements for aesthetic or other purposes must be specified to the supplier/manufacturer.

NA Not applicable.

* Shape Type A pavers – dentated pavers that key into each other and by their plan generally interlock and resist relative movement of joints parallel to both the longitudinal and transverse axes of the pavers.
Examples of Type A shapes

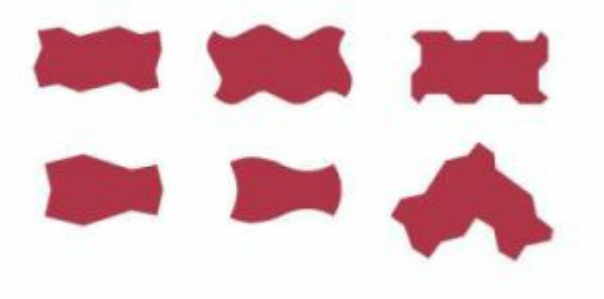


Table SC6.4.6.18.2 Maximum dimensional deviations determined by individual measurement

Category	Work Size dimensions, mm			
	Plan		Height	
	Standard deviation	Mean	Standard deviation	Mean
DP0	No requirement			
DPB1	2.0	± 3.0	3.0	± 2.5
DPB2	2.0	± 2.5	3.0	± 2.0
DPB3	Values declared by the supplier or by agreement between supplier and purchaser			
DPB4	1.5	± 2.0	2.0	± 2.0

Source: CMAA MA57-2010 Concrete segmental and flag pavements - guide to specifying - Table 2: Maximum Dimensional Deviations Determined for Pavers and Flags by Individual Measurement).

Note—all paving units will be categorised in accordance with AS/NZS4455.3 Method for Determining Dimensions.

(3) Clay segmental pavers
Clay segmental pavers must comply with the requirements of CBPI Manual 1:, *Clay paving design and construction* (chapter 3, Specifying clay pavers), and with the requirements of AS/NZS4455.

(4) Bedding sand or crusher dust

(a) The bedding material must be well-graded, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75 mm sieve. The bedding material must be from a single source or blended to achieve, when tested in accordance with AS1141.11, the following grading:

AS Sieve	**% Passing**
9.52mm	**100**
4.75	**95 - 100**
2.36	**80 - 100**
1.18	**50 - 85**

600µm	**25 - 60**
300	**10 - 30**
150	**5 - 15**
75	**0 - 10**

(b) The material must be of uniform moisture content when spread. It must be covered when stored on site to protect it from rain penetration.

(c) The bedding material must be free of deleterious soluble salts or other contaminants which may cause, or contribute to, efflorescence.

(5) Joint filling sand

(a) The joint filling sand must be well graded passing a 2.36mm sieve, and when tested in accordance with AS1141.11, having the following grading:

AS Sieve	**% Passing**
2.36mm	**100**
1.18	**90 - 100**
600µm	**60 - 90**
300	**30 - 60**
150	**15 - 30**
75	**5 - 10**

(b) The sand must be dry when spread. It must be covered when stored on site to protect it from rain penetration.

(c) The sand must be free of deleterious soluble salts or other contaminants.

(d) Material used for bedding is not suitable for joint filling.

(6) Concrete for edge restraints

(a) Concrete supplied and placed for the construction of edge strips must comply with sub-section SC6.4.6.28 Minor concrete works.

(b) Unless otherwise indicated on the drawings, or where the edge restraint is provided by kerb and/or gutter, the concrete used for edge restraints must have a minimum 28 day characteristic compressive strength of 32MPa for edge restraints to pavers on road pavements and 25MPa for edge restraints to pavers on footpaths, cycleways, medians and driveways.

SC6.4.6.18.3 Construction

(1) Subgrade preparation

(a) The subgrade must be formed to the required depth below finished surface level as shown on the drawings in accordance with SC6.4.6.10 Earthworks (construction).

(b) The finished subgrade foundation for the provision of subbase and/or base is subject to the approval of the Superintendent.

(2) Subbase

(a) As shown on the drawings, a subbase or working platform must be constructed in accordance with SC6.4.6.14.10 Subgrade Beams.

(b) The subbase must be constructed to the specified thickness, compaction and depth below finished surface level and to the design grade and crossfalls of the finished surface.

(c) The finished subbase is subject to the approval of the Superintendent.

(3) Base

(a) The base must be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the drawings in accordance with sub-section SC6.4.6.12 Flexible pavements.

(b) The base course must extend in width to at least the rear face of all new edge restraints.

(c) Notwithstanding the finished level tolerances contained within sub-section SC6.4.6.12 Flexible pavements for base of ±10mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving must be trimmed to within + 10mm or – 0mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving must not exceed 10mm. Bedding material must not be used as a levelling material to compensate for base finishing outside the above tolerances.

(d) The finished surface of the base must drain freely without ponding.

(e) The finished base is subject to the approval of the Superintendent.

(4) Edge restraints

(a) Edge restraints in the form of kerb and/or gutter or edge strips must be constructed along the perimeter of all segmental paving as shown on the drawings. Concrete kerb and/or gutter and edge strips must be constructed in accordance with sub-section SC6.4.6.9 Open drains and SC6.4.6.28 Minor concrete works.

(b) Faces of edge restraints abutting pavers must be vertical.

(c) Edge restraints must be supported on compacted base and/or subbase of the thickness as shown on the drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints must be 100mm adjacent to road pavements and medians, and 50mm adjacent to footpaths, cycleways and driveways.

(d) Unless otherwise shown on the drawings, contraction joints, 20mm depth must be formed every 5m of edge restraint length.

(e) After the concrete has hardened and not earlier than 3 days after placing, unless otherwise directed by the Superintendent the spaces at the back of the edge restraint must be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding design levels.

(5) Bedding

(a) The bedding course must be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and level. The bedding course must be laid such that a uniformly thick nominal 20-25mm layer is achieved following final compaction of the segmental paving.

(b) Any depressions in the screeding material exceeding 5mm must be loosened, raked and rescreeded before laying pavers.

(c) For the manual placing of paving units, the bedding material must be maintained at a uniform loose density. For mechanised laying, the bedding material must be uniformly and firmly, but not fully, compacted.

(d) Screeded material left overnight of subject to rain must be checked for level and rescreeded where necessary before pavers are placed. The material must not be screeded more than 2m in advance of the laying face at the completion of work on any day.

(6) Laying pavers

(a) Pavers must be uniformly placed on the screeded bedding to the nominated laying pattern. Pavers must be placed so that they are not in direct contact with each other and must have uniform 3mm nominal joint widths. The pavers must be mixed between various pallets to ensure that any colour variation from one pallet of pavers to the next is evenly distributed over the entire paved area.

(b) The first row must be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.

(c) In each row, full units must be laid first. Edge or closer units must be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in

size than one quarter of a full block must not be used.

(d) Access chambers, drainage gullies and similar penetrations through the pavement must be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

(e) Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, a joint must be provided in the pavers. The joint must consist of 10mm thick preformed jointing material of bituminous fibreboard.

(f) Any foot or barrow traffic must use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic is allowed on the pavement prior to compaction and provision of joint filling sand.

(g) On completion of subsequent bedding compaction and joint filling operations, all joints must have widths within the range 2-4mm.

(7) Bedding compaction

(a) After laying the pavers the bedding must be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units. Compaction must continue until all pavers form a smooth surface with adjacent paver edges matching. The level difference between adjoining edges of any two pavers must be a maximum of 2mm, to avoid trip hazards, unless approved otherwise by the Superintendent for rough textured pavers.

(b) Any units which are structurally damaged during bedding compaction must be removed and replaced. The pavement must then be recompacted for at least 1m surrounding each replacement unit.

(c) The paving operations must be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction must not be attempted within 1m of the laying face except on completion of the pavement against an edge restraint.

(d) The finished surface level must not vary from the design level at any point laid in any direction, by more than 6mm for all areas with Class 4 segmental pavements and 8mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, must not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8mm for all other areas of segmental paving.

(e) The channels formed between abutting chamfered units must finish with their inverts not less than 5mm nor more than 10mm above adjacent drainage inlets.

(f) All compaction must be complete and the pavement must be brought to design profiles before spreading or placing sand filling in the joints.

(8) Filling joints

(a) As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling must be spread over the pavement and the joints filled by brooming.

(b) To ensure complete filling of the joints, both the filling sand and pavers must be as dry as practicable when sand is spread and broomed into the joints.

(c) The pavement must then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

(9) Protection of work

Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic may not use the pavement until bedding compaction and joint filling operations have been completed.

(10) Opening to traffic

(a) As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should

be encouraged to traverse the greatest possible area of pavement to assist in the development of "lock-up".

(b) Excess joint filling sand must be removed prior to opening to traffic.

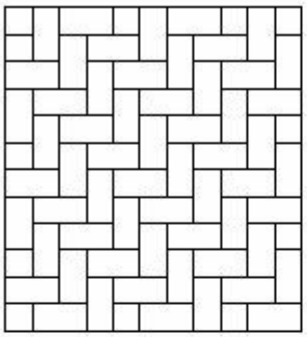
(c) The pavement must then be inspected by the Contractor at regular intervals up until the expiration of the defects liability period to ensure that all joints remain completely filled.

SC6.4.6.18.4 Limits and tolerances

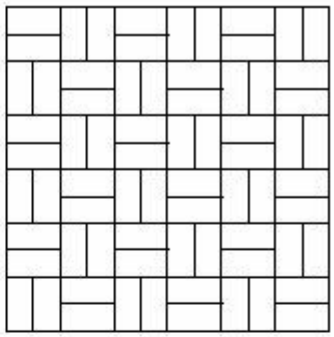
The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.18.3 below:

Table SC6.4.6.18.3 Summary of limits and tolerances

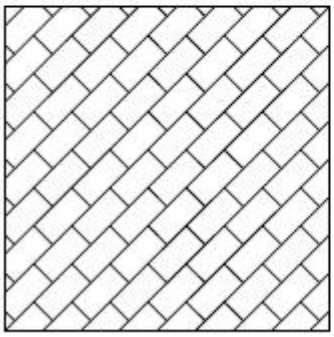
Item	Activity	Limits/Tolerances	Clause
1.	**Base**		
	(a) Surface Level	Finished level of base for road pavements to be within +10mm or -0mm of design levels.	SC6.4.6.18.3(3)
		Finished level of base other than for road pavements, to be within ±10mm of design levels.	SC6.4.6.18.3(3)
		The top surface of the base for all segmental paving must not deviate from a 3m straight edge, laid in any direction, by more than 10mm.	SC6.4.6.18.3(3)
2.	**Laying Paving Units**		
	(a) Joint widths	Within the range 2 -4mm.	SC6.4.6.18.3(6)
3.	**Completed Segmental Paving** (a) Surface level	Finished surface level of pavers must not vary from design levels by more than ±6mm for road pavements and ±8mm for other than road pavements.	SC6.4.6.18.3(7)
		Finished surface of pavers must not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other than road pavements.	SC6.4.6.18.3(7)
	(b) Level adjacent to drainage inlets	Invert level of channels between abutting chamfered units must be not less than 5mm and not more than 10mm above the level of adjacent drainage inlets.	SC6.4.6.18.3(7)
	(c) Difference in level of adjacent pavers	≤2mm	SC6.4.6.18.3(7)



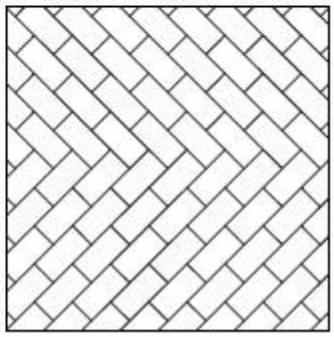
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond

SC6.4.6.19 Stabilisation

SC6.4.6.19.1 Introduction

(1) Scope

This sub-section identifies the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

The work to be executed under this sub-section consists of the supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade layer (including materials for the selected material zone, and selected backfill), at specified locations in the work and the spreading, compaction, trimming and curing of such materials.

This sub-section provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table SC6.4.6.19.1.

Table SC6.4.6.19.1 Types of pavement courses, subgrade zones or layers and stabilising binder

Pavement Course Or Subgrade Zone Or Layer	Stabilising Binder
PAVEMENT COURSE	
Base and Subbase	Cement Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ) Foam bitumen (MRTS07C)
SUBGRADE ZONE OR LAYER	
Selected Material Zone	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Other Subgrade Layers	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Selected Backfill Zone	Cement Hydrated Lime (pugmill)

The pavement course or subgrade zone or layer to be stabilised shall be as specified in sub section SC6.4.6.12 Flexible pavements, or as indicated on the drawings.
Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) The Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:
SC6.4.6.4 Stormwater drainage
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1141.11.1	*Particle size distribution – Sieving method*
AS 1289	*Methods of testing soils for engineering purposes*
AS 1289.5.7.1	*Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method)*

AS 1289.5.8.1	*Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode*
AS 1289.4.2.1	*Determination of the sulphate content of a natural soil and the sulphate content of the ground water - Normal method*
AS 1289.6.1.1	*Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 2350.4	*Methods of testing portland, blended and masonry cements -Setting time*
AS 2350.9	*Methods of testing portland, blended and masonry cements - Determination of residue on the 45 micrometre sieve*
AS 3582.1	*Fly ash*
AS 3582.2	*Slag - Ground granulated iron blast-furnace*
AS 3583.3	*Determination of loss on ignition*
AS 3583.6	*Determination of relative water requirement and relative strength*
AS 3583.12	*Determination of available alkali*
AS 3583.13	*Determination of chloride ion content*
AS 3583.14	*Determination of insoluble residue content*
AS 3972	*General purpose and blended cements*
AS 4489.6.1	*Test methods for limes and limestones – Lime index - Available lime*
AS 5101.4	*Methods for preparation and testing of stabilized materials – Unconfined compressive strength of compacted materials*

(c) Other publications:

Austroads

Guide to pavement technology Part 4D - Stabilised materials, AGPT04D-06.

The Glossary of Austroads Terms, AP-C87-10

NSW Roads and Maritime Services Test Methods

Test method T432: Rate of slaking of quicklime, 2012

SC6.4.6.19.2 Inspection, sampling and testing

(1) Pre-construction compliance

The Contractor shall provide a certificate from a laboratory with appropriate NATA registration stating that the stabilisation mix(es) submitted and the mix constituents comply with the mix nominated in approved stabilisation mix design approved as part of the pavement design and that the stabilised material meets the requirements of sub section SC6.4.6.12 Flexible pavements if incorporated into the works as a pavement layer or alternatively SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage.

(2) Construction compliance

Regular inspection, sampling and testing of pavement and subgrade materials shall be undertaken by the Contractor while stabilisation is in progress in accordance with this sub section.

SC6.4.6.19.3 Materials

(1) Unsuitable materials and shape correction

These shall be with unbound gravel of Type 1, Type 2, Type 3 or Type 4 in accordance with SC6.4.6.10 and SC6.4.6.12 New material shall not have a water soluble sulphate content exceeding 1.9 grams of sulphate per litre.

(2) Cement and stablising agent

The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS3972.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any time.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the time of manufacture, the Contractor shall arrange a re-test, to ensure the cement still complies with AS3972, before the cement is used in the work. Test results shall be forwarded to the Superintendent for approval at least 2 days in advance of usage of the material.

The Contractor shall order gravel material with the cement content required to achieve the designed unconfined compressive strength (UCS) of the pavement. It is the Contractor's responsibility to ensure the material being used achieves the required UCS.

(3) Quicklime stabilising agent
Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

(a) available lime - the content of calcium oxide, determined by AS4489.6.1, shall not be less than 85%. Unless otherwise specified, the spread rate for quick lime shall be 20kg/m^3; and

(b) slaking rate - the active slaking time shall not be greater than 20 minutes and the temperature rise on slaking, determined from the average of four samples tested in accordance with Test Method T432, shall not be less than 40°C in 6 minutes.

The particle size distribution of the quick lime determined by AS1141.11 shall comply with the following requirements in Table SC6.4.6.19.2.

Table SC6.4.6.19.2 Particle size distribution of quicklime

AS Sieve	Per Cent Passing
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

(4) Hydrated lime stabilising agent

(a) Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties:

(i) available lime - the content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80%;

(ii) form - the material shall be in a dry powder form; and

(iii) residue on sieving - the residue on a 300 micron sieve, determined by (Particle Size) AS3583.14, shall not exceed 2%.

(b) The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

(i) percentage of calcium hydroxide;

(ii) fineness percentage by mass passing the 45 micron sieve (AS 2350.9); and

(iii) source.

(5) Ground granulated blast furnace slag stabilising agent
The ground granulated blast furnace slag shall conform to AS3582.2.
The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness percentage by mass passing the 45 micron sieve (AS2350.9);

(b) relative strength (28 days) (AS3583.6); and

(c) source.

(6) Flyash stabilising agent
Flyash shall conform to AS3582.1.

The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness - percentage by mass passing the 45 micron sieve (AS2350.9);

(b) loss on ignition (AS3583.3); and

(c) source.

(7) Blended stabilising agents

The Contractor may utilise a blended stabilising agent. The Contractor shall obtain mill and batch information which will make the blended stabilising agent traceable to the supplier's test results.

Handling and storage requirements of the Supplier shall be complied with by the Contractor who shall also arrange for sampling of the agent as required by the Superintendent.

The mass of components of the nominated blended stabilising agent shall not vary by more than ± 3% from the blend percentages nominated in the mix design described in approved stabilisation mix design.

When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

(a) source of each component;

(b) fineness percentage by mass passing the 45 micron sieve (AS2350.9); and

(c) setting time (AS2350.4).

(8) Water (for curing)

Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than:

(a) 600 parts per million of chloride ion, determined by AS3583.13;

(b) 400 parts per million of sulphate ion, determined by AS1289.4.2.1; and

(c) 1% by mass of undissolved solids.

Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

(9) Foam bitumen

In accordance with MRTS07C.

SC6.4.6.19.4 Stabilisation processes

(1) General

The Contractor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work 14 days prior to commencement of the work. This submission, hereafter called the work plan, is to include the following:

(a) the sequence of operations;

(b) widths of stabilisation passes;

(c) provision for traffic if appropriate;

(d) comply with statutory requirements for WHS;

(e) testing methods and frequency;

(f) comply with this specification;

(g) survey control methods; and

(h) curing methods.

Notwithstanding submission to the Superintendent of the Contractor's equipment and stabilisation procedures, the work shall meet all the sub-section requirements, and statutory requirements for work health and safety, and the Contractor shall perform such tests as specified as the work proceeds, to ensure compliance.

Stabilisation of pavement materials shall not proceed during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.

(2) Application of stabilising agent

(a) Stationary mixing plant

Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the Superintendent.

Application rate measured in kg/t of product shall be monitored and recorded for every 100t of production.

The achieved accuracy of application rate shall be ±10% of the nominated rate nominated in approved pavement design's stabilisation mix design.

The application rate shall not be allowed to exceed the nominated rate by more than 10%.

(b) In-situ

For environmental reasons in urban areas the incorporation of stabilising agent is to be a closed system process where stabilising agent is added and mixed into the pavement within the bowl of the specialist mixing equipment.

Where approved in rural areas spreading shall be carried out using the mechanical spreader nominated in the work plan and subsequently approved by the Superintendent. The approved pavement design's stabilisation mix design nominates the spread rate.

The actual spread rate shall be within ±10% of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500m^2 of pavement treated (whichever is less) in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable four sided tray placed on the pavement and between the wheels of the closed system stabiliser. The rate of stabilising agent spread shall be calculated by dividing the mass collected (kg) by the area of the tray (m^2).

Where spreading/stabilising vehicles are fitted with load cells, the Contractor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Contractor shall record this data for each run and make it available to the Superintendent promptly. Such action will not cancel the Contractor's obligation to undertake prescribed testing of spread rate if required by the Superintendent.

Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property. Where open spreading is approved.

Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised. Where open spreading is approved.

Any spillage of the stabilising agent on site or at any loading location related to the site shall be removed as soon as possible and within the same work shift of such spillage.

(3) Mixing

(a) Stationary mixing plant

The stationary mixing plant shall be purpose built for the process of mixing road making materials. All equipment shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material.

The plant shall provide for the controlled and metered inclusion of water into the mix.

The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS1289.6.1.1, with a pair of test specimens tested for each 100 tonnes of production.

(b) In-situ

Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. Where directed a minimum of two passes of the mixing equipment is required. As mixing blades or tynes wear they shall be replaced so as to maintain mixing efficiency consistent with that demonstrated during the trial section. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in such a manner as to provide a uniformly moist mix to a target moisture content.

The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.

The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.

The Contractor shall carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Inspection results shall be recorded as cited in SC6.4.5 Construction management.

The Superintendent may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content.

(c) Paving equipment

For plant-mixed stabilising pavements, the mixture shall be placed by self-propelled paving machine purpose built for this work and with the capacity to place and spread the mixture in one pass at the required uncompacted thickness, width and shape. Other methods of paving may be considered by council where the use of a self-propelled paving machine is impractical.

(4) Field working period (allowable working time)

The time period from addition of water during the mixing process until the completion of compaction is nominated as the field working period.

The nominated field working period shall be provided in Stabilisation Mix Design for the stabilising agent approved as part of the pavement design. The Nominated field working period shall be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for standard compaction procedures decreases by more than 2 percentage points. This testing shall be undertaken utilising AS 1289.5.1.1 and samples of the materials representative of those to be utilised in the works. If the field working period is not specified as part of the pavement design, the maximum period between the commencement of mixing and the completion of compaction and trimming shall be 3 hours.

The Contractor will complete the compaction process within the Nominated field working period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions.

(5) Trimming and compaction

After mixing the layer shall be trimmed and compacted in accordance with sub-section SC6.4.6.12 Flexible pavements to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in clause SC6.4.6.19.4(7)(a) Levels and surface trim.

Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurrying will not be accepted. The Contractor's survey control methods as stated in the work plan will be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in clause SC6.4.6.19.4(7)(b) Layer thickness. When required by the Superintendent survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary

trimming.

Measurements with a 3m straight edge shall be taken at a minimum of ten randomly selected stations so as to represent each 200m lane length or part thereof. Deviation of the surface from the bottom of a 3m straight edge placed in any direction will meet the tolerance shown in clause SC6.4.6.19.4(7)(a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.1.1 is not less than as detailed in sub-sections SC6.4.6.12 Flexible pavements, SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage as appropriate.

To provide true relative compaction assessments the lots shall be sampled and tested within the nominated field working period in accordance with AS1289.5.1.1.

The maximum wet density (standard compaction) will be determined by sampling immediately after the determination of field density and testing will be undertaken within 2 hours of sampling. A determination of maximum wet density (standard compaction) representing the full layer depth is required for each sampling location when calculation of relative compaction is undertaken.

The field density may be determined by in situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS1289.5.8.1.

(6) Joints

Joints are defined in this sub-section to comprise interfaces between work episodes that are separated in time by more than the nominal field working period for the nominated stabilisation mix design. A longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the nominated field working period.

All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. A minimum longitudinal overlap of mixing runs shall be 75mm. Transverse joints shall be overlapped by a minimum of 2m. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work. No longitudinal joints shall be allowed within 500mm of the centreline of a typical wheelpath.

The level and shape of the joints shall be within the limits specified in clause SC6.4.6.19.4(7) Tolerances.

(7) Tolerances

(a) Levels and surface trim

The surface level after primary trimming shall be within a tolerance of +30mm and +10mm of the levels shown on the drawings.

The surface level after secondary trimming shall be within a tolerance of +15mm and -15mm of the levels shown on the drawings.

The pavement surface after secondary trimming and immediately prior to sealing shall be of a quality such that deviation under a 3m straight edge does not exceed 12mm.

Ensure the final surface level is within ± 15mm of the design levels in the event only a single trim is carried out.

(b) Layer thickness

The final thickness of the stabilised layer at any point shall be within a tolerance of +20mm and 10mm of the nominated layer thickness.

The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200m length of a lot. The average thickness shall not be less than that

required to meet the specified final thickness tolerances after trimming.

The layer thickness shall be measured at the edges of the stabilising run after compaction commences. The layer thickness shall be measured relative to the finished design level.

(c) Width
The width measured at any point of the stabilised layer shall be not less than the specified width as shown in the drawings by more than 50mm.

The average width of the layer shall be determined from measurements at three sites selected at random by the Superintendent over any 200m length of a lot and shall be not less than the specified width.

(8) Curing
The Contractor shall submit to the Superintendent details of the proposed method of curing as part of the Work Plan.

The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.

Water curing shall consist of frequent light uniform spraying (using fine spray jets) that will not produce significant run off or flooding on sections of the area. Conventional spray bars and high pressure nozzles are not permitted. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

Under this sub-section provision for curing up to the period indicated in the approved Stabilisation Mix Design shall be the responsibility of the Contractor.

(9) Trial section of stabilised earthworks
Prior to the commencement of works submit a trial section of stabilised earthworks to demonstrate the methods proposed to conform with this sub-section.

This trial section is constructed so that it may be incorporated in the finished work with a length of approximately 50m.

Construct the trial stabilisation using the materials, equipment and methods for placing and finishing the same as would be used for the entire stabilisation works. Demonstrate the methods proposed to be used for the construction of joints.

In the event of deficiencies in the stabilisation the trial section may not be approved. The method, equipment, materials and personnel will require to be reviewed and an explanation submitted. A further length of trial stabilisation may be requested. Non-conforming trial sections of stabilised earthworks must be removed to ensure preventing damage to the remaining stabilised earthworks and underlying materials. Dispose of the removed materials at an approved location.

(10) Insitu lime stabilisation of subgrade

Lime stabilisation of subgrade material shall be carried out as a two day operation to a minimum depth of 250mm, except for natural subgrades of CBR 0.5% where stabilisation depth shall be a minimum of 300mm. The stabilising agent shall be spread using a purpose built spreader and the stabilising agent and water shall be incorporated into the material using a reclaimer/stabiliser. Alternatively, a reclaimer/stabiliser with a calibrated integrated spreader/applicator may be used to incorporate the stabilising agent and water directly into the material to be stabilised. Where a reclaimer/stabiliser with calibrated integrated spreader/applicator is used, quicklime shall not be used as the stabilising agent.

Day 1: a single lime pass at a rate of up to half the required rate shall be applied. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the

requirements in this document. The depth of mixing shall not exceed 90% of the specified stabilisation thickness. The material shall be lightly rolled to seal the surface prior to the completion of work on that particular day.

Day 2: after the overnight amelioration period, the balance of the required lime shall be spread in accordance with the requirements in this document. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required before mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. Notwithstanding this, a minimum of two mixing passes shall be completed.

Lime shall be spread at a maximum spread rate of 12kg/m2. The number of passes shall be calculated to comply with this requirement. The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m2). The total rate of spread shall be such that the stabilising agent spread rate for the compacted material is within the specified tolerances. Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it. After each spreading run at least one mixing run, and trimming and/or compaction as required, shall be completed. Further mixing operations between spreading runs shall comply with requirements in this document.

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when further water is added to the lime. All through traffic shall be stopped during any slaking operation.

The entire stabilisation process shall not proceed in any of the following situations:

- during rainfall;
- when rainfall appears to be imminent;
- during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne;
- during conditions that may result in the work causing nuisance or danger to people, property, the environment, or livestock;
- when the pavement temperature, measured 50mm below the surface, drops below 10°C; and
- when the air temperature, measured in the shade exceeds 40°C.

SC6.4.6.19.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.19.3 Summary of limits and tolerances below.

Table SC6.4.6.19.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Quicklime		
	a) Available Lime	>85% Calcium Oxide content	SC6.4.6.19.3(3) Quicklime
	b) Slaking Rate	Active Slaking time < 20 minutes, and temperature rise on slaking not less than 40ºC in 6 minutes (for an average of four samples).	SC6.4.6.19.3(3) Quicklime
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve 96-100% for 9.5mm Sieve 70-100% for 4.75mm Sieve 0-90% for 2.36mm Sieve	SC6.4.6.19.3(3) Quicklime
2.	Hydrated Lime		
	a) Available Lime	>80% Calcium Hydroxide	SC6.4.6.19.3(4) Hydrated Lime
	b) Particle Size	<2% residue on a 300 micron Sieve	SC6.4.6.19.3(4) Hydrated Lime

Item	Activity	Limits/Tolerances	Clause
3.	Blended Stabilising Agents	Blend percentages shall not vary by more than ±3% from those nominated in SC6.4.6.19 Attachment A (Stabilisation mix design)	SC6.4.6.19.3(7) Blended Stabilising Agents
4.	Water		
	a) Chloride ion content	<600 PPM Chloride ion	SC6.4.6.19.3(8) Water
	b) Sulphate ion content	<400 PPM Sulphate ion	SC6.4.6.19.3(8) Water
	c) Undissolved solids	<1% by mass of undissolved solids	SC6.4.6.19.3(8) Water
5.	Application of Stabilising Agent		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within ±10% of the nominated rate	SC6.4.6.19.4(2) Application of Stabilising Agent
6.	Trimming and Compaction		
	a) Surface Level	After primary trimming be within +30mm and +10mm of levels shown on drawings After secondary trimming be within ±15mm of levels shown on drawings	SC6.4.6.19.4(7)(a) Tolerances
	b) Layer Thickness	Final thickness of layers shall not vary more than +20mm and -10mm of required thickness	SC6.4.6.19.4(7)(b) Tolerances
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing	SC6.4.6.19.4(7)(a) Tolerances
7.	Joints		
	a) Longitudinal Overlap	> 75mm overlap of mixing runs	SC6.4.6.19.4(6) Joints
	b) Transverse Overlap	> 2m overlap of transverse joints	SC6.4.6.19.4(6) Joints
	c) Longitudinal Joints	Shall not be allowed within 0.5m of the centreline of a typical wheelpath	SC6.4.6.19.4(6) Joints
8.	Width		
	a) Width of Stabilised Layer	At any point, the width shall be not less than 50mm short of the width shown on the drawings with an average width always greater than that shown on the drawings.	SC6.4.6.19.4(7)(c) Tolerances

SC6.4.6.19 Attachment A: Stabilisation mix design

Click here to obtain a copy of the following form.

SC6.4.6.20 Subsoil, foundation and pavement drains

SC6.4.6.20.1 Introduction

(1) Scope

(a) The work to be executed under this sub-section covers the excavation, bedding, installation and backfilling of subsoil, sub-pavement, intra pavement, edge and foundation drains.

(b) Subsoil and foundation drains shall be constructed where and as shown on the drawings or as directed by the Superintendent.

(c) This sub-section should be read in conjunction with SC6.4.6.21 Subsurface drainage.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Order of construction

(a) Subsoil and sub-pavement drains
Subsoil drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, subsoil drains shall be constructed after completion of stabilisation, except where excessive ground water is encountered, they may be constructed prior to stabilisation of the subgrade.

Where a selected material zone is specified and excessive ground water is encountered, subsoil drains may be installed in two stages as follows:

(i) Stage 1: standard subsoil drains installed below the base of the cutting prior to placement of select material in the selected material zone; and

(ii) Stage 2: extension of subsoil drain to top of the selected material zone after placement of selected material.

(b) Intra-pavement drains
Intra-pavement drains shall be constructed after the completion of the layer below the pervious pavement material or 40mm open graded asphaltic concrete subbase and preceding the construction of the subsequent layers.

(c) Edge drains
Edge drains shall be constructed after the construction of the rigid pavement and before the placement and compaction of verge material.

(d) Foundation drains
Foundation drains shall be constructed after completion of clearing and stripping operations, and preceding the commencement of embankment construction.

(3) Terminology

Subsoil drains	are intended for the drainage of ground water and/or the pavement in cuttings.
Sub-Pavement Drains	are intended for the drainage of the pavement layers unless the subbase is open graded or pervious in nature in which case intra-pavement drains shall be provided.
Intra-Pavement Drains	are intended for the drainage of the pavement layers of a flexible pavement where the subbase comprises an open graded or pervious pavement material or open graded asphaltic concrete.
Edge Drains	are intended for the drainage of rigid pavements.
Foundation drains	are required for the drainage of seepage, springs and wet areas within and adjacent to the foundations.

(4) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with

this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.12 Flexible pavements
SC6.4.6.13 Asphaltic concrete
SC6.4.6.21 Subsurface drainage

(b) Australian Standards:

AS 1289.3.3.1	*Calculation of the plasticity index of a soil*
AS 1289.5.4.1	*Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 1289.5.6.1	(R2016) Methods of testing soils for engineering purposes Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

SC6.4.6.20.2 Construction

(1) Subsoil and sub-pavement drains

(a) Excavation

(i) Excavation shall be undertaken in accordance with the requirement of SC6.4.6.21 Subsurface drainage.

(ii) Trenches shall be trimmed to the required line and depth in accordance with the approved drain design specific to site conditions and as directed by the Superintendent.

(iii) The bottom of the trench shall be excavated to the same grade as the design pavement surface in the direction of the trench except where the grade of the design pavement surface in the direction of the trench is less than 0.25 per cent. In this case, the trench depth shall be increased to provide a minimum grade of fall in the trench of 0.25 per cent.

(iv) The bottom of the trench shall be excavated so that no localised ponding of water occurs. The bottom of the trench must not be more than 50 mm below the specified level of the invert of the pipe and ensure that the bottom and sides of the excavation are smooth with no protrusion that will damage the geotextile where required.

(v) If at any location the trench is excavated below the specified floor level, the trench shall be backfilled with non-porous subgrade material so that when the subgrade material is compacted to a relative compaction, determined by AS 1289.5.4.1, of at least 95 per cent (standard compaction), the bottom of the trench shall be at the specified floor level.

(vi) Where the drain is constructed in two stages, the excavation for Stage 2 shall be carried out after placement and compaction of the selected material zone or the stabilised subgrade layer. The Stage 2 trench shall be excavated to the same line and width as the Stage 1 trench and to a depth to provide a clean, full contact with the filter material placed in Stage 1. All excavated material shall be disposed to waste or incorporated into fills.

(vii) After the completion of excavation, the Contractor must present to the Superintendent the trench for inspection to ensure conformance with shape, grade line, filling and compaction and removal of any protrusions.

(b) Laying of pipe

(i) The 100mm diameter corrugated slotted plastic piping, complying with SC6.4.6.21 Subsurface drainage, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the specified line and grade. The pipe shall not deviate from the specified line by more than 100mm at any point

(ii) The type of filter material shall be shown on the drawings as per the requirements of SC6.4.6.21 Subsurface drainage and shall be confirmed by the Superintendent prior to placement of material.

(iii) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

(c) Backfilling

(i) The trench shall be backfilled with filter material to the level specified. The type of filter material shall be shown on the drawings as per the requirements of SC6.4.6.21 Subsurface drainage and shall be confirmed by the Superintendent prior to placement. The filter material shall be placed and

compacted in layers with a maximum compacted thickness of 300 mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance to the pipe.

(ii) The filter material shall be compacted for its full depth to a Density Index of not less than 70 per cent as determined by AS 1289.5.6.1.

(iii) The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with selected free draining backfill material, conforming to the requirements of SC6.4.6.10 Earthworks (construction), compacted for its full depth to a relative compaction of not less than 97 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iv) Where shown on the drawings or as directed by the Superintendent, a geotextile conforming with the requirements of SC6.4.6.21 Subsurface drainage, shall be provided at the interface between the filter material and adjoining materials. Cover the bottom and sides of the trench with sufficient free fabric to wrap around the completed drain. Conform to the shape of the trench with minimal wrinkles, folds or air voids between fabric and trench, but not stretched on the soil. Laps of 500mm shall be provided at joints in the fabric. The Contractor must take all reasonable care to ensure that the geotextile is not damaged during installation and backfilling operations. Ensure the period between initial laying out and final cover of the geotextile with drainage backfill layer does not exceed 14 days. Where possible place geotextiles just ahead of construction works and cover with materials within 48 hours. Any geotextile fabric exposed for longer than 14 days must be removed and replaced by the Contractor as directed by the Superintendent.

(v) Where the outlet section of pipes discharging through the fill batters, the trench shall be backfilled with the nominated filter material to a depth of 50mm above the pipe. The balance of trench shall be backfilled with earth backfill material of maximum particle size of 50mm and shall be compacted for the full depth to a relative compaction of 95 per cent (standard compaction) as determined by AS 1289.5.4.1.

(d) Outlets

(i) Outlets are to be provided at maximum intervals of 150m. Where possible, subsoil drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the drawings shall be constructed at the discharge end with appropriate treatment to address erosion of adjacent areas.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(e) Cleanouts

(i) Cleanouts are to be provided at the commencement of each run of subsoil drain line and at intervals of approximately 60m or as shown on the drawings.

(ii) Details of the required cleanout construction are shown on the drawings. The standard Cl caps as shown on the drawings shall be supplied by the Contractor.

(iii) Upon completion of backfilling, pump clean water into the cleanout at the commencement of each run until only clean water discharges at the outlet. The minimum rate of flow of flushing water at the inlet must be 100L/min.

(2) Intra-pavement drains

(a) Excavation

(i) A "V" shaped trench approximately 75mm deep shall be cut to the required line in the pavement layer immediately below the permeable pavement layer. No excavation is required below a 40mm open graded asphaltic concrete subbase layer.

(ii) The bottom of the trench is to be to the same grade as the roadway. The bottom of the trench shall be constructed so that localised ponding of water does not occur.

(iii) Where the pipe is to discharge through the fill batter a trench shall be constructed on a grade

suitable for the pipe to discharge its contents without scour. After laying the pipe the trench shall be backfilled with fill material and compacted for the full depth to a relative compaction of not less than 95 per cent (standard compaction) as determined by AS 1289.5.4.1.

(b) Laying of pipe

(i) Thick walled unplasticised PVC pressure pipe, complying with AS 1477, and having a nominal diameter of 58mm, and a minimum pipe wall thickness of 6.5mm, shall be used with crushed rock subbases having not more than 10 per cent of material passing the 9.5mm AS sieve and having layer thicknesses neither less than 150mm nor more than 200mm or open graded asphalt subbases having layer thicknesses neither less than 80mm nor greater than 100mm.

(ii) Where crushed rock subbases require pavement drains and have a depth exceeding 200mm, the type of pavement drain will need to be certified to have adequate crushing strength and a written approval from the Superintendent to the proposed pavement drain type will be required. Similar proposals shall require Superintendent and council approval for pavement drain in asphalt subbases greater than 100mm in depth.

(iii) All pipe shall be slotted except where otherwise shown on the drawings. Details of slot sizes and spacings shall be in accordance with SC6.4.6.21 Attachment A for thick walled unplasticised PVC pressure pipe.

(iv) Thick walled unplasticised PVC pressure pipe shall have square ends and shall be butt jointed.

(v) Where spigot and socket type pipes are used, the pipes shall be joined with the socket ends facing upstream.

(vi) The pipe shall be laid to the specified line and level. The pipe shall not deviate from the specified line by more than 100mm at any point.

(vii) The inlet ends of all pipes shall be fitted with caps.

(viii) All pipes shall be securely held to the layer under the free-draining subbase to prevent movement of the pipes during placement and compaction of the free draining subbase. At least 7 days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes to the layer under the free-draining subbase for the approval of the Superintendent.

(ix) Notwithstanding the Superintendent's approval to the use of a method of securing the pipes to the layer under the free draining subbase, if such securing method allows movement of the pipes, the method shall be discontinued and the Contractor shall propose an alternative securing method for approval by the Superintendent.

(x) Any additional costs resulting from the use of the alternative method of securing the pipes shall be borne by the Contractor.

(xi) The outlet length of pipe from the outside edge of the free-draining subbase to an outlet structure in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with suitable couplings or mastic.

(c) Backfilling

(i) Subbase material shall be spread, compacted and trimmed, where appropriate, as follows:

(A) for crushed rock subbase, in accordance with sub-section SC6.4.6.12 Flexible pavements; and

(B) for open graded asphalt subbase, in accordance with sub-section SC6.4.6.13 Asphaltic concrete.

(ii) Tipping, spreading and compaction of the subbase shall be undertaken in such a manner as not to damage the intra-pavement drain pipes. If any pipes are damaged as a result of the tipping, spreading and compaction of the subbase, the Contractor shall remove and replace the damaged pipes.

(iii) The cost of the removal and replacement of such damaged pipes shall be borne by the Contractor.

(iv) The thickness of the layer of subbase material enclosing the pipe shall be within the limits specified in clause SC6.4.6.20.2(b) Laying of pipe for the type of pipe used in the intra-pavement drain.

(d) Outlets

(i) Outlets are to be provided as shown on the drawings or at maximum intervals of 150m. Where possible intra-pavement drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, each pipe shall be extended using a 60 degree bend and unslotted pipe to discharge through the fill batter and an outlet structure constructed on the discharge end in accordance with the drawings.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(iv) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a PVC cap.

(3) Edge drains

(a) Excavation

(i) The verge material shall be trimmed to subgrade level and to the minimum width shown on the drawings. The bottom of the trench is to be constructed at the same grade as the roadway and in such a manner that localised ponding of water does not occur.

(ii) Where the grade of the roadway is less than 0.25 per cent the trench shall be excavated to provide a minimum grade of 0.25 per cent.

(iii) When the pipe is to discharge through the fill batter a suitable trench shall be excavated to provide the required grade.

(b) Laying of pipe

(i) Generally, 65mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric, complying with SC6.4.6.21 Subsurface drainage, shall be used for edge drains.

(ii) Where any part of a shoulder consists of material other than concrete, slotted thick walled unplasticised PVC pressure pipe, complying with AS 1477, shall be used. Spigot and socket type pipes shall be joined with the socket ends facing upstream and the ends of each pipe shall be securely held against the vertical face of the rigid pavement. At least seven days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes against the rigid pavement for the approval of the council.

(iii) The pipe shall be laid on a prepared bed to the specified line and level. The pipe shall not deviate from the specified line by more than 100mm at any point.

(iv) Joints in the pipe shall be kept to a minimum number and shall be made using an external joint coupling approved by the Superintendent.

(v) The inlet end of the pipe shall be fitted with a cap.

(vi) The outlet section of a pipe from the vertical face of the rigid pavement to an outlet in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with mastic.

(c) Backfilling

(i) The pipe shall be covered with Type B filter material to the dimensions shown on the drawings.

(ii) Mechanical compaction of this filter material is not required, however after placement of the filter material it shall be soaked with water. Where necessary additional filter material shall be added and soaked to provide the final dimensions shown on the drawings.

(iii) Backfilling over the edge drain shall be done in such a manner as to avoid damage or disturbance of the pipe. Backfill material shall be selected material as required for verges and in accordance with the requirements of sub-section SC6.4.6.10 Earthworks (construction). Backfilling shall be compacted to a relative compaction of not less than 100 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iv) Upon completion of backfilling, pump clean water into the cleanout at the commencement of each

run until only clean water discharges at the outlet. The minimum rate of flow of flushing water at the inlet must be 100L/min.

(d) Cleanouts

(i) Cleanouts are to be provided at the commencement of each run of edge drain line and at intervals of approximately 60m or as shown on the drawings.

(ii) Details of the required cleanout construction are shown on the drawings. The standard CI caps as shown on the drawings shall be supplied by the Contractor.

(e) Outlets

(i) Unless otherwise shown on the drawings outlets are to be provided at maximum intervals of 150 m. Where possible edge drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the drawings shall be constructed at the discharge end.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(4) Foundation drains

(a) Excavation

Excavation shall be undertaken in accordance with the requirements of SC6.4.6.21 Subsurface drainage and clause SC6.4.6.20.2(1) Subsoil and sub-pavement drains of this sub-section.

(b) Laying of pipe

(i) The 100mm diameter corrugated slotted plastic piping, complying with SC6.4.6.21 Subsurface drainage, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

(ii) The type of filter material shall be shown on the drawings as per the requirements of sub-section SC6.4.6.21 Subsurface drainage or as directed by the Superintendent.

(iii) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a PVC cap.

(c) Backfilling

(i) The trench shall be backfilled with filter material in accordance with the provisions of clause SC6.4.6.20.2(3)(c) Backfilling.

(ii) The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with suitable earth backfill material, compacted for its full depth to a relative compaction of not less than 97 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iii) Where shown on the drawings or as directed by the Superintendent, a geotextile, conforming with the requirements of SC6.4.6.21 Subsurface drainage, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric.

(d) Outlets

An outlet structure in accordance with the detail shown on the drawings and SC6.4.6.21 Subsurface drainage shall be constructed at the discharge end.

The outlet shall be located so that erosion of the adjacent area does not occur or shall be protected by the placement of selected stone in the splash zone of the outlet.

SC6.4.6.20.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.20.1 Summary of limits and tolerances below.

Table SC6.4.6.20.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation**		SC6.4.6.20.2(3)(a)
	Trench Grade	0.25%	
2.	**Laying of Pipe**		
	• Alignment	Deviation <100mm from specified line at any point	SC6.4.6.20.2(3)(b)
3.	**Subsoil and Sub-Pavement Drain Backfill**		
	(a) Layer thickness	300mm max	SC6.4.6.20.2(3)(c)
	(b) Compaction (Relative)	70% Density Index	SC6.4.6.20.2(3)(c)
	Filter material	97% (Standard)	
	Backfill material		
4.	**Outlet Spacing**	150m max	SC6.4.6.20.2(3)(d)
5.	**Cleanout Spacing**	60m approx	SC6.4.6.20.2(3)(d)
6.	**Intra-Pavement Drain**		
7.	(a) Alignment	Deviation <100mm from specified line at any point.	SC6.4.6.20.3(b)
	Edge Drains		
	(a) Alignment	Deviation <100mm from specified line at any point	SC6.4.6.20.3(b)
	(b) Compaction (Relative) Backfill material	97% Standard	SC6.4.6.20.3(c)

SC6.4.6.21 Sub-surface drainage

SC6.4.6.21.1 Introduction

(1) Introduction

This is the general specification common and applicable to all types of subsurface drainage and must be read in conjunction with subsurface drainage sub-sections:

(a) SC6.4.6.20 Subsoil, foundations and pavement drains; and

(b) SC6.4.6.8 Drainage mats.

(2) Scope

(a) The work to be executed under this sub-section consists of:

(i) preparation for subsurface drainage construction;

(ii) siting of subsurface drainage facilities;

(iii) the supply of all materials associated with the provision of the subsurface drainage system;

(iv) all activities and quality requirements associated with the supply, placement and compaction of filter material;

(v) the provision of a detailed record of all subsurface drain installations; and

(vi) the marking on the ground of the location of all subsurface drains.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(3) Extent of work

Details of the work are to be shown on the approved drawings.

(4) Temporary drainage during construction

(a) All drainage works carried out by the Contractor must provide measures of erosion and sedimentation in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.

(b) The Contractor must make adequate provision for runoff flows at subsurface drainage works under construction, to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities.

(c) The Contractor's material and equipment must be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows.

(5) Siting of work

(a) Before commencing construction of any subsurface drainage activity, the Contractor must set out on site the position of the work to the location and levels shown on the drawings, and must present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions. Should the Superintendent require a change to the conditions of installation an appropriate variation must be ordered.

(c) Should the Contractor propose changes to the location, length, designed levels, conditions of installation or cover to suit the Contractor’s construction procedures, the Contractor must present the proposed set-out in addition to the designed set-out for consideration by the Superintendent. No changes shall be made unless the prior written approval of the Superintendent is obtained.

(6) Excavation

(a) In undertaking trench excavation the Contractor must provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(b) Where public utilities exist in the vicinity of drainage works the Contractor must obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(c) Excavation by blasting, if permitted, must be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed structure does not exceed 25 millimetres per second. The Contractor must comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(d) Trenches must be excavated to the line, grade, width and depth shown on the drawings or as directed by the Superintendent. The bottom of the trench must be constructed so that no localised ponding can occur. All loose material must be removed by the Contractor.

(e) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable must be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, must be parallel with the specified level or grade of the pipe.

(f) The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(7) Backfilling

Backfilling must be carried out in accordance with the requirements of the relevant subsurface drainage structures sub-sections.

(8) Outlet structures for subsurface drainage

(a) Subsurface drainage pipes must be connected to discharge into gully pits or to outlet structures as shown on the drawings or as directed by the Superintendent.

(b) Outlets must be spaced at a maximum interval of 150m.

(c) Outlets, including those discharging into gully pits, must be made rodent proof using galvanised wire netting unless otherwise indicated on the approved drawings.

(d) The outlet must be located so that erosion of the adjacent areas does not occur or must be protected by the placement of selected stone or similar treatment together with a marker post to indicate location and assist maintenance.

(e) Outlet pipes from curtain drains must be unslotted. At no point shall an outlet pipe be higher than the pipe at the end of the curtain drain.

(f) All concrete used in the construction of outlet structures must conform to the requirements of sub-section SC6.4.6.28 Minor concrete works.

(9) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.28 - Minor concrete works

(b) Australian Standards:

AS 1141.11.1	*Particle size distribution - Sieving method*
AS 1141.22	*Wet/dry strength variation*
AS 1289.5.5.1	*Determination of the minimum and maximum dry density of a cohesionless material – Standard method*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 2439.1	*Perforated drainage pipe and associated fittings*
AS 2758.1	*Aggregates and rock for engineering purposes – Part 1: Concrete aggregates*
AS 3705	*Geotextiles - Identification, marking and general data*

AS 3706	*Geotextiles - Methods of test*
AS 3706.9	*Determination of permittivity, permeability and flow rate*
AS 3706.11	*Determination of durability - Resistance to degradation by light, heat and moisture*

(c) Other:

Austroads, *Guide to Pavement Technology - Part 4G Geotextiles.*

ASTM International, ASTM-D2434-68 – *Standard test method for permeability of granular soils (Constant Head)*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.21.2 Materials

(1) Corrugated plastic pipe

(a) Corrugated plastic pipe must be Class 1000 complying with AS2439.1 of 65mm or 100mm diameter as indicated on the drawings. All pipe must be slotted except where shown on the approved drawings.

(b) Joints, couplings, elbows, tees and caps must also comply with AS2439.1 and only the manufacturer's recommended fittings shall be used.

(c) The Contractor must obtain from the Manufacturer Test Certificate demonstrating compliance with AS2439.1.

(2) Other types of subsurface drainage

Where a Contractor wishes to use a subsurface drainage pipe other than corrugated plastic pipe, the Contractor must submit full details of the type of pipe, certification from the manufacturer of its suitability and quality and written acceptance by the council for its use in each particular application. Certification of the suitability of any pipe must address the crushing strength, flexural strength, jointing system and slotting details.

(3) Filter material

(a) General

The types of filter material covered by this sub-section shall include:

(i) Type A filter material for use in trench drains and Type B drainage mats;

(ii) Type B filter material for use in trench drains and Type B drainage mats;

(iii) Type C filter material comprising crushed rock for use in Type A drainage mats; and

(iv) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

All filter material must consist of clean, hard, tough, durable particles. A sample of the proposed filter material must be submitted to the Superintendent for approval.

(b) Type A filter material

Type A filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.1.

Table SC6.4.6.21.1 Type A filter material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	6.7mm	100
	4.75mm	85 to 100
	2.36mm	0 to 40
	1.18mm	0 to 5
	425µm	0 to 2

(c) Type B Filter Material

Type B filter material must be granular material complying with the following grading requirements in Table SC6.4.6.21.2.

Table SC6.4.6.21.2 Type B filter material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	4.75mm	100
	2.36mm	95 to 100
	425µm	20 to 80
	300µm	0 to 30
	150µm	0 to 2
	75µm	0 to 0.1

In addition to the above grading requirements, Type B filter material must have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS1289.5.5.1 and then tested in accordance with Test Method ASTM D2434 68, of at least 8m per day after 3 hours of flow.

Type B filter material must not vary from its original grading as a result of compaction processes by more than the following amounts listed in Table SC6.4.6.21.3.

Table SC6.4.6.21.3 Type B filter material variation

AS Sieve	Variation From Grading Before Treatment (per cent of mass)
2.36mm	± 3
1.18mm	± 1
425µm	± 1
300µm	± 1
150µm	± 0.5
75µm	± 0.1

(d) Type C Filter Material

Type C filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.4.

Table SC6.4.6.21.4 Type C Filter Material

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	37.5mm
	Maximum passing the 9.5mm AS Sieve	5% by mass
	Maximum (D90:D10)*	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

Note—the D90 value must be determined by sieving the material using 75mm, 53mm, 37.5mm, 26.5mm, 19mm, 13.2mm and 9.5mm AS sieves, as appropriate, and then plotting the results on a graph of AS sieve size v percentage passing. The plotted points must be joined by straight lines and the D90 must shall be determined as the theoretical sieve size corresponding to 90 per cent passing.

D10 denotes the theoretical size of a sieve through which 10 per cent of the material would pass and must be determined from the same graph used to determine the D90 value.

(e) Type D Filter Material

Type D filter material must be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS2758.1 and the following requirements in Table SC6.4.6.21.5.

Table SC6.4.6.21.5 Type D Filter Material

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	75mm
	Maximum passing the 9.5mm AS sieve	5% by mass
	Maximum (D90 : D10)	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

(4) Geotextile

Prior to placing geotextiles, documentary evidence that the geotextile and installation process conform to the requirements of this sub-section must be produced and submitted to the Superintendent.

(a) General

The geotextile, other than seamless tubular filter fabric, must consist of either a woven or a non-woven type which must be manufactured from synthetic materials other than polyamide. Rolls of geotextile shall be marked with product identification and supplied with data sheets and information in accordance with the requirements of AS 3705.

The geotextile must be bio stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents when tested in accordance with the appropriate parts of AS3706.

The geotextile must be resistant to ultra violet light. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of 21 days. If exposure in excess of 21 days does occur, the geotextile must be tested in accordance with AS 3706.11 and if its characteristics have deteriorated to or below 90 per cent of the characteristics claimed by the manufacturer or the characteristics determined on unexposed geotextile, whichever is the better, it must be removed and replaced with a geotextile complying with this specification.

The geotextile material type, strength rating “G”, and minimum mass requirements must be as shown on the drawings.

The type, properties, functions, design and construction requirements for a particular application of geotextile installation must be compatible with recommendations provided by the Guide to Pavement Technology – Part 4G, as well as requirements indicated on the drawings.

In addition to the above mentioned requirements, geotextiles for curtain drains must consist of either polyester, polypropylene or polyethylene. The required rates of water flow are shown on Table 4.1 of Guide to Pavement Technology – Part 4G, under 100mm constant head determined using the perpendicular flow test to conform with AS3706.9.

(b) Seamless tubular filter fabric

Seamless knitted tubular filter fabric must be used to enclose all slotted pipes and must be manufactured from either polypropylene or polyester. The fabric must be free of imperfections in weave or yarn and have abrasion resistant and weave stability qualities such that it shall not form holes, ladder, deweave, tear or unravel more than 5mm from a cut end.

Fitting of the seamless tubular filter fabric must be in accordance with the requirements of SC6.4.6.21 Attachment A. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying will be removed and replaced so as to eliminate any damaged lengths.

SC6.4.6.21.3 Recording of subsurface drainage information

(1) The Contractor must keep a detailed record of all subsurface drainage pipes and the completed subsurface drainage systems must be shown on the work as executed plans to be returned to the Superintendent upon completion of work.

In addition, the Contractor must prepare a subsurface drainage information sheet or sheets; at the completion of construction of each drain or drainage system and must submit the subsurface drainage sheet or sheets to the Superintendent within 5 working days of the completion of the drain or drainage system.

SC6.4.6.21.4 Limits and tolerances

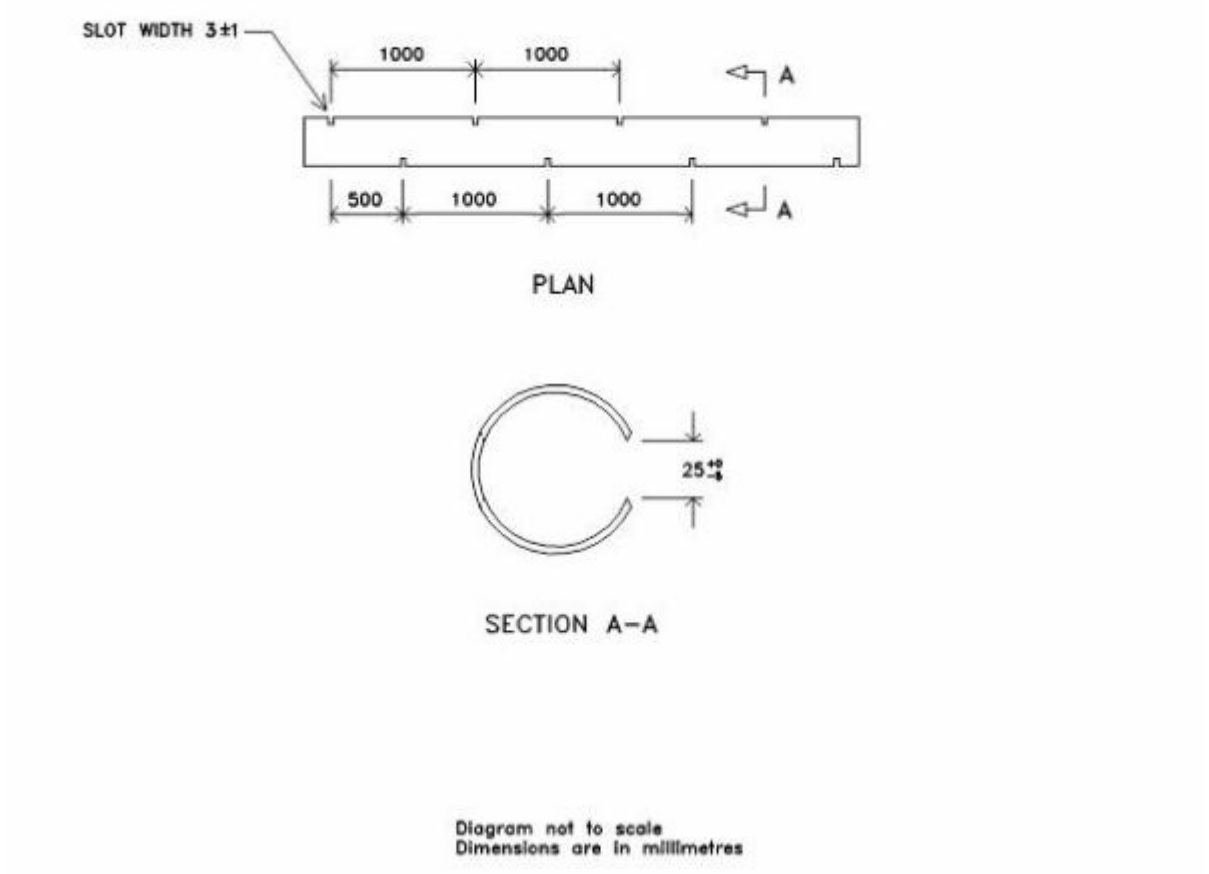
The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.21.6 Summary of limits and tolerances below.

Table SC6.4.6.4.21.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting** Peak particle velocity	25mm/s	SC6.4.6.21.1(6)
2.	**Outlets** Spacing	Max 150m	SC6.4.6.21.1(8)
3.	**Filter Material**		
	(a) Type A	Table SC6.4.6.21.1	SC6.4.6.21.2(3)
	(b) Type B	Tables SC6.4.6.21.2 and SC6.4.6.21.3	SC6.4.6.21.2(3)
	(c) Type C	Table SC6.4.6.21.4	SC6.4.6.21.2(3)
	(d) Type D	Table SC6.4.6.21.5	SC6.4.6.21.2(3)
4.	**Geotextile**		
	(a) Exposure to sunlight	<21 days If >21 days deterioration not to exceed 10% of claimed characteristics	SC6.4.6.21.2(4)

Attachment A

Figure SC6.4.6.21.1 Slotting details for thick walled PVC plastic pipe



1. Slotted pipes fitted with seamless tubular filter fabric

(a) Procedure for fitting seamless tubular filter fabric to slotted pipe

(i) Seamless tubular filter fabric must be fitted to slotted pipe immediately before the slotted pipe is to be laid in its final position in the work.

(ii) The filter fabric must be initially pulled over and onto a short length of smooth pipe of internal diameter between 20mm and 30mm greater than the external diameter of the slotted pipe to be enclosed by filter fabric. The short, larger diameter pipe must be referred to as the "mandrel".

(iii) The pipe to be enclosed by the filter fabric must be passed through the mandrel. The filter fabric must be slipped on to the pipe as the pipe emerges from the mandrel leaving enough overhang of the filter fabric to make a suitable joint with the filter fabric on the adjacent pipe. The filter fabric must be firmly held to the forward end of the pipe so that it cannot slip back along the pipe.

(iv) The pipe must be pulled right through the mandrel allowing the filter fabric to progressively slip over the pipe. The filter fabric shall be restrained from easily slipping off the mandrel thus ensuring the filter fabric is stretch fitted onto the pipe.

(v) When the end of the pipe emerges from the mandrel, the filter fabric must be clamped to that end of the pipe so that the filter fabric cannot slip down the pipe. The filter fabric must remain clamped to each end of the pipe to ensure the filter fabric remains stretch fitted onto the pipe when the pipe is placed in its final position in the drain. The filter fabric must be cut cleanly leaving enough overhang off the end of the pipe to make a fully covered join with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

(b) Precautions to be taken when using slotted pipe fitted with seamless tubular filter fabric

(i) Slotted pipe fitted with seamless tubular filter fabric must not be dragged over the ground. If carried, the pipe must be lifted clear of the ground and the filter fabric must be protected from damage at all times.

(ii) Seamless tubular filter fabric which has been so damaged as to affect its filtering properties must be removed from the pipe and replaced with undamaged filter fabric.

(iii) If at any time during the installation of a slotted pipe it is found that the enclosed filter fabric has become loose on the pipe it must be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric must be removed from the pipe and replaced with undamaged filter fabric.

SC6.4.6.22 Pavement markings

SC6.4.6.22.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the removal, setting out, supply and application of pavement marking paint, thermoplastic pavement marking material, pavement marking tape and raised pavement markers. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS1580.205.4	*- Paints and related materials – Methods of test – Application properties – Airless spraying*
AS1906.3	*- Raised pavement markers (retroreflective and non-retroreflective)*
AS2009	*- Glass beads for pavement-marking materials*
AS2700	*- Colour Standards for general purposes*
AS4049.1	*- Solvent-borne paint - For use with surface applied glass beads*
AS4049.2	*- Thermoplastic pavement marking materials - For use with surface applied glass beads*
AS4049.3	*- Waterborne paint - For use with surface applied glass beads*

(c) Queensland Department of Transport and Main Roads Publications:

Manual of Uniform Traffic Control Devices (MUTCD)

Guide to pavement markings (GTPM)

Q513 *Wet Film Thickness of Paint (Wheel Gauge), Materials Testing Manual*

MRS45 *Road Surface Delineation*

Traffic and Road Use Management Manual (TRUM):

- TRUM 1.34 - Coloured surface treatments for bicycle lanes, Volume 1: Signing and pavement marking
- TRUM 3.23 - School zones, Volume 3: Road Safety

(d) Other:

Australian Paint Approval Scheme – Specification 0041/4 - Roadmarking paint, thermoplastic

Australian Paint Approval Scheme – Specification 0041/5 - Roadmarking paint, water borne

(3) Type of markings

Details of the various types of pavement markings and devices are in accordance with the requirements of the MUTCD, TRUM and GTPM.

Colours

White paint must have a colour equivalent to or whiter than Off White, Colour Y35 in AS2700.

Where yellow is used, the colour shall be equivalent to Y12, Wattle or Y14, Golden Yellow as detailed in AS2700 or any other colour deemed to lie between these two colours.

Where Green is used as a coloured surfacing on bicycle lanes, guidance on the application of green coloured surface treatments is contained within TRUM 1.34. The colour must be equivalent to Emerald, Colour G13; Traffic Green, Colour G16 or Shamrock, Colour G23 in AS2700. Where only one shade of each colour is specified, Traffic Green, Colour G16 is used.

(4) Types of materials to be applied
The materials shall be applied as follows:

(a) Pavement marking paint
Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified;

(b) Thermoplastic pavement marking material
Permanent markings where explicitly indicated on the drawings;

(c) Pavement marking tape
Temporary markings on final wearing surfaces;
Temporary raised pavement markers (TRPMs);
Temporary markers fixed on any surface as a temporary marking.

(d) Reflective glass beads
To be applied to all painted and thermoplastic markings; and

(e) Raised pavement markers
Studs which may be retroreflective (RRPM) or non-retroreflective (NRPM) set into the roadway or attached to the road surface with adhesives, lane dividers, or pavement bars are installed as permanent as shown on the drawings.

(5) Material quality
The Contractor shall submit to the Superintendent NATA Registered Laboratory Test Reports, at least 7 days before work is scheduled to commence, on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use.
Only materials conforming to the requirements of the referenced Specifications/Standards shall be used.

(6) Setting out
The Contractor shall set out the work "spotting" to ensure that all markings are placed in accordance with the drawings.
The locations of pavement markings shall not vary by more than 20mm from the locations shown on the drawings. Spotting for longitudinal lines is generally at 10m intervals with 3m intervals on curves of less than 50m radius.
The contractor must obtain approval from the administrator of the spotting prior to any application of pavement marking.

(7) Surface preparation
Surfaces which are to receive pavement markings shall be cleaned of all dirt, loose material and other contaminants. Pavement surfaces shall be thoroughly dry immediately prior to the application of pavement markings. Pavement marking shall not be carried out during wet weather or, if rain is likely to fall during the process.
In all cases, the reinstatement of longitudinal markings, particularly barrier lines and dividing lines, should occur as soon as possible after the new seal has been laid.
Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled to remove fine mortar material (laitance).
All painted markings whether installed by machine or hand are retroreflectorised by the application of drop-on glass beads (ballotini).

(8) Provision for traffic and protection of work
In accordance with MUTCD, Part 3 Works on Roads, and SC6.4.6.30 Control of traffic while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently (no pick-up) so that traffic will not cause damage.

(9) Maintenance of pavement markings
The Contractor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement marking during the contract period and the contract defects liability period.
Council requires all linemarking to be refreshed prior to to the end of the Defects Liability Period.

SC6.4.6.22.2 Pavement marking paint

(1) Materials

Paint shall comply with the requirements of AS4049.1 or AS4049.3. In this sub-section, the term “paint” shall mean “pavement marking paint”.

Glass beads shall comply with the requirements of AS2009 for drop-on beads.

(2) Mixing of paint

All paint shall be thoroughly mixed in its original container before use in accordance with the manufacturer’s recommendations to produce a smooth uniform product consistent with the freshly manufactured product.

(3) Application of paint and beads

All longitudinal lines shall be sprayed by an approved self-propelled machine. Line must have uniform thickness and intensity. Two coats of paint and glass beads shall be applied on longitudinal lines to new surfaces. The first coat shall be cured to “no pick up time” prior to the application of the second coat. The two sets of lines forming a one way or two way barrier line pattern shall be sprayed concurrently.

Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.

The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.35mm nor more than 0.4mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 1.3kg/sqm immediately after application of the paint. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

Glass beads shall be similarly applied to all other paint markings at a net application rate of 0.3kg/sqm immediately after application of the paint by an applied method.

Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the surface of the pavement.

The lengths and widths of longitudinal lines and transverse lines must be within the tolerance specified in MUTCD/GTPM and MRST45.

The dimensions of arrows, chevrons and speed markings must be within the tolerances specified in MUTCD/GTPM as appropriate.

Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Glass beads shall be uniformly incorporated in all coats of paint concurrently with the application of the paint.

Longitudinal line marking, when applied, must have a minimum retroreflectivity of 350mcd/lux/m2 measured between 10 and 20 days of wear.

(4) Field testing

The thickness of the wet film applied to the road pavement shall be checked by the method described in AS1580, comb gauge or test Q513 – (07/10).

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

(5) Application rates

The minimum application rates for the paint and glass beads shall be as specified in Table SC6.4.22.1.

Table SC6.4.6.22.1 Application rates for paint and glass beads

Work type	Coverage (minimum per coat)	Wet application rate
Longitudinal lines – first coat Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Longitudinal lines – second coat Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Longitudinal lines – repaint Type B (drop-on beads)	> 200g/m^2	0.300L/m^2 ± 0.20
Longitudinal lines – second coat or repaint applying Type D beads	> 400g/m^2	0.500L/m^2 ± 0.25
Transverse lines – Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Transverse lines – Type D beads	> 400g/m^2	0.500L/m^2 ± 0.25

Source: MRTS 45

The combination application rates for anti skid and glass beads shall not exceed the values specified above and in SC6.4.6.22.2(6) unless specified by the manufacturer.

Table SC6.4.6.22.2 Volume of glass beads (ml) required in 10 seconds of operation

Road Speed km/h	Line Widths			
	75mm	**100mm**	**125mm**	**150mm**
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

Note—

1. Tolerance of +10% shall be permissible when measuring the above volume.
2. When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53g/ml.

(6) Anti skid

Transverse markings shall incorporate an anti skid treatment with a skid resistance greater than 45 BPN. The application of anti-skid shall comply with the manufacturer's requirements.

SC6.4.6.22.3 Thermoplastic pavement marking material

(1) Primer

A primer, of the type recommended by the manufacturer of the thermoplastic material, shall be applied to the surface immediately in advance of, but concurrent with, the application of thermoplastic material.

The primer shall be applied at the application rate recommended by the manufacturer and shall not be thinned.

(2) Application of thermoplastic material

Thermoplastic material may be applied by screeding, extrusion or profiling or as preformed material.

Thermoplastic material shall be applied to the pavement at a temperature between 180ºC and 200ºC unless a different temperature is recommended by the manufacturer.

The pavement surface to which thermoplastic material is applied shall be completely coated by the material and any voids in the pavement surface shall be filled.

(3) Application rate

Thermoplastic material shall be applied at the minimum thickness specified in Table SC6.4.6.22.3.

Location	Minimum application thickness (mm)
Longitudinal lines	2
Transverse markings	2

Editor's note - the term “thermoplastic material” shall mean “thermoplastic pavement marking material”.

Where specified, glass beads shall be applied immediately to the surface of the molten thermoplastic material at a rate of not less than 0.12kg/m2.

(4) Materials

Thermoplastic pavement marking material shall comply with the requirements of AS4049.2.

Glass beads shall be incorporated in thermoplastic material, in the proportion of 10% of the total mass, as part of the aggregate constituent and shall comply with the requirements of AS2009, Intermix type.

Glass beads for surface application shall comply with the requirements of AS2009, Drop-on beads.

Tack coat material shall be to the manufacturer's specification.

(5) Preparation of thermoplastic material on site

Immediately before application, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not be heated above the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than 6 hours for hydrocarbon resins and 4 hours for wood and gum resins. Should over-heating occur and/or the time expires for molten materials, then the thermoplastic material shall be discarded.

(6) Application of thermoplastic material and beads

Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the Superintendent and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material.

All longitudinal lines shall be sprayed by a self-propelled machine. The two sets of lines forming a one way or two way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 2mm with a tolerance of plus or minus 0.5mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 0.3kg/sqm immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, and templates to control the pattern.

Preformed thermoplastic sheeting applied in accordance with manufacturer’s specifications is an approved process.

The thermoplastic material for transverse lines, symbols, legends and arrows shall be applied uniformly and the cold film thickness shall be 3.5mm with a tolerance of plus or minus 1.5mm. The surface finish shall be smooth.

Glass beads for other than longitudinal lines shall be uniformly applied to screeded markings at a net application rate of 0.3kg/sqm immediately after application of the thermoplastic material.

Pavement marking must be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a

neat and smooth marking on the wearing surface of the pavement.

The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown in MUTCD/GTPM. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown in MUTCD/GTPM. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown in MUTCD/GTPM.

The dimensions of arrows, chevrons and speed markings shall not vary by more than 50mm from the dimensions shown on the drawings or in MUTCD/ GTPM as appropriate. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

(7) Field testing
The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

SC6.4.6.22.4 Pavement marking tape

(1) Materials
Pavement marking tape shall be a strippable type of tape, such as “Staymark Detour Grade”, or equivalent tape approved by the Superintendent. Pavement marking tape must only be used on temporary works.

(2) Application of pavement marking tape
The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations.

(3) Removal of pavement marking tape
When directed by the Superintendent, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations.

(4) Temporary raised pavement markers (TRPMs)
Temporary raised pavement markers must comply with the requirements of AS1906.

Temporary raised pavement markers may be used to mark the temporary travelled path at short-term work sites, or to indicate the permanent travelled path on new work prior to the application of permanent pavement markings.

The use of temporary raised pavement markers may preclude the need for spotting where existing markings are to be reinstated after a reseal, and for respotting if proposed line markings were set out before the final seal on new works is applied. In these cases, the distance between TRPMs should be the same as would apply for spotting.

Temporary raised pavement markers should not take the place of spotting, as TRPMs may be broken off by traffic before final marking can be carried out. Once the longitudinal lines have been marked, the Temporary raised pavement marker flaps can be removed by cutting them off flush with the pavement surface.

SC6.4.6.22.5 Raised pavement markers

(1) Materials
Raised pavement markers, both reflective and non reflective, shall comply with AS1906.3 and shall have the dimensions shown on the drawings.
The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be a hot-melt bitumen adhesive or an equivalent product approved.

(2) Installation of raised pavement markers

The use of raised retroreflective pavement markers must be in accordance with the MUTCD, GTPM and TRUM 1.25 Fire Hydrant Indication System.

Raised pavement markers shall be fixed to the wearing surface of the pavement using a hot melt bitumen adhesive or an equivalent product. The adhesive shall be freshly heated to the manufacturer's instructions and thoroughly mixed.

The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set.

On rough surfaces, such as newly laid coarse sprayed bituminous seals, an initial pad of adhesive of diameter 20mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level. The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the pavement, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface to ensure good adhesion.

When installed, raised pavement markers shall conform to the tolerances specified in Table SC6.4.6.22.4.

Table SC6.4.6.22.4 Tolerances - raised pavement markers

	Tolerance (mm)	Distance
Lateral position –	+ 25, - 50	from edge of line
• barrier/edge line	± 10	from edge of line
• broken line	± 10	from centre of line
• flush medians		
Longitudinal position –	± 10	1m from start of line
• broken line	± 100	1m from start of line
• new construction	± 300	1m from start of line
• replacement		

(1) General

The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

Where required, existing pavement markings must be removed by the appropriate method stated in Table SC6.4.6.22.5.

The method of removal shall be submitted to the Superintendent for approval before commencement of the work.

Table SC6.4.6.22.5 Method of removal of existing pavement marking

Method of removal	Duration of result
Black paint	< 1 week
Emulsion and sand	< 2 weeks
Black cold applied resin or plastic	< 6 months
Chip seal	Permanent
Line grinder (asphalt only)	Permanent
Profiler (asphalt only)	Permanent
Abrasive blasting	Permanent

SC6.4.6.22.7 Surface treatments for bicycle lanes and school zone threshold

(1) Coloured surface treatments for bicycle lanes

Refer to the Traffic and Road Use Management Manual - Coloured Surface Treatments For Bicycle Lanes.

(a) The preferred colour is G13 Emerald (AS2700 S 1996). To accommodate different materials and varying conditions, an approximate colour match to one of the following three AS2700 S greens is permitted - G13 Emerald, G16 Traffic green or G23 Shamrock. Approximate colour match is determined in accordance with AS/NZS1580.601.1.

(b) A consistent green colour should be provided along a route or within a given locality.

(c) Where green surface colouring is used, it should be continuous through the required area and be bounded by the bicycle lane lines. Pavement markings, such as bicycle symbols and any directional arrows, should be placed over the coloured surface.

(d) A coloured surface treatment needs to do more than just provide a colour contrast. It must be designed to function like any other road surfacing, providing a sound, durable surface layer, which maintains the required texture and skid resistance for its design life.

(e) The design and specification of a coloured surface treatment for bicycle lanes should:

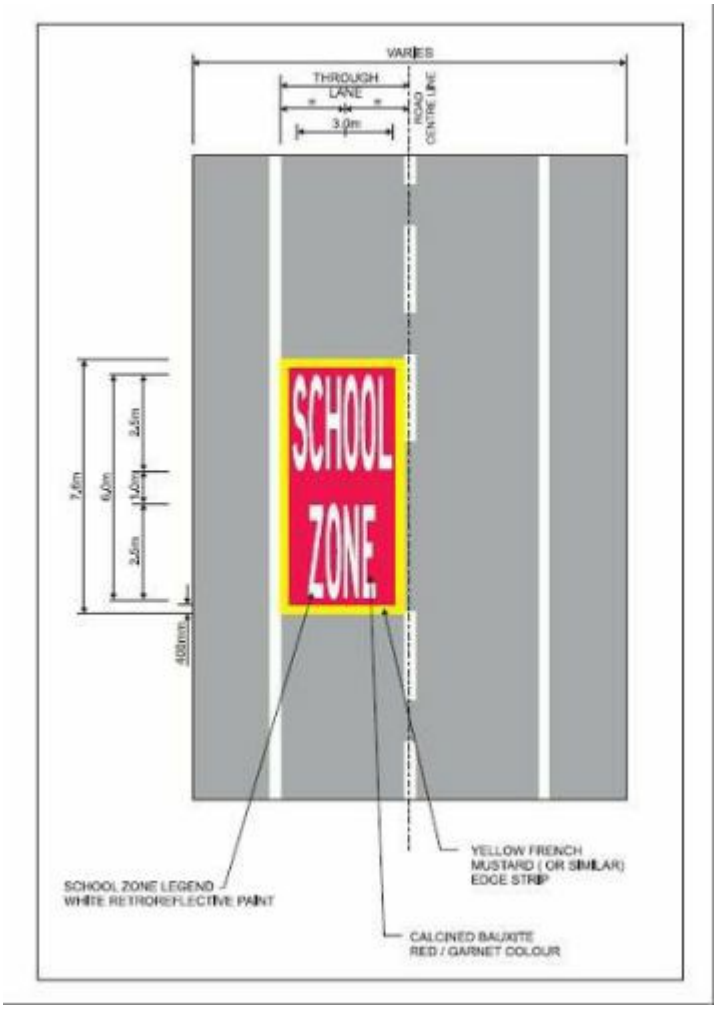
- ensure the suitability of the existing surface to support and bond with the colour treatment;
- provide a surface texture and skid resistance suitable for bicycle use, including in wet conditions; and
- limit differential skid resistance between the bicycle lane and adjacent traffic lanes.

(f) The Department of Transport and Main Roads is considering development of a formal specification for coloured surface treatments for Queensland. Until this is available it is recommended that advice on performance requirements, and the suitability of any product or service being considered for use, be sought from the Superintendent for approval before commencement of the work.

(2) Surface treatments for school zone thresholds

Refer to the Traffic and Road Use Management Manual - 3.23 Traffic and Road Use Management Manual - School Zones.

Threshold treatments may be provided at entrances to school zones to create a change in driver perception of the speed environment. A typical threshold treatment for a school zone is shown in Figure SC6.4.6.22.1.



Source:TRUM.

Figure SC6.4.6.22.1 Typical threshold treatment for a school zone

Advice on performance requirements, and the suitability of any product or service being considered for use, is to be sought from the Superintendent for approval before commencement of the work.

The pavement marking treatment (set out, type of material, preparation of surface, rate of application, method of application and maintenance) must be submitted to the Superintendent for approval before commencement of the work.

SC6.4.6.22.8 Limits and tolerances

The limits and tolerances applicable to the various clauses of this Specification are summarised in Table SC6.4.6.22.6 – Summary of limits and tolerances below:

Table SC6.4.6.22.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Location of Markings**	± 20mm from specified location	SC6.4.6.22.1(6)
2.	**Longitudinal Lines**		
	(a) Length	± 20mm from lengths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
	(b) Width	± 10mm from widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
3.	**Transverse Lines**		

	(a) Length	± 10mm from lengths and widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3)
	(b) Width		SC6.4.6.22.2(3)
4.	**Arrows, Chevrons, Speed Markings etc.**	± 50mm from the dimensions shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
5.	**Application of Paint**		
	(a) Film Thickness	>0.35mm <0.40mm	SC6.4.6.22.2(3)
6.	**Application of Thermoplastic**		
	(a) Longitudinal Lines Cold Film Thickness	2.0mm ± 0.5mm	SC6.4.6.22.3(3)
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	3.5mm ± 1.5mm	SC6.4.6.22.3(3)
7.	**Glass Beads**		
	(a) Volume used in operation	0.3kg/sqm + 10%	SC6.4.6.22.2(3) SC6.4.6.22.3(3)

Attachment A: Procedure for measurement of rate of application of spherical glass beads

(1) **Scope**

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

(2) **Spherical Glass Beads**

The glass beads shall comply with AS2009.

(3) **Measurement**

The method of field measurement shall be as follows:

(a) Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.

(b) Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level but do not compact the glass beads in the cylinder.

(c) Compare the volume of glass beads collected with the correct figure given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation. Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.3kg/sqm for different line widths and road speeds. The glass bead volume figures given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation are calculated for an actual application rate of 0.34kg/sqm.

(d) These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line; and

(e) The volume is measured with beads not compacted.

SC6.4.6.23 Guide posts

SC6.4.6.23.1 Introduction

(1) Scope

This policy subsection provides, minimum requirements for the setting out, supply of all materials and erection of guide posts in areas where street lighting is not provided to maintain safety of movement network.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:
SC6.4.6.30 - Control of traffic

(b) Australian Standards:
AS 1906.2 - *Retroreflective devices (non-pavement application)*
AS1580 -*Paints and related material*

(c) Queensland Department of Transport and Main Roads specification:
MRST14 *Road Furniture*

SC6.4.6.23.2 Materials

(1) General

Guide posts must be a proprietary metallic or flexible (driveable or non-driveable) post.

The surface of all posts must have a gloss or semi-gloss white finish. The surface shall be smooth and easily cleaned.

Proprietary posts must be minimum 1500 mm in length and must have one face of a minimum 80 mm width.

(2) Proprietary posts

Where a proprietary metallic or flexible guide post is proposed, the Contractor must supply details of the proposed guide post including the manufacturer's recommended installation procedure, technical specifications and test certificates for approval by the Superintendent.

(3) Delineators

Corner-cubed delineators, conforming to AS 1906.2 must be attached to each post. The delineators must conform to MRST14 *Road Furniture*.

SC6.4.6.23.3 Construction

(1) General

The Contractor must at all times conform to the requirements of sub-section SC6.4.6.30 Control of traffic.

Where the shoulder is in embankment or at natural surface level, the guide posts must be placed near the outer edge of the shoulder and at a uniform distance, minimum 1m, from the pavement edge line. Where the shoulder is located in a cutting, the guide posts must be placed on the road pavement side of the table drain, and minimum 1m from the pavement edge line, in such a manner that it does not impede the flow of water in the drain.

Guide posts must be erected at the locations shown on the Drawings. Underground services laid in proximity to the guide posts must be located prior to erection of posts all care must be taken not to damage such services.

(2) Erection of guide posts

Guide posts must be set vertically in the ground to a depth of approximately 500mm. In order to offset shoulder irregularities this depth must be varied so as to give uniform display of guide posts to a height of approximately 1000mm above ground level, with the tops evenly graded. Each guide post must be erected with the widest face at right angles to the centre line of the road.

Allowance must be made in the height of guide posts above the ground for the effects of superelevation and other road geometry in order to keep the guide posts within the range of the beam of vehicle headlights.

Backfilling must be compacted in layers of depth not more than 150mm for the full depth of the guide posts up to ground level. The density of the compacted backfilling must not be less than that of the adjacent undisturbed ground. Guide posts must be firm in the ground to the satisfaction of the Superintendent.

Proprietary guide posts, when installed in the ground in accordance with the recommendations of the manufacturer, must resist overturning, twisting and displacement from wind and impact forces. The Contractor must provide the manufacturer's instructions for anchorage.

If the guide posts are proposed to be installed on concrete pavements, the Contractor must provide the Superintendent details of fixing the guide posts to the concrete prior installation.

All necessary steps must be taken to prevent people and stock from stepping into the post holes during the erection of the guide posts.

(3) Delineators

"Corner Cubed" delineators, complying with AS1906.2, must be attached to each guide post using one way, anti-theft screws or rivets etc. In the case of proprietary posts, the delineators must be glued or otherwise fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact. The delineators must be mounted so that the top of the reflector is 100mm below the top of the guide post. The delineators must be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side.

SC6.4.6.24 Signposting

SC6.4.6.24.1 Introduction

(1) Scope

This sub-section provides standards advice and guidelines for:

(a) the supply and erection of the regulatory, warning, guide, information and direction signs as described in Manual of Uniform Traffic Control Devices MUTCD.

(b) the supply and erection of sign support structures to support the signs, and

(c) the adjustment of existing signs and sign support structures.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.6.28 - Minor concrete works

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1163	*Cold-formed structural steel hollow sections*
AS 1214	*Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)*
AS 1379	*Specification and supply of concrete*
AS/NZS 1554.1	*Welding of steel structures*
AS/NZS 1580.602.2	*Measurement of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees*
AS 1580.108.2	*Dry film thickness - Paint inspection gauge*
AS/NZS 1734	*Aluminium and aluminium alloys - flat sheet, coiled sheet and plate*
AS/NZS 1866	*Aluminium and aluminium alloys - extruded rod, bar, solid and hollow shapes*
AS 2700	*Colour standards for general purposes*
AS/NZS 3678	*Structural steel - hot-rolled plates, floorplates and slabs*
AS/NZS 3679.1	*Structural steel - hot-rolled bars and sections*
AS 3990	*Mechanical equipment - Steelwork*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

(c) Queensland Department of Transport and Main Roads Publications:

Manual of Uniform Traffic Control Devices (MUTCD)

Traffic and Road Use Management Manual (TRUM)

(3) Provision for traffic

The Contractor shall provide all necessary traffic safety measures in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic.

Where a sign is erected before its intended use by traffic and is visible to traffic, the face of the sign shall be completely and securely wrapped in porous cloth sheeting or other opaque covering material approved by the Superintendent, until the Superintendent directs that the sign shall be uncovered.

SC6.4.6.24.2 Materials

(1) General

The Contractor shall advise the names of the proposed suppliers of signs and sign support structures for the Superintendent's concurrence. Only suppliers who have previously established or can now establish their competence to carry out the work in accordance with this sub-section shall be used.

The Contractor shall supply documentary evidence, satisfactory to the Superintendent that all materials and parts proposed for use comply with the requirements of the appropriate Australian Standard(s) as stated in this policy sub-section.

Details of the signs and sign support structures to be provided under the Contract shall be as shown on the drawings.

The dimensions, legend and background for each sign shall be in accordance with this sub section and the drawings.

(2) Sign blanks

Sign blanks shall be 1.6 mm thick aluminium sheet alloy. The aluminium alloy shall be Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS 1734.

Sign blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blank shall be within plus or minus 1.5 mm of the dimensions specified and the finished sign shall be flat within a maximum allowable bow of 0.5 per cent of the maximum dimension of the sign blank in any direction.

Sign blanks shall be one piece except where the sign is of such a size as to require more than one full sheet of aluminium in which case a multipiece sign shall be allowed.

A multipiece sign shall be made up of the minimum number of pieces practical and sheets of the multipiece sign shall be butted together with a maximum gap of 1 mm at any point along the joint.

All joints shall be covered by a backing strip. The backing strip shall be riveted to each sheet with rivets, coloured to match the background material on the face of the sign, at a spacing not exceeding 200 mm. Backing strips shall be of the same material and colour as used for the sign blank and shall have a minimum width of 50 mm over the full length of the joint.

The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.

The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. Where the sign blank is to receive a paint background, the face shall be spray painted with a compatible etch primer.

The back of each sign blank shall be uncoated and the surface finish shall be rendered dull and non reflective either by mechanical or chemical means and shall be free of scratches and blemishes.

Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the drawings.

(3) Aluminium extrusion backing

The signs shall include special aluminium extruded sections for mounting purposes. The aluminium shall be Type 6063 T5 in accordance with AS 1866.

The aluminium extrusion shall be fixed at the centre spacings as shown on the drawings and shall be riveted to the sign blank with correctly coloured rivets at a spacing not exceeding 200 mm.

(4) Retro-reflective material for background and legend

Retro reflective material shall conform in colour and class to the requirements of AS 1743 and Table 1 in Section 1.2 of DTMR’s Traffic and Road Use Management manual for Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the drawings, the material shall be Class 2.

(5) Non-reflective background material

(a) Background paint

Background paint shall be an approved long life industrial quality, two compound polyurethane paint. The paint shall exhibit high standards of adhesion, abrasion resistance, resistance to weathering and colour fastness under widely varying conditions of exposure. The paint shall be compatible with the etch primer used on the sign blank.

The paint shall be applied using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested in accordance with AS 1580.108.2.

Background paint shall be as specified from one of the following colours:

(i) White Gloss

(ii) “Dark” Green Matt Colour No G61 as specified in AS 2700.

(iii) “Tourist” Brown Matt Colour No X65, Dark Brown, as specified in AS 2700.

(iv) “Dark Grey” Matt Colour No N64, Dark Grey as specified in AS 2700.

(b) Background sheet material
Adhesive cast vinyl sheet material or other equivalent material approved by the Superintendent may be used in place of background paint.

(c) The material shall be of uniform density and compatible with the material used for the legend both in application and durability.

The colours and gloss levels shall be uniform and conform to the requirements of clause SC6.4.6.24.2(5)(a) Background paint.

(6) Non-reflective material for legend

(a) Legend screening ink
Screening ink shall be a high quality, full gloss, non fade, non bleed and scratch resistant type of ink compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which the screening ink is applied.

(b) Legend sheet material
Adhesive cast vinyl sheet material or other equivalent material approved by the Superintendent may be used in place of screening ink. The material shall be of uniform density and compatible with the material used for the background both in application and durability.

(c) Colours and finish
The requirements of clause SC6.4.6.24.2(5)(a) Background paint shall also apply to non reflective materials for legends but additional colours complying with AS 2700 may be specified.

(7) Rivets
Each rivet shall consist of a domed head and shank made of aluminium alloy and a steel mandrel which is discarded after securing the rivet.

A paint coating shall be applied to the domed head so that when the rivet is in position it will show the same colour as the material to which it is attached. Paint may cover the shank of the rivet, providing the coating thickness does not restrict the insertion of the shank into the standard drilled hole for that rivet.

The paint shall be an alkaloid enamel, which shall be applied after an appropriate treatment of the shank of the rivet to ensure long lasting adhesion.

(8) Reference markings
All signs shall be clearly and permanently stamped or engraved with an identification coding. The coding shall appear in ciphers of height neither less than 6 mm nor more than 10 mm on the rear of the sign and shall be carried out in such a manner that the front face of the sign is not damaged.

Manufacturers shall include coding information in the following format:

(a) sign reference number;

(b) manufacturer's name;

(c) month and year of manufacture; and

(d) manufacturer and class of retro reflective material.

(9) Sign support structures

(a) General
Sign support structures shall be fabricated from steel sections which shall comply with the requirements of AS 1163, AS 3678 and AS 3679.1.

Signs support structures shall be standard round galvanised posts of 50, 65 or 80 mm nominal bore or purpose designed steel structures as shown on the drawings and manufactured in accordance with the requirements of AS 1250.

Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds.

All welding shall be as shown on the drawings and in accordance with the requirements of AS 1554.1, Category GP.

(b) Protective treatment
Except for standard galvanised posts, all steel components including brackets shall be protected by hot dip galvanising after all fabrication processes are completed.

The steel components shall be finished by the hot dip galvanising process in accordance with AS/NZS 4680 to provide an average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains.

Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214.

Splices in standard galvanised posts shall be painted by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised by the Contractor.

(c) Attachment of signs
Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolt hole in the sign panel.

The Contractor shall submit details of the proposed attachment systems for the Superintendent's approval.

SC6.4.6.24.3 Erection of new signs

(1) Setting out
The location of signs shall be as shown on the drawings or as directed by the Superintendent. The Contractor shall set out the work to ensure that all signs and support structures are placed in accordance with the drawings or as directed by the Superintendent.

Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve. On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located. Parking signs will generally be aligned at

45 degrees to the kerb line if not otherwise specified on drawings.

The Contractor shall submit details of and set out, for the Superintendent's inspection and approval, the proposed location and alignment of each sign support structure.

Work on the foundations of the sign support structure shall not commence until the Superintendent has approved the location and alignment of the sign support structure.

The Contractor is responsible in locating existing underground services in proximity of the signs prior to placement of footings and erection of signs to protect services from damage

(2) Clearing

The Contractor shall advise the superintendent of any trees and undergrowth within 3 m of the sign support structure and along a driver's line of sight to the front of the sign that are required to be cleared and removed. On receipt of this advice from the superintendent, council will inspect and advise what action is to be taken by the contractor.

(3) Sign structure footings

The footings for a simple pipe support or the footings for each post of a purpose-designed sign support structure shall be constructed in accordance with the drawings or as directed by the Superintendent.

The footings shall be neatly excavated to the depth and width shown on the drawings. The material from the excavation shall be disposed of in a responsible and legal manner.
When anchor bolt assemblies are specified they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure baseplates to allow adjustment of the structure after installation.

Steel reinforcement shall be placed as shown on the drawings.

Concrete in the footings of sign support structures shall comply with sub-section SC6.4.6.28 Minor concrete works and have a minimum compressive strength at 28 days of 20 MPa for pipe support footings and 32 MPa for purpose-designed support footings.

If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

(4) Erection

All components shall be accurately positioned and supported during erection.

The top of each pipe support post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel.

For pipe support multi post installations, the tops of the posts shall be at the same level except where sign shape or the arrangement of sign panels dictates otherwise.

During erection, sign panels shall be suitably supported and braced and the sign face protected from damage. Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Contractor.

Galvanised coatings on purpose-designed support structures which are scratched or slightly damaged during erection shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680. This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised.

SC6.4.6.24.4 Adjustment of existing signs and support structures

Where shown on the drawings and where directed by the Superintendent, the Contractor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including footings and re erection of signs including all fittings.

SC6.4.6.24.5 Special requirements

(1) Street name, service and tourist signs

All street name, service and tourist signs shall comply with council's adopted signage system and with the details as shown on the drawings.

Proprietary signs shall be manufactured and installed in accordance with the requirements of Parts 1 and 6 of MUTCD to the following details:

(Sample only - to be completed by compiler)

(a) Colour:

(i) Legend - Blue, Non-reflective

(ii) Background - Yellow, Class 1 Retroreflective

(b) Lettering and Numerals:

(i) Font Type - Series D

(ii) Height – 100 mm

Details of council's logo shall be supplied to the Contractor by the council.

Details of the signs and legends are to be shown on the drawings.

The Contractor shall submit details of Manufacturer, all sign materials and sign attachment system to the Superintendent for approval by the council prior to commencement of sign manufacture.

SC6.4.6.24.6 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.24.1 Summary of limits and tolerances below:

Table SC6.4.6.24.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Sign Blanks**		
	(a) Dimensions	± 1.50mm	SC6.4.6.24.2(2)
	(b) Bow	< 0.5% of maximum dimension	SC6.4.6.24.2(2)
	(c) Butt gap in multipiece sign	< 1mm	SC6.4.6.24.2(2)
	(d) Rivet spacing in backing strip	< 200mm	SC6.4.6.24.2(2)
	(e) Backing strip width	> 50mm	SC6.4.6.24.2(2)
2.	**Extrusion Backing**		
	(a) Rivet Spacing	< 200mm	SC6.4.6.24.2(3)
3.	**Background Paint**		
	(a) For matt coatings, gloss level	> 12% and < 15%	SC6.4.6.24.2(5)
	(b) For gloss coatings, gloss level	> 85% and < 95%	SC6.4.6.24.2(5)

Item	Activity	Limits/Tolerances	Clause
4.	**Reference Marking**		
	(a) Height of Coding	> 6mm and < 10mm	SC6.4.6.24.2(8)
5.	**Sign Support Structures**		
	(a) Protective Treatment thickness	> 100 microns	SC6.4.6.24.2(9)(b)
	(b) Paint coating over Splices in standard galvanised posts	> 100 microns	SC6.4.6.24.2(9)(b)
	(c) Damaged Surface of galvanised surfaces		
	(i) Coating with zinc rich paint	Area < 2500 sq. mm	SC6.4.6.24.2(9)(b)
	(ii) Regalvanise	Area > 2500 sq. mm	SC6.4.6.24.2(9)(b)
6.	**Clearing**		
	(a) Trees and Undergrowth to be cleared	< 3 metres from sign support structure	SC6.4.6.24.3(2)
7.	**Concrete in Foundations of Sign Support Structures**		
	(a) Strength	> 25 MPa at 28 days	SC6.4.6.24.3(3)

SC6.4.6.25 Non-rigid road safety barrier system

SC6.4.6.25.1 Introduction

(1) Scope

The work to be executed under this sub-section consists of the setting out, supply of all materials and erection of road safety barriers and terminals, in accordance with the requirements for non-rigid road safety barrier systems in TMR Road Planning and Design Manual (Chapter 8), at the locations shown on the drawings or as directed by the Superintendent.

This sub-section details the requirements for public domain non-rigid road safety barrier systems. Where a patented non-rigid road safety barrier system is specified and shown on the drawings, all materials shall be in accordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied to this sub-section are as follows:
SC6.4.6.30 Control of traffic
SC6.4.6.28 Minor concrete works

(b) Department of Transport and Main Roads Standards:
Road Planning and Design Manual (RPDM) 1st edition – (Chapter 8), Safety Barriers and Road Side Furniture – as amended.

(c) Australian Standards:

AS/NZS 1906.2	*Retroreflective devices (non pavement application)*
AS/NZS 3845	*Road safety barrier systems*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

SC6.4.6.25.2 Materials

(1) Components

All steel components for public domain non-rigid road safety barrier systems, W beam and Thriebeam, shall be designed and constructed strictly in accordance with the RPDM (Chapter 8 – as amended) using crushable energy-absorbing materials and shall be of the type as shown on the drawings.

(2) Certification

Road safety barrier components shall not be erected until the Contractor has produced documentary evidence to the Superintendent that such safety barrier components conform to the requirements of this sub-section.

For galvanized steel components provide a manufacturers certificate of compliance certifying that the zinc coating mass conforms to AS/NZS 4680 or, for components of proprietary safety barrier systems or devices, to the manufacturer's recommendations.

SC6.4.6.25.3 Construction

(1) General

The Contractor shall at all times conform to the requirements of sub-section SC6.4.6.30 Control of traffic.

Construction of non-rigid road safety barrier shall comply with RPDM, except where explicit departures are approved on the drawings.

Road safety barriers shall be erected after the construction of the base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by the Superintendent.

The Contractor shall set out the work to ensure that all road safety barriers and terminal sections are located,

in accordance with the drawings or as directed by the Superintendent.

Underground cables and ducts laid in the road safety barrier area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts.

The posts should be set to the full depth as shown on the drawings. If this is not possible due to the presence of an underground obstruction, an alternative method of setting the posts, as approved by the Superintendent, shall be used.

Posts shall stand vertical and the spacing shall be such that when the safety barrier is erected no post movement is necessary in order to align holes or for any other reason.

(2) Erection of steel posts

The safety barrier posts are to be located as shown on the drawings. The top of the post shall be 750mm, 845mm or 905mm as appropriate for W beam, Thrie beam or modified blockout Thrie beam respectively, above the ground level, unless otherwise shown on the drawings. On terminal ends, the level of the posts shall be such as to conform to the extended crossfall of the main pavement unless otherwise shown on the drawings.

When erected in position the posts shall be on a smooth line both horizontally and vertically with the tops of posts within ±10 mm of the heights specified in paragraph 1 of this clause.

Steel posts shall be erected by driving, or by other means, as directed by the Superintendent, in accordance with the requirements for foundation posts in the TMR RPDM. The open section of the post shall point in the same direction as adjacent traffic. The posts are to be firm in the ground and any movement at ground level shall not exceed 3mm in any direction when force tested in accordance with TMR guidelines

The posts shall not have any obvious deformation as a result of driving. Any damage which does occur to the posts is to be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any post which has been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at their own expense.

(3) Erection of road safety barrier rails

Steel blockout pieces shall be erected with the open section pointing in the same direction as adjacent traffic.

All rail laps shall be in the same direction as adjacent traffic such that approach rail ends are not exposed to traffic.

Stiffening pieces, 300mm long, shall be used on intermediate posts.

Road safety barrier rails and blockout pieces shall be handled and erected in such a manner that no damage occurs to the galvanising. Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any road safety barrier rails or blockout pieces that have been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at their own expense.

Road safety barrier rail attachment bolts and splice bolts are to be tightened initially such that the barrier can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kinks or bumps. The overall line of the top of the safety barrier rails is to visually conform with the vertical alignment of the road pavement.

When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail.

(4) End treatment of road safety barriers

Both approach and departure ends of the road safety barrier shall be constructed with leading and trailing terminal sections at locations shown and as detailed on the drawings.

An appropriate terminal end treatment shall be constructed, as detailed on the drawings, at the approach and end locations of road safety barriers as shown on the drawings. Consideration of alternate terminal end treatments will include sufficient clearance behind the safety fence to accommodate pedestrians and cyclists, where applicable.

The approach and departure ends of double sided road safety barriers shall have terminal sections as detailed on the drawings.

Non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets shall be as detailed on the drawings.

(5) Delineators

Delineators complying with AS 1906.2 shall be fixed with brackets to the road safety barrier, to the details and at the locations shown on the drawings beginning at the first post and then in accordance with Table SC6.4.6.25.1 below.

Table SC6.4.6.25.1 Spacing of reflectors on barriers

Radius of Curve	Spacing of Reflectors on Barrier
m	every
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365 (including straight road)	16th post

The delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

(6) Connection to existing safety fencing

The Contractor is to inspect and document the condition of all existing barrier fencing and its suitability to meet current specifications and standards, prior to connection or incorporation into the subject works. All documentation of existing fencing is to made available to the Superintendent for future inspection, if requested.

If any existing safety fencing is deemed not to comply with current design and safety standards, it is to be replaced.

SC6.4.6.25.4 Limits and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.25.2 Summary of limits and tolerances below:

Table SC6.4.6.25.2 Summary of limits and tolerance

Item	Activity	Limits/Tolerances	Clause
	Vertical Alignment	± 10mm	SC6.4.6.25.3(2)
	(a) Tops of steel posts.		
	(i) Post Movement	£ 3mm	SC6.4.6.25.3(2)
	Concrete Footings	-0mm or +50mm	SC6.4.6.25.3(3)
	(a) Diameter		

SC6.4.6.26 Landscaping

SC6.4.6.26.1 Introduction

(1) Scope

This sub-section sets out the standards and provides advice and guidelines for the construction of landscape works that will become a council asset.

Landscape works includes but is not limited to, site co-ordination, turfing, gardens, grass seeding, tree plantings, pathways, paved areas, concrete works, stormwater drainage and infrastructure.
This sub-section consists of:

(a) the vegetation of cut and fill batters, median areas, pathway verges, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection works, hydroseeding, hydromulching and straw mulching; and

(b) the supply of plants, planting at locations fertilising, mulching, staking, watering and maintenance of plants.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

All design and documentation, materials supplied and work carried out shall be in accordance with the following standards.

(a) Development manual planning scheme policy sub-sections to ne read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 - Earthworks (construction).

(b) Australian Standards:

AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289	*Methods of testing soils for engineering purposes – General requirements and list of methods*
AS 1672.1	*Limes and limestones – Limes for building*
AS 2507	*The storage and handling of agricultural and veterinary chemicals*
AS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS 3700	*Masonry structures*
AS 3798	*Guidelines on earthworks for commercial and residential developments*
AS 3972	*General purpose and blended cements*
AS 4419	*Soils for landscaping and garden use*
AS 4454	*Composts, soil conditioners and mulches*
AS/NZS 4671	*Steel reinforcing materials*
AS 4843	*Synthetic weed blocking fabric*
AS 4970	*Protection of Trees on Development Sites*

(c) Other:

Electricity Act 1994
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

(3) Terminology

For the purposes of this document the following definitions apply:

Defects liability period	refer to Section SC6.4.7 Acceptance of completed works.
Gardens, garden beds and garden areas	means a defined area of mulched “garden” containing various shrubs, trees, plants or hedges.

Litter	means bottles, paper, cigarette packets, cigarette butts, drink cans, ice cream sticks, plastic, rubber, glass, milk and fruit juice cartons, paper plates and the like. Litter also includes fallen branches, palm fronds, waste, household rubbish, condoms, sharps/syringes, leaves where leaves are unsightly or cause damage to lawn or garden areas, or other dumped material.
Maintenance period	equivalent to the defects liability period and includes the plant establishment period.
Plant establishment period	coincides with the defects liability period.
Planter box	means a transportable or in situ container designed specifically for containing a garden of trees and /or shrubs.
Sub grade	means the level at the underside of garden or turf top soil or the level at the underside of paving gravel base course.
Superintendent	means the nominated representative for council.

SC6.4.6.26.2 Works management

(1) Qualified personnel

Personnel shall be suitably qualified and competent in all aspects of landscape works and shall be familiar with all relevant Australian Standards. All maintenance work to new and existing trees shall be carried out under the supervision of an Arborist with formal qualifications (Level 5 Australian Qualification Framework) or at least 5 years recognised experience in Arboriculture.

(2) Design approval

The design of the landscape works will be prepared by a qualified Landscape Architect.

(3) Contractor inspections

Inspections must be certified and documented by a Registered landscape Architect (the supervising landscape architect). All approved works are required to be inspected by Townsville City Council.

(4) Council inspections

(a) Council may inspect the following:

(i) sub grade prior to placing fill;

(ii) sub grade prior to placing garden soil or turf soil;

(iii) sub grade prior to placing the gravel base course;

(iv) sub grade prior to placing paving or concrete works;

(v) installation of gypsum;

(vi) condition of plants after delivery to site and prior to planting, including planting holes prior to planting;

(vii) gardens prior to planting;

(viii) turf areas prior to laying turf;

(ix) areas to be hydro-mulched / seeded prior to treatment;

(x) concrete structures (formwork) prior to placing concrete;

(xi) block work and reinforcing prior to placing core fill concrete; and

(xii) other elements considered necessary by the Superintendent.

(b) Inspection of irrigation works shall be undertaken by the Superintendent and a council Irrigation Officer in association with the Landscape works and is detailed below:

(i) all mainline to be inspected prior to covering;

(ii) drip tube layout prior to covering;

(iii) 240v power conduit from Ergon POS to controller for correct depth prior to covering;

(iv) all envelopers (conduits) work under hard surfaces prior to covering;

(v) all envelopers (conduits) under hard surfaces must be continuous 100 mm PVC CL9, all conduit ends must be sealed with expanding foam prior to covering; and

(vi) water meter assembly installation prior to covering to ensure correct installation of thrust blocks and copper protection.

(5) Inspection results

(a) Work inspected that complies with the sub-section and/or the design plans will be accepted by council.

(b) Any work inspected that does not comply with the sub-section and/or the design plans, will not be accepted by council. Items not acceptable will be noted for rectification.

(c) The contractor is required to rectify these items prior to proceeding to the next construction phase and shall apply for a re-inspection by council on completion of the rectification work.

(6) A minimum of 24 hours notice by is required for notification of an Inspection. Failure by the Contractor to notify council of any inspections required, will result in the works being excavated at the Contractors cost to allow an inspection to be carried out.

(7) Inspection documentation.

Editor's note—this section relates to Inspection Test Plans and is currently under development.

SC6.4.6.26.3 Supply of materials

(1) Materials supply - general

(a) Substitutions

The Contractor shall notify the council immediately if an item is unavailable for inclusion in the works and shall provide alternative supply details if appropriate. Substitutions of any materials or products shall not be made unless approved by the Superintendent in writing.

(b) Material samples

In certain instances, council may request the Contractor to provide samples of materials to be installed or used for work under the development approval.

(c) Materials testing

In certain instances, council may request the Contractor to provide results of materials testing. Where applicable, testing requirements will be set out in the conditions of approval.

(d) Materials warranty

Where requested, the Contractor shall provide to council all relevant warranty details for the materials nominated in any conditions of approval.

(2) Supply of plants

(a) Plant specifications

(i) All plants supplied shall be in a healthy condition free from weeds, pests and diseases. Plants shall be well foliated, showing signs of active growth, true to type and of a form and shape considered typical for the species or variety.

(ii) Leaves shall be of normal size, shape, colour, and texture with no physical or insect damage or disease lesions.

(iii) The plant roots shall be fibrous, well developed and not root bound, with no kinking, knotting, girdling or spiralling and shall be free of any pests or diseases or any other root defects.

(iv) All plants supplied shall be hardened off and in a condition suitable for planting in the Townsville climate.

(v) Trees supplied (unless required to be multi-stemmed) shall have a single leading stem and shall

be self-supporting and unstaked.

(vi) Root bound plants, deformed plants and plants showing recent signs of root pruning will not be accepted.

(vii) At time of delivery to the site, each group of plant species shall be clearly and accurately labelled according to botanical nomenclature. Labels shall be water resistant and tied securely to one plant in every 20 for each species.

(viii) Plants which are above the minimum size requirements may be accepted for inclusion within the works.

(b) Container stock

Plants grown in containers shall have a root system firmly established with no large roots growing out of the container, shall be of such a size that the roots have penetrated to the bottom of the container and occupy 95-100% of the soil volume and/or have sufficient roots to hold the container soil together after removal of the plant from the container.

(c) Ex-ground stock plants

(i) Where plants are growing in ground prior to delivery to the site, the necessary root pruning and/or preparation procedures in accordance with accepted transplanting practice shall be commenced in sufficient time to ensure that, at the time of planting the plant is ready and will meet the specified requirements. Transplanting of ex-ground stock should be conducted under the supervision of a qualified (Level 3 Australian Qualification Framework) horticulturalist or arborist.

(ii) Refer to Table SC6.4.6.26.1 for minimum acceptable root ball sizes for ex-ground stock plants.

Table SC6.4.6.26.1 Acceptable root ball sizes

Small Trees		Large Trees	
Height of Tree (mm)	Root Ball Diameter (mm)	Approximate Tree Trunk Diameter (mm) (300 mm above ground)	Root Ball Diameter (mm)
600 - 900	300	40	500
900 - 1200	350	50	550
1200 - 1500	400	65	600
1500 - 1800	450	75	800
1800 - 2100	550	100	950
2400 - 2700	600	125	1200
2700 - 3000	650	150	1450
3000 - 3600	750	175	1600
3600 - 4200	800		
4200 - 5000	900		

(d) Substitutions

Substitutions of plants shall not be permitted unless approved in writing by council. In the event that a plant is unavailable the Contractor may request to provide a substitution. Substituted plants shall be of the same specified type, quality and size unless otherwise agreed to by council.

(3) Supply of imported soil mix

(a) Imported soil mix shall be organic soil, soil blend or top dressing in accordance with the Australian Standard AS 4419 Soils for landscaping and garden use.

(b) The Contractor shall note the requirements of AS 4419.

(4) Supply of turf

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf.

(b) The soil of the turf sod shall be an even thickness of 25 mm minimum.

(c) Turf shall be free from any matter toxic to plant growth and shall be free from roots, weed or weed

seeds.

(5) Supply of hydro seeding/mulching
The specific mix/blend of hydro seeding/mulching required shall be nominated on the drawings and supplied by specialist supplier of hydro seeding/mulch.

(6) Supply of mulch materials

(a) All mulch materials supplied shall be in accordance with the current relevant AS 4454 Composts, soil conditioners and mulches.

(b) Organic and inorganic mulch shall be of the type and quality as noted on the drawings.

(c) Organic mulch derived from vegetation cleared on site may only be used where it is free from deleterious materials such as rock, soil and weed material.

(7) Tree stakes and ties

(a) Unless otherwise noted on the drawings or approved by council, tree stakes shall be durable hardwood, straight, free from knots or twists and pointed at one end.

(b) Small plants may only require 1 stake where required.

(c) For trees up to 45 litre 2 stakes – 50 mm x 50 mm x 1800 mm long.

(d) For trees over 45 litre 3 stakes – 50 mm x 50 mm x 2400 mm long.

(e) Ties shall be 50 mm wide furniture grade hessian webbing or similar.

(f) Supply of proprietary items
Timber/concrete garden edging, soil conditioners, root barrier, furniture items, play equipment and other project specific items shall be supplied to the requirements and details noted on design and/or construction drawings.

(8) Supply of gypsum
Gypsum application rates shall be supply in accordance with AS 4454 and as required by soil types specific to the site.

(9) Supply of fertiliser
Fertilisers supplied shall be:

(a) delivered to the site in sealed bags clearly marked to show the manufacturer or vendor, weight, fertiliser type, N:P:K. ratio, recommended uses and application rates; and

(b) applied at the locations and frequencies in accordance with the manufacturer's recommendations.

SC6.4.6.26.4 Earthworks

(1) General
Earthworks relates to gardens, grass areas, pathways and paved areas and includes:

(a) site clearing;

(b) stripping of existing vegetation;

(c) stripping of existing top soil;

(d) excavation to sub grade level;

(e) filling to sub grade level; and

(f) cultivation of the sub grade surface.

(2) Quality management
All materials supplied and work carried out shall be in accordance with the current, relevant Australian Standards:

(a) AS 1289 - Methods of testing soils for engineering purposes; and

(b) AS 3798 - Guidelines on earthworks for commercial and residential developments.

(3) Existing services

Per sub-section SC6.4.6.11 Clearing and grubbing, the Contractor is required to locate all existing and newly installed services prior to commencement of any earthworks. Care shall be taken in areas to be excavated, filled or cultivated not to unearth or damage services. Any damage to services caused by the Contractor shall be reinstated by the Contractor at no cost to council.

(4) Site preparation

(a) Clearing/Demolition

(i) Clearing shall mean the removal of trees, shrubs, scrub and undergrowth and other vegetation above ground level and includes the removal of artificial obstructions such as fences, concrete slabs rubbish, timber, boulders, rubble and other man made products.

(ii) Clearing shall be carried out in accordance with sub-section SC6.4.6.11 Clearing and grubbing.

(b) Grubbing

Grubbing shall mean the removal from below ground level of trees, roots, stumps, rocks and artificial obstructions as defined and specified by sub-section SC6.4.6.11 Clearing and grubbing.

(c) Stripping of existing vegetation

Areas to be excavated or filled shall be stripped of all vegetation to a depth just sufficient to include the root zone (nominal 50 mm). All stripping of vegetation is to be in accordance with sub-section SC6.4.6.11 Clearing and grubbing and must not affect trees/vegetation to be retained, as per clauses SC6.4.5.2.1(18) and (19).

The striped material shall be removed from site or may be stockpiled on site for later reuse, if approved by council and in accordance with clause SC6.4.5.2.1(17) Stockpiling of materials.

(d) Existing topsoil

Existing topsoil excavated on site may be reused provided that the material conforms to the AS 4419 requirements and is approved for reuse by the Superintendent. The material may be stockpiled on site, in accordance with clauses SC6.4.5.2.1(16) and (17).

(5) Excavation (down to sub grade level)

(a) General

The existing surface of areas to be excavated shall be stripped of all vegetation prior to excavating. Care shall be taken not to unnecessarily expose subsoils through the area of construction by over excavation, to prevent any potential for the development of acid sulphate conditions.

(b) Excavation in gardens

(i) Garden beds shall be excavated down to subgrade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if present) and the topsoil shall be shaped to fall from the centre of the bed outwards in all directions.

(iii) Excavation in gardens shall be in accordance with council's approved standard drawings.

Editor's note— standard drawings for these works are under development.

(c) Excavation in grass areas

(i) Grass areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if any) and shall be graded evenly to follow the finished surface profile.

(iii) Excavation in grass areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(d) Excavation for pathways and paved areas (paving)

(i) Pathways and paved areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits or subsoil drains.

(ii) Excavation for pathways and paved areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(e) Excavation near existing trees
Excavation near existing trees shall be undertaken in accordance with clause SC6.4.5.2.1(19) Work adjacent to trees and protection of environmentally significant vegetation.

(f) Spoil

(i) Spoil material resulting from excavation shall be reused on site wherever practicable, provided that the material conforms to the specified requirements for its intended use (e.g. filling or top soil) as per AS 4419.

(ii) Spoil material to be reused may be stockpiled on site as per clause SC6.4.5.2.1(17) Stockpiling of materials.

(iii) After the excavation process has been completed, the sub grade surface shall be inspected for springs, soft soil areas and other structural weaknesses. Where such weaknesses are encountered the following remedial works may be required:

(A) excavation and replacement of unsuitable material;

(B) surface drainage blankets of sand; and

(C) subsoil drains.

(6) Filling (up to sub grade level)

(a) Existing surface treatment
The existing surface of areas to be filled shall be stripped of all vegetation prior to placing any fill. The existing surface shall then be scarified to a depth of 200 mm. If required, water shall be added to bring the existing surface up to optimum moisture content prior to placing any fill.

(b) Unsuitable existing surface
After the stripping process has been completed, the existing ground surface shall be inspected for springs, soft soil areas and other structural weaknesses in the naturally occurring soil. Where such weaknesses are encountered, the following remedial works may be required:

(i) excavation and replacement of unsuitable material;

(ii) surface drainage blankets of sand; and

(iii) subsoil drains.

(c) Acceptable types of fill material for gardens and grass areas
Fill material to garden and grass areas shall be either:

(i) "general purpose soil" to AS 4419 Clause 4.1; or

(ii) "natural soil" to AS 4419 Clause 4.3; or

(iii) spoil from on site excavations if approved by the Superintendent, with a maximum particle size 25 mm.

(d) Acceptable types of fill material for pathways and paved areas
Fill material to pathways and paved areas shall be:

(i) crusher dust, free from organic matter and lumps of clay; or

(ii) crushed rock gravel uniformly graded, nominal particle size 25 mm; or

(iii) other granular material approved by the Superintendent.

All material used shall have a linear shrinkage - 0 - 8%, Soaked California Bearing Ratio – 15 minimum.

(e) Fill in gardens
Gardens shall be filled up to sub grade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any).

(f) Fill in grass areas
Grass areas shall be filled up to sub grade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any) or gully pits and to mirror the finished surface profile.

(g) Fill to pathways and paved areas
Path ways and paved areas shall be filled up to subgrade level as required to suit the finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits.

(h) Fill around existing trees
For informatin regarding placement of fill and compaction issues refer to AS 4970 Protection of trees on development sites and Clause SC6.4.5.2.1(18) Work adjacent to trees and protection of environmentally significant vegetation.

(7) Placing and compacting fill

(a) Fill material shall be placed and compacted in successive horizontal layers to the dimensions, levels, grades, and cross sections as shown on the drawings and so that the surface is always self-draining. Refer to Table SC6.4.6.26.2 for compaction standards. Care shall be taken to ensure that fill to garden areas is not excessively compacted.

(b) Each fill layer shall be scarified, and/or harrowed and processed to a finely divided condition, uniformly watered or aerated as the case may be, to obtain moisture content within the range of 80% - 90% of the optimum moisture content. The loose depth of the material in each layer shall be not more than 150 mm.

(c) Fill shall be placed in layers simultaneously on both sides of structures, culverts and pipe work to avoid differential loading. Fill shall not be placed against concrete or masonry structures, walls and the like until the concrete or masonry work has been in place for a minimum of 14 days.

(d) Existing works and structures shall be protected from damage due to compaction operations. Compaction by mechanical means shall not be carried out within 300 mm of paths, kerbs or structures. Compaction in these locations shall be carried out by hand or the size of compaction equipment shall be limited to ensure no damage is caused. Commence compaction of each fill layer at the structure and proceed away from it.

Table SC6.4.6.26.2 Fill compaction standards

Location	Compaction standard
Gardens and Grassed Areas.	85% Relative Dry Density Standard Compaction.
Pathways, Paved Areas and Structures.	95% Relative Dry Density Standard Compaction.

(8) Grading

(a) Runoff from impervious surfaces such as roofs, driveways and car parks, and overland flows from turf and garden beds is to be captured and allowed to infiltrate into subsoils by reshaping existing landforms through the use of swales, contour banks, soaks, percolation pits and basins, rain gardens and bioretention filters.

(b) To reduce runoff and erosion and encourage rainwater infiltration into soil, a landscape embankment is not to exceed grades of 1 in 5.

(c) The regrading of land is not to occur within the tree protection zone of existing trees to be retained.

(9) Cultivation

(a) Applies to gardens and grass areas (if directed or if noted on the drawings).

(b) Where shown on the drawings, the sub grade of Gardens and Grass Areas shall be cultivated prior to placing garden mix soil or turf top soil.

(c) The sub grade shall be thoroughly cultivated by ripping parallel to the final contours to loosen the compacted ground and to the depths nominated in Table SC6.4.6.26.3.

Table SC6.4.6.26.3 Cultivation depths

Location	Cultivation depth
Garden Areas	200 mm
Grass Areas	100 mm

(d) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all gardens at a minimum rate of 2 kg per square metre and shall be thoroughly blended and incorporated into the subgrade during cultivation.

(e) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all grass areas at a minimum rate of 2 kg per square metre and shall be:

(i) thoroughly blended and incorporated into the subgrade during cultivation if cultivation is to be carried out; or

(ii) spread prior to placing turf soil.

(f) Any soil additives and/or imported materials other than gypsum, that may be required to be applied to the natural soil shall be thoroughly blended with or spread over the subgrade.

(g) Cultivation shall not be carried out when the soil is wet or plastic.

(h) The Contractor shall ensure that no damage occurs to tree roots, underground services, kerbing and the like during the cultivation process. Cultivation by mechanical means shall not be carried out within the drip line of trees to be retained or within 300mm of pathways, paved areas and/or structures. Cultivation in these locations shall be carried out by hand. Refer to Clause SC6.4.5.2.1(19) Work adjacent to trees and protection of environmentally significant vegetation.

(i) After cultivation soil lumps shall have a maximum dimension of 50 mm. Stones exceeding 25 mm, clods of earth exceeding 50 mm, weeds, roots, sticks, rubbish and any other deleterious material brought to the surface during cultivation shall be removed. Any depressions caused by the removal of these materials shall be filled with top soil or on site spoil material approved by the Superintendent.

(j) After cultivation the surface shall be graded smoothly and evenly and trimmed to the required levels allowing for placing the specified depth of imported soil to achieve the finished surface levels as noted on the drawings. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(10) Backfilling trenches

(a) Backfill to trenches up to sub grade level under pathways and paved areas shall be clean sand or crusher dust compacted to 95% relative dry density standard compaction.

(b) Backfill to trenches up to sub grade level in gardens and grass areas shall be imported soil mix or material excavated from the trench or may be other on site material approved by the Superintendent.

(c) Trenches excavated in gardens within the imported garden mix soil shall be backfilled with imported garden mix soil mix as specified.

SC6.4.6.26.5 Vegetation of slopes and drains

(1) Execution and timing of work

(a) The work to be executed under this clause includes the vegetation of cut and fill batters, pathway verges, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the drawings.

(b) Exposed ground shall be vegetated before the area exceeds one hectare or lesser area in compliance

with council requirements.

(2) Materials

(a) Topsoil

The Contractor shall use topsoil stockpiled on site under the sub-section SC6.4.6.10 Earthworks (construction). Where imported topsoil is required it shall comply with AS 4419 and shall:

(i) be of a friable, porous nature;

(ii) be free of weeds and weed seeds, bulbs, corms and vegetable propagules;

(iii) contain no refuse or materials toxic to plant growth;

(iv) contain no stumps, roots, clay lumps or stones larger than 50 mm in size;

(v) have an organic content of at least 3 per cent by mass;

(vi) have a pH neither less than 5.5 nor more than 7.5; and

(vii) have a soluble salt content not exceeding 0.06 per cent by mass.

(b) Herbicide

Herbicide used shall be a glyphosate-based herbicide listed in SC6.4.6.26 Attachment A.

(c) Seed

(i) All seed used shall be of the species and varieties list in SC6.4.6.26 Attachment A and shall be sown at the application rates specified therein. The Contractor shall submit to the Superintendent the name/s of the proposed seed supplier/s within 2 weeks of the acceptance of the tender.

(ii) The Contractor's attention is drawn to the lead time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

(iii) All seed must be accompanied by a "Certificate of Authenticity" which shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

(iv) The Contractor shall not take possession of the seed more than 7 days before sowing is to occur. The seed shall be stored in clean, air tight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

(v) The Contractor shall replace at his own expense any exotic seed batch found not true to type.

(d) Turf

Turf shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with 25 mm depth of topsoil. The type of grass turf to be used shall be selected from SC6.4.6.26 Attachment A and in accordance with the drawings. Unless specified, Kikuyu grass shall not be used. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300 mm, and shall be in sound unbroken condition.

(e) Fertiliser

Fertiliser shall be an organic type listed in SC6.4.6.26 Attachment A with Nitrogen: Phosphorus: Potassium (N:P:K) ratios of 8 : 3.6 : 2.

(f) Vegetable mulch

Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm. Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50 per cent by mass of the total mulch.

(g) Water

Water used shall be potable.

(h) Binder

The binder used in hydromulching and strawmulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

(i) Wetting agent

The soil wetting agent added in hydromulching or hydroseeding shall be listed in SC6.4.6.26 Attachment A and applied at the application rate specified therein.

(j) Pesticide
Pesticide used shall be a liquid or powder listed in SC6.4.6.26 Attachment A. The storage and handling of pesticides shall be in accordance with AS 2507.

(3) Vegetation of slopes 3 to 1 or flatter

(a) Preparation of surface

(i) Slopes shall be sprayed with herbicide applied at the rate specified in SC6.4.6.26 Attachment A to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks.

(ii) The surface shall then be tyned to a depth of 200 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

(b) Topsoiling
Topsoil shall be uniformly applied to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location. The topsoiled area shall be cultivated to a depth of 50 mm to provide a roughened surface with soil lumps not exceeding 50 mm dimension.

(c) Mixing of seed
The Contractor shall give the Superintendent 2 days notice before each sowing operation. Seed shall be sown on the day of mixing with pesticide.

(d) Incorporation of pesticide
Immediately before sowing, all grass and native seed shall be treated with pesticide. The pesticide shall be thoroughly mixed as a dry powder with the seed at the rate specified in SC6.4.6.26 Attachment A to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with SC6.4.6.26 Attachment A.

(e) Sowing

(i) Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5 mm or shall be raked or harrowed to provide 5 mm cover.

(ii) Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in SC6.4.6.26 Attachment A. Fertiliser shall be applied concurrently with the seeding operation.

(f) Turfing

(i) Turf shall be placed on the prepared topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow. Turf seams shall then be topdressed with topsoil.

(ii) Four to six weeks after placement, the turf shall be lightly topdressed with topsoil to correct any undulations or unevenness in the established turf.

(g) Watering
The Contractor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by the Superintendent, to promote and maintain growth.

(4) Vegetation of slopes steeper than 3 to 1

(a) General
Where required or directed by the Superintendent, slopes shall be vegetated by one of the following methods:

(i) topsoiling and hydromulching;

(ii) topsoiling, hydroseeding and straw mulching; or

(iii) hydroseeding.

(b) Preparation of surface

(i) Weeds shall be killed by spraying with herbicides as specified in SC6.4.6.26 Attachment A.

(ii) No more than 7 days before seeding all loose material shall be removed from fill batters and cut

batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by the Superintendent.

(c) Topsoiling

Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(d) Hydromulching or hydroseeding

(i) The hydromulch or hydroseed shall comprise the materials shown in Table SC6.4.6.26.4. The materials shall be applied at the application rates shown in Table SC6.4.6.26.4.

(ii) Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

(iii) During preparation of the hydromulch or hydroseed slurry, liquid form pesticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of pesticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table SC6.4.6.26.4.

(iv) Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.

(v) A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface.

(vi) Hydromulch or hydroseed shall not be applied under the following weather conditions at the site:

(A) when temperature is higher than 35 ºC;

(B) when winds exceed 15 km/hr;

(C) where, in the opinion of the Superintendent, the surface is too wet; or

(D) during rain periods or when rain appears imminent.

(vii) Application rates shall be in accordance with Table SC6.4.6.26.4.

Table SC6.4.6.26.4 Materials and application rates

Application Rate per Hectare		
Material	**Hydromulching**	**Hydroseeding**
i) Vegetable Mulch (kg)	2,500	Nil
ii) Water (L)	35,000	20,000
iii) Binder (L)	700	Nil
iv) Fertiliser	See SC6.4.6.26 Attachment A	
v) Seed	See SC6.4.6.26 Attachment A	
vi) Wetting Agent (L)	35	20
vii) Pesticide (L)	5	5

(e) Straw mulching

The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20 mm at any location.

(5) Vegetation of open drains

(a) Preparation of surface

The Contractor shall so execute the work that the excavation of open drains to the specified profiles is followed within 7 days by the vegetation of the surface as specified in this clause. Topsoil shall be spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(b) Sowing
Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in SC6.4.6.26 Attachment A by one of the following procedures as directed by the Superintendent:

(i) mechanical sowing;

(ii) hydromulching or hydroseeding; and

(iii) by hand.

(c) Surface protection - general
Where shown on the drawings or directed by the Superintendent, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

(d) Surface protection - spraying with bitumen emulsion
An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of 1 litre of bitumen emulsion per square metre of surface.

(e) Surface protection - lining with organic fibre mat

(i) The channel surface shall be lined with an organic fibre mat listed in SC6.4.6.26 Attachment A. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched.

(ii) The upstream end of the matting shall be slotted into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. The trench shall be backfilled with soil and compacted by foot.

(iii) The pins shall be `U' shaped, 4 mm gauge wire, 50 mm wide and 150 mm long legs.

(iv) Adjacent runs of matting shall be overlapped 100 mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500 mm centres and along the middle of each run at 1 m centres. End overlaps shall be 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

(f) Turfing

(i) Turf shall be as specified under clause SC6.4.6.26.5(2)(d).

(ii) Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain, and pinned into position at 500 mm centres.

(iii) Seams of turf shall be topdressed with topsoil.

(g) Watering
The Contractor shall water treated areas in order to promote and maintain growth as specified under clause SC6.4.6.26.5(3)(g).

SC6.4.6.26.6 Garden construction

(1) Scope
The following work activities relate to the construction of garden beds, garden areas and mass planting areas:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing garden mix soil;

(d) supply and placing mulch;

(e) supply and planting of trees, shrubs, ground cover plants and the like including stakes and other plant supports;

(f) supply and application of fertiliser;

(g) supply and installation of garden edging; and

(h) supply and installation of subsoil drains.

All garden construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 - *Soils for landscaping and garden use*; and

- AS 4454 - *Composts, soil conditioners and mulches*.

(2) Co-ordination

The sequence for placing garden mix soil, installing irrigation, placing mulch and planting will vary according to the type of plants and irrigation system. The Contractor is required to liaise with other Contractors and the Superintendent to ensure the best possible method of construction is undertaken.

(3) Earthworks

Gardens may require Excavation or Filling to achieve the finished surface levels nominated on the drawings. After excavation or filling, all gardens may require cultivation.

(4) Garden bed dimensions

Planting bed dimensions are in accordance with the following:

(a) garden beds have an average minimum width of 1.2 m, provided that the bed is no less than 0.5 m wide; and

(b) root zone depths for plants are at least that of the root ball of the plant at planting.

(5) Soil condition

(a) Priority is to be given to using existing site soil as imported soil is a limited resource.

(b) Existing topsoil is conserved by either not disturbing the soil during construction or by stockpiling it prior to construction commencing, in accordance with SC6.4.5.2 Stockpiling of materials.

(c) Subsoil is to be cultivated to a minimum depth of 200 mm for garden beds and 100 mm for turfed areas unless this will adversely affect the roots of established trees.

(d) The minimum top soil depth is:

(i) 100 mm for non-irrigated turf areas;.

(ii) 200 mm for irrigated turf areas; and

(iii) 300 mm for garden beds.

(e) If additional soil is required to meet these minimum depths, soil is to meet AS4419 Soils for landscaping and garden use.

(f) The soil quality is sufficient to allow plants to grow effectively. Soil amelioration measures to improve the infiltration of existing soils, the soil's macropore and micropore balance and ensure a stable soil ecosystem, include the following:

(i) scarification of crusted topsoil layers;

(ii) aeration of topsoil layers;

(iii) deep ripping of subsoil layers;

(iv) using hand tools only within the tree protection zone of a tree identified for retention;

(v) the application of gypsum to sodic clay topsoils and subsoils;

(vi) installing a 50 mm layer of lucerne hay between the topsoil and mulch layer;

(vii) adding worms to the topsoil;

(viii) applying soil rhizobia in solution to the topsoil;

(ix) inoculating plants with Mycorrhizal fungi; and

(x) incorporating soil wetters, crystals and wettable foams.

(6) Soil improvement additives

Any soil additives to be applied shall be as required/recommended by soil test results.

(7) Placing imported soil in gardens

(a) Garden mix soil shall be an imported "Organic Soil".

(b) Garden mix soil shall be a minimum depth of 300 mm after consolidation.

(c) Garden mix soil shall be placed, spread and graded evenly in maximum 150 mm thick layers to finish at a level which allows the surface of the mulching material after consolidation to be flush with adjacent finished levels. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(d) Garden mix soil shall be graded evenly to form a gentle crowned appearance at the centre of the garden bed and/or shall conform to the finished levels detailed on the drawings.

(e) The surface of the garden mix soil shall be smooth and free from stones or lumps of soil prior to planting.

(8) Mulch material
Refer to clause SC6.4.6.26.3 Supply of materials.

(9) Placing mulch

(a) Mulch shall be placed as soon as practicable after planting and shall be placed progressively as planting proceeds along the length of the garden or planting area.

(b) Mulch shall be spread smoothly and evenly over the entire garden so that after initial consolidation the finished level of the mulch is flush with adjacent finished levels.

(c) Mulch shall be shaped around plants to slope into the plant and shall be kept a minimum of 50 mm clear of plant stems to avoid collar rot.

(d) Organic mulch
Organic mulch shall be placed to a depth not greater than 100 mm and as a minimum shall be maintained to a depth of 75 mm after consolidation.

(e) Inorganic mulch
Not less than 14 days prior to the placing of inorganic mulch, herbicide shall be applied to the entire area to be mulched and prior to placing the mulch.

(f) Inorganic mulch shall be placed to a minimum depth of 100 mm unless noted otherwise on the drawings for the type of mulch specified.

SC6.4.6.26.7 Planting

(1) General

(a) Planting shall be carried out in accordance with the best horticultural practices.

(b) Plants shall be installed at the spacings and locations detailed on the drawings to avoid existing services or to cover an area uniformly.

(c) In feature planting areas at least 25% of tree plantings are to be provided as larger advanced stock, with a minimum 25 litre pot size.

(d) The Contractor is required to locate all existing services prior to planting.

(e) Planting shall not be carried out if the soil is very wet or water logged or during periods of extreme weather conditions such as extreme heat, cold wind or rain.

(f) Plant supplies are to be healthy, attractive, and a general high standard of stock in order to ensure long-term viability of the specimen. The stock will be free from disease, pests and weeds and structural defects, as per clause SC6.4.6.26.3 Supply of materials.

(2) Planting procedure – container stock

(a) A planting hole with vertical sides shall be excavated to a width of twice the diameter of the root ball of the plant and to a minimum depth of 100 mm deeper than the height of the plant container.

(b) The depth of the planting hole shall allow for the clearance specified and shall be in relation to the finished surface level where applicable.

(c) The sub grade material at the bottom of the planting hole shall be loosened to a depth of at least 50% of the root ball depth and the compacted sides of the planting hole shall be loosened to prevent confinement of root growth to the hole. Additional excavation of the base of the planting hole may be

required to ensure that the plant has sufficient sub grade drainage.

(d) Plants shall be thoroughly watered in the pot prior to planting so that when removed from the pot the root ball is moist. Plants shall be removed from their pots without damage to the root system. Plants shall not be removed from pots until the planting hole is complete and ready for planting.

(e) The plant shall be placed in the centre of the hole with the stem vertical and shall be set at a height such that the top of the potting material is level with the surrounding soil. Plants placed on a slope shall be set in the centre of the hole with the top of the potting material level with the lowest side of the planting hole and the plant stem vertical.

(f) Fertiliser tablets or granules shall be placed in the planting hole at the time of planting in accordance with the manufacturers recommended rates of application. The fertiliser shall be placed around the plant at half the depth of the planting hole and shall be covered with backfill soil to ensure no direct contact with the plant roots.

(g) Plants other than container stock trees placed in gardens shall be backfilled with garden mix soil as specified for the entire planting hole. The garden mix soil shall be lightly tamped around the plant and thoroughly watered to eliminate air pockets.

(h) During planting care shall be taken to ensure that soil is not mixed with the mulch. Mulch that is contaminated with soil shall be replaced.

(i) Container stock trees shall be backfilled in 150 mm layers up to within 200 mm of the top of the planting hole. The backfill soil shall be tamped around the tree and thoroughly watered to eliminate air pockets. Backfill the top 200 mm with garden mix soil.

(j) In areas other than heavily planted borders, shrubs or tuft plants, each individual plant shall have a watering basin for the extent of the planting hole formed with garden mix soil around the base of the plant.

(k) Individual container stock trees located in irrigated grassed areas shall have a 150 mm high watering basin for the extent of the planting hole formed with garden mix soil around the base of the tree.

(l) Plants placed on a slope shall have a small horizontal terrace formed for the extent of the planting hole.

(m) Immediately after planting, the plants shall be watered to thoroughly water the root ball and the backfill. Watering shall be carried out progressively as planting proceeds to ensure that plants do not dry out and as a minimum, plants shall be watered within a maximum of 1 hour from planting.

(n) All identification labels, nursery ties and the like shall be removed from the plants immediately after planting

(3) Planting procedure - ex ground stock plants

Editor's note—content under development.

(4) Transplanting trees

(a) Trees to be transplanted will be noted on the construction drawings prior to the commencement of construction.

(b) Preparation of the tree prior to transplanting shall be carried out in accordance with accepted transplanting practice and any requirements provided by council to suit the particular species and project.

(c) Preparation of the tree for transplanting shall be commenced in sufficient time to ensure that at the time of planting the tree is adequately prepared and will meet the specified requirements.

(d) All transplanting work shall be carried out under the direction of a suitably qualified horticulturist or arborist.

(e) Planting of the transplanted tree shall be generally in accordance with the details shown on the drawings.

(f) The resulting excavation after the tree has been removed shall be backfilled with compacted fill material suitable for the location.

(5) Root barrier

(a) Locations and type of root barrier shall be noted on the drawings or shall be as directed by the Superintendent.

(b) Root barrier shall be installed as per the manufacturer's recommendations and with particular attention to the location of any underground services and service pits.

(c) Root barrier must be installed in all situations where it is likely that tree roots may interfere or adversely affect infrastructure - such as driveways, kerbs, pathways and other street furniture and buildings, e.g. where species such as Ficus are to be planted in reasonable proximity to pathways.

SC6.4.6.26.8 Staking, ties and guying

(1) Every container stock tree shall be staked and tied unless otherwise approved by the Superintendent. Tree stakes

(a) Stakes shall be:

(i) a minimum of 2 stakes per tree;

(ii) placed outside of the tree root ball;

(iii) driven into the ground a minimum one third of their length;

(iv) for smaller trees (trees up to 45 litre), at least 1.0 metre apart; and

(v) for columnar trees, spaced to avoid excessive root ball damage.

(b) Care shall be taken to avoid damage to the tree root system and any services when installing stakes.

(c) All stakes shall remain in place for the entire “maintenance period” unless otherwise instructed by the Superintendent.

(2) Ties

Ties shall be fixed securely with staples to the stakes in a figure eight pattern around the tree stem. As a minimum one tie at half the height of the main stem shall be provided with additional ties as necessary to stabilise the tree.

(3) Guying

(a) Trees requiring the installation of guying shall be noted on the construction drawings or shall be as directed by the Superintendent.

(b) Guying consists of a minimum of three heavy duty stakes of either steel or timber driven into solid ground, with heavy duty galvanised wire ties firmly fasten to the stakes and looped around the tree trunk with suitable wrapping to protect the trunk.

(c) Underground guying where required to be used, shall be positioned for stability purposes, placement of the guy wires shall away from the tree trunk to avoid girdling issues as the tree matures. Such tree guying practices shall be removed prior to Off Maintenance inspection and acceptance by council.

Editor’s note—underground guying is accepted where suitable for the tree in question.

SC6.4.6.26.9 Sub soil drains construction

(1) Sub soil drains in gardens may be required in areas of heavy clay soils and in roadway medians, roundabouts and the like. Sub soil drains shall be installed at the locations and to the details shown on the drawings.

(2) Pipes and fittings shall be perforated plastic Type 1 Class 200 to AS2439: Part 1. Sub soil drain filter fabrics shall be approved geo fabric material in accordance with the relevant Australian Standards.

(3) Pipe surround shall be a coarse washed river sand complying with the grading requirements given in Table SC6.4.6.26.5 and shall completely surround the perforated pipe.

(4) The subsoil drain pipe shall be laid to grade continuously to the outlets nominated on the drawings at a

minimum grade of 1:100.

(5) Sub soil drains may be inspected by the Superintendent prior to placing any garden mix soil or backfill.

Table SC6.4.6.26.5 Recommended grading for sub-soil drain sand

A.S. SIEVE	% PASSING
9.5 mm	100
4.75 mm	98-100
2.36 mm	70-100
1.18 mm	30-78
600 µm	2-15
300 µm	0-4
150 µm	0-1

SC6.4.6.26.10 Garden edging

(1) Supply and installation of timber, concrete or recycled plastic proprietary garden edging shall be in accordance with the details on the drawings and the manufacturer's recommendations where applicable. Timber or recycled plastic garden edging must have a minimum thickness of 30 mm.

(2) Supply and installation of concrete kerbing shall be as specified in clause SC6.4.6.26.15.

SC6.4.6.26.11 Planter boxes

(1) Planter boxes shall be constructed at the locations and to the details shown on the construction drawings.

(2) Planter box soil shall be an imported soil mix (Potting Mix). Refer to project specific specifications where applicable.

(3) Planter boxes must have appropriate drainage (see clause SC6.4.6.26.9 Sub soil drains construction) provided that it is connected to a lawful discharge point. The drainage discharge is not permitted to cause nuisance, such as staining or sediments, to adjacent areas.

SC6.4.6.26.12 Grass area construction

(1) General

The following work activities relate to grass areas construction:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing turf soil;

(d) supply and lay grass turf;

(e) supply and lay grass seeding;

(f) supply and installation of hydro-seeding/mulching; and

(g) supply and application of fertiliser.

All grass area construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 Soils for landscaping and garden use; and
- AS 4454 Composts, soil conditioners and mulches.

(2) Co-ordination

The sequence for placing turf soil, installing irrigation and placing turf will vary according to the type of plants and irrigation system.

(3) Earthworks

Grass areas may require excavation or filling to achieve the finished surface levels detailed on the construction drawings. Refer to clause SC6.4.6.26.4 Earthworks.

(4) Placing turf soil

(a) Turf soil shall be an imported soil mix Type 2 “Soil Blend”.

(b) Turf soil shall be a minimum depth of 100 mm after light compaction.

(c) Turf areas shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding. As a minimum turf areas shall be graded to fall at 1:100.

(d) Turf soil shall be spread evenly and shall be lightly compacted to finish at a level which allows for the finished turf surface to be flush with adjacent surfaces such as paved areas, pathways mowing strips and the like. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(e) The surface of the turf soil shall be smooth and free from stones or lumps of soil prior to laying the turf.

(5) Turf material

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf approved by the Superintendent.

(b) Where turf areas are provided within centre medians, round-abouts and other identified areas of road reserve where edging/mowing may require traffic control, all turf is to be Empire Zoysia or approved similar turf and of a minimum width of 1.6 m to allow for clear mowing access.

(6) Laying turf

(a) Prior to laying turf, fertiliser shall be thoroughly mixed into the turf soil. Refer to Table SC6.4.6.26.5 for application rates.

(b) Areas to be turfed shall be divided into sections that can be prepared and completed (including adequate watering) in the same day.

(c) Turf shall be laid in straight lines in a stretcher bond pattern across the fall of the slope or parallel with the long side of level areas. Cross joints shall be staggered with a maximum gap of 5 mm between adjacent sections of turf.

(d) Immediately after laying the turf shall be rolled with a roller weighing not more than 90 kg/m of width.

(e) As soon as practicable after rolling turf shall be watered thoroughly with a fine spray to a depth of 150 mm. Watering shall continue as necessary to maintain moisture to this depth and to maintain the turf in a healthy condition.

(f) Where levels have deviated from the design levels after placing and watering the turf shall be lifted and the section regraded with turf soil to achieve design levels prior to replacing the turf.

(g) Turf shall be protected from pedestrian traffic until established and shall be protected from vehicle traffic at all times.

SC6.4.6.26.13 Hyrdo seeding/mulching

(1) General

(a) Excavation, filling, cultivation and placing imported soil mix for hydro seeding/mulching areas shall be as specified for turf areas.

(b) Details for hydro seeding/mulching supply and sowing shall be as noted on the drawings and/or as specified under separate cover.

(c) Organic mulches are to be applied to landscaped garden beds and trees which:

(i) meet AS 4454 Composts, soil conditioners and mulches;

(ii) are applied to a depth of 75 – 100 mm;

(iii) are of a coarse texture to allow water penetration to prevent nitrogen drawdown of the soil;

(iv) are aged prior to application;

(v) do not use plastic sheeting, typically used for weed suppression as it prevents rainwater from infiltrating soils and inhibits gaseous exchange between the soil and air; and

(vi) use a biodegradable mulch mat on any waterway embankment.

(d) Inorganic mulches, such as recycled concrete or brick cobbles, are limited to feature or themed landscapes, or in windy areas where organic mulches may be blown away.

(2) Supply of mulch materials

(a) Mulch materials supplied shall be free of deleterious and extraneous matter such as soil, weeds, seeds, rubbish, vermin, insects, pests, fungus, sticks, disease, declared plants or noxious weeds and shall be free of any matter toxic to plant growth or germination.

(b) All mulch materials supplied shall be in accordance with AS 4454 Composts, soil conditioners and mulches.

(c) Organic mulch
Organic mulch may be either:

(i) tea tree mulch from an approved supplier; or

(ii) wood chip produced by the chipping of native and other approved vegetation removed during the clearing and grubbing process on site (max 50 mm size); or

(iii) wood chip obtained from a council stockpile as directed by the Superintendent or his delegated site supervisor; or

(iv) other material as noted on the drawings.

(d) Inorganic mulch
Inorganic mulch shall be of the type and quality and noted on the construction drawings.

(3) Surface preparation

(a) Level sites
Prior to hydro seeding/mulching the area to be treated shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding.

(b) Embankments and slopes (1 on 5 maximum slope)
Prior to hydro seeding/mulching the area shall be lightly cultivated across the slope to minimise surface run-off and erosion. After cultivation, soil crumb size shall not exceed 20 mm.

(c) The surface of the area to be treated shall be free from weeds, stones, roots, sticks or other deleterious material and have a general moisture content of around 10% just prior to applying the hydroseed/mulch.

(4) Irrigation
An approved temporary above ground irrigation system shall be installed to ensure establishment of the hydro seeding/mulching is achieved within the timer frame specified. Refer to SC6.4.6.27 Irrigation.

SC6.4.6.26.14 Paving construction
Refer to sub-section SC6.4.6.18 Segmental paving.

All areas of road reserve fronting a subject site must be assessed against, and treated in accordance with SC6.4.3.3 Footpath treatment policy where specified.

SC6.4.6.26.15 Concrete kerbs
This section contains specific details for construction of concrete kerb in landscape and open space situations. Concrete kerb is most commonly used for garden edge or as a restraint for softfall areas in playgrounds.

All concrete garden edge kerb or similar structure shall have minimum rectangular profile dimensions of 150 mm wide x 200 mm deep with edges rounded to a radius of 20 mm (minimum) and constructed in accordance with clause

SC6.4.6.28.2(2) Kerb and channel. Where the concrete garden edge kerb abuts grass areas, the surface of the kerb must finish level with the surface level of the grass area.

SC6.4.6.26.16 Concrete works

For all concrete works associated with Landscaping activities refer to sub-section 6.4.6.28 Minor concrete works.

SC6.4.6.26.17 Masonry work

This section covers the supply of all materials, placing and finishing of all masonry blockwork including concrete core-filling and clay brickwork. Masonry Work includes walls, retaining walls, free standing piers, structures and the like. All masonry work shall conform to the requirements of AS 3700.

(1) Materials

(a) Blocks - Hollow load bearing masonry blocks shall conform to the requirements of AS 3700 - Section 2, and shall have a characteristic unconfined compressive strength of 15 MPa unless nominated otherwise agreed.

(b) Masonry blocks shall be sound, dry, clean and crack free and shall have been cured for not less than 14 days before delivery. The correct type of block shall be used to make provision for all lintels, pilasters, bond beams, openings, etc.

(c) Clean out blocks shall be used in the first course of all reinforced cores and/or where cores are to be concrete filled.

(d) Cement - for mortar shall be Portland Cement Type A and shall conform in all respects with the requirements of AS 3972.

(e) Sand - for mortar shall be clean, sharp and free from organic impurities and excess fines and efflorescing salts.

(f) Water - used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

(g) Hydrated lime shall conform to the requirements of AS 1672.1.

(h) Admixtures - no air-entraining additives or other admixtures shall be incorporated in the mortar unless specifically approved by the Superintendent.

(i) Reinforcement - shall comply with AS/NZS 4671 as applicable.

(j) Clay bricks - and brickwork shall conform to AS 3700. Clay brick shall have a characteristic unconfined compressive strength of 40 MPa unless otherwise agreed.

(2) Mortar for blockwork

(a) All mortar for blockwork shall consist of a homogeneous mixture of the ingredients and shall be classified as M4 in AS 3700. The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement 1: Lime 0 to 0.25: Sand 3.

(b) The mortar components shall be properly volume batched using calibrated volume boxes. Batching by shovel will not be permitted.

(c) Mortar shall be mixed in an approved mixing machine for not less than 3 minutes. Handmixing shall not be permitted unless specifically approved by the Superintendent. The dry ingredients shall be thoroughly mixed prior to the addition of water, which shall then be worked thoroughly through the mixture.

(d) Mortar shall be transported in a covered container such that excessive evaporation will be prevented. Retempering of mortar shall not be permitted.

(3) Core-fill concrete

(a) Core-fill concrete shall comply with the relevant requirements of AS 3600 Concrete Structures. Ready mixed concrete from an approved supplier shall be used. As a minimum and unless shown otherwise on the drawings, core-fill concrete supplied shall have the following properties in Table SC6.4.6.26.6.

Property	Design Value
Characteristic strenght F'c at 28 days	N 20
Norminal maximum size of aggregate	10 mm
Slump	230 mm +/-30 mm

(b) Testing of core-fill concrete supplied shall be carried out by the Concrete Supplier as part of the suppliers Quality Assurance System. The Contractor is required to provide the Superintendent with copies of the suppliers Test Certificates relating to the particular batch of core-fill concrete supplied.

Core-fill concrete supplied that does not meet the requirements of this specification shall be liable to rejection by the Superintendent. If directed by the Superintendent the Contractor will rectify any masonry wall which has been filled with rejected core-fill concrete.

(4) Laying blocks

(a) All work shall be carried out by experienced tradesmen to the general requirements of AS 3700 - Section 8. Blockwork shall be laid in lifts or not more than 2400 mm in height.

(b) All blocks shall be laid dry and wetting of the blocks shall not be permitted under any circumstances.

(c) Cutting of blocks shall be reduced to an absolute minimum by setting out to avoid irregular or broken bond.

(d) Blocks shall be stacked on planks or other supports free from contact with the ground and shall be covered at all times to ensure that the blocks remain dry.

(e) Blocks shall be laid in straight uniform courses of running bond unless noted otherwise on the drawings. Intersecting walls shall be bonded as shown on the drawings.

(f) The surface of the concrete footing, floor slab, beam, etc. on which the base course is to be laid shall be thoroughly cleaned prior to laying the base course to ensure all laitance is removed.

(g) The base course shall incorporate clean out blocks at every reinforced core, with the clean out opening on the inside face of the wall.

(h) Reinforcement starter bars shall be checked for alignment prior to laying the base course. Starter bars shall be vertical. Bending starter bars to allow the laying of the base course is not acceptable. Any starter bars out of position shall be rectified by the Contractor as directed by the Superintendent.

(i) For unreinforced and reinforced masonry walls, horizontal joints shall have full mortar coverage on the face shells and on the webs.

(j) For unreinforced masonry walls all vertical joints shall have full mortar coverage. For reinforced masonry walls all vertical joints shall be buttered only for the thickness of the face shells.

(k) All horizontal and vertical joints shall be 10 mm in width with a maximum mortar intrusion into the cores of 6 mm. Mortar droppings into cavities or cores shall be avoided.

(l) Tooling of the joints shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a V-shaped or round bar in a manner that will compact the mortar rather than drag it out. Raked joints shall not be permitted to encroach more than 5 mm in depth.

(m) If it is necessary to move a block after it has been set in place with mortar, then the block shall be removed from the wall, the mortar removed and the block shall be reset in fresh mortar.

(n) Capping blocks shall be fixed with a suitable flexible external grade adhesive as detailed on the drawings. Laying capping blocks in mortar only is not acceptable.

(o) Where new blockwork is to be laid on top of an existing masonry block wall, the existing core concrete shall be cleaned to expose all aggregate and treated using an adhesion enhancer such as bondcrete or approved equivalent before block laying is commenced.

(p) Extreme care shall be exercised to prevent mortar adhering to the face of blockwork. Acid shall not be used to clean down masonry walls.

(5) Reinforcement

(a) Steel reinforcement shall be supplied and bent in accordance with AS 3700. Rebending of reinforcement

with or without heating is not permitted unless approved by the Superintendent.

(b) Steel reinforcement shall be free from rust, oil, varnish, mud or any other coatings, cracks, scale blister and other defects and shall comply in all respects with AS/NZS 4671.

(c) All horizontal reinforcement shall be laid into the wall as the block laying progresses. Galvanised wire loops shall be cast into the horizontal joints prior to placing the reinforcement to ensure correct positioning of the reinforcement.

(d) Vertical reinforcement shall be placed after the wall has been laid and shall be placed in the core with the correct cover to the face of the blocks as detailed on the drawings. Unless noted otherwise on the drawings vertical reinforcement shall be placed in the centre of the core.

(e) Splice lengths for both horizontal and vertical reinforcement shall not be less than 45 bar diameters for plain round bars or 30 diameters for deformed bars or 450 mm, whichever is the greater.

(f) All reinforced block walls shall have vertical reinforcement in the core at the ends, corners, sides of openings, adjacent to control joints, at unbonded intersections and at the maximum centres between these points.

(6) Cast in elements

(a) The Contractor shall co-ordinate with all other trades as necessary to ensure that all conduits, fitments, penetrations and the like are incorporated in the masonry as detailed on the drawings and as specified.

(b) All bolts, anchors and other steel fittings shall be accurately set into the walls as the work progresses and positioned such that they shall be thoroughly embedded in mortar or core-filling concrete as required.

(c) Where items to be cast into the blockwork are found to be out of position and cannot be satisfactorily corrected, then the section of blockwork shall be completely demolished, and then reconstructed to allow correct positioning.

(7) Joints in blockwork

(a) Joints in blockwork shall be the type and at the locations detailed on the drawings. Joints with steel dowels shall have the dowels securely supported to ensure that the dowel remains in the correct position during the placing of core-fill concrete.

(b) Construction joints shall be located as detailed on the drawings or shall be located where agreed with the Superintendent to suit specific site requirements.

(c) Joint filling compounds shall be as detailed on the drawings and shall be installed in accordance with the manufacturers recommendations, with particular attention to the preparation of the blockwork surface to suit the application of the joint filling compound.

(8) Placing core-fill concrete

(a) Masonry walls shall cure for at least 3 days before core-fill concrete is placed.

(b) The cores to receive core-fill concrete shall be cleaned of all mortar protrusions by rodding from the top of the wall. All mortar droppings and foreign matter shall then be removed via the clean out openings at the base of the wall, the vertical reinforcement positioned and formwork fixed in place to seal the clean out block opening.

(c) Core filling shall not proceed until the reinforcement and cores have been inspected by the Superintendent. Clean out openings shall not be sealed until the inspection has been carried out.

(d) Core-fill concrete shall be thoroughly compacted into place as it is poured with the aid of small immersion vibrators or rodding. Block cores shall be topped up after settlement occurs.

(e) Core-fill concrete shall be placed for the full height of the blockwork in lifts of not more than 2400 mm in height. A minimum delay period of 1 hour and a maximum delay period of 3 hours shall be observed between lifts.

(f) Proprietary core plates shall be used to confine the core-fill concrete to the reinforced cores.

(g) Placing of core-fill concrete in bond beams shall be done in one continuous operation for the full length of the bond beam. Construction joints in bond beams other than control joints, are not acceptable.

(h) Extreme care shall be exercised to prevent slurry adhering to the face of blockwork. Acid shall not be used to clean down masonry walls.

(9) Mortar for clay bricks

(a) All mortar for clay bricks shall consist of a homogeneous mixture of the ingredients and shall be classified as M3. Refer to AS 3700.

(b) The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement: 1, Lime: 1, Sand: 6.

(c) Mortar for clay bricks shall be generally in accordance with clause SC6.4.6.26.17(2) Mortar for block work.

(10) Laying clay bricks

(a) Clay bricks shall be fully bedded and fully faced. Bed joints shall be 10 mm nominal height.

(b) Clay brick masonry walls shall be laid with galvanised brick ties at 600 mm maximum centres each way and at 300 mm centres adjacent to openings in accordance with manufacturer's specifications.

(c) Laying of clay bricks shall be generally in accordance with clause SC6.4.6.26.17(4) Laying blocks.

(11) Protection of walls

(a) During construction and after the wall is laid and prior to placing core-fill concrete; under no circumstances shall masonry blocks be wetted or allowed to become wet.

(b) At the completion of a day's work and during wet weather the top and sides of all walls shall be covered to prevent rain penetrating the cores and wetting the blocks.

(c) During the construction of masonry walls and prior to the core-fill concrete having gained its full strength, the Contractor shall protect the wall by suitable means such as bracing to ensure that the wall is not damaged and to ensure the safety of workers on the site.

(12) Tolerances

(a) All masonry shall be built true and plumb such that the maximum "out-of-plumb" in a 3 m height does not exceed 10 mm.

(b) The bed joint at any level shall be within ± 3 mm.

(13) Surface finishes to masonry

(a) Surface finishes, such as painting, rendering or textured finishes shall be as detailed on the drawings or as nominated in the Finishes Schedule.

(b) Prior to applying any surface finish the substrate shall be free from dirt, dust, oil, grease, mould, fungi, efflorescence, release agents, bond breakers, scaling and laitance or any other contaminants or foreign material that may affect adhesion. Remove all traces of loosely adhering material by scraping, grinding, wire brushing or air blowing as necessary.

(c) Preparation of the surfaces to be treated, application of the surface finish and curing after application if required, shall be carried out in strict accordance with the manufacturer's recommendations. Particular attention shall be made to application during suitable weather conditions.

(d) Gap fill and/or sealant material used for joints or cracks in walls shall be checked for compatibility with the proposed surface finish.

(e) Anti-vandal coatings shall be used in circumstances where walls are exposed (i.e. not screened by soft landscaping) and prone to graffiti.

(f) Dissimilar materials adjacent to surfaces to be treated shall be masked to avoid contact, (e.g. capping and flashings).

(g) The Contractor shall provide the Superintendent with all warranty details of the surface finishes.

SC6.4.6.26.18 Stormwater drainage

All stormwater drainage shall be constructed in accordance with the relevant stormwater drainage guidelines contained in SC6.4.6.4 Stormwater drainage.

SC6.4.6.26.19 Infrastructure items

Supply and installation of infrastructure items such as timber decking, timber and steel fencing, seats, picnic sets, barbeques, play equipment and signage shall be as detailed on the drawings and constructed in strict accordance with the manufacturers' specifications. The Contractor shall provide the Superintendent with all warranty details. Concrete for footings, plinths and the like for infrastructure items shall be in accordance with clause SC6.4.6.26.16 Concrete works.

SC6.4.6.26.20 Electrical

The installation of electrical components shall comply with the requirements of AS 3000. Where required under the *Electricity Act 1994*, electrical installations shall be installed by a registered Electrical Contractor as defined by that Act. Refer to the electrical engineer's drawings and specifications for all requirements.

SC6.4.6.26.21 Summary of limited and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.26.7 below.

Item	Activity	Limits/Tolerances	Clause
1.	**Topsoil**	>3% by mass	SC6.4.6.26.5(2)(a).
	a) Organic Content		
	b) pH	>5.5 <7.5	SC6.4.6.26.5(2)(a)
	c) Soluble Salt	<0.06% by mass	SC6.4.6.26.5(2)(a)
2.	**Turf**	Widths >300mm.	SC6.4.6.26.5(2)(d)
3.	**Vegetable mulch**	maximum size <10mm	SC6.4.6.26.5(2)(f)
	a) Material	<50% by mass of total mulch	SC6.4.6.26.5(2)(f)
	b) Paper Pulp		
4.	**Topsoiling**	Minimum compacted thickness	SC6.4.6.26.5(3)(b)
		at any location of 30mm	SC6.4.6.26.5(4)(c)
			SC6.4.6.26.5(5)(a)
5.	**Straw mulching**	Finished thickness >20mm.	SC6.4.6.26.5(4)(e)
	a) Straw Mat		
6.	**Mulch**	Shall not exceed 5% by volume.	SC6.4.6.26.3(6)
	a) Fines		
	b) Woodchip	Maximum size <50mm.	SC6.4.6.26.3(6)
7.	**Plant material**	Contain >20% <25% by volume	SC6.4.6.26.3(2)
	a) Container Soil Mix	of clay.	

Attachments

SC6.4.6.26 Attachment A: Landscaping materials

MATERIAL *(sample only - to be completed by compiler)*	**TYPE**	**MINIMUM APPLICATION RATE**
1. HERBICIDE *	"Roundup"	As per manufacturers recommendations
2. SEED		
a) Grass	Rye Corn (April-August) or	60 kg/ha
Japanese Millet (September-March		60 kg/ha
Hulled Couch		5 kg/ha
Red Clover (Inoculated)		5 kg/ha
White Clover (Inoculated)		5 kg/ha
"Elka" Perennial Rye		5 kg/ha
(b) Native	Acacia dealbata	4 kg/ha
Acacia buxifolia		1 kg/ha
Acacia decurrens		1 kg/ha
Acacia pravissima		1 kg/ha
Leptospermum lanigerum		1 kg/ha
Hardenbergia violacea		500 g/ha
Kennedia prostrata		500 g/ha
Acacia implexa		200 g/ha
Banksia marginata		200 g/ha
Bursaria spinosa		200 g/ha
Callistemon pallidus		200 g/ha
Dodonaea viscoca		200 g/ha
3. TURF GRASS (a) Medians (b) Verges/Footpaths (c) Other Areas	Couch Buffalo Couch	Refer to drawings " "
4. FERTILISER * (a) Vegetation of Slopes/Drains (b) Landscape Planting	Dynamic Lifter "Nitro" "Kokei" pellets	1000 kg/ha
5. WETTING AGENT *	"Aquasoil"	1 litre/1000 litres of mix water
6. PESTICIDE * (a) Liquid (b) Powder	"Lorsban 500 EC" "Lorsban 250 W"	5 litres 10 kg
7. ORGANIC FIBRE MAT *	"Sta-firma" (light grade)	-
8. MULCH	Composted/Pasteurized	100mm thick
* Material shall be as listed or equivalent as approved by council.		

SC6.4.6.27 Irrigation

SC6.4.6.27.1 Introduction

(1) Scope

(a) This sub-section sets out the standards for design, installation and construction of irrigation systems that will become a Townsville City Council asset.

(b) Irrigation systems that will be connected to an alternative water supply have additional requirements to this sub-section.

(2) Reference and source documents

All design and documentation, materials supplied and work carried out shall be in accordance with the following:-

(a) Australian Standards:

AS 1432	*Copper tubes for plumbing, gas fitting and drainage applications*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 2032	*Installation of PVC pipe systems*
AS 2033	*Installation of polyethylene pipe systems*
AS 2053	*Conduits and fittings for electrical installations (all Parts)*
AS 2129	*Flanges for pipes and valves and fittings*
AS 2698.2	*Plastics pipes and fittings for irrigation and rural applications –Polyethylene rural pipe*
AS 2698.3	*Plastics pipes and fittings for irrigation and rural applications –Mechanical joint fittings for use with polyethylene micro-irrigation pipes*
AS 2845.1	*Water supply – Backflow prevention devices – Materials, design and performance requirements*
AS 2845.2	*Water supply – Backflow prevention devices – Registered air gaps and registered break tanks*
AS 2845.3	*Water supply – Backflow prevention devices - Field testing and maintenance of testable devices*
AS 3000	*Electrical installation (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3008.1.1	*Electrical Installations –Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions*
AS/NZS 3500	*Plumbing and Drainage*
AS/NZS 3500.0	*Plumbing and drainage Part 0: Glossary of terms*
AS/NZS 3500.1	*Plumbing and drainage – Water services*
AS 3500.1.1	*National plumbing and drainage - Water supply – Performance requirements*
AS 3500.2.1	*National Plumbing and Drainage Sanitary plumbing and drainage - Performance requirements*
AS 3500.2.2	*National Plumbing and Drainage Sanitary plumbing and drainage - Acceptable Solutions*
AS/NZS 3808	*Insulating and sheathing materials for electrical cables*
AS/NZ 3879	*Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ASA pipes and fittings*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZ 4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*

(b) Legislation:

Water Act 2000

Electricity Safety Act 2002

Work Health and Safety Act 2011

(c) Other:

Department of Energy and Water Supply, *Queensland Water Recycling Guidelines*, December 2005

(d) Authorities

The rules and regulations of the relevant local electricity supply authority.

The rules and regulations of the relevant local water supply authority.
The requirements of any other Authority having jurisdiction over the installation.

SC6.4.6.27.2 Irrigation pipework

(1) Standards
All pipes shall be supplied, installed and joined in accordance with the manufacturer's recommendations and all relevant, current Australian Standards.

(2) Class of pipe

(a) Main line pipes (pressurised) of nominal 80mm diameter and larger shall be minimum Class 12 uPVC rubber ring jointed (RRJ) or PN12.5 (Poly pipe).

(b) Main line pipes (pressurised) of nominal diameter less than 80mm shall be minimum Class 12 uPVC solvent welded joint (SWJ) or PN12.5 (Poly pipe).

(c) All lateral line pipes (non pressurised) shall be minimum Class 6 (uPVC) or PN6.3 (Poly pipe), except for lateral line pipe work under road pavements which shall be Class 12 (uPVC) or PN12.5 (Poly pipe).

(d) Supply line to a drinking fountain or a water tap shall be a minimum of 32 mm Class 12 uPVC or PN12.5 (Poly Pipe). Copper pipe is not acceptable.

(e) Copper pipe to a Water meter, drinking fountain and water tap assemblies shall be minimum Type B.

(f) All irrigation pipe work under pavements (road or otherwise) shall be encased in a conduit.

(3) Conduit crossings

(a) All conduits used to encase irrigation line pipes shall be 100mm Class 9 PVC SWJ Pipe as standard unless otherwise approved by the Superintendent. Storm water or waste water pipe used as conduit is not acceptable.

(b) Conduit crossing ends shall be sealed with duct tape to stop the ingress of soil and material from entering the conduit.

(c) Conduit crossings within road reserves and medians are to have the outer 50mm of conduit sealed with expanded foam, to stop the transportation of water through the conduit.

(d) Where underground bores or conduits crossings have been installed, a stainless steel tag shall be used to mark the start and finish of the conduit. The tag shall be a minimum of 38mm diameter and 1.6mm thick. It is to be nailed, glued or set into the surface of the crossing. The marker shall be engraved with the words "Irrigation Water", given a unique number and recorded on the as constructed drawings.

(4) Pipe fittings

(a) All fittings for uPVC pipe shall be minimum Class 18 PVC SWJ.

(b) All fittings for poly pipe shall be metric compression fittings, Plasson or Philmac.

(c) All fittings for low density pipe shall be barbed type, with all joints fitted with stainless steel cobra clamps – or approved equivalent.

(d) All threaded fittings, except sprinklers, shall be sealed using PTFE thread tape and Liquid Teflon.

(5) Pipe installation generally

(a) Interior of pipes shall be kept free of dirt and debris at all times.

(b) Where pipe work is left unfinished during installation, the open ends of pipes shall be sealed off with plastic secured to the end of the pipe or have end caps fitted.

(c) Pipes laid in a common trench shall be separated by a minimum of 100mm.

(d) Refer to SC6.4.4.8 Standard drawings SD-13.1, Figures 1 to 6 for pipe alignments for all irrigation works in road reserves.

(6) UPVC rubber ring jointed pipe – installation (i.e. Main line pipes of nominal 80mm diameter and larger).

(a) All uPVC rubber ring jointed pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2032.

(b) All uPVC rubber ring jointed pipe work shall be laid in a minimum of 100mm sand bedding and surround.

(c) All connections and changes of direction horizontally and vertically in rubber ring joint (RRJ) pipe work shall be installed with concrete thrust blocks.

(d) Thrust block design and size shall follow pipe manufacturers recommendations ("Thrust Block Design – Pressure Pipeline Fittings" Iplex uPVC Design Manual). Thrust blocks shall be 15 MPA concrete in accordance with AS 2032. All thrust blocks are to be cast in situ against undisturbed ground and shall have neatly formed sides.

(e) The ends of pipes used for rubber ring joint (RRJ) connections shall have a smooth chamfer 15 degrees to the outer edge and shall be free of all burrs and rough edges. Rubber rings and lubricant used shall be in accordance with the pipe manufacturer's recommendations.

(f) Each pipe length shall be laid in the following direction; water flow runs from the socket end to the spigot end of the pipe, with the exception of ring mains.

(g) Trenches may be curved to avoid obstructions within the limits of the curvature of the pipe.

(7) UPVC Solvent welded joint pipe installation (i.e. main line pipes of nominal diameter less than 80mm or lateral line pipes).

(a) All uPVC Solvent welded joint pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2032.

(b) All uPVC solvent welded joints shall be primed and cemented.

(c) Primer and solvent cement shall conform to AS/NZ 3879.

(d) Primer is to be "Priming Fluid (red)".

(e) Solvent is to be "Christy's PVC Red Hot Blue Glue" or approved Type "p" solvent cement.

(f) All pipes shall be primed before cementing the joint.

(g) Pipe ends shall be free of all burs and rough edges.

(h) All uPVC solvent welded joints shall not be subjected to water pressure for at least 24 hours after cementing the joint.

(i) All mainline uPVC solvent welded joint pipes shall be laid in a minimum of 100mm sand bedding and surround.

(8) Polyethylene pipe installation

(a) All polyethylene pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2033.

(b) Poly pipe shall be laid with sufficient allowance for contraction and expansion of the pipe.

(c) Pipe ends shall be free of all burs and rough edges and shall be chamfered with the appropriate tool before jointing.

(d) Polyethylene tapping saddles are only to be used to connect sprinklers and dripper tube to polyethylene pipe work.

(9) Trenching

(a) All pipe work shall be laid in trenches, with the exception of:

(i) pipes which are installed in underground conduits; or

(ii) pipes which are installed above ground due to obstacles i.e. bridges, walls, etc.

(b) Trenches shall:

(i) be sufficiently wide to allow adequate working clearance;

(ii) be excavated in straight lines between bends or pits;

(iii) have vertical sides and be a constant depth for the full length of the trench; and

(iv) be of adequate depth to allow for pipe bedding and adequate cover to the pipe as specified.

(c) Trenches for multiple pipes shall be sufficiently wide to allow adequate working clearance and a minimum of 100mm separation between pipes.

(d) Pipes shall be firmly and evenly supported with bedding material or approved backfill material in the centre of the trench.

(e) Minor adjustment to the irrigation systems design layout will be permitted to clear underground obstructions.

(f) Trenching machinery shall be avoided within 1m of existing services. Hand trench to expose existing services, prior to connection or use of trenching machinery.

(g) Cover to pipes

The minimum and maximum depth of cover to pipes shall be as noted in Table SC6.4.6.27.1.

Table SC6.4.6.27.1 Depth of cover to pipes

Pipe	Minimum	Maximum
Main lines in road reserves (UPVC and Polyethylene)	600mm	750mm
Main lines all other locations (UPVC and Polyethylene)	400mm	600mm
Lateral lines - all locations	300mm	500mm
Drinking fountain and water tap supply lines. (except in land fill sites)	300mm	400mm
Drinking fountain and water tap supply lines in land fill sites	450mm	600mm
Dripper tube (turf)	75mm	100mm
Dripper tube (garden)	Surface	Surface

Note—depth of cover is defined as the distance from the top of the pipe to the finished surface level or from the top of the pipe to the underside of paving, concrete or road pavement. Refer to SC6.4.4.8 Standard drawings SD-18.1 for Typical Pipe Trench details.

(10) Pipe bedding

(a) A minimum of 100mm sand bedding and surround is required for:

(i) all main lines;

(ii) all uPVC Rubber Ring Jointed pipes;

(iii) all pipes under road pavements;

(iv) all pipes laid on solid rock;

(v) all pipes where rubble, rocks and/or debris is encountered in the trench;

(vi) all potable water lines; and

(vii) all electrical conduits.

(b) Bedding sand shall be clean sand with rounded grains free of any rocks, debris and organic matter and graded such that 100 per cent passes a 4.75mm sieve size.

(c) Pipe work, other than those listed in clause SC6.4.6.27.2(10)(a) may be laid without sand bedding, provided the trench is free of rubble, rocks and /or debris.

(d) Pipe work, other than those listed in clause SC6.4.6.27.2(10)(a), in locations where the natural earth contains rocks, debris and any materials that may damage pipes over time or where excessive ground movement is likely to occur shall be laid in a minimum of 75mm sand bedding and surround.

(11) Approved backfill to trenches

(a) Excavated material may be used as backfill, provided that the material is free of rubble, rocks, debris, organic material and any sharp or solid objects and/or materials that may damage the pipe over time.

(b) Where material excavated from the trench is unsuitable for backfill, clean sand, garden loam shall be used as backfill.

(c) Backfill to trenches shall be compacted with a wheel roll or plate compactor. Completed backfill is to be mounded 50mm higher than the surrounding surface for the full length of the trench, to allow for further consolidation.

(d) Backfill to trenches under road pavements and pathways shall be crusher dust material placed in 150mm compacted layers.

(e) On completion of backfilling operations, all excess material is to be either reused on site where possible or shall be removed from the site.

(12) Exposed pipes

(a) Any exposed pipe shall be constructed of stainless steel or lagged copper and shall comply with AS/NZS 3500 standards for exposed pipe.

(b) All above ground works are to conform to AS/NZS 3500.1, Section 5.7 "Support and fixing above ground".

(c) Bracing around the pipes is to be lined with an appropriate material to prevent damage to the pipe.

(d) Pipes are to be labelled “potable” or "non potable" in accordance with Australian Standards.

(13) Proximity to other services

Table SC6.4.6.27.2 lists the separation required between water pipes and electricity and gas services. Separation for all other services shall be as outlined in AS/NZS 3500.1 Section 5.3 entitled “Proximity to other services”.

Service	Separation
Electrical Cables with Warning Tape or Mechanical Protection (Water Pipes DN65mm and below)	100mm
Electrical Cables with Warning Tape or Mechanical Protection (Water Pipes larger than DN65mm)	300mm
Electrical Cables with no Warning Tape or Mechanical Protection	600mm
Consumer Gas Pipe with Marker Tape 150mm above complying with AS2648.1 (Water Pipes DN65mm)	100mm
Consumer Gas Pipe with Marker Tape 150mm above complying with AS2648.1 (Water Pipes larger than DN65mm)	300mm
Consumer Gas with no Marker Tape or Mechanical Protection	600mm

SC6.4.6.27.3 Control system

(1) Scope

This section covers the furnishing of all labour, materials and services in connection with the fabrication, factory testing, delivery and site installation of the irrigation controller and associated cabinets.

(2) Network requirements

(a) Townsville City Council operates an irrigation control system that consists of a Motorola Irrinet Supervisory Control and Data Acquisition (SCADA) System. This system is commonly known as the Irrigation Central Control (ICC). The ICC System communicates to irrigation controllers throughout the Townsville region over UHF wireless telemetry communication networks.

(b) All irrigation controllers shall be operated via the ICC System unless an alternative controller system is approved by the Superintendent

(c) Contractors are required to provide an approved irrigation controller to adequately service the proposed irrigation system. The Controller shall provide for the number of stations including master valve and fertigation control valve required for:

(i) the current irrigation system to be installed; and

(ii) defined future requirements of the controller.

(d) Irrinet M Slave, Irrinet M and Irrinet ACE controllers by Motorola are the approved irrigation controllers.

(e) All irrigation controllers must be capable of communicating with the ICC System across the telemetry communication network. Each controller must be fitted with an approved radio transceiver and antenna.

The transceiver must have the correct frequency configuration to communicate on the network.

(f) Each irrigation controller shall be allocated a logical address by Maintenance Services – Irrigation Design Unit for communications to the ICC System.

(g) All irrigation controller system components shall operate within the ranges specified by the manufacturer.

(3) Irrigation controller selection

(a) Irrigation controllers are to be selected from Table SC6.4.6.27.3.

Table SC6.4.6.27.3 Controller selection list

Controller Name	Power Type / Source	Valve Capacity
AC Irrinet M Slave 12 - 24	AC / 240 V Mains	12 to 24
AC Irrinet M Slave 36 - 48	AC / 240 V Mains	36 to 48
AC Irrinet M 12 - 24	AC / 240 V Mains	12 to 24
AC Irrinet M 36 - 48	AC / 240 V Mains	36 to 48
AC Irrinet ACE 24 - 48	AC / 240 V Mains	24 to 48
XR 1 - 4	DC / 6 V Solar	1 to 4

(b) AC powered irrigation controllers are the preferred option of the Superintendent. DC powered irrigation controllers are not acceptable unless approved by the Superintendent.

(4) Operating environment
Ambient conditions

(a) All equipment mounted inside cabinets and cubicles shall be suitable for operation in temperatures up to 60 °C. Measures shall be taken to ensure that high ambient temperatures and full load operation do not cause temperatures to exceed maximum allowed operating temperatures.

(b) Since all cabinets are to be mounted outdoors, particular consideration shall be given to minimise heating by direct solar radiation.

(5) Irrigation controller specification (general)

(a) General requirements

(i) The irrigation controller cabinet and component parts shall conform in all respects to the highest standards of design and workmanship and appropriate requirements of the latest applicable state or local codes.

(ii) When mounting accessories to the back panel, use fine threaded tapped screws.

(iii) The irrigation controller cabinet shall be completely wired, and assembled, with all devices and controls installed as shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1 so that the entire assembly is an operating unit ready for installation and the wiring of field devices.

(iv) Wiring shall meet the latest requirements of the AS 3000 and applicable workplace safety codes.

(b) Wiring

(i) All wire shall be 0.5mm²/PVC 105/ stranded, insulated for 600 V.

(ii) A "bootlace ferrule" shall be used on wires connected to terminals which have only a screw for securing the wire. Ferrules shall be properly crimped using a professional crimping tool.

(iii) All manufacturer terminal block wiring shall be restricted to the panel side of the blocks. The manufacturer shall connect no more than two wires to any terminal point. The field side of the terminal blocks shall be left completely free of wires and jumpers. Wiring on terminal blocks shall be so arranged that not more than one wire to the field side of any terminal point will be connected with the exception of the earth.

(iv) All multiple common connections shall be wired via bridging links on the terminal blocks.

(v) Horizontal and vertical wiring between the terminal blocks and the devices shall be enclosed in ducts except wiring between the ducts and the devices may run exposed for distances not exceeding 100mm. Duct loading shall not exceed 75 per cent rated fill at any point.

(vi) All exposed wiring shall be formed neatly with square corners and where possible, grouped in packs. Each pack shall be bound with plastic ties and be substantially supported throughout its full length. Cabled wire is not acceptable.

(vii) Splicing of wires on electrical circuits is not acceptable.

(c) Terminal blocks

Terminal blocks shall be provided for all wiring which exits the panel. All terminal blocks shall be mounted and of the colour as shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-24.8.

(d) Consumer power

(i) The irrigation control cabinet shall be equipped with a (Clipsal 4CC6 or approved equivalent) enclosed consumer panel. Consumer power shall be wired direct into the consumer panel. The consumer panel shall enclose a neutral link and an earth bus with the panel structure connected to the bus so as to effectively earth the entire structure. A solder-less clamp type terminal lug shall be provided at the end of the earth bus for a 6mm² stranded earth cable to be attached from the external earth-stake.

(ii) Whenever the electrical diagrams indicate an earth for a circuit at the panel, a single wire for each circuit earthed shall be run independently to the earth bus and fastened thereto using a ring lug and a machine screw inserted in a tapped hole.

(iii) Earthing of the enclosure and back panel from the consumers panel shall be made using 4mm² stranded earth cable.

(iv) The consumer panel shall be wired with a main isolation switch an RCD/MCB and a suitably rated "Isatrol" mains filter unit, din-rail mounted within the consumer panel to provide power to the GPOs. One double GPO and one single GPO are to be mounted on the face cover of the consumer panel. Care shall be taken when positioning the GPOs not to cover the access screw holes to the consumer panel.

(v) Each device requiring 240 V AC power shall have an individual line plug and plug into an allocated GPO on the consumer panel.

(vi) Power will be supplied as a single phase voltage at 50 Hz and 240 V ± 10 per cent.

(vii) All 240 V connections are to be tool proof and either housed in the consumer panel or behind a protective cover.

(6) Irrigation controller specifications (specific)

(a) Irrinet M Slave, Irrinet M and Irrinet ACE.

(i) Each controller's maximum valve output is listed in Table SC6.4.6.27.3 including master and fertigation valves. The controller shall have as a minimum, two inputs from electronic pulse water meter and rain switch.

(ii) The general control voltage shall be 24 VAC for controller outputs used for water valve operation.

(iii) The 24 VAC power is via the PELV system with common tied to earth.

(iv) The irrigation controller cabinet layout, dimensions and wiring are shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD 29.1.

(v) The irrigation controller cabinet shall be a B&R NI (NI06062/S) or (NI06063/S) with dual key lock (NI030) or approved equivalent as shown within SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1. The controller pole, mast and cross arms shall be coated with 2PAK Epoxy Paint in Heritage Green colour.

(vi) Control equipment shall be selected from the Preferred Equipment list - Controller and Telemetry Components within SC6.4.4.8 Standard drawings SD-5.1 through SD 5.10 and SD-20.1 through SD-29.1, unless otherwise specified by the Superintendent.

(vii) All firmware incorporated in CPUs and other intelligent modules shall be the latest released

version.

(viii) The radio telemetry equipment involves the installation of the following equipment:

(A) TX-3600 GME Transceiver with blind front panel, programmed with Parks Services frequencies;

(B) YB6-61 Yagi Antenna, UNV2 mounting bracket and RG58 coax cable terminated with a N88 N type male connector;

(C) PS123 GME Power Supply or DC1224X Aeon UPS (for Irrinet M controllers);

(D) IS50NX Surge Arrestor flange mounted with N type female connectors;

(E) RG58 Coax Fly Lead terminated with N88 N type and BNC113 male connectors; and

(F) Data cable connecting controller to transceiver.

(ix) The transceiver shall be mounted on the door such that the indicator lights are visible when the door to the panel is opened. The antenna cable and data cable are to be feed from the controller via the cabinet ducting towards the door hinge and onto the door bracket. The transceiver shall be mounted in such a way to allow for its easy removal. The mounting bracket is to be securely fastened to the back of the door. All cabling on the door shall be neat and fastened in place by cable ties, SC6.4.4.8 Standard drawings SD-26.2, SD-26.4 and SD-5.10 refers.

(x) A Surge Arrestor shall be mounted on the cabinet earth lug and suitably earthed refer SC6.4.4.8 Standard drawings SD-27.1 and SD-5.10. The coax fly lead shall be connected from the transceiver BNC connector to the “Equipment” side of the surge arrestor. The coax cable from the antenna will enter the panel and be terminated on the “Antenna” side of the surge arrestor.

(xi) Before the transceiver is powered up a qualified radio technician shall fit the antenna coax plug and carry out a SWR / radio check and set the modulation level.

(xii) The “data cable” shall connect the controller to the transceiver and shall be secured and neatly run through the ducting.

(xiii) PS123 GME Power Supply 240 VAC to 12 VDC is to be mounted on the door bracket to supply power to the Transceiver and Interposing Relays refer SC6.4.4.8 Standard drawings SD-5.5.

(xiv) DC1224X Aeon UPS (uninterrupted power supply) 240 VAC to 12 VDC is to be mounted on the door bracket to supply power to the Irrinet CPU memory and Transceiver, refer SC6.4.4.8 Standard drawings SD-20.1 through SD-29.1.

(xv) A separate 24 V AC power supply shall be provided as shown within SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1:

(A) Irrinet M, Irrinet M Slave and Irrinet ACE controllers require 1 Powertech 240 V/24 V 150 VA Transformer part No. MP3045 to be direct mounted to supply power to the controller and field solenoids.

(xvi) The controller shall have two conduits connecting the cabinet to the ground. The following conduit types and sizes shall be used:

(A) M.D. 50 mm electrical conduit (24 V Control Cable); and

(B) H.D. 25 mm electrical conduit (240 V Power Supply).

(xvii) A Mini-Clik II Rain Switch or approved equivalent is to be installed on the controller pole. Construction details are given in SC6.4.4.8 Standard drawings SD-29.1. The device is to be set on a 13mm setting.

(b) Piccilo XR

(i) The output control voltage used is a DC Pulse through a 2 wire circuit suitable for activating DC latching coils used for water valve operation - Hunter ICV with DC Coil option or approved equivalent. With the Piccilo XR output voltage adjusted to 18 V (from the factory default of 12 V).

(ii) The controller assembly is powered by a 6 volt sealed lead acid battery which is charged via a solar panel and regulating semiconductors. SC6.4.4.8 Standard drawings SD-4.2.

(iii) The irrigation controller cabinet layout, dimensions and wiring are shown in SC6.4.4.8 Standard drawings SD-4.1 through SD-4.4.

(iv) The Irrigation controller cabinet shall be a B&R NI (NI03021/S) with single key lock (NI030) or

approved equivalent as shown within SC6.4.4.8 Standard drawings SD 4.1 through SD-4.4. The controller pole, mast and cross arms shall be coated with 2PAK Epoxy Paint in Heritage Green Colour.

(v) Control equipment shall be selected from the Preferred Equipment list - Controller and Telemetry Components within SC6.4.4.8 Standard drawings 4.5, unless otherwise specified by the Superintendent.

(vi) All firmware incorporated in CPUs and other intelligent modules shall be the latest released version.

(vii) The radio telemetry equipment involves the installation of the following equipment:

(A) Qty 1, CD51 Whip Antenna (cut to wave length) with .5M of RG58 coax cable terminated by a SMA type male connector;

(B) Qty 1, Antenna Mounting Bracket; and

(C) the radio telemetry component is integrated within the XR Controller unit. So no external transceiver is required.

(viii) The antenna coax SMA male plug shall be connected into the XR Controller SMA socket mounted on the top of the unit.

(ix) Before the XR Controller is powered up a qualified radio technician shall fit the antenna coax plug and carry out a SWR / radio check on site.

(x) A Kyocera Mini Module Solar Panel as detailed in SC6.4.4.8 Standard drawings SD 4.5 shall be fastened to the top of the enclosure refer SC6.4.4.8 Standard drawings SD-4.3. An external grade silicon base sealant shall be applied to the solar panel perimeter to maintain the enclosure IP rating.

(xi) The regulator components shall be installed as detailed in SC6.4.4.8 Standard drawings SD-4.2 and tested by an electronics technician prior to final connection of the battery and XR units.

(xii) A 6 V 12 AH SLA Battery is placed inside on the bottom of the enclosure and connected to the terminal blocks. Refer SC6.4.4.8 Standard drawings SD-4.1 and SD 4.2.

(xiii) The controller shall have one 25mm conduit connecting the cabinet to the first electrical pit.

(7) Controller location

The final location of the controller shall be determined by taking into consideration all of the following factors:

(a) radio path tests (to be carried out by a qualified radio technician) to ensure reliable communications from the controller to the ICC System Base Station;

(b) the location shall be clear of large trees or structures that may interfere with the performance of radio communications, or solar panel. In newly planted areas the location shall make allowance for future tree growth;

(c) safe 24 hour access for maintenance by maintenance services personnel and equipment;

(d) the location shall allow access by motor vehicle and elevated platform (antenna servicing); and

(e) the Controller shall not be installed less than 3 m from a roadway unless approved by the Superintendent.

(8) Cabinet installation

The pre-assembled Controllers shall be installed in the ground as follows:-

(a) The pre-assembled Controller cabinet support post shall be embedded in a 200mm diameter x 600mm deep hole with a 400mm deep concrete footing (N25 concrete minimum). The concrete shall be poured up to the underside of the conduits entering the support post. Covering the conduits in concrete is not acceptable. The Cabinet shall be installed at a height of 1200mm from the finished ground level to the underside of the cabinet (1090 mm for XR controllers Refer SC6.4.4.8 Standard drawings SD-4.4).

(b) XR Controller Cabinet is to be orientated with the door side facing north to maximise the absorption of solar radiation into the solar panel, unless approved by the Superintendent.

(9) Controller cabinet and controller wiring

(a) All conduits shall be terminated at the controller cabinet with a suitable conduit adaptor. All conduits shall be sealed with an external grade Butyl Mastic sealant, such as “Selleys Butyl Mastic” or similar approved to a depth of 25mm into the conduit to prevent vermin entering the controller cabinet.

(b) Earth stakes shall be located in the electrical pit adjacent the controller. The location of the earth stake is to be indicated on the as constructed drawing.

(c) Earth stake connections are to be sealed with cold gal paint.

(d) All field wired cables entering the controller cabinet shall be made secured – in this instance only by the application of sealant to the conduit end inside the enclosure (see clause (9)(a) above). From this point on, the double insulation shall be removed from the cable for ease of wiring to the terminal blocks.

(e) All single insulated cables inside control cabinets shall be loomed together and cable tied in a neat orderly manner to the panel so that the connections into the terminal strip are not stressed.

(f) All cables inside the controller cabinet shall be of sufficient length to ensure that all cores will reach their termination point without any stress or joining of cables.

(g) All field cables inside the controller cabinet shall be of sufficient length to ensure that all cores will reach the upper and lower most termination points without any stress or joining of cables.

(h) All cables to be connected within the controller cabinet shall be terminated with a bootlace ferrule, CABOC BLP 150 or similar approved. Pin lugs are not acceptable.

(10) Field electrical wiring

(a) Cable types

(i) All electrical cabling shall conform to current Australian Standards.

(ii) All cables shall be Tyflo multi-core irrigation cables or similar approved with a minimum core size of 1.5 mm. Table SC6.4.6.27.4 details cable specifications.

Table SC6.4.6.27.4 Multicore cable specifications

Nominal core dia.	Conductor no. and size	Amp rating	Resistance Ohms/Klm	Number of cores
1.5 mm	7/0.50	16	13.6	3,5,7,9,13
2.5 mm	7/0.67	23	7.4	2,7
4 mm	7/0.85	30	4.6	2

(iii) All cables shall have an outer sheath of flexible 75□C PVC to AS/NZS 3808, over an Inner core of a sheath of HDPE, over a multi-strand plain copper wire.

(iv) Inner cores are to be readily available in 13 colours namely- Black, Blue, Green, Dark Brown, Brown, Grey, Light Blue, Orange, Pink, Red, Violet, White and Yellow.

(b) Cable installation

(i) A 7 core cable shall be run continuously from the controller to the water meter assembly solely for the operation of Master Valve, Pulse Meter and Fertigation. The black core shall be common, red core shall be Master Valve control, brown core shall be Fertigation control and run to the Fertigation Venturi Point and the blue and white shall be Pulse Meter and Pulse Meter common respectively.

(ii) An additional 20% of the total number of cables or 2 extra cores (whichever is the greater) shall be provided as spares. Designated spares shall run from the controller to the furthest most point from the controller in the cable run. The spares are to be marked at the controller. At the furthest point all spares shall be connected together and sealed with heat shrink so that a continuity test can be performed at the controller to confirm the total number of spares.

(iii) All extra low voltage cables shall be installed inside a conduit. The conduit size used shall be a minimum size of 50mm or 2.5 times the combined size of all the cables being installed, whichever is the greater.

(iv) The single insulation on the cable core shall not be cut or damaged when the outer sheath (double

insulation) is removed. All cables shall have the insulation removed from the cores using appropriate cable strippers. Use of a knife or other sharp blade is not acceptable practice.

(v) Cables shall be continuous between electrical inspection pits. Cable joints located between electrical inspection pits are not acceptable. Cable joints shall be kept to a minimum and shall only occur at valve take off points.

(vi) Where required each individual cable shall be joined using the appropriately sized insulated crimp links, to maintain a double layer of insulation at the joint after the heat shrink is installed, and shall be installed with a professional ratchet type crimping tool.

(vii) Bare conductors shall not be exposed.

(viii) Each individual cable joint shall be waterproofed by using ES-2 resign filled heat shrink three times the length of the insulated crimp link.

(ix) Multiple cables shall not be joined or heat “shrinked” together.

(x) All cut unused cables (spares) shall be sealed using ES-2 resign filled heat shrink.

(xi) Cable markers shall be attached to each cable at every electrical inspection pit indicating the individual cable number as shown on the design plan; refer SC6.4.4.8 Standard drawings SD-7.2. Cable markers shall be round 38mm diameter aluminium identification tags commercially available. Numbering shall be clearly stamped onto one side of the tag using a punch set with 13mm high numerals. Tags shall be fastened to the appropriate cable using a quality grade plastic cable tie attached at the mid-point of the cable loop.

(xii) The Black cable shall be used as the designated common.

(xiii) All spare cable in electrical inspection pits shall be left full length, individually sealed with heat shrink and grouped together.

(xiv) All continuous cable that passes through an electrical inspection pit shall have a loop of at least 1.5m in length and be neatly coiled and tied.

(xv) A draw wire is to be left in the conduit from the controller cabinet to the first electrical inspection pit.

(xvi) All electrical cable locations shall be recorded on the as constructed drawings.

(c) Electrical inspection pits

(i) Electrical inspection pits shall be heavy duty rectangular with rounded ends and fitted with a precast concrete lid, type P1 or P2.

(ii) The first electrical inspection pit shall be located a maximum of 1m from the Controller cabinet support base. A draw wire together with the electrical cables is to be installed in the conduits from the controller to the first electrical pit to allow for future works.

(iii) Electrical inspection pits shall be located adjacent to valve boxes and offset from the main irrigation line a maximum of 200mm as shown in SC6.4.6.27 Attachment A 17.2 (Plan View).

(iv) Electrical inspection pits shall be located at changes in direction and no more than 50m spacing.

(v) Electrical inspection pits shall be installed so that the top of the pit is flush with the finished surface level and matches the slope of the finished surface level.

(vi) All electrical inspection pit locations shall be recorded on the as constructed drawings.

(vii) All conduits shall enter at the end of an electrical pit. Side entry of conduits into electrical pits in not permitted.

(viii) All conduits shall enter an electrical pit at no greater than 45 degrees of the horizontal centre.

(ix) Electrical pits shall not be installed in drainage swales or places where water is collected during rainfall and irrigation.

(x) Electrical pits shall not be installed less than 3m from the road kerb, unless approved by the Superintendent.

(d) Electrical conduits

(i) All electrical conduit shall conform to current Australian Standards.

(ii) All conduit (extra low voltage electrical) buried in ground shall be Grey M.D.

(iii) All electrical conduits that are exposed above ground shall have a protective outer sheath of polyethylene pipe rating PN12.5. The sheath is to encase the conduit for the entire length of conduit above ground and for a depth of 150mm minimum below ground.

(iv) All electrical conduits that are exposed above ground shall be fixed in place so that they are vertical and shall be secured firmly to the accessory.

(v) Electrical conduit above ground shall be adequately secured to avoid damage by grass cutting operations.

(vi) All electrical conduit ends shall be neatly cut and free of burrs or rough edges.

(vii) The final 500mm of conduit entering an electrical inspection pit shall be M.D. corrugated flexible conduit which is to be connected to the M.D. PVC Conduit by a Socket. SC6.4.4.8 Standard drawings SD-17.2 (Electrical Pit), gives a typical construction drawing of the assembly.

(e) Electrical conduit trenching

(i) All electrical conduits shall be laid in trenches and bedded in sand.

(ii) Low voltage conduits (240 V) shall be installed with continuous electrical warning tape laid over the conduit for the entire length of the trench.

(iii) Low voltage conduit (240 V) shall not be installed in the same trench as irrigation lines.

(iv) Extra low voltage conduits (24 V) installed in the same trench as irrigation lines shall be bedded in sand and separated from the irrigation lines by a minimum distance of 100mm.

(v) Depth of cover to electrical conduits from finished surface level or from the underside of finished pavement level (e.g. pavers or concrete) shall be:

(A) 300mm minimum - for extra low voltage cables (24 V); and

(B) 600mm minimum - for low voltage cables (240 V). Refer SC6.4.4.8 Standard drawings SD-18.1.

(vi) Electrical conduits under roadways shall be a minimum 50mm M.D. Electrical conduit encased in a 100mm Class 9 PVC Pipe.

SC6.4.6.27.4 Water meter assembly

(1) Design and installation

(a) Water meter assembly components vary, as follows:

(i) For drinking fountains and water taps (potable water) the water meter assembly includes:

(A) isolation valve; and

(B) mechanical water meter (supplied by Townsville Water, a business unit of Townsville City Council).

(ii) For irrigation the water meter assembly includes:

(A) isolation valve;

(B) mechanical water meter (supplied by Townsville Water);

(C) master valve and electronic flow meter unit;

(D) RPZ back flow prevention device with two isolation valves;

(E) screen filter;

(F) lockable cover;

(G) cable and conduit; and

(H) protective bollards (depending on location).

Table SC6.4.6.27.5 Allowable water meter assembly component size combinations

Water Service	Townsville Water Water Meter	Irrigation Water Meter	Backflow	Master Valve
25mm	25mm	32mm Arad Multijet (1 pulse/10L)	25mm	25mm Hunter ICV*
32mm	32mm	32mm Arad Multijet (1 pulse/10L)	32mm	25mm or 40mm Hunter ICV*
50mm	50mm	Include in Master Valve (1 pulse/10L)	50mm	50mm Arad Hydrometer
80mm	80mm	Include in Master Valve (1 pulse/10L)	80mm	80mm Arad Hydrometer
100mm	100mm	Include in Master Valve (1 pulse/100L)	100mm	100mm Arad Hydrometer

*external master valve

(iii) All water meter assemblies with a 25mm and 32mm Water Service are to have a master valve external to the main assembly. Refer to SC6.4.4.8 Standard drawings SD-10.3 and SD-10.4.

(iv) Water meter assemblies with a water service sized, 50mm, 80mm and 100mm are to have a master valve as part of the main assembly. Refer to SC6.4.4.8 Standard drawings SD-10.1 and SD-10.2.

(b) Water meters

(i) All water meters and pipe work from the town mains to the water meter shall be supplied and fitted by Townsville Water.

(ii) The water meter type is selected by the following criteria:

(A) for drinking fountains and water taps a standard mechanical water meters shall be used.

(B) for irrigation refer to Table SC6.4.6.27.5 for water meter selection relative to the water service size.

(c) Master valves

(i) All irrigation systems shall be fitted with a master valve.

(ii) The master valve is to be selected by the following criteria:

(A) all water service assemblies sized 25mm and 32mm shall have an external master valve installed in a valve box and shall be fitted to the copper tail pipe of the backflow device. Refer to SC6.4.4.8 Standard drawings SD-10.3 and SD-10.4 for installation details; and

(B) all water service assemblies sized, 50mm, 80mm and 100mm shall be fitted with an assembly mounted master valve. The master valve is to consist of a flange mounted Arad Hydrometer including water (flow) meter module as detailed in Table 5 and 24VAC Solenoid actuator; or approved equivalent. Refer to SC6.4.4.8 Standard drawings SD-10.1 and SD-10.2 for installation details.

(d) Backflow devices design and installation

(i) Backflow prevention is to conform to AS 2845.1, AS 2845.2 and AS 2845.3.

(ii) The Backflow device shall be selected on the required size:

(A) 25mm, 32mm, and 50mm - Tyco Backflow System RP03 or similar to the following specification. The assembly shall be connected with the “ring and tail” to allow easy removal or replacement of the device in accordance with AS/NZS 3500.1. Main valve and internals shall be of stainless steel construction and to have pressure rating of 1600 kPa and a temperature rating of 90ºC. All internal parts and elastomers are to be accessible through a top entry point of the main valve to allow inline maintenance. Valve shall also be fitted with test points with BSPT threads to allow testing to AS 2845.3; and

(B) 80mm and 100mm - Tyco Backflow System RP03 or similar to the following specification. The main valve shall be constructed from ductile iron and coated with Rilsan Nylon 11 to AS/NZ 4158. All internals shall be constructed from stainless steel and to have pressure

rating of 1600 kPa and a temperature rating of 60ºC. Main valve body shall not form part of the wetted check valve sealing area or mechanism. All internal parts and elastomers are to be accessible through a top entry point of the main valve to allow inline maintenance. Valve connection shall be flanged to AS/NZS 4087. Valve shall also be fitted with test points with BSPT threads to allow testing to AS2845.3.

(iii) The velocity through the backflow device shall not exceed 2.2 m/s.

(iv) All backflow devices shall be reduced pressure zone (RPZ) rating.

(v) All backflow devices sized 25mm, 32mm, and 50mm shall be fitted with a locking mechanism, which prevents the two isolation valves and the three test cocks from unauthorised opening. The backflow device is to be lockable at a single point. A council standard series A padlock is to be fitted to the locking mechanism.

(e) Isolation valves

(i) All isolation valves fitted to the water service assembly shall be tested and approved to Australian Standards.

(ii) All isolation valves fitted to the water service assembly shall be selected on the following criteria:

(A) all water meter assemblies sized 25mm, 32mm and 50mm shall be fitted with brass ball valves; and

(B) all water meter assemblies sized 80mm and 100mm shall be fitted with resilient seated gate valves.

(f) Strainer

All water meter assemblies shall be fitted with a brass strainer immediately downstream of the isolation valve and upstream of the back flow device. Refer SC6.4.4.8 Standard drawings SD-10.1 to SD-10.4 for details.

(g) Water meter assembly installation

(i) The water meter assembly shall be supported by the appropriate size Support Stands as detailed in SC6.4.4.8 Standard drawings 10.5 and set into a concrete footing as detailed SC6.4.4.8 Standard drawings SD-10.1 to SD-10.4. A minimum distance of 300 mm from the underside of the assembly to the finished ground level is required.

(ii) A lockable stainless steel sheet metal cover shall be fitted over the water meter and master valve to prevent vandalism and weather damage. Water meter assembly covers shall be built from 316 Stainless Steel as detailed in SC6.4.4.8 Standard drawings SD-31.1 and SD-31.2 and for water meter assemblies sized:

(A) 25mm, 32mm, the cover shall be held in place using U-bolts; and

(B) 50mm, 80mm and 100mm the cover shall be fastened between each set of tightened flanges, using flange bolts.

(iii) Each cover shall be locked using a 40mm KA1 series lock.

(iv) A minimum of two recycled plastic bollards shall be provided at each water meter assembly as directed by the Superintendent, to protect the assembly from vehicle damage, except in garden beds.

Bollards shall be nominal 100mm diameter blue recycled plastic, embedded 450mm minimum into a 350 mm diameter concrete footing. The top of the bollards shall be 900mm above finished ground level.

(v) All cables running from the water meter to the ground shall be encased in a protective outer sheath of polyethylene pipe rating PN12.5. The conduit shall be firmly installed vertical to the ground so as not to be easily damaged by grass cutting operations.

(vi) Copper pipes shall be Type B.

(vii) All fittings to the backflow device shall be either copper of brass. PVC or Poly fittings are not acceptable.

(2) Valve assembly

(a) Design and installation

(i) The valve assembly includes:

(A) solenoid valve;

(B) ball valve;

(C) brass barrel union; and

(D) valve box.

(ii) Refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4 for standard details. Valves shall be connected to the main line via a tee.

(b) Solenoid valves

(i) Refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4 for solenoid valve assembly details.

(ii) Solenoid valves used shall be sized in accordance with Table SC6.4.6.27.6.

Table SC6.4.6.27.6 Approved solenoid valves

Manufacturer	Model	Size	Maximum flow rate (litres per minute).
Hunter	ICV	25mm	100
Hunter	ICV	40mm	250
Hunter	ICV	50mm	360
Hunter	ICV	80mm	700

(iii) Electronic solenoids for AC systems shall be 24 volt coils.

(iv) Electronic solenoids for DC systems shall be 12 volt 2 wire latching coils.

(v) Solenoid valves shall be wired in the following order:

(A) the first controller output shall be assigned to the master valve control;

(B) stations are to be wired to the controller outputs from output 2 on. Station 1 (Controller output 2) is to be located on one side of the site. The last station is to be located on the opposite side of the site. The controller outputs are to follow a logical geographical pattern from one side to another; and

(C) the same wire colour shall be maintained along the entire length of the cable run between the controller and each individual solenoid valve.

(vi) Only one valve shall be allocated per controller output.

(vii) Doubling up of stations on the same output is not allowed.

(viii) Valve boxes shall not be installed within 3m of the road kerb unless approved by the Superintendent.

(ix) The distance from a valve to the first sprinkler or first drip emitter shall not exceed 50m.

(c) Gate and Ball valves

(i) A Ball valve shall be installed on the upstream side of the Solenoid valve. A brass barrel union shall separate the Ball valve from the Solenoid valve to allow for ease of maintenance. Refer to SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD 14.4.

(ii) Ball valves shall be tested and approved to AS 3500.1.

(d) Valve boxes

(i) The valve assembly is to be located in a heavy-duty lockable valve box fitted with a stainless steel lock-down bolt in the lid.

(ii) Valve boxes shall be Heavy Duty Carson or similar approved.

(iii) Valve boxes used are to be of adequate size to ensure that there is sufficient space around the valve assembly to allow for ease of maintenance.

(iv) Valve boxes shall not require removal to facilitate maintenance of the valve assembly.

(v) All valve boxes shall be:

(A) supported on bricks so that the box does not rest on any pipes;

(B) installed so that the top of the box is flush with the finished turf surface level for turf areas, or 50mm to 100mm above the finished mulch surface level for garden areas;

(C) installed so that the clearance from the underside of the valve box lid to the top of the stem of the valve is; 150mm maximum – 50mm minimum for non drip valves and 75mm maximum – 50mm minimum for drip valves, refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4;

(D) installed so that the clearance from the underside of the valve housed within the valve box to the bottom of the box is at least equal to or greater than 50mm;

(E) the pipe holes shall be sealed with Geofabric around the openings to prevent the ingress of foreign material in the valve box;

(F) cutting of valve boxes for entry/exit of pipe work shall be keep to a minimum, boxes cannot be cut higher than 1/3 its height. Over cut boxes are not acceptable; and

(G) installed in association with its housed components so as not to require excessive cutting of the valve box to the satisfaction of the Superintendent.

(vi) All valve box lids shall be clearly marked with the identification of the contents using the follow key:

(A) IV = Isolation Valve;

(B) MV = Master Valve;

(C) A1 = Controller A Station 1 (Refer SC6.4.4.8 Standard drawings SD-8.1) for valve key; or

(D) 3 digit DTMF number as supplied by the Superintendent, for example “045” identifying the Irrinet System number.

(vii) Valve box lids shall be engraved by using a 50mm to 75mm high Signet 14474 / 14494 zinc Stencil Set or approved equivalent as a template. The engraving finish shall be evenly 1.5mm deep at its deepest point and between 4mm to 8mm wide by using an engraving power tool fitted with a spherical engraving bit. The finished engraving shall then be painted with a Signet 12205 White Marker or approved equivalent. Note excessively deep engraving will weaken valve box lids and is not acceptable.

(viii) No valve boxes shall be installed in drainage swales or places where water is collected during rainfall.

(ix) Stainless steel re-enforcing plates may be fitted to valve box lids to repair damaged threads only.

(x) Conduit connecting valve boxes with electrical inspection pits and other Valve Boxes is to be M.D. corrugated flexible conduit of a minimum 500mm and maximum 1500mm in length. SC6.4.4.8 Standard drawings SD-17.2 gives a typical construction drawing of the assembly.

(e) Valve nest enclosures

(i) Refer to SC6.4.4.8 Standard drawings SD-33.1 through SD-33.4 for valve nest enclosure details.

(ii) Valve nest enclosures may be installed where groups of more than three valves can be located together.

(iii) Allowance must be made for larger lateral pipe sizes to offset increased friction losses where longer lateral pipe lengths are required.

(iv) Allowance must be made for increase lateral sizes and quantity leaving the one location.

(v) Where three or more laterals leaving a valve nest cover share a common trench, bedding sand must be used to back fill trenches.

(vi) Lateral pipes leaving a valve nest cover must be run parallel in trenches (not twisted).

(vii) Valves inside a valve nest cover must be clearly identifiable via round 38mm diameter aluminium identification tags commercially available. DTMF numbering shall be clearly stamped onto one side of the tag using a punch set with 13mm high numerals. Tags shall be fastened to the appropriate solenoid valve using a quality grade plastic cable tie.

(viii) Electrical cables shall be cable tied to each solenoid valve control valve.

(ix) Enclosures shall be fitted with a pad lock and keyed to fit council “F” series.

(x) Solenoid valves shall be connected to a common copper manifold via individual brass barrel union and ball valve.

(xi) Copper manifolds (from 40mm to 80mm) must be of sufficient size to allow multiple stations to run simultaneously in program where required.

(xii) Copper manifolds connecting to PVC mainline shall be done via Cop-A-Mate flange or approved similar, installed 25mm above ground level.

(xiii) Copper manifolds connecting to Poly mainline shall be done via metric female compression fitting installed 25mm above ground level.

(xiv) Install Valve Nest Cover using 10mm 316 S.S dyna bolts fastened to 200mm diameter by 300mm deep concrete footings poured on site.

(xv) Top of concrete footings shall be installed level and 25mm above finished ground level.

SC6.4.6.27.5 Sprinklers, turf valves and drip irrigation

(1) Sprinkler design

(a) Sprinklers used shall be in accordance with Table SC6.4.6.27.7.

Table SC6.4.6.27.7 Approved sprinklers

Manufacturer	Model	Type
Hunter	PGP	Gear
Hunter	MPR	Rotating Nozzle**
Toro	570	Static
Rainbird	3500	Gear
Rainbird	5000 Plus	Gear
Rainbird	5505	Gear
Rainbird	6504	Gear

** Use on Toro 570 Body.

(b) Sprinkler uniformity shall not exceed a scheduling coefficient of 1.3 (5 per cent Window) SC6.4.4.8 Standard drawings SD-19.1, provides a definition of the scheduling coefficient and the process for calculation.

(c) Where possible, individual sprinkler stations shall be fitted with either all full circle sprinkler arcs or all part circle sprinkler arcs.

(d) All sprinklers on the same valve shall provide “matched precipitation”. The ratio of water supplied shall be even across all arcs of coverage. Sprinklers of different pressure and / or precipitation rate on the same station are not acceptable.

(e) The variation in flow between any sprinklers on a single station is not to exceed 10 per cent.

(f) All sprinklers are to be run at the manufacturer’s recommended pressure.

(g) All sprinkler heads on each individual station shall be the same type.

(h) Locations which are susceptible to low head drainage shall be fitted with either internal check valves, or Hunter or similar approved external check valves.

(i) No water shall be applied by design to locations where over spray is undesirable, (i.e. adjacent non-irrigated areas, roads, footpaths, private property etc.). The manufacturer’s published throw distance shall govern for design purposes.

(j) On roadway corners no water shall be applied by design to the road pavement whilst no unirrigated areas shall exceed 1m from the road edge. The manufacturers published throw distance shall govern. Examples of acceptable sprinkler layouts are given in SC6.4.4.8 Standard drawings SD-16.1.

(k) All static sprinklers are to be fitted with “fixed pattern” nozzles.

(l) Sprinklers are to be designed and installed in such a way that no electrical boxes, control cabinets, transformers, meter assemblies and the like are hit by direct water streams.

(2) Sprinkler installation

(a) No sprinklers shall be fitted until all main lines, lateral lines and risers have been flushed clean.

(b) Sprinklers shall be placed 150mm clear from walls, garden edges, pathways and the back face of concrete kerbs or concrete garden edges.

(c) Sprinklers shall be installed as detailed in SC6.4.4.8 Standard drawings SD-12.1 Figure 2, slightly above the finished surface level.

(d) Sprinklers shall be installed plumb unless placed on a slope in which case they shall match the slope of the surface.

(e) Where directed by the Superintendent sprinklers in grassed areas shall be installed with a sod of turf (300mm square) placed around them at the finished surface level to help stabilise the sprinkler.

(f) Sprinklers shall be connected to pipes (lateral lines) via either a tapping saddle or a BSP/F Tee and a flexible swing hose riser. All swing hose risers shall face downstream of the solenoid valve. Refer to SC6.4.4.8 Standard drawings SD-12.1 Figure 1.

(g) In locations where soils may be of a corrosive nature, 316 stainless steel bolt and nuts shall be used on all tapping saddles.

(h) The flexible swing hose riser used shall be either:

(i) 25mm safety yellow industrial hose, with nylon type elbows secured with stainless steel hose clamps; or

(ii) HR Products E-Z riser tube and E-Z riser elbows. (for sprinklers with 15mm and 20mm inlets).

The length of the flexible swing hose riser shall be no less than 500mm and no greater than 750 mm.

(i) Nozzle diffuser screws shall not reduce the wetted throw of a sprinkler by more than 20 per cent of the undiffused radius of a sprinkler.

(3) Bollard sprinkler installation

(a) Bollard sprinklers shall be installed where approved by the Superintendent in locations where sprinklers may be obstructed by plants or plant growth.

(b) Bollard sprinklers shall be assembled and installed as detailed in SC6.4.4.8 Standard drawings SD-12.2.

(4) Turf valves

(a) All turf valves shall be plasson.

(b) Turf valves shall be installed with an articulated riser connected to the main line via a tee coupling. Connecting turf valves to main line with tapping saddles is not allowed.

(c) Turf valves that are to be used as a hose watering point for garden establishment shall be installed in a valve box.

(d) Turf Valves Systems where sprinklers are directly inserted into the turf valves may be installed without a valve box flush with the soil surface.

(e) Turf valves located under valve box lids shall have the lid of the valve box clearly marked with an engraving tool and paint with the letters “TV”.

(5) Drip irrigation design and installation

(a) All drip irrigation systems shall be installed with an RPZ backflow device.

(b) The length of the drip tube shall be determined, based on all drippers along the line having sufficient pressure to operate 100 Kpa above the pressure compensation point as nominated by the dripper manufacturer. The maximum allowable inlet pressure shall be 300 Kpa.

(c) All drip tube used shall be Netafim Uni Ram 16 - 0.4m spacing @1.6lph or approved equivalent.

(d) The maximum spacing for drip tube is as shown in Table SC6.4.6.27.8.

Table SC6.4.6.27.8 Dripper spacing

SOIL TYPE	LOCATION	
	Grassed areas	Gardens
Loam and Clay Soil	400mm maximum	500mm maximum
Sandy Soil	300mm maximum	400mm maximum

(e) Refer SC6.4.4.8 Standard drawings SD-14.1 and SD-14.2 for typical drip irrigation details.

(f) Pressure compensation shall be fitted to each individual drip irrigation station. The devices used shall be retro fitted to the solenoid valve. The following two options are acceptable:

(i) Hunter Accu-Set pressure regulator, refer SC6.4.4.8 Standard drawings SD-14.3; and

(ii) inline pressure regulation device as specified by the Superintendent, refer to SC6.4.4.8 Standard drawings SD-14.4.

(g) A 120 mesh Disc Filtration system shall be installed immediately up stream of the solenoid valve in accordance with the manufacturer's specifications to ensure that the correctly sized filtration system is used. The following two filtration systems are acceptable:

(i) Netafim Tech Filter, (rated at 120 mesh by Netafim); and

(ii) Arkal 120 mesh Disc Filter fitted into a Netafim Tech filter housing, may be used during construction and for a period no greater than 1 month after installation of the drip tube.

(h) The filter, pressure regulator valve and solenoid valve assembly shall be installed in a valve box. Barrel Union/s shall be fitted to allow for easily removal of the filter, refer SC6.4.4.8 Standard drawings SD-14.3 and SD-14.4. The order of component installation from upstream to downstream is to be: Barrel Union, Filter, Barrel Union, Solenoid valve and Pressure Regulator. The fitting of these devices and the size of the valve box shall allow for:

(i) the filter cartridge to be easily serviced and changed; and

(ii) the pressure regulator to be easily adjusted and serviced.

(i) Drip tube shall be installed:

(i) in turf with 75mm cover to the finished surface level.

(ii) drip Tube laid on the surface shall be fitted with holding pins placed every 1.5m along the tube. Holding pins are to be constructed from 2.3mm minimum diameter Stainless Steel wire of 304 grade. Refer to SC6.4.4.8 Standard drawings SD-15.1 for details.

(j) Drip tube shall not be installed:

(i) directly into heavy clay or rocky soils where conditions may cause damage to the drip tube. In these soil types the drip tube must be installed between a 50mm surround of imported loan soil; and

(ii) in areas subject to significant vehicle traffic, where these condition would cause damage to the drip tube.

(k) All dripper lines shall terminate to a flushing manifold on the downstream side of the line. The head loss in the manifold shall be sized to lose no more than 1m based on twice the flow rate of the flow during normal operation. Each flushing line shall be fitted with a ball valve and 1 m of industrial vacuum and delivery hose. The ball valve shall be installed to provide easy operation. The ball valve shall be positioned in the valve box to prevent the industrial vacuum and delivery hose from kinking. The hose is to be held in place with a stainless steel hose clip. See SC6.4.4.8 Standard drawings SD-14.1 and SD-14.2 for component layouts. The valve box shall be sized as follows:

(i) 25mm ball valve – Carson or equivalent round valve box; and

(ii) 40mm and 50mm ball valves – Carson or equivalent rectangular valve box.

(l) All high point(s) in the dripper layout shall be fitted with a Bermad vacuum relief valve (Model ARV). The vacuum valve is to be installed in a valve box. A section of drip tube shall cross connect all drip tubes to the vacuum relief valve. The vacuum relief valve shall not be fitted to the supply manifold. See SC6.4.4.8 Standard drawings SD-14.1 and SD 14.2 for a typical installation.

(m) Netafim HCNL drip tube and/or Hunter adjustable check valves (or approved equivalent) shall be fitted if

the fall in the drip irrigation system exceeds 3m. Each side of the check valve shall be fitted with independent Flushing Valves and Vacuum Relief Valves. The check valves shall be set to 3m. The two methods for installation of the check valves are:

(i) check valves fitted to each drip tube; and

(ii) check valves fitted to both the supply manifold and the flushing manifold.

(n) Each drip irrigation station shall be fitted with operation indicators. The operation indicators consist of a Toro 570 100mm pop-up sprinkler fitted with an SST nozzle set to zero flow, sealed with silicon and installed level with the ground. The operation indicators are to be installed in a garden bed or next to a tree (not be a tripping hazard) and be visible from the drip valve assembly. Additional operation indicators shall be installed at the ends of each station and connected using a HR Products E-Z riser tube and 15mm E-Z riser elbows.

(o) Prior to the installation of the drip irrigation system the area to be drip irrigated shall be soaked with water and allowed to dry. Any resulting subsidence or soil shrinkage shall be filled with soil up to the finished surface level. The process of soaking with water and filling to a finished surface shall be repeated until the required surface level is achieved. Drip tubes may then be laid with the correct cover.

(p) On slopes the drip irrigation tubes shall following the contour lines of the area.

(q) “Snaking” of dripper lines shall be avoided.

(r) The minimum size of the header manifold is to be 25mm low density poly pipe.

(s) Drip tube shall be laid in straight runs inside roundabouts.

(t) No drip tube shall be installed within 150mm from walls, garden edges, pathways and the back face of concrete kerbs or concrete garden edges.

(u) Drip tube shall only be connected to low density poly pipe 25mm and 32mm using FI Tees and Netafim elbow adapters (3/4 inch to 17mm) with all low density pipe fittings clamped using Cobra stainless steel clamps or similar approved type. The use of quick start connectors is not approved by the Superintendent.

(v) Drip tube shall only be connected to PN 6.3 Poly Pipe using poly tapping saddles and Netafim elbow adapters (3/4 inch to 17mm). The use of grommet connectors is not approved by the Superintendent.

(w) In locations where soils may be of a corrosive nature, 316 stainless steel bolt and nuts shall be used on all tapping saddles.

SC6.4.6.27.6 Drinking fountain and water tap

(1) Drinking fountain

(a) A drinking fountain assembly includes:

(i) bowl - cast alloy, powder coated white;

(ii) turret - Ex 219 OD stainless steel tube powder coated "Heritage Green";

(iii) tap - BUB228C cam action Enware;

(iv) bubbler - Enware Type 61 push button bubbler with 3/8th - 1/2"x 3" male BSP tail;

(v) copper tube connection – 13mm Annealed Copper;

(vi) isolation valve;

(vii) precast concrete plinth base;

(viii) precast concrete pipe and aggregate backfill;

(ix) potable water supply line and water meter; and

(x) SC6.4.4.8 Standard drawings SD-32.1 contains the construction drawings for the fountain assembly.

(b) All pipe work to a drinking fountain shall comply with AS 3500. All pipe work installation to a drinking fountain, shall be carried out by a licensed plumber.

(c) The supply line to a drinking fountain shall be a “standalone” potable water line with its own water meter. Pipe work shall be a minimum 32mm PN12.5 Poly Pipe (from meter to isolation valve) laid in a trench with sand bedding and surround to the pipe and with 300 mm minimum cover over the pipe. Drinking

fountains and water taps may be installed on the same potable water line.

(d) The drinking fountain turret shall be installed on a precast concrete plinth base set on top of a 600 dia x 1.2m long reinforced concrete pipe embedded into the ground and backfilled with 20mm aggregate for drainage. Details of the base are given in SC6.4.4.8 Standard drawings SD-32.2. Alternately, the drinking fountain may be connected into an existing sewer drainage line.

(e) The Drinking fountain shall be isolated by a 15mm Ball Valve. The isolation valve shall be located a nominal 600mm from the drinking fountain adjacent the concrete plinth base and shall be installed in a circular valve box.

(f) The drinking fountain tap and bubbler shall be connected to the isolation valve with a flexible stainless steel hose.

(g) All bolts, screws and masonry anchor bolts fitted to the drinking fountain assembly shall be stainless steel.

(h) On completion and at commissioning of the drinking fountain the pressure shall be adjusted so the stream of water exiting the bubbler does not spill over the bowl.

(2) Water tap

(a) A water tap assembly includes:

(i) tap with vacuum breaker;

(ii) stainless steel support post;

(iii) concrete splash pad; and

(iv) potable water supply line and water meter.

(b) All pipe work to a water tap shall comply with AS 3500. All pipe work installation to a water tap shall be carried out by a licensed plumber.

(c) The supply pipe line to a water tap shall be a “standalone” potable water line with its own water meter. Pipe work shall be a minimum 32mm PN12.5 Poly Pipe (from the meter to copper tail pipe) laid in a trench with sand bedding and surround to the pipe and with 300mm minimum cover over the pipe. Water taps and drinking fountains may be installed on the same potable water line.

(d) Tap shall be a 15mm brass hose cock or similar approved connected to a 20mm copper tail pipe installed inside the support post.

(e) Support posts shall be 40mm x 40mm x 1.6mm stainless steel SHS fitted with a plastic cap and cast 350mm minimum into a 350mm dia x 450mm deep concrete footing.

(f) Splash pads shall be either:

(i) 600mm square x 100mm thick N25 concrete cast insitu; or

(ii) 600mm square x 50mm thick precast concrete.

(3) Fertigation

A fertigation point consisting of 25mm tested ball valve connected to the irrigation main line close down stream from the back flow assembly must be installed unless advised by the Superintendent. The fertigation point is to be housed in a round enclosure with the lid marked “FRT” for identification.

SC6.4.6.27.7 Effluent reuse systems

(1) Design and installation

(a) All works must comply with the *Queensland Water Recycling Guidelines*, current health and safety, environmental and related acts.

(b) Effluent reuse irrigation systems shall have:

(i) sprinklers fitted with lilac ID caps;

(ii) lilac coloured drip tubing;

(iii) lilac coloured valve box lids;

(iv) mainline and lateral pipe material (plastic) shall be lilac in colour or contain a lilac strip;

(v) all above ground pipe work shall be lilac coloured and/or clearly labelled “Recycled Water”, “Non Potable Water”; and

(vi) minimum separation of Pipe work for Potable and Recycles water systems shall be maintained at 300mm for below ground pipe work and 100mm for above ground pipe work.

SC6.4.6.27.8 Installations located in landfill sites

(1) Trenching in landfill sites

(a) When excavating in landfill sites or areas containing rock the trench shall be excavated to a minimum depth of 600mm.

(b) All trenching material removed from the trench shall be removed to the local refuse dump.

(c) All trenching spoil shall be totally removed from the surrounding surfaces and site and inspected by the Superintendent.

(d) Bedding sand shall be used to backfill to 200mm below finished soil level. The final 200mm shall be filled with an approved loam.

SC6.4.6.28 Minor concrete works

SC6.4.6.28.1 Introduction

(1) Scope

(a) This sub-section provide details for the supply and placement of concrete, including sprayed concrete, and ancillary requirements including excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the drawings but not having individual policy sub-sections. These works include kerb and channel, New Jersey type barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

(b) The work also includes supply and placement of miscellaneous minor concrete work for water and sewerage construction such as valve chambers, thrust and anchor blocks, bulkheads, pumping stations, bedding, encasement and cast-in-situ access chambers.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.6 - Pipe drainage
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.5 Construction management.

(b) Australian Standards:

AS1012.1	*Sampling of fresh concrete*
AS1012.3.1	*Determination of properties related to the consistency of concrete - Slump test.*
AS1012.8.1	*Method of making and curing concrete - Compression and indirect tensile test specimens*
AS1012.8.2	*Method of making and curing concrete - Flexure test specimens*
AS1012.9	*Determination of the compressive strength of concrete specimens*
AS1012.14	*Method for securing and testing cores from hardened concrete for compressive strength*
AS1141.14	*Particle shape, by proportional caliper*
AS1141.21	*Aggregate crushing value*
AS1141.23	*Los Angeles value*
AS1141.24	*Aggregate soundness – Evaluation by exposure to sodium sulphate solution*
AS1289.3.3.1	*Calculation of the plasticity index of a soil*
AS1289.5.1.1	*Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS1289.5.4.1	*Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS1379	*Specification and supply of concrete*
AS1478.1	*Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS/NZS1554.3	*Welding of reinforcing steel*
AS/NZS1859	*Reconstituted wood-based panels*
AS2082	*Visually stress-graded hardwood for structural purposes*
AS/NZS2271	*Plywood and blockboard for exterior use*
AS2758.1	*Concrete aggregates*
AS3600	*Concrete structures*
AS3610	*Formwork for concrete*
AS3799	*Liquid membrane-forming curing compounds for concrete*
AS3972	*General Purpose and blended cements*
AS/NZS4671	*Steel reinforcing materials*
AS/NZS4680	*Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other:
NSW RTA, *Shotcrete design guidelines*

SC6.4.6.28.2 Excavation and foundations

(1) General

The foundation where specified, shall be formed at the required depth below the finished surface levels shown on the drawings. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete. Compaction requirements must meet the appropriate compliance standards as specified in sub-section SC6.4.6.10 Earthworks (construction).

All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Superintendent, and the subgrade shall be compacted to provide a minimum relative compaction as specified in SC6.4.6.10 Earthworks (construction). If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

Preparation of the foundation is required in accordance with foundation type, as follows:

(a) concrete working base - remove projections above the plane surface, and loose material; and

(b) graded prepared subgrade - blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

Editor's note—Provision of a vapour barrier for external slabs on ground prevents water loss to the subgrade and has the potential to reduce slab curling at edges and corners.

AS2870 Section 5.5 provides additional requirements and detailing of damp proof membranes for concrete slabs and footings exposed to either saline or acid sulphate soils. AS2870 Section C5.5 and CCAA T56 provide information on concrete exposed to saline soils.

Polymeric Film Underlay must be installed over the prepared foundation. Lap joints at least 200mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces past the damp proof course where applicable, and tape fix at the top. Patch or seal punctures or tears before pouring concrete. Cut back as required after concrete has gained strength and forms have been removed.

The Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with statutory requirements. The excavation shall be kept free of water.

Prior to the construction of footings for cast-in-situ concrete walls on earth foundations, cover the latter with a mass concrete blinding slab. Unless otherwise specified, place precast concrete wall sections on a fresh mass concrete bedding layer while it is still in a plastic state. Ensure the following is adhered to:

(a) for earth foundation, place concrete not less than 50mm thick; and

(b) for rock foundation, place the concrete at least 50mm above the highest points of rock.

Place neither forms nor other materials on the bedding layer within 48 hours of the concrete being placed.

(2) Kerb and channel

Kerb and channel may be constructed in fixed forms, by extrusion or by slip forming, in accordance with AS2876.

The foundation, concrete quality, curing and testing details shall be in accordance with AS2876 except where placed on pavement courses, where the requirements of the respective pavement course must prevail. Kerb and channel will be constructed to the profile nominated on the drawings.

The top and face of the finished kerb and channel shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and channel shall have a steel float finish.

The level at any point on the surface of the kerb invert shall be within ±6mm of the design level. When a straight edge 3m long is laid on top of or along the face or invert of the kerb, the surface shall not vary more than 5mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression. The drainage invert shall be free draining and shall not pond water.

Unless shown otherwise on the drawings, contraction joints, shall be formed every 5m of kerb invert length for a minimum of 50% of cross sectional area. The joint shall be tooled 20mm in depth to form a neat groove of 5mm minimum width.

Unless shown otherwise on the drawings, expansion joints, 15mm in width for the full depth of the kerb and channel, shall be constructed where the kerb invert abuts against kerb gully pits, both sides of kerb laybacks/ramps for vehicular or pedestrian access, retaining walls and overbridges. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Where kerb and channel is cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and channel.

All house stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe, through the kerb as shown on the drawings providing correctly graded drainage outlet into channel. Pipework shall be in accordance with the requirements for UPVC pipes in sub-section SC6.4.6.6 Pipe drainage, or as directed by the Superintendent for other types of pipe.

At all driveway crossings, where shown on the drawings or where directed by the Superintendent, barrier kerb shall be discontinued to provide for vehicular or pedestrian access. At such locations, kerb laybacks/ramps must be constructed in accordance with the drawings and Standards. Footpath crossovers shall be constructed to meet the laybacks as shown on the drawings, or reinstated to match existing materials where not otherwise shown.

After the new kerb and channel has been constructed and not earlier than 3 days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the drawings, or as instructed by the Superintendent.

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50mm diameter, or material as approved by the Superintendent.

Backfill material behind the kerb shall be compacted in layers not greater than 150mm thick, to a relative compaction of 95% when tested in accordance with AS1289.5.4.1, for standard compactive effort. The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards.

Pavement material adjacent to new gutter shall be backfilled in accordance with the drawings or as directed by the Superintendent.

Where specified in drawings, kerb only work shall be pinned as detailed in Standard drawings.

(3) New jersey type barriers, driveways and footpaths

For New Jersey type barriers, driveways and footpaths a subbase of approved quality and of minimum 150mm compacted thickness, unless otherwise shown on the drawings, shall be placed over the subgrade. The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

The subbase material shall be compacted to provide a minimum relative compaction as determined by AS1289.5.4.1 of 100% for standard compactive effort as specified in SC6.4.6.10 Earthworks (construction).

The finished subbase shall not deviate more than 15mm under a straight edge 3m long, subject to any necessary allowance on vertical curves.

(4) Drainage pits and other supplementary structures
Where the excavation is in sound rock, and the Superintendent so directs, part of the concrete lining of gully pits and other structures may be omitted, provided that a neatly formed pit of the required dimensions is constructed, and provided that the wall of the pit adjacent to and parallel with the road is constructed of formed concrete in all cases.

(5) Retaining walls, headwalls and wingwalls
In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of 150mm. Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be reduced to 100mm.

Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete bedding layer at least 50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the bedding layer within a period of 48 hours after the concrete has been placed.

Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete bedding layer while it is still in plastic state. In the case of soil foundations, the concrete shall be not less than 50mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50mm above the highest points of rock.

SC6.4.6.28.3 Formwork

(1) General
Formwork shall be provided in accordance with AS3610 to produce hardened concrete to the lines, levels and shapes shown on the drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the insitu earth.

Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2m or to move concrete along the formwork after deposition.

Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the drawings.

Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the drawings.

Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

(2) Approval of formwork design
For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted for the Superintendent's concurrence before manufacture of the formwork is commenced.

(3) Provision for drainage
Where shown on the drawings, or where directed by the Superintendent, weepholes of 50mm diameter shall be provided in retaining walls and wingwalls.

(4) Construction

The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.

Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with AS2271, the hardwood shall comply with AS2082 and the particle board with AS/NZS1859.

Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1m and uniform lengths of not less than 2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than 15mm thick. Form panels less than 15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern.

Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board.

Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.

(5) Erection

(a) General

(i) Dimensions and position of forms shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work. For tolerances in plan position and levels, refer to clauses SC6.4.6.28.5(7) Finishing of unformed surfaces and SC6.4.6.28.5(10) Treatment of formed surfaces.

(ii) Joints as erected shall be mortar tight.

(iii) The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints.

(iv) Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.

(b) Approval by the Superintendent

(i) The formwork shall be inspected by the Superintendent, and the placing of reinforcement in the spaces formed, where specified, shall not commence until the formwork is approved by the Superintendent.

(ii) Placing of concrete shall not commence until the reinforcement, where specified, has been accepted by the Superintendent, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

(iii) When an inspection is requested by the Contractor, a notice of not less than 24 hours, excluding Saturdays, Sundays and public holidays, shall be given to the Superintendent.

SC6.4.6.28.4 Materials for concrete

(1) Cement

Cement shall be Type GP Portland Cement complying with AS3972.

When submitting details of the nominated mix in accordance with clause SC6.4.6.28.4(6) Testing of materials, the Contractor shall nominate the brand and source of the cement. On approval of the nominated mix by the Superintendent, the Contractor shall only use the nominated cement for the work.

Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, a re-test shall be required at the Contractor's expense before the cement is used.

All cement shall be transported in watertight containers, and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Water

Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty nor brackish.

Water which is not potable for human beings shall not be used in reinforced concrete.

(3) Fine aggregate

Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS2758.1 in respect of bulk density, water absorption (maximum 5%) material finer than 2 micrometres, impurities and reactive materials.

Fine aggregates shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.1 Fine aggregate grading, and shall not deviate from the proposed grading by more than the amounts in Table SC6.4.6.28.1.

Table SC6.4.6.28.1 Fine aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	±5
1.18mm	40 - 85	±10
300µm	8 - 30	±10
150µm	2 - 10	±5
75µm	0 - 4	±3

(4) Coarse aggregate

Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag and shall conform to the requirements of AS2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5%), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this sub-section. If required, coarse aggregate shall be washed to satisfy these requirements.

The percentage of wear shall be determined by AS1141.23, and the loss of weight shall not exceed 30%.

When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

(a) crushing value - AS1141.21
The aggregate crushing value shall not exceed 25%;

(b) soundness - AS1141.24
The loss of mass when tested with sodium sulphate shall not exceed 12%; and

(c) particle shape - AS1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35%.

Coarse aggregate shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.2 Course aggregate grading and shall not deviate from the grading of the samples submitted under clause SC6.4.6.28.4(6) Testing of materials by more than shown.

Table SC6.4.6.28.2 Coarse aggregate grading

Australian Standard Sieve (mm)	Proportion Passing (% of Mass)			Deviation Proposed Grading (% of Mass of Sample)
	40mm Nominal	20mm Nominal	Extrusion Concrete	
	For Walls exceeding 150mm thickness	For all other structures		
53.0	100			±10
37.5	95 - 100			±10
26.5		100		±5
19.0	30 - 70	95 - 100		±5
13.2			100	
9.50	10 - 35	25 - 35		
4.75	0 - 10	0 - 10		
2.36	0 - 2	0 - 2		

(5) Admixtures
Chemical admixtures and their use shall comply with AS1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used.

During the warm season, (October to March inclusive), a set retarding admixture approved by the Superintendent shall be used to control slump within the limits stated in clause SC6.4.6.28.5(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS1478.1 shall be submitted to the Superintendent, together with the proposed “dosage chart” in accordance with SC6.4.6.28.4(6) Testing of materials. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall require approval by the Superintendent by providing the necessary certificate of compliance.

(6) Testing of materials
The Contractor shall submit to the Superintendent a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed to be used in the work.

The materials shall only be used after receipt of the Superintendent's notification of acceptance, and then only as long as the materials accord with the Specification.

SC6.4.6.28.5 Handling and treatment of concrete

(1) Measuring
All materials shall be measured by weight, except that:

(a) water may be measured by volume with an approved adjustable water-measuring and discharging device;

(b) cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement, and for this purpose one bag of

cement shall be assumed to weigh 40kg. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper; and

(c) measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

(2) Measuring by weight, on-site mixing

Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table SC6.4.6.28.3 Materials in batch containing 1 bag (40kg) cement may be used as a guide to produce the classes of concrete specified. Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete. The use of proportions shown in Table SC6.4.6.28.3 shall not relieve the Contractor of his obligation to provide concrete of the specified compressive strength.

Table SC6.4.6.28.3 Materials in batch containing 1 bag (40kg) cement

MPa	Cement kg	Fine Aggregates kg	Coarse Aggregates kg	Total Aggregates kg
10	40	130	250	380
15	40	100	190	290
20	40	88	126	214

The proportions set out in Table SC6.4.6.28.3 make allowance for moisture contents of aggregates of 6% for fine aggregates and 1% for coarse aggregates. Where the moisture content of aggregates exceeds 8% or 3% respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

(3) Measuring by volume, on-site mixing

Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

The nominal proportions given in Table SC6.4.6.28.4 Volume batching may be used as a guide for volume batching.

Table SC6.4.6.28.4 Volume batching

MPa	Parts by Volume		
	Cement	Fine Aggregate	Coarse Aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins. The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level. Measurements by shovels or like methods will not be permitted. Batch proportions shall be so arranged that each batch contains 1 bag of cement. One 40kg bag of cement shall be assumed to have a volume of 27.5 litres.

(4) Consistency

A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface. If required by the Superintendent, the Contractor shall determine the consistence of the concrete in accordance with AS1012.3.1. Except for extruded concrete, the nominated slump shall not exceed 80mm, plus the field tolerance of ±15mm.

In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10mm to 15mm.

(5) Mixing and delivery

(a) General

(i) Concrete may be mixed either at the site or at a central mixing plant. All concrete shall be mixed

with mechanically operated mixers. In an emergency, hand mixing may be permitted. Submit proposal for concrete mixing other than pre mixed concrete for approval by superintendent.

(ii) Any concrete which exhibits signs of segregation shall not be used.

(b) Machine mixing at site

(i) The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.

(ii) The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer's rated capacity of the mixer.

(iii) The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.

(iv) The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

(c) Mixing in an emergency

(i) In the case of breakdown of the mechanical mixing equipment, hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint is permitted.

(ii) Hand mixing shall be done on a water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10% more than the amount specified for machine mixed concrete.

(iii) The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer. The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler. After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance. Hand-mixed batches shall not exceed 25m^3 each.

(d) Ready-mixed concrete

(i) The concrete shall be mixed and delivered in accordance with the requirements of AS1379 relating to:

(A) mixing and delivery; and

(B) use of non-agitating equipment,

(ii) The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

(6) Placing and compacting concrete

No concrete shall be mixed or placed, without the approval of the Superintendent, while the air temperature is, or is likely to be within 24 hours, below 5°C or while the shade temperature exceeds 38°C. All concrete shall be placed in the dry. Prior to placing concrete the area shall be clean and moist but free from any ponding of water.

The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2m, or be deposited in large quantities at any point and moved or worked along the forms. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed. The concrete

shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face. The freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units. Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement.

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, comprised of two parts of plasterer's sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

(7) Finishing of unformed surfaces

(a) Surfaces other than wearing surfaces

Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water which comes to the surface. A capping of mortar will not be permitted.

All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

(b) Wearing surfaces

Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than 2m. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner. The departure from grade shall not exceed 5mm in any 3m length.

Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.

(c) Finished levels and location

The unformed surface of concrete structures not adjacent to road pavements shall not vary more than 25mm in plan position and not more than 25mm from the specified levels. In the case of barriers, drainage pits, culvert slabs and other structures adjacent to road pavements, the finished concrete shall not vary more than 10mm from the specified levels and alignment. Barriers, footpaths and similar shall not deviate from level or alignment by more than 5mm from a straight-edge 3m long, subject to any necessary allowances on vertical and horizontal curves.

(8) Curing and protection

All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds, in accordance with AS3799, for a minimum period of 3 days. During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete. All costs involved in making good or replacing any work that has been damaged due to the above mentioned factors shall be borne by the Contractor.

Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in AS3600.
If it is proposed to use a liquid membrane-forming curing compound submit the following information:

(a) certified test results for water retention to AS3799 Appendix B;

Editor's note—It is likely that polyvinyl alcohol (PVA-based) products will not comply with water retention requirements.

(b) evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.

For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

(9) Removal of forms

All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10 °C during the periods specified.

Mass retaining walls, headwalls, wingwalls, gully pits, sumps, and similar drainage structures	48 hours
Footpaths, driveways and similar	17 hours
Sides of reinforced concrete walls when height of each day pour is:	
• under 0.6m	1 day
• 0.6m to 3m	2 days
• 3m to 6m	3 days
• 6m to 9m	5 days
Supporting forms under deck slabs of culverts	10 days

To permit the satisfactory finishing of barriers, forms shall be removed in not less than 12 hours nor more than 48 hours after placing concrete, depending upon weather conditions.

Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70% of the design strength.

Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

(10) Treatment of formed surfaces

All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result. Formed concrete surfaces shall be presented for inspection by the Superintendent within 1 day of stripping of formwork and finishes in accordance with the classes of surface finish in AS3610 as follows:

(a) Non-visible surfaces - Class 4.

(b) Visible surfaces - Class 2.

As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of

application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer.

The formed surfaces of concrete structures not adjacent to road pavements shall not vary more than 25mm in plan position and not more than 25mm from the specified levels. In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

(11) Joints

Submit proposed methods, timing and sequence of sawing joints for approval by superintendent a minimum of 7 days prior to works commencing.

Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Superintendent. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

Retaining walls shall be provided with vertical expansion joints as shown on the drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

Where barriers are extruded or cast in place, narrow transverse vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints, shall be at intervals of 3m.

In barriers, unless shown otherwise on the drawings, expansion joints, 15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding 15 m and where the barrier abuts against gully pits. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

In footpaths, median toppings and driveways, unless otherwise shown on the drawings, expansion joints, 15mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form “slabs” no bigger than $2m^2$. The ratio of the longest side to the shortest side shall not exceed 1.6.

(12) Strength of concrete

When tested in accordance with AS 1012.9, the concrete shall have a characteristic compressive strength not less than that shown on the drawings or if not shown shall have a compressive strength not less than that specified in Table SC6.4.6.28.5 Concrete strength requirements for the particular class of work. The cement content restrictions shown in Table SC6.4.6.28.5 refer to Portland cement. Where General Purpose Blended cements are utilised the acceptable minima are indicated in brackets.

The characteristic strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

In general, two pairs of test specimens shall be moulded for each $15m^3$ of concrete, or part thereof, one pair being intended for the 7 day test if required and the other pair for a 28 day test.

Table SC6.4.6.28.5 Concrete strength requirements

Use	Charac-teristic Strength MPa	Minimum Portland Cement per 3 metre (Minimum GB Blended Cement)	Coarse Aggregate Nominal Size	Characteristic Cylinder Strength Required	
				7 days	28 days
		kg	mm	MPa	MPa
Foundations, mass retaining walls	20	270 (330)	40	15	20
Mass concrete footings, pitching, linings etc.	20	270 (330)	20	15	20
Miscellaneous minor concrete work	20	270 (330)	20	15	20
Reinforced concrete culverts, drainage structures, driveways footpaths, headwalls, base slabs, sign structures. Large footings, retaining walls	32 50	320 (380) 350 (455)	20 20	24 36	32 50
Extruded concrete Safety Barriers	25 40	270 (330) 330 (380)	14 20	15 24	20 40

Note—the total cement and Portland cement quantities indicated as minima are aimed at providing suitably durable concrete for exterior public works under normal circumstances.

The strengths specified at 28 days shall be increased by multiplying by factors as shown in Table SC6.4.6.28.6 Concrete age conversion factors for tests at ages in excess of 28 days.

Table SC6.4.6.28.6 Concrete age conversion factors

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25
*For intermediate ages the factor shall be determined on a pro-rata basis	

If the test specimens fail to achieve the specified characteristic strength, the Contractor may, with the approval of the Superintendent, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements nominated in Table SC6.4.6.28.5 Concrete strength requirements, the concrete will be accepted.

If cores taken fail to satisfy the strength requirements, the concrete shall be removed.

(13) Sampling concrete

Equipment and facilities shall be provided by the Contractor for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work.

Concrete test specimens shall be cylinders 300mm long and 150mm diameter, moulded concurrently in the presence of the Superintendent or Superintendent's representative, in accordance with AS1012.8, from samples taken in accordance with AS1012.1.

SC6.4.6.28.6 Reinforcement for concrete

(1) Fibre reinforced concrete

Footpath/Bikeways/Driveways.
The concrete shall be reinforced with a mixed dose of High Performance Polymer and Discreet Graded Fibrillated filament fibres. These fibres shall be provided as a coarse filament in an engineered contoured sinusoidal profile of not less than 600 denier and discreet graded fibrillated filament fibres of not greater than 6 denier. These fibres are to be manufactured from virgin polypropylene and added to the concrete by the concrete company, at the rate of 4.6kg/m^3. The 4.6kg consists of 3.8kgs of HPP and 0.8kgs of discrete Graded Fibrillated filament fibres.

Two bags of "Novomesh" HPP as supplied by Tapex Concrete Fibres Qld or approved equivalent added per m^3, will be deemed suitable for council's use. Where footpaths/bikeways are not subject to wheel loads one bag of fibres per m^3 will suffice.
Any alternate product must have prior written approval obtained from council.

(2) Steel reinforcement

Steel reinforcement shall comply with AS/NZS4671 *Steel reinforcing materials*.
The type and size of bars shall be as shown on the drawings.

If changes are proposed to reinforcement shown on the drawings, submit details to superintendent for approval 2 days prior to commencing works.
Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Damaged galvanising must be repaired in accordance with AS/NZS4680 Section 8 and notification of repairs made to the superintendent for approval.

The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS4671. Test certificates shall show the results of mechanical tests and chemical analysis.

Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2m in length. The cost of all samples and tests shall be borne by the Contractor.

Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at 23 ± 5°C without malfunction. The Contractor shall demonstrate that the proposed chairs conform with these requirements.

(3) Bending

Reinforcement shall be formed to the dimensions and shapes shown on the drawings. It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the drawings will not be accepted. Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

(4) Splicing

(a) General

All reinforcement shall be furnished in the lengths indicated on the drawings. If splicing is required, it shall be in accordance with the provisions of AS/NZS4671.

The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor.

(b) Lapped splices

Laps in reinforcing bars, wire or fabric shall be as shown on the drawings. Laps not shown on the drawings shall be as follows for unhooked bars:

(i) Plain bars, Grade 250 40 bar diameters.

(ii) Deformed bars, Grade 400 35 bar diameters.

(iii) Hard-drawn wire 50 bar diameters.

Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25mm.

(5) Marking

Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire. Each bundle shall have a stout metal label of not less than 40mm diameter attached to it. Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings. If called for on the drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately.

(6) Storage

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

(7) Delivery and receipt of reinforcement

Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until all tests and inspections have been satisfactorily completed and permission to deliver has been granted by the Superintendent.

The Contractor shall give 10 working days' notice to the Superintendent for carrying out inspection and testing. The Superintendent will carry out the inspection and testing with reasonable expediency, but the Contractor shall not be entitled to an extra as a result of any delays in this connection.

(8) Placing

Reinforcement shall be accurately placed as shown on the drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25mm. Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on the drawings or otherwise approved by the Superintendent.

The Superintendent may approve the use of tack welding instead of wire ties on reinforcing wire. All welding of reinforcing steel shall be in accordance with AS1554.3. Tack welding of cold-worked and hard grade bars shall not be permitted.

The reinforcement in each section of the work shall be approved by the Superintendent before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours.

Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the drawings. Where not so indicated it shall be as stated below:

(a) concrete normally in contact only with air:

(i) slabs: 40mm;

(ii) other than slabs: 45mm; and

(b) concrete in contact with earth or fresh water:

(i) slabs of box culverts: 50mm; and

(ii) other than culverts: 50mm.

(9) Cores, fixings and embedded items general

Cores, fixings and embedded items identified on shop drawings showing the proposed locations, clearances and cover, and indicating proposed repositioning of reinforcement must be presented for inspection by the superintendent.

If cutting or coring of hardened concrete is proposed, provide details to the superintendent for approval.

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. If required, provide for temporary support of adjoining elements during construction of the concrete.

If in external or exposed locations, galvanize anchor bolts and embedded fixings, or propose alternative materials such as stainless steel.

Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

SC6.4.6.28.7 Backfilling

(1) General

Backfilling at barriers, paving, etc., and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

No superimposed load on any part of what will become a load bearing structure within 21 days after placing concrete shall occur unless the structure is effectively and independently supported to the satisfaction of the Superintendent (approval must be sought at a minimum of 3 working days prior to loading upon evidence of early strength) or until the Contractor can demonstrate that 85% of the design strength of the concrete has been achieved.

Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS1289.3.3.1. The material must be placed in layers not exceeding 150 mm and must be compacted to provide a relative compaction as specified in sub-section SC6.4.6.10 - Earthworks (construction).

(2) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

(a) the maximum particle dimension shall not exceed 50mm; and

(b) no more than 5% by mass shall pass the 9.5mm A.S. sieve.

The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least

450mm vertically above the level of the weepholes.

Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.

SC6.4.6.28.8 Sprayed concrete

(1) References

NSW RTA – *Shotcrete Design Guidelines*.

(2) General

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

The minimum depth of sprayed concrete to be applied shall be 75mm.

Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour.

Sprayed concrete shall have a minimum cement content of 380kg/m3 as discharged from the nozzle and shall have a minimum compressive strength of 25MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS1012.14. Equipment and facilities shall be provided by the Contractor for the taking of cores from the work. The Contractor shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the Superintendent.

The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.

At least 14 days prior to applying any sprayed concrete the Contractor shall submit to the Superintendent details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS3600.

(3) Test panels

Not less than 7 days before applying concrete, the Contractor shall prepare at least three test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent. The test panels shall be made by applying a 75mm thickness of sprayed concrete to a hardboard panel approximately 750mm square. The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works. The panels shall be submitted to the Superintendent for examination.

The Contractor shall cut four 75mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed. The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days.

Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Sprayed concrete shall not be applied to the Works until the Contractor produces test panels for the approval of the council.

(4) Surface preparation

Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.

Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete.

Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.

The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

(5) Application of sprayed concrete

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

Spraying shall be discontinued if wind causes separation of the nozzle stream.

Concrete shall not be sprayed in air temperatures less than 5 °C.

Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

(6) Curing

Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS3799 and applied in accordance with manufacturer’s specifications.

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least 7 days.

SC6.4.6.28.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.28.7 – Summary of limits and tolerances below:

Item	Activity	Limits/Tolerances	Clause
1.	**Foundation**		
	(a) Relative Compaction	³95% RDD(standard compactive effort) within 0.3m below subgrade	SC.6.4.6.28.2(1)
2.	**Barriers, Footpaths etc.**		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 15mm under a straight-edge 3m long.	SC6.4.6.28.2(2)

Item	Activity	Limits/Tolerances	Clause
	(b) Relative Compaction of Subbase	³100% (standard compactive effort)	SC6.4.6.28.2(2)
3.	**Formwork**		
	(a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	SC6.4.6.28.3(5)
4.	**Fine Aggregate**		
	(a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.1.	SC6.4.6.28.4(3)
5.	**Coarse Aggregate**		
	(a) Percentage of wear	Loss of weight shall not exceed 30%	SC6.4.6.28.4(4)
	(b) Crushing Value	Crushing value shall not exceed 25%	SC6.4.6.28.4(4)
	(c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	SC6.4.6.28.4(4)
	(d) Particle Shape	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%	SC6.4.6.28.4(4)
	(e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.2.	SC6.4.6.28.4(4)
6.	**Aggregate Moisture Content**	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	SC6.4.6.28.5(2)
7.	**Consistency**	In accordance with AS1012.3, Method 1 the slump shall not exceed the nominated slump ±15 mm.	SC6.4.6.28.5(4)
		In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm.	SC6.4.6.28.5(4)
8.	**Ready-Mixed Concrete**		
	(a) Mixing & Delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours. Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	SC6.4.6.28.5(5)
9.	**Placing & Compacting of Concrete**	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	SC6.4.6.28.5(6)
10.	**Finishing of Unformed/Formed Concrete Surfaces**		
	(a) Wearing Surface	to be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3m length.	SC6.4.6.28.5(7)(b)
	(b) Finished Surfaces		

Item	Activity	Limits/Tolerances	Clause
	(i) Not Adjacent to Roads	≤25mm Plan position	SC6.4.6.28.5(7)(c)
		≤25mm Level	SC6.4.6.28.5(10
	(ii) Adjacent to Roads	≤10mm Alignment	SC6.4.6.28.5(7)(c)
		≤10mm Level	SC6.4.6.28.5(10)
	(iii) Culvert Inverts	≤25mm Alignment	SC6.4.6.28.5(7)(c)
		≤10mm Level	SC6.4.6.28.5(10)

SC6.4.6.29 Boundary fencing

SC6.4.6.29.1 Introduction

(1) Scope

The work to be executed under this sub-section includes setting out, clearing of fence line, supply of material and erection of fencing and gates, in accordance with the drawings or as directed by the Superintendent.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:

SC6.4.6.11 - Clearing and grubbing

SC6.4.6.28 - Minor concrete works

(b) Australian Standards:

AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*

AS 1725.1 – *Chain link fabric fencing - Security fences and gates.*

AS 2423 - *Coated steel wire fencing products for terrestrial, aquatic and general use.*

(c) Queensland Department of Transport and Main Roads publication:

Manual of Uniform Traffic Control Devices (Queensland) (MUTCD)

SC6.4.6.29.2 Materials

(1) General

All materials shall be supplied by the Contractor and shall be of dimensions, manufacture and quality in accordance with the requirements of this policy and all galvanised wire fencing products shall conform to AS 2423.

For each type of material to be supplied, the Contractor shall submit to the Superintendent for approval the source, manufacturer, and also the type if applicable.No materials shall be used until approved by the Superintendent.

(2) Galvanised posts, braces and rails

All posts, bracing and rails shall be galvanised iron pipe in accordance with AS 1725.1. The pipes shall be to the dimensions shown on the drawings.

All pipe joints shall be welded. All welds shall be satisfactorily cleaned and painted with a cold galvanising compound to the satisfaction of the Superintendent.

(3) Chain wire

Galvanised chain wire mesh, 1200 mm high, 1450 mm high or 1830 mm high for Manproof Fencing shall be of 3.15 mm diameter wire woven to a 50 x 50 mm square mesh. Chain wire shall be supplied in lengths of not less than 30 m. The zinc coating shall be uniform, continuous, free from imperfections and thoroughly adherent. The coating shall be applied to the wire before the mesh is woven. The weight of the zinc coating shall not be less than 290 g/sq m of wire surface.

Where specified, the chain wire shall be coated in black PVC after galvanising.

(4) Wire netting

Wire netting shall be standard quality galvanised 1.40mm diameter wire, 40mm mesh, 1.05m wide for normal use and 1.60mm diameter wire, 50mm mesh, 0.90m wide where used in creek crossings.

(5) Gates

Gates shall be of galvanised tubular steel construction, 3.6m in width by 1.5m or 1.2m (as specified) in height,

and shall be fitted with substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the drawings or directed by the Superintendent.

Where required, gates shall have stout and well supported rabbit-proof mesh to a height of at least 900mm above ground level.

(6) Reinforced concrete posts

(a) Strainer posts
Concrete strainer posts shall be approximately 150 x 150 square in section and lengths as shown on the drawings. Each post shall be provided with 12mm dia holes to suit the spacing of the wires shown on the drawings for the particular type(s) of fencing to be erected.

The posts shall be reinforced longitudinally with not less than four reinforcing bars each 12mm diameter. All posts shall have suitable stirrup reinforcement to control diagonal cracking. Longitudinal reinforcement shall have 25mm minimum cover. End cover on reinforcement shall be 25mm.

(b) Intermediate posts
Intermediate Posts shall generally conform to the requirements for Strainer Posts, except that the longitudinal reinforcing bars may be 9mm dia.

(7) Prestressed concrete posts

(a) Strainer posts
At least four longitudinal high carbon deformed high tensile strands (or equivalent) of 5mm diameter, shall be provided. The strands shall be tensioned to a stress of 800 MPa minimum prior to placing concrete. Cross sectional dimensions of the posts shall be as shown on the drawings.

Concrete shall have a minimum compressive strength of 32 MPa at 24 hours. In lieu of holes for wires, grooves may be provided to suit the spacing of the wires shown on the appropriate drawings for the particular types of fencing to be erected. The grooves shall be at least 5mm deep and 5mm wide at the surface of the post.

(b) Intermediate posts
Intermediate posts and strainer stays shall generally conform to the requirements for Strainer Posts except that two only high tensile, high carbon deformed strands shall be required.

Cross sectional dimensions shall be as shown on the drawings.

(8) Steel posts (rural fencing)
Steel posts shall be "STAR" pattern. Posts shall be drilled to suit the spacing of the wires shown on the Drawing(s), and shall be black varnished or galvanised. The total weight of 300 posts each 1.65m long shall be at least 1 tonne.

(9) Galvanised pipe posts (rural fencing)
Galvanised pipe posts shall be used where shown on the drawings. The pipes shall be of the dimensions shown on the drawings and shall be of first grade quality in accordance with AS 1725.

(10) Wires

(a) Plain wire
Plain wire shall be standard galvanised drawn annealed steel wire of diameters shown on the drawings.

(b) High tensile plain wire
High tensile wire shall be galvanised and of diameters shown on the drawings.

(c) Barbed wire
Barbed wire including barbs shall be 2.5mm diameter galvanised drawn annealed steel wire, with clusters of four barbs spaced at 90mm maximum. Alternatively barbed wire may be of 1.6mm diameter high tensile steel wire, with clusters of barbs spaced at 90mm maximum.

(d) Cable wire
Cable wire shall consist of three pairs of 2 x 3.15mm galvanised iron wire tightly twisted around posts and located as shown in the drawings.

(e) Tie wire
The wire shall be 2mm diameter galvanised wire.

(11) Concrete backfilling
All concrete backfilling of post holes specified on the drawings shall be of minimum 20 MPa 28 day compressive strength and shall conform to the requirements of sub-section SC6.4.6.28 Minor concrete works.

SC6.4.6.29.3 Construction

(1) General
Fencing shall be erected prior to the commencement of other work on a particular section of the work, unless directed otherwise by the Superintendent.

All fencing shall be erected in a workmanlike manner, and when completed shall be sound, strong and of neat appearance.

For a clear width of one metre on either side of the fence line, and for the full length of the line, all logs, boulders, stumps, roots, undergrowth and rubbish shall be removed and disposed of by the contractor in accordance with SC6.4.6.11 Clearing and grubbing. Trees within this area shall be removed only as directed by the Superintendent and approved by council's authorised officer.

If trees on or adjacent to the fence line are to be retained the arrangement of the fencing at the trees shall be as directed by the Superintendent.

Wire shall not be strained around or against any trees to be left in the fence line, and strainer posts are to be provided on both sides of each tree.

Where minor irregularities occur in the ground the vertical alignment of the fence shall not follow these irregularities, but shall be aligned to a uniform grade between definite changes in the natural slope of the ground.

All boundary fencing is to be erected on the common boundary line (where practicable) which has been surveyed and marked with pegs by a registered cadastral surveyor. The placement of the proposed fence (including footings), relative to the marked boundary line, is to be such that no (or minimal) loss of accessible land results for either property owner once the fence is erected. Any deviation of the proposed fence line away from the marked property boundary is to be mutually agreed to by all parties prior to erection of the fence.

The Contractor shall maintain the fencing at all times in a condition secure against the ingress or egress of stock, and shall take such precautions as are necessary to prevent people or stock from stepping into holes excavated for the construction of fencing.

Where old fencing is to be replaced by new fencing, all holes left after removal of the old fencing shall be backfilled and rammed firmly in layers of maximum depth 150mm.

The Contractor shall be held responsible for any loss, damage, or injury to buildings, goods, crops, livestock, property of any kind or persons due to negligence on the Contractor's part.

(2) Chain link fencing

(a) Erection of posts
All posts shall be erected vertically and set in concrete blocks approximately 250mm diameter and 600mm deep except for end, corner, strainer and gate posts which shall be set in concrete blocks approximately 250mm diameter and 900mm deep unless otherwise shown on the drawings. Concrete shall have a minimum compressive strength of 20 MPa at 28 days and shall conform to the requirements

of sub-section SC6.4.6.28 Minor concrete works.

Galvanised weather caps shall be fitted to all galvanised posts.

Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. Distances between strainer posts shall not exceed 120m.

(b) Erection of wire

All wire shall be spaced as shown in the drawings. Wire shall be securely fastened and strained to an even tension between strainer posts.

Where specified, or shown on the drawings, chain wire mesh shall be erected on the outside of the posts and fastened with two turns of tie wire to each cable wire on both sides of each post and at intervals of not more than 900mm between posts and to each post midway between cable wires.

(3) Stock-proof fencing

(a) Erection of posts

All posts shall be erected vertically. Reinforced concrete posts shall be erected in neatly cut holes sunk in earth, or in rock where this is encountered. Steel posts, except where placed in rock, shall be driven with suitable driving equipment, care being taken not to damage the tops of the posts during driving.

Where prestressed posts are proposed to be used, they shall be either erected as for reinforced concrete posts or shall be driven. Where driven, the Contractor shall use a suitable post driver which shall be equipped with two sets of guiding rollers, to hold the post vertical and in position during driving.

A steel cap with a plywood cushion shall be used to protect the top of the post during driving.

If the post cannot be driven for the full depth specified, or if it becomes significantly damaged, or cannot be driven vertically, it shall be removed. The same post if undamaged, or a new post, shall be erected as described for reinforced concrete posts.

Posts shall be sunk to the depths shown in Table SC6.4.6.28.1 Post depth in ground.

Table SC6.4.6.29.1 Post depth in ground

Type of Post	Depth	
	Earth	Rock
Concrete Corner Posts and Strain Posts	900	*600
Concrete Intermediate Posts	600	*450
Steel Posts	450	450

Note —*permitted only in cases where posts of the correct length are provided (see below), otherwise the depth of sinking shall be the same as for earth.

Cutting of concrete posts will not be permitted, and in order to take advantage of the lesser depth of sinking permitted in rock, it will be necessary to use posts manufactured in lengths to suit the depth of sinking. Where rock is encountered, steel posts shall be sunk in drill holes of sufficient diameter to permit them to be refilled with cement mortar consisting of one part of cement to two parts of clean sand.

Earth shall be backfilled around intermediate posts in layers of maximum depth 150mm for the full depth of the hole and up to ground level. The relative compaction of the rammed material shall be not less than that of the original undisturbed ground.

Where concrete posts are placed in rock, the space around the posts shall be tightly filled with cement mortar consisting of one part of cement to two parts of sand, or concrete where this is available.

Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. These posts shall be backfilled with approved concrete to their full depth.

Distances between strainer posts shall not exceed 120m in the case of fencing using steel intermediate posts, and 90m in the case of fencing for the retention of cattle (for which only concrete posts are permitted). Junctions with existing fencing shall be made in an approved manner.

(b) Erection of wires

All wire shall be placed as shown on the drawings. Wires shall be securely fastened and strained to an even tension between strainer posts with an approved wire strainer. Where barbed wire is to be used, it shall be tied in position at the top of intermediate posts, and where additional barbed wires are called for they shall be secured to the sides of the posts as shown on the drawings.

Where concrete posts are used and the barbed wires are secured either to the tops or sides of the posts by tie wire, the tie wire shall be stretched tight and shall fit snugly against the sides of the posts to prevent movement of the barbed wire.

Where prestressed posts are used, wires shall be securely tied so that they seat firmly in the grooves.

All joints in wires shall be as shown on the drawings.

(4) Crossing of watercourses and depressions

The crossing of all watercourses and depressions, shall be made secure by longer posts, suitably strutted as directed by the Superintendent. Additional cable wire and chain wire/wire netting shall be provided as necessary to make the fence stock proof.

The fence shall allow the passage of floodwater without the accumulation of debris. If directed by the Superintendent, flood gates shall be provided in accordance with clause SC6.4.6.29.3(6) Flood gates.

(5) Connections to existing fences

Existing cross fences shall be connected to the new fence using a strainer post with braces in each direction of strain (including cross fence) and the wires in both fences properly fastened to the post.

(6) Flood gates

(a) General

Suitable provision for the passage of flood waters past the fence shall be made at all watercourses. In all cases flood gates shall be of the type indicated on the drawings, or as directed by the Superintendent, and shall be erected so as to prevent the accumulation of flood debris, while remaining stock-proof or rabbit-proof.

(b) Small watercourses

Flood gates, in accordance with the drawings, shall be provided in small gullies at the locations indicated on the drawings or as directed by the Superintendent. The opening of each flood gate shall provide a waterway area at least twice that of the culvert opposite to which it is placed, or as otherwise directed by the Superintendent.

(c) Large gullies and creeks

Flood gates, in accordance with the drawings, shall be provided in gullies and creeks at the locations indicated on the drawings, or as directed by the Superintendent.

A 9mm galvanised wire rope shall be carried over the gully in one span, threaded through a strainer post and tied back to an anchor at an adjacent concrete intermediate post. Turnbuckles are to be provided at each end to tension the wire rope. Netting shall be suspended from the wire rope and shall be overlapped and securely tied. The netting shall be of sufficient length to lie on the ground for a distance of not less than 1.0m on the downstream side.

Ballast, of sound timber securely tied to the netting, shall be provided at the downstream end of the netting.

The sides of the gully shall be trimmed, as necessary, to ensure that the flood gate shall be stock-proof

or rabbit-proof. The flood gate shall have sufficient movement of the suspended portion under the flow of flood waters to prevent damage to the fence and the accumulation of debris against it. Each strainer post shall be stayed in three directions, as shown on the drawings.

(7) Erection of gates

Where gates are specified or shown on the drawings, they shall be erected so that they swing away from the road. Double gates shall be supplied if directed by the Superintendent, otherwise a single gate only shall be supplied.

At the location of gates the surface shall be levelled and shall be nearly horizontal. The area where the gates swing shall be similarly levelled.

The gates shall be hung as indicated in the drawings.

(8) Where required, existing fencing is to be removed as shown on the drawings.

No fencing is to be removed if there is a risk of egress or ingress of stock. If the existing fence is a rabbit-proof fence, then the contractor shall ensure that at night and weekends and other such times when work is not in hand that the whole of the fence is maintained in a rabbit-proof condition, even if temporary fencing is required.

All material removed in demolishing existing fencing shall be disposed by the Contractor as provided by clause SC6.4.6.29.3(9) Removal and disposal of surplus material and rubbish.

(9) Removal and disposal of surplus material and rubbish

All surplus material, offcuts, timber, roots and other debris resulting from the fencing contract shall be removed or otherwise disposed of to the satisfaction of the Superintendent.

The contractor shall not burn any timber, vegetation or refuse on site unless specifically approved by council's authorised officer.

(10) Cattle grids

Cattle grids shall be erected in accordance with the drawings.

The cattle grid shall be evenly bedded on a continuous layer of compacted sand or other granular material approved by the Superintendent. The bedding material shall be compacted so that the relative compaction as determined by AS 1289.5.4.1 is not less than 95 per cent.

Cattle grids shall be installed on raised abutments with approach ramps where possible. Alternatively, a cattle grid may be placed over an excavated pit, in which case adequate drainage shall be provided.

Crossfall for single lane cattle grids shall be level and for two lane cattle grids each section shall have a crossfall conforming to the crossfall of the approach road.

The cattle grid construction shall include all activities associated with the cattle grid including any adjustments to the fencing as shown on the drawings.

Advance signposting, in accordance with MUTCD, shall be provided on each approach to the cattle grid in accordance with sub-section SC6.4.6.24 Signposting.

SC6.4.6.30 Control of traffic

SC6.4.6.30.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for work necessary to provide for the safe movement of traffic and the protection of persons and property through and/or around the work site.

The extent of work includes the design, construction, maintenance and removal of temporary roadways and detours, the provision of traffic controllers, signposting, roadmarkings, raised pavement markers, lights, barriers and any other items required. All temporary traffic arrangements required by works are included under this sub-section except where specified otherwise.

Control of traffic shall be in accordance with Manual of Uniform Traffic Control Devices (MUTCD), this sub-section, and the drawings.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.4 - Stormwater drainage
SC6.4.6.5 - Drainage structures
SC6.4.6.6 - Pipe drainage
SC6.4.6.9 - Open drains
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.11 Clearing and grubbing
SC6.4.6.12 - Flexible Pavements
SC6.4.6.13 - Asphaltic concrete
SC6.4.6.16 - Sprayed bitumen surfacing

(b) Australian Standards:

AS 1742 – *Manual of uniform traffic control devices*
AS 1742.3 - *Manual of uniform traffic control devices – Traffic control for works on roads*
AS 1743 - *Road Signs - Specifications*
AS 1744 - *Standard alphabets for road signs*
AS/NZS 1906 - *Retroreflective materials and devices for road traffic control purposes*
AS/NZS 4602 - *High visibility safety garments*

(c) Austroads publications:

Guide to Road Design - Part 3 Geometric Design
Guide to Traffic Management – Part 6 Intersections, Interchanges and Crossings
Guide to Road Safety – Part 9 Roadside Hazard Management

(d) Queensland Department of Transport and Main Roads publication:

Manual of Uniform Traffic Control Devices (Queensland) (MUTCD).

(e) Other:

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment control council*

(3) Traffic guidance scheme

The Contractor shall construct the work with the least possible obstruction to traffic.

Two weeks before undertaking work which would involve any obstruction whatsoever to traffic the Contractor shall submit, for the Superintendent's approval, a Traffic guidance scheme in accordance with Part 3 of the MUTCD.

The Traffic guidance scheme shall include:

(a) design drawings for any temporary roadways and detours in accordance with clause SC6.4.6.30.2(3) Design drawings, showing pavement, wearing surface and drainage details;

(b) details of arrangements for construction under traffic in accordance with Part 3 of MUTCD;

(c) a signpost layout plan showing:

  (i) location, size and legend of all temporary signs;

  (ii) temporary regulatory signs and temporary speed zones, and

  (iii) all traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guard fence and barrier boards; and

(d) working times when traffic control measures are in place to minimise disruption to traffic during periods of peak flows.

The Contractor shall obtain all necessary approvals for temporary traffic arrangements except where specified otherwise.

Where the Traffic guidance scheme involves Regulatory traffic control signs or devices and/or where a disruption to traffic (including pedestrian) to the existing road is likely to be significant, the contractor must undertake consultation with all stakeholders and where identified, must include changes to bus routes and the establishment of temporary bus stops, relocation of any taxi ranks and parking bays for people with disabilities, establishment of any work zones on the roadway amd arrangements for the safe movement of pedestrians past the work site as part of the application to council for approval.

In the case of an intersection with a State controlled road approval from the Department of Transport and Main Roads (DTMR) must also be obtained.

The Traffic guidance scheme shall be in accordance with the requirements of this sub-section and the drawings.

Special consideration to the safety of pedestrians and workers shall be given in the preparation of the Traffic guidance scheme. Particular care shall be taken when requiring reversal of traffic flows or the separation of unidirectional flow by medians or other physical separation.

An approved copy of the Traffic guidance scheme must be kept on site at all times. This must be used to check the arrangement and maintenance of traffic control devices.

For staged works and complex traffic guidance schemes, the Contractor shall conduct a regular safety audit during the construction phase including risk assessments for the workers safety as recommended in *Guide to Road Safety – Part 9 Roadside Hazard Management.*

For non-complex traffic guidance schemes such as short term and mobile works not involving full or part road closure or works involving relatively simple part-roadway closures, the Contractor is required to carry out risk assessments considering factors such as traffic volume and speed, road geometry and width and general behaviours of road users. A fully protected work site will be required if identified risks cannot be tolerated.

(4) Side roads and property accesses

The Contractor shall provide safe and convenient passage for vehicles, pedestrians and stock to and from side roads and property accesses connecting to the roadway. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate alternative provisions to the prior satisfaction of the Superintendent.

Where interuptions to access is required, they are to be kept to a minimum and the contractor must advise the property owners of any interruption to access by way of a letter drop at least 24 hours before the intended interruption. The contractor shall repeat this advice verbally to the property owner where possible before proceeding with the access closure. All interuptions to access must have the the approval of the superintendent.

(5) Traffic controllers

The Contractor shall advise the Superintendent of the names of proposed traffic controllers with a signed declaration that they are appropriately trained in the duties of traffic controllers in accordance with the MUTCD.

In situation where restricted sight distance is identified by the Superintendent, an additional traffic controller shall be placed at the tail end of the queue.

(6) Approved clothing for work personnel

All personnel shall wear high visibility clothing to the requirements of the MUTCD.

(7) Temporary speed zoning

Where a temporary speed limit has been approved by the council, or in the case of a gazetted or State controlled road the District Manager of DTMR, the Contractor shall arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection. Where and when directed by the Superintendent, the Contractor shall erect these signs, cover the signs when the speed zone is not in use and remove the signs when the speed zone is no longer required as part of the provision for traffic. A diary recording operation times of the speed zone shall be kept by the Contractor.

(8) Plant and equipment

During the day plant and equipment working in a position adjacent to traffic and having a projection beyond the normal width of the item, for example, a grader blade, shall have a fluorescent red flag attached to the outer end of the projection. During poor light conditions or at night, an additional traffic controller with an illuminated red wand shall direct traffic around such plant and equipment.

At night, where traffic is permitted to use the whole or portion of the existing road, all plant items and similar obstructions shall be removed from the normal path of vehicles to provide a lateral clearance of at least 6 m where practicable, with a minimum clearance of 1.2 m.

Plant and equipment, within 6 m of the normal path of vehicles, shall be lit by not less than two yellow steady lamps suspended vertically from the point of the obstruction nearest to a traffic lane and one yellow steady lamp at each end of the obstruction on the side furthest away from the traffic lane.

SC6.4.6.30.2 Temporary roadways and detours

(1) Approval

The design of all proposed temporary roadways and detours; to be undertaken in accordance with this policy sub-section

(2) Design standards

The standard of alignment and grading adopted shall be in accordance with specific provisions of this policy and shall otherwise be in accordance with the *Guide to Road Design – Part 3 Geometric Design*

Intersections shall be designed in accordance with the Guide to Traffic Management – Part 6 Intersections, Interchanges and Crossings.

Design drawings, geometric standards, design speed, wearing surface type and pavement design of the proposed temporary roadways and detours shall be submitted by the Contractor with the Traffic Guidance Scheme.

(3) Design drawings

Design drawings submitted for approval should show:

(a) alignment and grading at a horizontal scale of 1:2000 for rural roads and 1:500 for urban roads. Where the temporary road rejoins the existing road, levels showing the full cross section shall be extended along the existing road for a minimum length of 200 m;

(b) a sight distance diagram if opposing traffic is to use a single carriageway;

(c) intersections, and any other locations where traffic may be required to make turning, merging or diverging movements, at a scale of 1:500;

(d) pavement marking details;

(e) sufficient cross sections to indicate the feasibility of making connections between various parts of the work;

(f) sufficient dimensions, especially lane widths, to make clear the geometry and clearances of the proposed works;

(g) a north point or some other location method to orientate the plan;

(h) roadside furniture;

(i) drainage structures (existing/temporary and proposed); and

(j) pavement and surfacing type.

(4) Drainage

Drainage structures and drains shall be constructed in accordance with the following sub-sections:

(a) SC6.4.6.4 - Stormwater drainage;

(b) SC6.4.6.6 - Pipe drainage;

(c) SC6.4.6.5 - Drainage structures; and

(d) SC6.4.6.9 - Open drains.

Drainage proposed in accordance with clause SC6.4.6.30.1(2) Traffic guidance scheme shall be able to cope with upstream rainfall run off resulting from all rainfall intensities up to that expected for a once in five year frequency, without overflow over the road.

Pavements shall be designed and constructed to not pond water on the wearing surface or shoulders. Temporary formations to be constructed shall not dam water.

(5) Construction of earthworks and pavement

Temporary roadways shall be constructed in accordance with the following specifications:

(a) *Best Practice Erosion and Sediment Control*;

(b) SC6.4.6.11 Clearing and grubbing;

(c) SC6.4.6.10 Earthworks (construction); and

(d) SC6.4.6.12 Flexible Pavements.

(6) Surfacing

The wearing surface width shall extend across the full width of the traffic lanes plus the width for each shoulder, or as otherwise demonstarted.

The wearing surface shall be carried onto any existing connecting roadway so as to finish square to the existing roadway centreline.
Surfacing shall be constructed in accordance with:
SC6.4.6.16 - Sprayed bitumen surfacing; and
SC6.4.6.13 - Asphaltic concrete

(7) Road safety barrier

Corrugated steel road safety barrier shall be erected on all temporary embankments where the vertical height between the edge of the shoulder and the intersection of the embankment slope and natural surface exceeds 2m.

Road safety barrier shall be erected in accordance with:
SC6.4.6.25 - Non-Rigid Road Safety Barrier Systems.

(8) Opening to traffic

Temporary roadways and detours (including portable or temporary traffic signals sites) shall not be open to traffic until they have been inspected, approved and authorised in writing.

All signposting, pavement marking, guardfence and portable or temporary traffic signals shall be completed before the opening of temporary roadways to traffic.

The opening of temporary roadways shall be arranged so that sections of existing roadway being replaced are not disturbed for a minimum of 48 hours in the event of temporary roadway failure and there is a warrant to redirect traffic back onto the existing roadway. The determination to redirect traffic shall be by the Superintendent.

The redirection of traffic back onto the existing roadway shall be the responsibility of the Contractor.

Unless otherwise approved by the Superintendent, traffic shall be switched to a temporary roadway or detour only where the Contractor's usual workforce will be on site for a minimum of 2 days thereafter.

(9) Maintenance

The Contractor shall be responsible for the maintenance of temporary roadways and detours and shall ensure the road surface is kept safe for traffic. Any potholes or other failures shall be repaired without delay.

(10) Removal

Upon completion of the work the temporary roadways and/or detour arrangements shall be removed and the area restored to a condition equivalent to that which existed prior to the commencement of the work.

SC6.4.6.30.3 Arrangements for traffic

(1) Construction under traffic

Where a temporary roadway or a detour is not provided or available then, subject to the approval of the Superintendent, construction under traffic may be permitted provided a minimum of 3.5 m lane width is available for through traffic on a two lane roadway and where 3.5 m lanes are available in both directions for through traffic when working on multilane roads.

The carriageway/s shall be restored to a safe and trafficable state for through traffic prior to cessation of work each day in accordance with the approved Traffic guidance scheme.

Full details of temporary signposting, traffic control devices and traffic control methods, in accordance with the appropriate arrangement diagrams in MUTCD, are to be submitted for the Superintendent's approval at least 5 working days before undertaking any work which would involve construction under traffic.

(2) Opening completed work

The Contractor shall give the Superintendent at least 5 working days written notice confirming the date of opening completed work to traffic. The procedure for opening shall be determined through consultation between the Superintendent, the Contractor and the council.

The Contractor shall be responsible for the removal of all temporary traffic control devices no longer required for the safety of traffic, when the works or part thereof are opened to traffic.

SC6.4.6.30.4 Traffic control devices

(1) Arrangement of traffic control devices

The arrangement and placement of traffic control devices shall be carried out in accordance with the approved Traffic guidance scheme, and MUTCD. The arrangement diagrams illustrate the more common examples of the arrangement of traffic control devices and set out the minimum requirements.

All temporary traffic control devices, when no longer required, shall be covered and/or removed without delay in order to maintain unambiguous safe guidance to traffic.

(2) Maintenance of traffic control devices

All traffic control devices shall be maintained in accordance with MUTCD so that they are in good order and in the correct positions day and night. They shall be neat and clean, and signs shall be clear and legible at all times.

To ensure the preceding clause is complied with, the Contractor shall inspect the site at least once every 24 hours for the maintenance of all traffic control devices.

The Contractor may need to be contacted outside normal working hours to arrange for adjustments or maintenance of traffic control devices. The Contractor shall notify the Superintendent and the council in writing, the names, addresses, and means of communicating with personnel nominated for this purpose.

(3) Adequate traffic control devices

Where the Contractor fails to provide and maintain adequate traffic control devices specified in this sub-section, the Superintendent shall arrange to have such items provided and maintained.

(4) Regulatory traffic control signs and devices

A regulatory traffic control sign or device shall be in accordance with the MUTCD, and shall require approval by the council, or in the case of a gazetted or State controlled road, the District Manager of DTMR, before its erection. This approval should be obtained through the Superintendent, refer to clause SC6.4.6.30.1(6) Temporary speed zoning.

(5) Signs

Signs shall be designed and manufactured in accordance with AS 1743. Details of each letter shall be as shown in AS 1744.

The reflective material used on signs shall be Class 2 material complying with AS 1906.1 except where otherwise specified.

(6) Supplementary signs

Signs supplementary to the MUTCD are shown in SC6.4.6.30 Attachment A Supplementary temporary warning signs to MUTCD. Approval must be obtained from DTMR prior to their use.

(a) Heavy Machinery Crossing
This temporary sign, shown as Sign SW5-22, if approved, may be used in lieu of W5-22, trucks entering.

(b) Cycle Hazard Grooved Road
This temporary sign, shown as Sign ST1-10, if approved, may be used in addition to T1-10 of AS 1742.3 where the road is grooved and is a hazard to cyclists.

(c) Tar Spraying Possible Short Delay
This temporary sign, shown as Sign ST3-1, if approved, may be used in addition to T3-1 for bituminous surfacing works.

(7) Flashing arrow signs

Flashing arrow signs shall comply with MUTCD.

(8) Barrier boards

Barrier boards shall comply with MUTCD.

Trestles supporting the barrier boards may be manufactured of timber, metal or other suitable material and shall be yellow. The trestles shall provide firm supports for the barrier board and be kept in place by sandbags suitable devices. The bases of the trestles shall not protrude beyond the ends of the boards.

(9) High visibility mesh fencing

High visibility mesh fencing shall be constructed where shown on the drawings, Traffic Guidance Scheme or as directed by the Superintendent.

High visibility mesh fencing shall be constructed in accordance with MUTCD, containment fences.

The mesh fencing shall be approximately 1 m in height and of a red-orange colured flexible material as approved by the Superindendent.

(10) Temporary post-mounted delineators
In addition to the requirements of MUTCD, temporary post mounted delineators shall be provided in conjunction with high visibility mesh fencing which is erected parallel to and in close proximity to traffic.

(11) Cones and bollards
Traffic cones and bollards shall comply with MUTCD and be placed in accordance with the arrangement diagrams in MUTCD.

Unless cones are firmly fixed in position they shall be used only while work is in progress, or in locations where there is an employee in attendance who shall reinstate any of the cones which have been dislodged by traffic. Otherwise they shall be removed and bollards or barriers substituted.

Cones and bollards used under night conditions shall be reflectorised in accordance with MUTCD.

(12) Traffic warning lamps
Traffic warning lamps shall comply with MUTCD and shall be installed in accordance with MUTCD. The Contractor shall ensure that warning lamps are in good working order, correctly aligned and positioned with respect to the direction of traffic flow each night, before the site is left unattended.

(13) Temporary pavement markings
All pavement markings shall be reflectorised and consist of painted lines, roadmarking tape and/or raised pavement markers in accordance with the relevant Australian Standards or as otherwise approved by the Superintendent and shall be provided in accordance with MUTCD.

Where the adjoining roadway is edgelined, temporary roadways shall be similarly edgelined.

(14) Temporary linemarking
Where temporary linemarking is required on the final wearing surface, only pavement marking tape shall be used.

Where the pavement linemarking has become ineffective in the opinion of the Superintendent, remarking shall be undertaken within 48 hours of direction by the Superintendent.

Where a single carriageway is opened adjacent to or used in lieu of an existing dual carriageway length, pavement arrows indicating the direction of flow of traffic shall be placed at not more than 500 m or at a spacing nominated by the Superintendent. The arrows shall be removed if the section is then reincorporated as dual carriageway.

Immediately before or after placement of new markings all superseded pavement markings shall be obliterated or removed to the satisfaction of the Superintendent.

On a final surface, obliteration by painting shall not be permitted.

(15) Raised pavement markers
Where raised pavement markers have become ineffective in the opinion of the Superintendent, they shall be replaced within 24 hours of direction by the Superintendent.

All superseded raised pavement markers shall be immediately removed from the pavement by the Contractor.

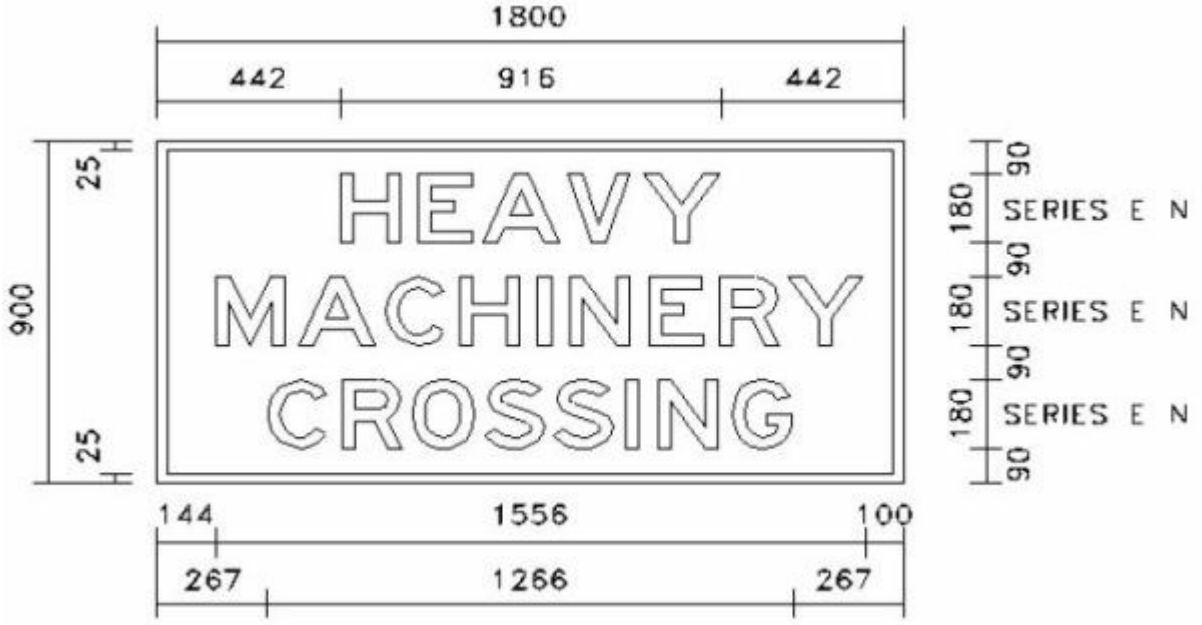
Attachment

SC6.4.6.30 Attachment A Supplementary temporary warning signs to MUTCD

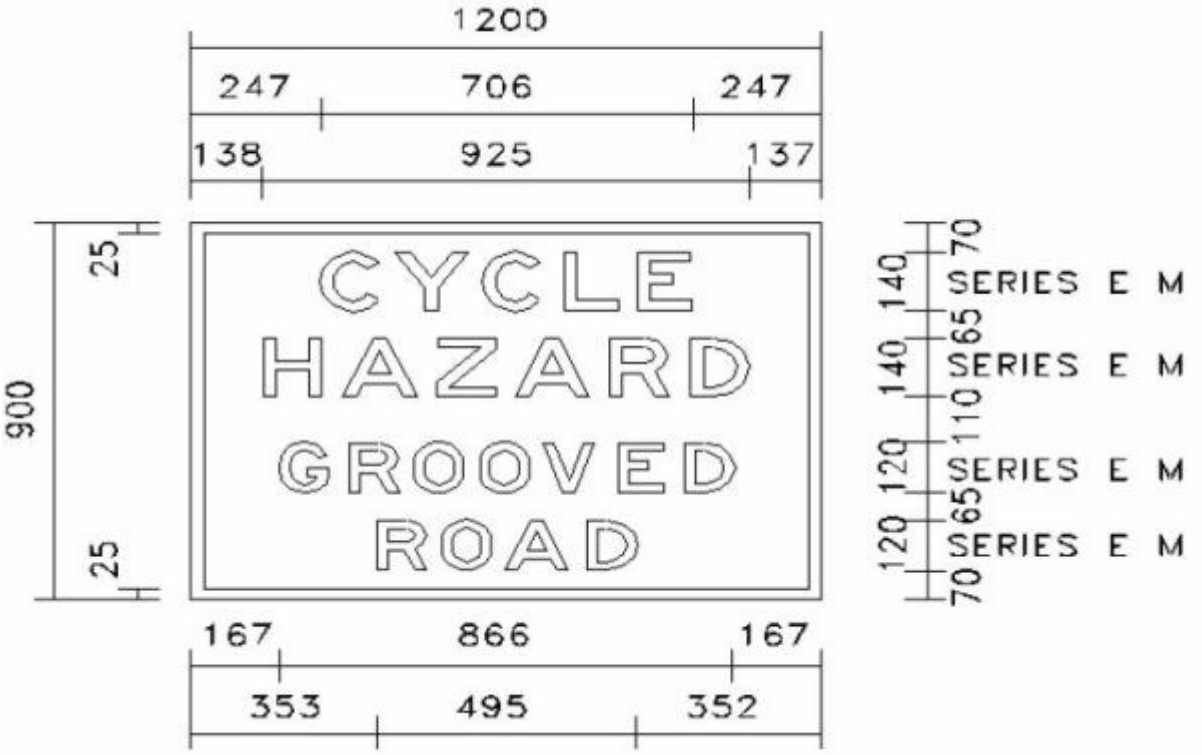
(1) Black letters and border on yellow reflectorised ground.

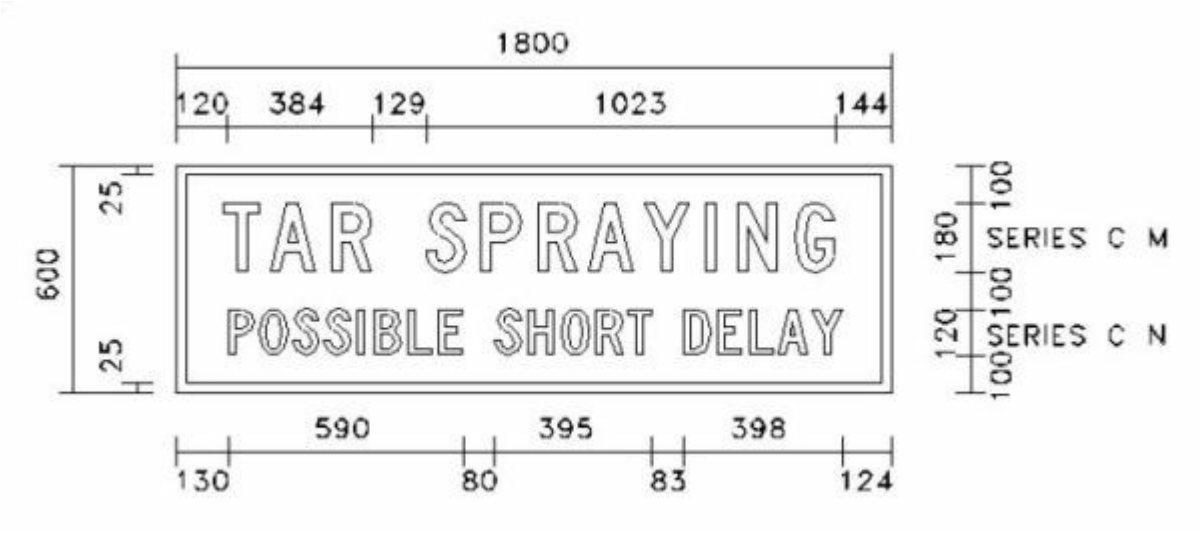
(2) Dimensions are in mm.

SW5-22



ST1-10




1800
120
384
129
1023
144
600
25
25
TAR SPRAYING
POSSIBLE SHORT DELAY
180
100
SERIES C M
120
100
SERIES C N
100
590
395
398
130
80
83
124

ST3-1

SC6.4.7 Acceptance of completed works

SC6.4.7.1 Release of the plan of survey

SC6.4.7.1.1 Introduction

The Release of the plan of survey sub-section details the requirements that must be met prior to the release of the Plan of Survey.

(1) Principles

Prior to the release of the Plan of Survey the developer must:

(a) comply with all conditions of the development permit; and

(b) ensure that all required fees, bonds, contributions, infrastructure charges and outstanding rates are paid.

Works will not be accepted on maintenance until the formal Plan of Survey has been released.
Where exceptional circumstances exist and an early release of the Plan of Survey is agreed to by the Director Planning and Development, the developer is required to bond any outstanding work.

(2) Terminology

Terms in this policy have the same definition as in the *Planning Act 2017*, unless otherwise defined.

DEHP	*Department of Environmental and Heritage Protection*
Plan of Survey	Includes all surveys undertaken by a cadastral surveyor as defined by the *Surveyors Act* 2003 and for the purpose of: • subdividing one or more lots; or • dedicating land to public use; or • redefining a lot by resurvey; or • amalgamating two or more lots to create a smaller number of lots; or • defining an area for an easement, lease, profit a prendre or covenant; or • any other purpose that the Registrar may require the registered proprietor to undertake.
On maintenance date	The date the works have been inspected and are complete, relevant conditions of the Development Permit have been satisfied, council has accepted maintenance responsibility for agreed public infrastructure and the developer commences the defects liability period.
Off maintenance date	The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes.
Maintenance period	The period of time between when council accepts the works on-maintenance until council accepts the works off-maintenance. This includes any establishment periods and the defect liability period, the period of time during which the developer is required to repair defects that occur. A defect is an imperfection, fault of deficiency in the works and does not include general wear and tear of items or damage due to misuse.

SC6.4.7.1.2 Release of plan of survey requirements

The following must be received or completed prior to the release of the Plan of Survey.

(1) Certification

(a) The developer must submit one print of each drawing, excluding council Standard Drawings:

(i) as originally approved by council;

(ii) including amendments incorporated in the construction of the development; and

(iii) overprinted with a certificate from a Licensed Surveyor or Registered Professional Engineer of

Queensland (RPEQ) as detailed below.

(b) An RPEQ and/or a Registered Landscape Architect must certify that the completed works comply with the development approval, the specific outcomes of the applicable regulations and good engineering practice.

The RPEQ and/or Registered Landscape Architect must also certify the 'as constructed drawings by including the following statement on each drawing:

"I/We (Name) of (Firm) hereby certify that the works as shown on the 'as constructed' drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated)".

(c) A Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each as constructed drawing:

"I/We (Name) of (Firm) herby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated)".

(2) As constructed drawings

One signed hard copy and digital copies of the as constructed drawings (AutoCAD DWG and a copy converted to PDF A1 format correctly scaled to A3 size) must be submitted and approved by council. As constructed information must be provided for all completed works, and must include the following information.

(a) Lot

(i) The lot layout as approved and as shown on the Plan of Survey.

(ii) Approved street names.

(b) Earthworks

(i) As constructed contours or where allotments are under 2000m^2 spot levels will be adequate to verify a minimum as constructed surface gradient of 1 in 250.

(ii) Denote location, extent and depth of fill.

(iii) The maximum depth of fill on each lot must be indicated.

(iv) Flood lines as adopted by council.

(v) Street names as approved by council and noted on the Plan of Survey.

(c) Infrastructure

(i) Pavement and kerb and channel information (e.g. edge of pavement and kerb and channel alignment and depths of pavement, kerb type, road surface type and depth, road pavement details, type and depth, road cross sections).

(ii) Stormwater drainage information, including:

(A) pipe alignments denoting sizes and invert levels at each end;

(B) manhole location; and

(C) inlet pit types to be denoted.

(iii) Major overflow paths and trunk drainage channels located and clearly shown.

(iv) Invert levels and offsets of the junction points and manhole connections where roof water drainage systems have been used.

(v) Sewerage 'as constructed plans', including all required details, lodged and approved.

(A) Location of maintenance structure (MH, MC, JU and end of PCS or house drain connection point); and

(B) Material type and sizes.

(vi) Details of all water mains, fittings of consequence and markers, including relevant dimensions,

included on as constructed plans, which are to be lodged and approved.

(vii) Location and dimensioning of subsoil cleanout points.

(viii) BOS data to detail location of house drain connection point - building envelop upgraded.

Editor's note: -

a) The accuracy of as constructed plans locating house connections is essential.

b) Council's Inspector, while on site, may take measurements that will permit some cross checking of as constructed plans. Should these checks indicate discrepancies, then reopening of the work will be required for checking measurement of the work.

(3) Ongoing operational requirements

Where requested, applicants are required to identify the ongoing operational requirements in a relevant Maintenance Plan, as detailed in Section SC6.4.2 Development application guidelines.

(4) The on maintenance inspection

The on maintenance inspection must be satisfactorily completed prior to the release of the Plan of Survey. The Consulting Engineer must undertake and report on the following prior to requesting the on maintenance inspection.

(a) Lodgement

(i) Demonstrated full compliance with all conditions of relevant Development Approvals.

(ii) Building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA).

(iii) Plan of Survey submitted in accordance with approved proposal plan and any approved amendments, or where the Plans of Survey differ from the approved proposal plan, details of any changes must be provided with the application.

(iv) A Supervision Certificate from the Consulting Engineer and request to have the works accepted on maintenance.

(v) Infrastructure Agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure.

(vi) Approval by other authorities, e.g. evidence of NBN Agreement, Certificate of Acceptance or Letter of Supply from Ergon.

(b) Sewer

Sewerage works

(i) Pressure test all sewers and manholes to ensure the requirements of the specification are met.

(ii) Check by internal examination (closed circuit television) that all sewers are straight, clean and to grade.

(iii) Check that all manholes are sound, smooth and clean and benched as per the required standard.

(iv) Check that house connection jump up construction complies with council's standards.

(v) Performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station.

(vi) Obtain licences for overflows to the sewerage system from DEHP.

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers must have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.3 Sewer pump-out agreements.

(c) Water

(i) Water reticulation

(A) Pressure test and supervise the swabbing (if necessary) and sterilisation of the water mains.

(B) Check location of hydrants and valves to ensure they are in their correct location.

(C) Check that all valves and hydrants are working satisfactorily (include lid arrangement as per SD-350).

(D) When water mains have been constructed, mains must be commissioned in accordance with council requirements.

(ii) All works associated with water supply on site must be 100 per cent complete, and all water mains must be tested and live. Reservoirs and associated pump stations must be commissioned prior to the lodgement of survey plans unless otherwise approved by council.

(d) Earthworks

(i) All allotment preparation work and earthworks on allotments must be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthwork construction, with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(ii) Where specific revegetation works have been bonded for future completion, the earthworks and top soiling must be complete prior to the release of the Plan of Survey.

(iii) All survey pegs placed.

(e) Roads

(i) Roads must be completed and fully sealed.

(ii) Pavement line markings completed at major intersections.

(iii) All traffic control devices, including traffic islands to be completed.

(iv) All traffic signage to be in place and completed compliant with Manual of Uniform traffic control devices (MUTCD) requirements.

(v) Traffic signals, if present, to be installed, completed and fully functional, compliant with the relevant requirements and legislation.

(vi) Retaining walls within road reserve to be completed and maintenance requirements documented.

(vii) Fences and noise abatement/screening walls to be completed and maintenance requirements documented.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(iii) Performance testing of pumping equipment must be passed satisfactorily. This testing will require the connection of the electricity supply and water to the pump station.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and NBN Co infrastructure, reticulation of electricity and the provision of street lighting, and gas service providers for provision of gas (if gas is provided).

(h) Payments and Bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be a minimum 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding rates paid.

(iii) All infrastructure charges required by the conditions of the development permit must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

SC6.4.7.1.3 Bonds

To enable early release of the Plan of Survey it will be necessary to bond all outstanding works and requirements. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(1) Standard bond conditions

(a) Estimates

(i) To verify the maintenance bond estimates, council must be supplied with a schedule of the works together with the appropriate estimated rates and amounts for all the items.

(ii) To verify the incomplete works bond estimates, council must be supplied with a schedule of the incomplete works together with the appropriate estimated rates and amounts for the incomplete works.

(iii) Such estimated prices must be fair and reasonable.

(b) Conditions

(i) The amount of the security for incomplete works must be for an amount of not less than one hundred and fifty per cent (150 per cent) of the certified cost of the works remaining to be completed as at the date of the release of the subject Plan of Survey.

(ii) Incomplete works must be itemised, valued and certified by an RPEQ.

(iii) All bonds submitted must be clearly identified as to the particulars of the site and the purpose of the bond.

(iv) Insurance and indemnity certificates must be current and valid to cover the period outstanding works are being completed.

(c) Acceptable security

(i) Cash bonds.

(ii) Unconditional bank guarantees.

(A) A bank guarantee must include:

- a binding contractual relationship between council and the guaranteeing bank;
- specific requirements for renunciation of the guarantee; and
- a requirement of adequate notice of renunciation.

(B) Bank guarantees must not have expiration dates.

(2) Incomplete works bond

(a) Incomplete works condition

In addition to the standard bond conditions:

(i) Where council consents to the early release of a Plan of Survey in line with the minimum requirements listed in Section 3, the developer will be required to lodge a security (bond) and an undertaking to complete the works within an agreed timeframe. These works must be completed to the satisfaction of council and the security submitted in a format as detailed in this sub-section. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(ii) Outstanding works must be itemised, valued and certified by an RPEQ.

(iii) Potential purchasers of lots must be advised of the arrangements.

(b) Required information

The RPEQ must provide the following information:

(i) certification of the value of incomplete works;

(ii) detailed schedule of the scope and cost of the incomplete works for auditing purposes;

(iii) certification that all external and internal works can be completed and accepted on maintenance within the timeframes detailed elsewhere in this Policy sub-section;

(iv) certification that the contract has been let for the construction of the remaining internal and external works and the name of the Contractor;

(v) proposed finish dates for remaining internal and external works; and

(vi) security lodgement form completed clearly indicating that the purpose of the bond is for incomplete works.

(3) Revegetation bonds

Revegetation bonds may be required where conditioned by a development permit. At the time of on maintenance council may accept the drains and earth batters within a subdivision whereby the vegetation is not in accord with the objectives of this and other SC6.4 Development manual planning scheme policy sub-sections, subject to the following requirements.

(a) Revegetation performance bond

(i) A bond for the incomplete revegetation must be included as a performance bond for incomplete works along with all other bonds for incomplete works upon that subdivision.

(ii) The bond for the revegetation works must be 150 per cent of the approved estimated cost of the revegetation works to allow for the typical seasonal weather encountered in the region, due to the risk of erosion and scouring in areas of exposed earth.

(iii) The revegetation performance bond will be considered for acceptance on and off maintenance separate to the general subdivision works.

(b) Revegetation maintenance bond

(i) The revegetation performance bond will be reduced to a revegetation maintenance bond upon achievement of a minimum scour protection, which is deemed as 40 per cent vegetal coverage, which includes 15 per cent of the total area having the specified species. The revegetation maintenance bond must be equal to the approved estimate of the value of the works required to achieve the specified grass coverage by the off maintenance date.

(ii) The acceptance of revegetation on maintenance will correspond with the reduction of the performance bond for revegetation works. The acceptance of the revegetation works off maintenance and release of the revegetation maintenance bond will require the specified grass coverage to be completed but will not occur prior to the remainder of the development being accepted off maintenance.

(4) Sewer pump station bonds

(a) Where a sewage pump station is a pump station identified by council in the Priority Infrastructure Plan (PIP) and that sewage pump station is identified as minor trunk infrastructure, then consideration will be given to the release of the Plan of Survey prior to the completion of the works associated with that pump station.

(b) The pump station must be located upon land that is or will be under the control of the council upon the registration of the subject Plan of Survey.

(c) The working drawings and specifications must have been completed and approved by council for construction.

(d) The Consultant Engineer acknowledges that with respect to the nominated works that they are working for council and not the developer, and that the specifications nominate council as the Principal of the Contract.

(e) The tenderers must have been reported to council and council must have approved the successful tenderer.

(f) The Contract must have been let, and a submitted works program must indicate that the trunk

infrastructure is programmed to be completed prior to when the commencement of dwelling construction is envisaged, including provision for a normal wet season.

(g) The developer must enter into a Deed of Agreement with council, as detailed in SC6.4.7.3 Sewer pump-out agreements that includes provision for a pump-out service and a security for this pump-out. The template in Attachment A of SC6.4.7.3 Sewer pump out agreements may be used for the Agreement.

SC6.4.7.1.4 Early release of the plan of survey

(1) Justification for early release

Council may elect to release plans of survey prior to satisfaction of the development permit on the basis that critical works are provided and security is afforded for the outstanding works. This process requires the developer to request the early signing in writing at the time of lodging a survey plan and payment of a fee, demonstrating how conditions of the development approval are satisfied or secured.

Early approval and dating of the Plan of Survey does not discharge the developer from obligations to satisfy the conditions of development approval, and the development may be subject to enforcement action for non-compliance with the development permit(s) and/or the undertaking given to complete the outstanding works.

The aim of this clause is to enable the developer to have the Plan of Survey released from the council as early as possible while at the same time ensuring that the allotments being constructed will be fully serviced at the time that the Plan of Survey is registered and subsequent sales of the allotment takes place.

(2) Early release of survey fees

A fee for the early release of the Plan of Survey in accordance with council's schedule of fee's and charges at the time of payment will also be required as payment separate to the incomplete works bond.

(3) Minimum requirements

Council will not sign any Plans of Survey where the relevant works or matters are incomplete, unless the following are completed:

(a) Early Plan of survey on maintenance inspection

An on maintenance inspection must be satisfactorily completed in accordance with SC6.4.7.1.2(4) and as detailed below, however some minor defects may be outstanding, with minor defects defined as those not impacting on public safety and/or the ability of council to operate and maintain the infrastructure.

(b) Earthworks

All allotment preparation work and earthworks on allotments to be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthworks (construction), with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(c) Sewerage

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.1.3(4)). Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment.

(d) Water

All works associated with water supply on site are 100 per cent complete, and all reticulation has been pressure tested, sterilised, completed and connected to an existing supply. All water pumping stations must be certified by an RPEQ as being 100 per cent complete and in full working order.

(e) Roads

Roads must be completed to the point where the pre-seal inspection has been carried out by council's inspectors and the pavements are approved for application of bitumen or asphalt.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage, other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large WSUD measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and broadband infrastructure, reticulation of electricity (e.g. Letter of Supply) and the provision of street lighting and gas service providers for provision of gas (if gas is provided).

(h) Payments and bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding levied rates are paid.

(iii) All infrastructure charges required by the conditions of approval must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

(j) As constructed plans

As constructed plans must be submitted in accordance with SC6.4.7.1.2(2) showing all works completed to date, including as a minimum, the requirements above in parts (a) – (i). All works not shown on the as constructed drawings at the time of submission for early release of Plan of Survey, will be required to be bonded in accordance with the requirements of this section.

(4) Timing

All incomplete works must be completed and ready for council inspection within 1 month of council releasing the Plan of Survey. Should the developer not be able to meet this requirement they must submit justification to council detailing exceptional circumstances. The RPEQ must submit for the approval of council, a program of works to certify that the incomplete works can be completed within 1 month (or longer as agreed by council).

(5) Sewer pump stations

Early release of the Plan of Survey may be considered if council developed sewer pump stations are almost complete. See SC6.4.7.1.3(4) for more information.

SC6.4.7.2 On maintenance/final completion/off maintenance requirements

SC6.4.7.2.1 Introduction

This sub-section provides guidance and advice for the requirement for on maintenance/final completion/off maintenance to facilitate the release of the plan of survey (see SC6.4.7.1 Release of the plan of survey).

SC6.4.7.2.2 Lodgement

(1) Requirements for on maintenance:

(a) building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA);

(b) a supervision certificate from the Consulting Engineer and request to have the works accepted on maintenance;

(c) a workmanship guarantee from the Contractor;

(d) submission to and acceptance by council of as constructed information. The RPEQ must certify the "as constructed" drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the as constructed drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated);

(e) a Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each relevant as constructed drawing:

I/We (Name) of (Firm) hereby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated);

(f) infrastructure agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure;

(g) approval by other authorities, e.g. evidence of NBN Agreement, or Certificate of Acceptance from Ergon;

(h) the works must remain on maintenance for a minimum period of 12 months;

(i) the works subject of other approvals for which the works of this approval are dependent must also have been accepted on maintenance; and

(j) where on maintenance can be achieved within 1 month of the release of the plan of survey then the date for the on maintenance will be backdated to the date of the release of the plan of survey. Otherwise, on maintenance will be from the date that all requirements have been satisfied.

SC6.4.7.2.3 Sewer

(1) Requirements for on maintenance:

(a) pressure test all sewers and manholes in accordance with WSA to ensure the requirements of the specification are met;

(b) check by internal examination (closed circuit television) that all sewers are straight, clean and to grade. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment;

(c) check that all manholes are sound, smooth and clean and benched as per the required standard;

(d) check that house connection "jump up" construction complies with council's standards;

(e) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(f) certified results of pressure tests on all mains;

(g) certified results of field tests on pumping equipment;

(h) operations manual, performance specifications and maintenance requirements for all pump stations; and

(i) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

SC6.4.7.2.4 Water

(1) Requirements for on maintenance:

(a) pressure test and supervise the swabbing and sterilisation of the water mains (if necessary);

(b) check location of hydrants and valves to ensure they are in their correct location;

(c) check that all valves and hydrants are working satisfactorily(include lid arrangement as per SD-350;

(d) when water mains have been constructed, mains must be commissioned in accordance with council requirements;

(e) certified results of pressure tests on all mains;

(f) certified results of field tests on pumping equipment;

(g) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications; and

(h) no concrete footpaths installed over water main where property connections are yet to be constructed.

SC6.4.7.2.5 Earthworks

(1) Requirements for on maintenance:

(a) all survey pegs placed; and

(b) compaction results of each layer of earthworks on roads and on each allotment where depth of fill exceeds 0.5 m. The maximum depth of fill on each lot must be indicated on the as constructed drawings. Allotment fill must be in layers no greater than 200 mm and compacted a minimum standard of 95% standard compaction for residential subdivision and 98% standard compaction for commercial subdivision. The fill material must be free of vegetation and organic material.

SC6.4.7.2.6 Roads

(1) Requirements for on maintenance:

(a) roads must be completed and fully sealed;

(b) all tests and hold point documentation completed and finalised;

(c) pavement line markings completed, including passing and turning lanes at major intersections;

(d) where a double coat bitumen seal has been used, copies of bitumen spray sheets and calculated average spray rate and aggregate spread rate are required;

(e) where asphaltic concrete surfacing has been used, test results on samples of the material supplied to the site must be taken at the Asphalt Plant together with field tests to confirm asphalt depth and percentage of voids filled;

(f) all traffic control devices, including traffic islands, to be completed;

(g) all traffic signage to be in place and completed in accordance with *Manual of uniform traffic control devices'* requirements;

(h) traffic signals, if present, to be installed, completed and fully functional in accordance with the relevant requirements and legislation;

(i) retaining walls within road reserve to be completed and maintenance requirements documented;

(j) fences and noise abatement or screening walls to be completed and maintenance requirements documented;

(k) compaction results of subgrade and each course of pavement; and

(l) grading, Atterberg limits and a California Bearing Ratio (CBR) test of each course of pavement material in accordance with SC6.4.5.3 Quality management system.

SC6.4.7.2.7 Stormwater

(1) Requirements for on maintenance:

(a) stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All

stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided;

(b) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment;

(c) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(d) certified results of field tests on pumping equipment;

(e) operations manual, performance specifications and maintenance requirements for all pump stations; and

(f) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

SC6.4.7.2.8 Landscaping and irrigation

(1) Introduction

This clause outlines the conditions and timeframes associated with acceptance by council of landscape and irrigation works (Works) constructed as part of a Development Permit.

(2) Principles

(a) the establishment period will be included within the maintenance period;

(b) council will accept works on maintenance that have reached practical completion and have met the relevant conditions of the Development Permit, but may still require time to establish;

(c) the establishment date will be used to determine satisfactory establishment;

(d) council will accept responsibility for maintenance of hard landscape assets from the on maintenance date;

(e) the Developer will remain responsible for maintenance of soft landscape assets during the maintenance period;

(f) the Developer is responsible for all defects in the works until the off maintenance date; and

(g) council will accept responsibility for maintenance of soft landscape assets from the off maintenance date.

(3) Terminology

In addition to the terms previously defined in SC6.4.7.1.1(2) the following terms and definitions apply to this clause, specific to landscape and irrigation works:

Contractor	A person or company who has entered into a contract with the developer to supply and install infrastructure, landscaping and/or an irrigation system.

Establishment period	The period of time between when council accepts the works on-maintenance until when council accepts the works as established (the established date). Works are deemed established when: (i) all the defects identified at the on-maintenance and practical completion; (ii) defects identified at inspection have been rectified unless agreed otherwise; (iii) all turfed areas have "taken root" and there are no obvious gaps between strips of turf; (iv) all turfed areas have been rolled and/or topdressed to fill any depressions; (v) all plants are showing signs of healthy, new growth, and that the planting design intent is starting to take shape; (vi) generally, the landscape works indicate that they are being maintained in accordance with the Development Permit; and (vii) revegetation areas have achieved specified cover.
Hard landscaping	Structures, paths and facilities such as playground equipment constructed from building materials (but excluding irrigation systems).
Maintenance period	The period of time between when council accepts the works on-maintenance until council accepts the works off maintenance. This includes any establishment periods and the defect liability period. This is to be: (i) a minimum of 12 calendar months; and (ii) include the establishment period and the defect liability period.
Off maintenance date	The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes. This date must be: (i) after the established date; (ii) after all defects have been remedied; (iii) at least 12 months after the on maintenance date; (iv) after an inspection by council which considers that all works are satisfactory.
Soft landscaping	Trees, plants, grass and vegetation generally and any irrigation system associated with such vegetation.

(4) Ownership and responsibilities

The ownership of the works transfers to council on the earlier of:

(a) the date when the land on which the works are constructed is transferred to council; or

(b) the on maintenance date.

(5) Typical timelines

(a) Construction

(i) achieve practical completion;

(ii) conduct inspections to determine the on maintenance date; and

(iii) release Plan of Survey if applicable.

(b) 0 weeks

(i) on maintenance date.

(c) 12 weeks

(i) normal established date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory, establishment date will be deferred.

(d) 52 weeks

(i) normal off maintenance date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory the off maintenance date will be deferred.

(6) Landscape works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) maintenance inspection;

(ii) the Registered Landscape Architect must certify as constructed drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the "as constructed" drawings reflect any changes that were made during the course of construction;

(iii) all asset transfer documentation is submitted and approved by council including the following:

(A) Open Space Asset Data Collection Form – This form contains the asset information relating to the construction of new assets; or

(B) Asset Change Form – This form contains information about minor changes to existing assets; and

(C) warranty details for all items with a value greater than $500.00. This information is required by council to assist in future warranty claims;

(iv) plantings, gardens and turfed areas must be exhibiting a "strike", but compliance with full establishment requirements is not essential at on maintenance;

(v) the defects liability period for soft landscape works shall be concurrent with the defects liability period for any associated irrigation system; and

(vi) the defects liability period for landscape works shall not commence until:

(A) the associated irrigation system has been commissioned; and

(B) all requirements of the Special Conditions of Approval have been met.

(7) Landscape works defects liability period

(a) Establishment

(i) All soft landscaping will be subject to a 12 week landscape establishment period. The landscape establishment period is included in the 12 month maintenance period. The Developer is responsible for establishing the works during the establishment period until the established date as advised by council.

(ii) The developer may be required to undertake additional works during the establishment period such as additional watering, formative pruning, topdressing, turfing, replenishment of mulch and replacement of plants.

(iii) At the conclusion of the landscape establishment period a landscape establishment inspection may be conducted, and if the landscaping establishment is not satisfactory additional works may be requested and/or the maintenance period may be extended.

(b) Landscape maintenance period requirements and responsibilities

(i) Council is responsible for maintenance of hard landscaping during the maintenance period.

(ii) The developer is responsible for maintenance of soft landscaping during the maintenance period until the off maintenance date.

(iii) Water costs

(A) The developer is responsible for the cost of water during the maintenance period.

(B) Council is responsible for cost of water from the off maintenance date.

(iv) Vandalism, theft and damage caused by unexpected events or third parties

(A) For soft landscaping, the developer is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(B) For hard landscaping, the council is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(v) Extended maintenance periods

(A) In addition to provisions detailed, where negotiated as conditions of the development approval, extended maintenance period beyond the 12 month period may apply.

(B) Where the landscape maintenance period is extended as a condition of development approval or due to provisions within this policy, this extension may concurrently apply to any irrigation system associated with the landscape works.

(vi) General maintenance activity requirements

(A) All maintenance activities must be undertaken in accordance with council's public open space maintenance specifications. Any maintenance activities that deliver a level of service above and beyond council's specification is at the discretion and cost of the developer.

Editors Note - council's Public open space maintenance frameworks are currently under development.

(B) Maintenance activities include, but are not limited to mowing, top dressing, litter collection, watering, pruning, fertilising, weeding, mulching, pest and disease control.

(C) All maintenance work to new and existing landscaping shall be carried out in accordance with the best horticultural practices.

(vii) Watering requirements

(A) All soft landscaping shall be watered regularly (either by hand watering or by irrigation) to ensure the continuing healthy establishment and growth of all plants taking into account soil type, plant type and size, prevailing weather conditions and seasonal variations.

(B) Watering methods are to be suitable for watering the root ball of newly planted plants during the critical first several weeks of establishment.

(C) Watering shall not cause displacement of mulch or erosion of garden mix soil.

(viii) Weeding, pest and disease control

(A) Gardens and turf shall be regularly weeded. Six weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for weed growth and treated with an appropriate selective herbicide. All chemicals shall be used in accordance with the manufacturer's recommendations.

(B) Plants shall be regularly inspected for pest and diseases throughput the defects liability period. Any pest or disease detected shall be reported to the Superintendent. Acceptable horticultural techniques shall be employed by the Contractor to manage any infestations as directed by the Superintendent. 12 weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for pests and disease and treated with an appropriate pest and disease control.

(ix) Planting and tree maintenance

(A) All maintenance work to new and existing trees shall be carried out by an arborist with formal qualifications or at least 5 years recognised experience in Arboriculture. The works shall be carried out in accordance with the AS 4373 *Pruning of Amenity Trees* and shall not proceed without the written approval of the Superintendent.

(B) Stakes and ties and guying shall be checked for firmness and support and shall be adjusted as necessary to prevent any damage to the bark or roots of the tree. Stakes and ties or guying shall be removed when the tree is self-supporting and/or as directed by the Superintendent.

(x) Planting, trees, turf and hydroseed failure and replacement

(A) Plants and trees lost through vandalism, theft or that have died shall be replaced by the Contractor on a monthly basis.

(B) Plants, trees, and turf supplied by the Contractor that have failed to become established during the defects liability period or are diseased and/or dying shall be removed and replaced by the Contractor twelve weeks prior to the end of the defects liability period ("off maintenance") and at no cost to council. If the loss is significant, it will be at the discretion of the Superintendent if an extension on the defects liability period for the failed landscaping is warranted.

(C) Areas of hydro seeding/mulching that have failed to become established or have died during the defects liability period shall be removed and retreated by the Contractor at no cost to council. If the area is of significant size it will be at the discretion of the Superintendent if an extension to the defects liability period for the failed area is warranted.

(8) Landscaping inspections during the defects liability period

In addition to the requirements outlined in SC6.4.7.2.8(2) Principles, the following requirements apply to landscaping works:

(a) any work inspected that does not comply with the specification and/or the design plans or has not been adequately maintained in accordance with SC6.4.7.2.8(2) will not be accepted by council and will be noted for rectification. The contractor is required to rectify these items as soon as is practical and as a minimum before the next scheduled inspection; and

(b) failure by the Contractor to rectify unacceptable items prior to the next inspection may result in the defects liability period for those items being extended by the number of weeks that have lapsed prior to the rectification work being completed.

(9) Landscaping off maintenance/final completion

(a) Final inspection and completion

(i) Soft landscaping shall be inspected by the Superintendent for acceptance ("off maintenance") at the end of the defects liability period, subject to any special conditions of approval.

(ii) In addition to the requirements outlined in SC6.4.7.2.8(2), the final inspection and completion requirements apply as detailed below.

(b) Final acceptance criteria (Gardens)

The acceptance criteria for gardens shall be:

(i) gardens shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(ii) gardens shall be free of disease and pests;

(iii) mulch shall be to the minimum thickness specified;

(iv) plants shall be as specified; and

(v) plants shall be placed at the spacings nominated and in the quantities nominated as detailed on the drawings or as specified.

(c) Final acceptance criteria (plantings)

The acceptance criteria for plants shall be:

(i) plants shall exhibit signs of healthy active growth;

(ii) plants shall show no signs of yellowing or wilting;

(iii) plants shall be well formed;

(iv) plants shall be free of disease and pests;

(v) plants shall have healthy root systems and shall not be root bound; and

(vi) plants are true to cultivar, type or form as specified.

(d) Final acceptance criteria (turf)

The acceptance criteria for turf areas shall be:

(i) the achievement of an even green colour with a dense sward over the entire area with no open joints;

(ii) turf shall exhibit signs of healthy active growth;

(iii) turf shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material; and

(iv) turf shall be free of disease and pests.

(e) Final acceptance criteria (hydro seeding/mulch)

The acceptance criteria for hydro seeding/mulch areas shall be:

(i) the achievement of an even green colour over the entire area and exhibiting healthy active growth with acceptable vegetative cover. Of this cover 95% shall be the nominated dominate grass species with the remaining 5% made up of annual and perennial grasses;

(ii) free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(iii) free of disease and pests; and

(iv) the area shall not be mowed for at least 5 days prior to the inspection.

(f) Final inspection documentation

(i) Following the final inspection (off maintenance) council will issue a site inspection report (defects list). Any items not acceptable to council will be noted for rectification.

(ii) The Contractor is required to rectify these items and apply for a re-inspection when all rectification items have been completed.

(iii) A certificate off final completion will be issued by council following the rectification of all defects noted at the off maintenance inspection.

(10) Irrigation works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) all as constructed drawings and documentation nominated in SC6.4.7.2.8(2) is submitted and approved by council;

(ii) all asset transfer documentation including the following:

(A) Irrigation Asset Data Collection Form – This form contains the asset information for the construction; or

(B) Irrigation Asset Change Form – This form contains information about minor changes to existing assets;

(C) Irrigation Network Controller Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will configure the telemetry network. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system;

(D) Irrigation Program Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will setup the irrigation controller program. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system. After the program has been set up, the Infrastructure Services Irrigation Technician will issue a copy of the program to the Contractor;

(E) Warranty details for all irrigation components with a value greater than $500.00 excluding GST. This information is required by council to assist in future warranty claims; and

(F) Plumbing and Drainage Application Forms 1, 2 and 7 are to be completed by a licensed plumber and submitted to the Hydraulic and Building Services Unit of the Townsville City Council. The Backflow Test Certificate must be lodged with Hydraulic and Building Services Unit of the Townsville City Council. A copy of the Backflow Test Certificate must also be supplied to Infrastructure Services; and

(iii) commissioning of the irrigation system shall not proceed until all of the above documentation is submitted and approved by the council.

(11) Irrigation defects liability period

(a) A defects liability period applies to all irrigation systems installed by contractors. The defects liability

period shall be undertaken in accordance with this policy and any special conditions of approval.

(b) If applicable the defects liability period for the irrigation system shall be concurrent with the Defects Liability Period for any associated landscaping works.

(c) The defects liability period for an irrigation system shall not commence until:

(i) all of the documentation nominated in SC6.4.7.2.8(10)(a) above is submitted and approved by council;

(ii) all requirements of the special conditions of approval have been met;

(iii) if applicable the associated landscaping works are accepted “on maintenance”;

(iv) the irrigation system has been commissioned; and

(v) the site has been jointly inspected by the council and contractor and the irrigation system is free of defects at the time of inspection.

(12) Irrigation inspections during the defects liability period

During the defects liability period, council may require access to the site to undertake the following tests:

(a) main lines pressure test – the main line is pressurised to test for leaks. All valves are shut and the pressure is taken over a determined length of time;

(b) sprinkler pressure test – the sprinkler pressure is taken at the nozzle using a pitot pressure gauge and is then compared to manufacturer recommendations;

(c) dripper pressure test – measurement at flushing valves are taken and the pressure gauged to make sure it conforms to the manufacturer recommendations. The inlet pressure is then tested under the same conditions to check it does not exceed 300Kpa; and

(d) lateral pressure loss test – the first and last sprinklers of the lateral line are pressure tested. The variation in flow is then calculated and compared with the limits nominated in the specification.

(13) Irrigation off maintenance/final completion

(a) Final inspection and completion
Final completion shall be managed in accordance with this policy and any special conditions of approval.

(i) Following the final inspection, council will issue an irrigation inspection defects list detailing items that do not comply with the specification and/or design plan.

(ii) The contractor is required to rectify these items and apply for a reinspection when all rectification work has been completed.

(iii) After reinspection of the rectification work, and if the work is satisfactory to council an Irrigation Inspection Report (Defects List) will be issued with the status noted as “Ready to proceed to off maintenance”.

(iv) A Certificate of final completion will be issued by the Superintendent when the Contractor has met all obligations under the Contract.

SC6.4.7.2.9 Quality assurance documentation

(1) Requirements for on maintenance

(a) Copies of the Test Certificates from a National Association of Testing Authorities (NATA) registered laboratory; and

(b) A single quality control document must be submitted, including but not be limited to:

(i) pavement levels;

(ii) compaction tests;

(iii) pavement materials tests;

(iv) concrete tests;

(v) asphalt tests;

(vi) sewer pressure tests;

(vii) water pressure tests;

(viii) water bacteriological tests;

(ix) landscaping soil tests;

(x) playground and fitness equipment certification;

(xi) softfall under surfacing certification;

(xii) structural certification (forms 15, 16 and 21);

(xiii) electrical safety, testing compliance certification; and

(xiv) backflow certificate.

SC6.4.7.2.10 Defects liability period

The defects liability period for all works is a minimum of 12 months from the date of the release of the formal plan of survey or from the date of acceptance on maintenance, whichever is later, at which time the bond will be refunded subject to the off maintenance requirements being completed to the satisfaction of council. If for any reason during the maintenance period, a defect of substantial proportions is discovered then council reserves the right to extend the defects liability period for a further 12 months from the date of correction of the defects, or as negotiated e.g. infrastructure is required to be reconstructed after a significant failure due to deficiency in design/construction.

SC6.4.7.2.11 Bonds and fees advice

(1) Requirements for on maintenance

(a) A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the works being accepted.

(b) A reinspection fee (at the rate applicable at the time of payment) will be applicable where an additional inspection is required due to works being incomplete or unsatisfactory at the initial inspection. The reinspection fee must be paid prior to the additional inspection being conducted.

(c) A maintenance bond (5% of the value of the works as determined and certified by a Registered Professional Engineer of Queensland (RPEQ) or Registered Landscape Architect) and supporting Schedule of Works with costs certified by the RPEQ or Registered Landscape Architect must be lodged with council. The bond must be in favour of council and in the form of cash or an unconditional bank guarantee (non-expiring). If the security is in the form of a bank guarantee, the guarantor must be a bank or financial institution acceptable to council.

(d) In the event of a default by the developer relating to defects, council may undertake whatever action required to secure compliance with the conditions of approval and may apply the security for that purpose. The security (or balance) will be returned to the developer upon satisfaction of the conditions of approval relating to maintenance responsibility.

SC6.4.7.2.12 On maintenance inspection and final inspection and compliance check

(1) Requirements for on maintenance:

(a) The developer must provide council at least 5 business days' notice, requesting the works be checked for compliance with the approvals and be accepted on maintenance.

(b) A report must be submitted, showing the scope of works, date and outcome of works inspected by the supervising Registered Professional Engineer of Queensland or supervising Registered Landscape Architect.

(c) Council must be satisfied with the results of an on maintenance inspection and compliance checks against the development approvals. Council will issue an On Maintenance Certificate, identifying the relevant works and any defects applicable.

(d) Prior to requesting an on maintenance inspection, the developer must correct any defects arising from faulty workmanship, materials or design identified in the On Maintenance Certificate or during the maintenance period (or extended period following rectification of such defects).

(e) The on maintenance date may be backdated to the date of the initial on maintenance inspection date or the release of the plan of survey (whichever is the latter), if all outstanding requirements were met within 4 weeks of identification.

SC6.4.7.2.13 Off Maintenance

(1) The works will become off maintenance subject to:

(a) rectification of all defects identified at on maintenance or during the maintenance period;

(b) council being satisfied with the results of an off maintenance inspection and compliance check against development approvals conducted by council officers following the end of the maintenance period;

(c) the development will only be accepted off maintenance in its entirety and all works must be performing satisfactorily at this stage;

(d) the developer, or their representative, must arrange with council an inspection of all defects 1 month prior to the work being due off maintenance;

(e) the whole of the works must be inspected at the off maintenance inspection. The consulting engineer is responsible for thoroughly inspecting the development and any necessary remedial work prior to the off maintenance inspection; and

(f) acceptance of the works off maintenance does not discharge the developer from their obligation to provide a development free of defects. Any defect that is discovered after the acceptance off maintenance, which attributed to the failure to deliver a development in accordance with the conditions of the development permit, must be repaired at the developer's expense.

SC6.4.7.3 Sewer pump-out agreements

SC6.4.7.3.1 Introduction

(1) Purpose

In accordance with SC6.4.7.1 Release of the plan of survey, council may consider early sealing of the survey plan for a development if:

(a) incomplete or non-commissioned trunk infrastructure is preventing the developer providing infrastructure from being fully commissioned; and

(b) the non-delivery of this trunk infrastructure is impacting on council's process for signing of the survey plan.

(2) Scope

This sub-section sets out the circumstances in which a sewage pump out agreement may be entered into, and the mandatory requirements that will be included in such an agreement under the *Sustainable Planning Act 2009.*

(3) Reference and source documents

This section shall be read in conjunction with the following standards and legislation:
Environmental Protection Act 1994
Local Government Act 2009
Plumbing and Drainage Act 2002
Sustainable Planning Act 2009
Water Supply (Safety and Reliability) Act 2008
WSA 02-2002 2.3 *Sewerage Code of Australia*
WSA 04-2005 2.1 *Sewerage Pumping Code of Australia*

SC6.4.7.3.2 Sewage pump-out deed of agreement requirements

(1) A Deed of Agreement relating to the incomplete or non-commissioned trunk infrastructure must be entered into. The agreement must ensure that all risks associated with the temporary pumping out and disposal of sewage are adequately addressed by the developer. The following sections must be addressed within the Deed of Agreement at a minimum:

(a) Timing

The trunk infrastructure must be programmed to be commissioned prior to when the completion of dwelling construction is envisaged.

(b) Supply of electricity

(i) Sewer pump stations must be provided with a continuous and reliable electrical supply. Details of the provision of power supply must be provided with the sewage pump station design.

(ii) Alternatively, if temporary power supply is proposed to be supplied by a generator, details of this arrangement must be included as part of the agreement.

(c) Lawful effluent disposal and access arrangements

Access arrangements for pump stations and/or other wastewater maintenance holes required for the pump-out service must be specified, and the wastewater maintenance hole or licensed septic disposal facility designated. The disposal of all sewage must be as directed by Townsville Water from time to time by a registered operator following agreed transport routes, for the duration of the agreement, and under the supervision of a suitably qualified engineering consultant.

(d) Developer's provision of pump-out service
A minimum standard for the developer's provision of a pump-out service must be specified.

(e) Management of odour complaints, fish kills and wastewater spills
Details of management of overflow/spills or environmental harm must be included in the Deed of Agreement and actions undertaken in accordance with the *Environmental Protection Act 1994.*

Click here to obtain a copy of the following form.

SC6.4.7.3.3 Template agreement

Council's Template Agreement for Sewage Pump-Out may be used to assist in the preparation of the Deed of Agreement (see SC6.4.7.3 Attachment A).

SC6.5 Economic impact assessment planning scheme policy

SC6.5.1 Introduction

Short Title - The planning scheme policy (PSP) may be cited as the Economic impact assessment PSP.

SC6.5.1.1 Purpose

(1) The purpose of this planning scheme policy is to provide applicants with direction on how to undertake an economic impact assessment which council request to inform the proper assessment of a development application. Particularly, the policy provides direction on the standard information requirements expected to be incorporated within an economic impact assessment report.

An economic impact assessment report may be required to demonstrate compliance with the Townsville City Plan particularly for significant in-centre or out-of-centre development of a commercial nature. It is likely to be required where there is potential conflict with the Townsville City Plan, or for impact assessable development of a commercial nature in any zone.

SC6.5.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.5.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan.

SC6.5.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1 terminology.

SC6.5.2 Planning scheme policy details

SC6.5.2.1 Terms of Reference for an economic impact assessment report

(1) Council intends to protect the economic viability and the intended role and successful functioning of centres. An economic impact assessment report will need to demonstrate that the proposed development will meet the relevant performance outcomes in the planning scheme codes and the intentions expressed in the strategic framework. Where the development is inconsistent with the planning scheme the assessment may form part of the basis for determining whether sufficient grounds exist to approve such a development.

(2) The standard requirements for the preparation of an economic impact assessment report should typically provide the following information:

(a) an outline of the purpose of the study;

(b) a description of the methodology used;

(c) a description of the proposed size, function and tenancy mix of the proposed development, together with details of any pre-commitment;

(d) the identification of the proposed development's trade area, supported by the reasoning and methodology behind the identification of the area;

Note—Refer to section SC6.5.2.2 Trade Area of this policy for guidance on identification of trade areas.

(e) an examination of the population growth prospects and socio-economic characteristics of the trade area, including socio-economic factors such as expenditure potential;

(f) the identification of any approved or proposed development that may affect the proposed development or be affected by the proposed development;

(g) the identification of the location, size, nature, function and tenancy mix of competitive business, commercial or centre uses likely to be affected by the proposed development;

(h) evidence that any feasible alternative, appropriately zoned location/s have been investigated and discussed so that reasoning behind the selection of the preferred site is clear;

(i) an estimation of the demand, or likely future demand, for business, commercial or centre floor space in

the trade area;

(j) an estimation of the market share of the proposed development;

(k) where an out-of-centre development is proposed, demonstration as to why the proposed development is required, including why the development cannot be accommodated within the existing centres;

(l) commentary on changes to the supply/demand balance upon approval of the proposed development, including whether the proposal represents an excess of supply for the community;

(m) a calculation of the quantitative economic impact upon competitive centres likely to be affected by the proposed development including a description of the consequent effects on the competitive centres;

(n) the identification of the impacts the proposed development would have on the successful trading of other centres (including the period of time) and the identification of the impacts on the Townsville hierarchy and functionality of activity centres;

(o) the changes, if any, to the range of services that existing centres will continue to provide; and

(p) a summary of the overall need for the proposed development including a description of the community benefits.

(3) The economic impact assessment report referred to in (1) above must be prepared by a suitably competent person.

Note — For the purpose of this section of the planning scheme policy, a competent person is an appropriately qualified and experienced economist or economic analyst with appropriate and proven technical experience in providing advice about the economic impacts of development.

SC6.5.2.2 Trade Area

For developments that are trade area based, the definition of the trade area should have due consideration to the following:

(1) the existing centres hierarchy and other relevant competition;

(2) the nature, scale and functionality of the proposed development;

(3) the nature of the potential users of the development (e.g. residents, workers, students, other businesses);

(4) typical travel routes of potential users of the development; and

(5) the attracting capacity of any neighbouring uses.

A map(s) of the trade area should be included in the economic impact assessment report, which clearly defines the trade area boundary, identifies relevant existing centres, identifies the site of the proposed development and includes key transport corridors. The economic impact assessment report should include a justification of the proposed trade area boundary.

SC6.6 Emerging community planning scheme policy

SC6.6.1 Introduction

Short Title - The planning scheme policy (PSP) may be cited as the Emerging community PSP.

SC6.6.1.1 Purpose

The purpose of this planning scheme policy is to provide applicants with direction on how to undertake structure planning for a greenfield development area contained within an emerging community zone. Such a structure plan is likely to be required to demonstrate compliance with the zone code and reconfiguration of a lot code.

The provision of this planning scheme policy may also be relevant to other large scale development within the city.

SC6.6.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.6.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in Parts 6 and 9. The Emerging community planning scheme policy specifically relates to the assessment of any development application for a material change of use or reconfiguring a lot within the Emerging community zone.

SC6.6.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1.

SC6.6.2 Planning scheme policy details

SC6.6.2.1 Structure planning framework

A structure plan prepared under this planning scheme policy will address the following aspects at a minimum:

(1) type of development and land uses proposed;

(2) scale, density and height of development;

(3) servicing of the development by transport and other infrastructure;

(4) how the proposal addresses the relevant planning scheme overlays; and

(5) integration of the development with the local context.

SC6.6.2.2 Structure plan contents

A structure plan should identify the major elements of the locality surrounding a development that can impact on the planning and design of the site. It does not constitute an approval for land outside the development site but ensures the continuation of corridors, networks and linkages.

The major components of the development are to be designed with consideration of this broader context. It must be clear how the proposed development will integrate with the surrounding community and with the existing parks, centres, service and infrastructure networks and the movement system (road network, public transport facilities and pedestrian and cyclist paths) in the area. Where necessary, the structure plan will identify upgrades to infrastructure which are required to achieve the development outcomes proposed in the structure plan.

(1) Preparing a structure plan:

The steps that should be followed and information provided when preparing a structure plan are outlined below. Separate maps and reports may be provided for each step.

(a) Step 1—Site context:

Prior to preparing the structure plan an assessment of the site and its context must be undertaken and a site description of the land prepared, supported by a map containing the following features as a minimum:

(i) topography—contours and levels;

(ii) the street network, intersections and treatments, and public transport routes and stops;

(iii) existing and approved land uses on surrounding sites (including subdivision layouts) and including the location of nearby schools, activity centres, employment generators and other community facilities; and

(iv) the existing and proposed park network and pedestrian and cyclist paths.

(b) Step 2—Constraints mapping (identification):

Land may possess attributes or be subject to constraints which affect the development on the site. State planning regulatory provisions and overlays must be considered as part of the constraints mapping process.

(c) Step 3—Constraints analysis, land use allocation and infrastructure provision:

The site context mapping (step 1) and identification of constraints (step 2) will inform a further detailed analysis of the conditions on the site. This process will seek to 'ground truth' the sites constraints. It will involve technical investigation to identify specific constraints and their implications on future development of the land. The outcomes of the constraints analysis will determine which land is able to be developed for urban purposes and will also provide guidance to suitable uses of the land.

The design response should consider:

(i) the proposed layout and land use mix are integrated appropriately with surrounding land;

(ii) constraints are reflected on the structure plan and are in accordance with their relevant values;

(iii) an appropriate and well-designed proposed transport network;

(iv) the development incorporates appropriate provision for infrastructure (water, sewer, stormwater, parks and community services) for the land and demonstrates how the infrastructure is able to be coordinated with adjoining development where applicable; and

(v) where needed, land uses buffers to other uses or values.

(d) Step 4—Documenting the structure plan:

The structure plan for the land may include the following, as relevant to the land:

(i) the vision and principles for the structure plan area;

(ii) appropriate controls for land use and density, connectivity, open space and public realm and built form and design;

(iii) identification of specific precincts with individual characteristics and development outcomes, as relevant to the land and the site constraints;

(iv) levels of assessment where this is proposed to be altered through a preliminary approval; and

(v) any alternative code provisions where these are proposed to be altered through a preliminary approval. Any proposed code is to be constructed to be consistent with the format of codes within the Townsville City Plan.

SC6.7 Flood hazard planning scheme policy

SC6.7.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Flood hazard PSP.

SC6.7.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) provide background information on the derivation of the Flood hazard overlay identified as overlay maps OM-06.1 and OM-06.2; and

(2) provide applicants with additional information and guidance in meeting the requirements of the Flood hazard overlay code.

SC6.7.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.7.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan and applies to the whole of the local government planning scheme area. Flood hazard PSP specifically relates to the assessment of Flood hazard overlay code.

SC6.7.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1 Definitions.

SC6.7.2 Background information

SC6.7.2.1 Flood mapping

The flood hazard overlay maps show flood hazard derived from numerous sources and include:

(1) Detailed flood modelling studies identified in SC6.7.2.1.1 of this planning scheme policy; and

(2) Interim flood assessment overlay mapping completed by the Queensland Reconstruction Authority and amended for local constraints by Townsville City Council.

SC6.7.2.1.1 Flood modelling studies

Flood modelling studies are complex technical investigations requiring a detailed understanding of catchment hydrological processes and floodplain hydraulic controls. Computer simulations are used to quantify runoff from rainfall and evaluate flow patterns and flooding extents around floodplains. There are numerous flood modelling studies which have been completed for the Townsville local government area. Results from these flood modelling studies have been combined to provide the Flood overlay maps.

At the commencement date of the planning scheme, the flood modelling studies that have contributed to the Flood overlay maps are:

(1) Alligator and Whites Creek Flood Study (Alligatorcreek);

(2) Althaus Creek Flood Study - Baseline Flooding Assessment (AlthausCk);

(3) Townsville Flood Hazard Assessment Study (Arcadia, NellyBay and PicnicBay);

(4) Balgal Beach Infrastructure Master Planning Report (BalgalBeach);

(5) Black River Flood Study - Baseline Flooding Assessment (BlackRiver);

(6) Bluewater Creek Flood Study (Bluewater);

(7) Captains Creek Flood Study - Baseline Flooding Assessment (CaptainsCreek);

(8) Deeragun Flood Study - Baseline Flooding Assessment (Deeragun);

(9) Douglas/Annandale Flood Study - Baseline Flooding Assessment (DougAnnan);

(10) Gordon Creek Flood Study - Baseline Flooding Assessment (GordonCreek);

(11) Horseshoe Bay Flood Study - Baseline Flooding Assessment (HorseshoeBay);

(12) Little Bohle River Flood Study - Baseline Flooding Assessment (LittleBohle);

(13) Lousia Creek Flood Study - Baseline Flooding Assessment (LousiaCreek);

(14) Lower Bohle Flood Study - Baseline Flooding Assessment (LowerBohle);

(15) Townsville State Development Area - Flood Modelling (LowerStuart);

(16) Middle and Upper Bohle Flood Study - Baseline Flooding Assessment (MiddleBohle and Upper Bohle);

(17) North Ward Flood Study - Baseline Flooding Assessment (NorthWard);

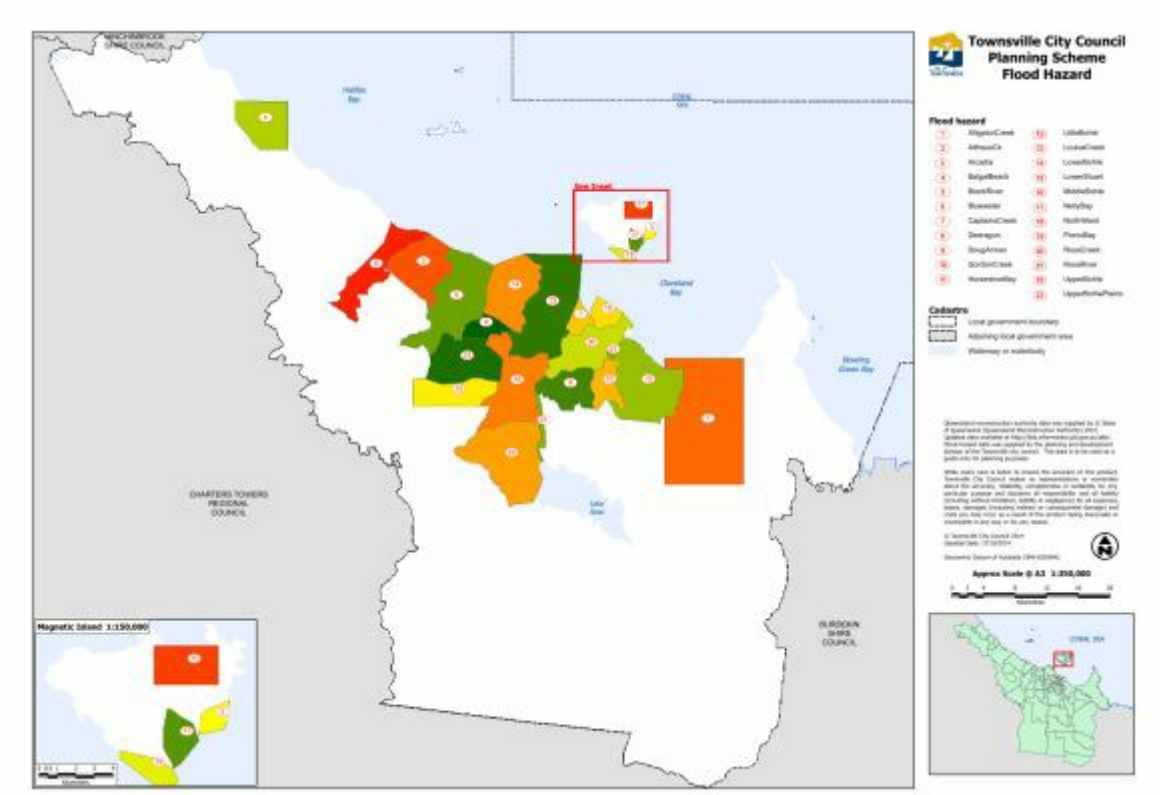
(18) Ross Creek Flood Study - Baseline Flooding Assessment (RossCreek);

(19) Ross River Flood Study - Baseline Flooding Assessment (RossRiver); and

(20) Upper Bohle Plains Flood Study - Baseline Flooding Assessment (UpperBohlePlains).

The area of applicability for each of the flood modelling studies identified in the aforementioned have been graphically presented on Figure SC6.7.1– Flood modelling study areas.

Flood modelling studies are under constant development due to the construction of infrastructure and the acquisition of new data. This information is available on Townsville City Council's website and contains digital copies of the latest and current flood modelling studies.



Click here to view PDF high resolution map.

Figure SC6.7.1 - Flood modelling study areas

SC6.7.2.2 Flood hazards

The Flood hazard overlay maps OM-06.1 and OM-06.2 have the following flood hazard ratings identified:

(1) high flood hazard;

(2) medium flood hazard;

(3) low flood hazard; and

(4) medium flood hazard – further investigation.

SC6.7.2.2.1 High and medium flood hazard

Both the high flood hazard and the medium flood hazard areas mapped on the Flood hazard overlay maps OM-06.1 and OM-06.2 are based on the 1% AEP flood. A velocity-depth criterion is used to distinguish between high flood hazard and medium flood hazard areas. High flood hazard areas are characterised by faster flowing and/or deeper floodwaters.

Figure SC6.7.2 – Flood hazard categorisation on 1% AEP flood (below) - shows the velocity depth criteria for designating the high flood hazard and the medium flood hazard areas from the 1% AEP flood. Velocity and depth information for the 1% AEP flood has been determined from flood modelling studies (refer SC6.7.2.1.1).

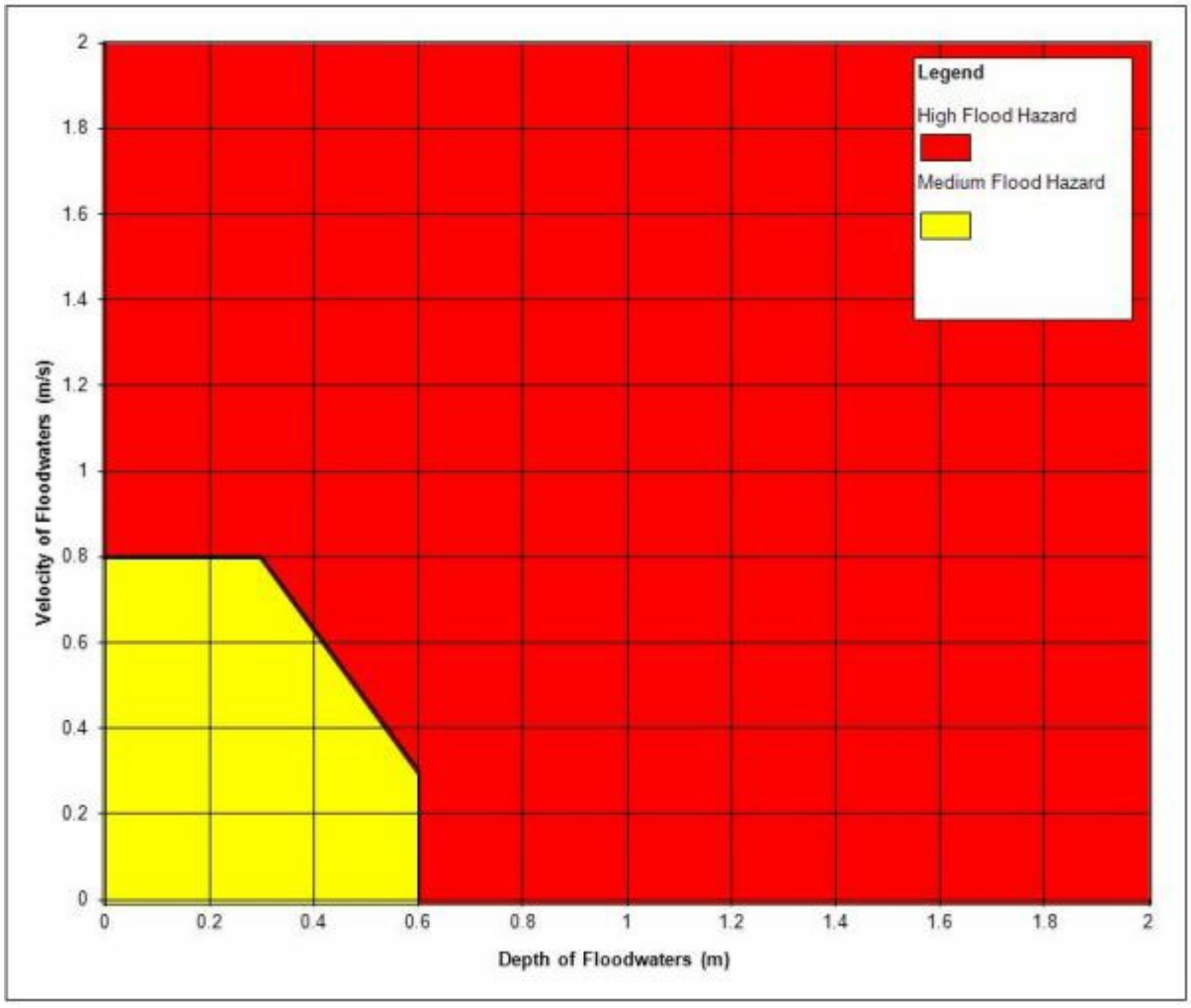


Figure SC6.7.2 - Flood hazard categorisation on 1% AEP flood

SC6.7.2.2.2 Low flood hazard

Areas of the floodplain outside the 1% AEP flood extent are still susceptible to flooding in rarer, more extreme flood events. Within the Flood hazard overlay maps OM-06.1 and OM-06.2, the low flood hazard area is identified as areas inundated by the probable maximum flood outside the combined extent of the high and medium flood hazard areas. The extent of the probable maximum flood has been determined from flood modelling studies (refer SC6.7.2.1.1).

SC6.7.2.2.3 Medium flood hazard - further investigation

Areas identified as medium flood hazard – further investigation on the Flood hazard overlay maps OM-06.1 and OM-06.2 are areas outside the extent of flood modelling studies and have been mapped by the Queensland

Reconstruction Authority. The Interim flood assessment overlay mapping produced by the Queensland Reconstruction Authority has been reviewed and amended by Townsville City Council to reflect local conditions. This information is less reliable than the other areas mapped on the flood hazard overlay maps OM-06.1and OM-06.2. Limited information is available on the flood characteristics in these areas as there is no information about flood depths, levels or velocities.

Within areas identified as medium flood hazard – further investigation, assessable development is likely to require further detailed flooding investigation, involving:

(1) development of a base-line flood study in accordance with Attachment 1 - Guidelines for preparation of flood studies and reports at a scale suitable to represent relevant floodplain process and site specific features;

(2) assessment of the potential impacts on flooding of the proposed development;

(3) identification of suitable measures to mitigate any adverse impacts on flooding; and

(4) demonstration of how the proposed development layout reduces the risk of flooding.

SC6.7.2.3 Defined flood level

Most development applications for which the Flood hazard overlay code is triggered will require details of the defined flood event (DFE). The DFE is the 1% AEP flood, which is spatially represented by the combined extent of the high flood hazard and the medium flood hazard areas mapped on the Flood hazard overlay maps OM-06.1 and OM-06.2.

For development which is accepted subject to requirements, it is most likely that existing information from flood modelling studies for the DFE will be adequate to address the acceptable outcomes of the Flood hazard overlay code. Information on the DFE derived from the flood modelling studies can be obtained from council's website.

SC6.7.3 Application requirements

This section provides information for a development application, guidance and advice for addressing assessment benchmarks.

SC6.7.3.1 Addressing assessment benchmarks

SC6.7.3.1.1

Development that is accepted subject to requirements and triggers the Flood hazard code only has to address the acceptable outcomes for performance outcomes 1 and 2 of the code.

Performance outcome 1
Development in medium and high hazard areas is designed and located to minimise susceptibility to and potential impacts of flooding.

Other than in the medium hazard - further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer SC6.7.2.1.1).

In some areas, storm tide hazard areas will also co-exist with flood hazard areas. In these instances, the floor levels and other design responses will need to be sufficient to comply with both the Coastal environment overlay code, the Flood hazard overlay code and the *Building Regulation 2006*. Typically, floor levels will need to be based on the highest of either the defined flood level or the defined storm-tide level as depicted in Figure SC6.7.3.1.1.1-Floor control levels for both flooding and storm tide (below).

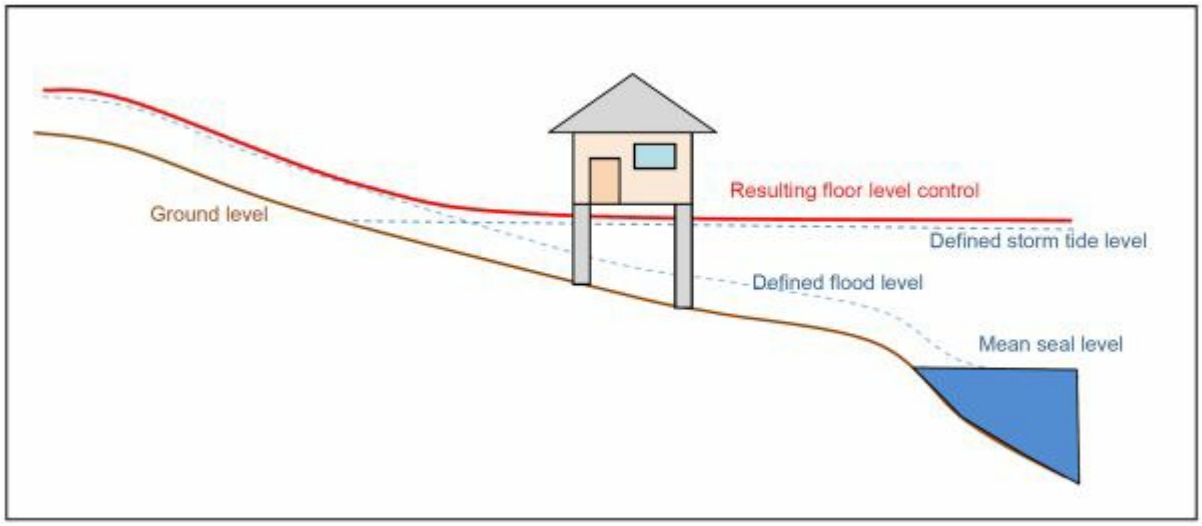


Figure SC6.7.3.1.1.1 - Floor control levels for both flooding and storm tide

Performance outcome 2

Development in high hazard areas does not significantly impede the flow of flood waters through the site or worsen flood flows external to the site.

The delineation of the high flood hazard areas on Flood hazard overlay maps OM-06.1 and OM-06.2 allows for clear identification of areas where performance outcomes 2 is applied.

Performance outcome 3

Development does not intensify use in high hazard areas, in order to avoid risks to people and property.

The delineation of the high flood hazard areas within Flood hazard overlay maps OM-06.1 and OM-06.2 allows for identification of areas where performance outcome 3 applies. Where flood flows are potentially altered by the development, a flood study will likely be required and the revised extent of the high flood hazard area will need to be mapped.

Performance outcome 4

Siting and layout of development maintains the safety of people and property in medium hazard areas.

Other than in the medium hazard – further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer to SC6.7.2.1.1).

Alternatively, council's online flood mapping service can be used to obtain the height of flood levels for any particular locations.

Where flood flows are potentially altered by the development, a flood study will likely be required and the revised extent of the medium flood hazard area will need to be mapped.

Performance outcome 5

Signage is provided within high and medium flood hazard areas to alert residents and visitors to the flood hazard.

Signage will need to clearly state the nature of the flood hazard, with regards to inundation depths and flow velocities. Signage should also be able to function during a flood event and be practically visible.

Performance outcome 6

Development within high and medium flood hazard areas ensures any changes to the depth, duration, velocity of flood waters are contained within the site.

A flood modelling study, completed by a suitably qualified and experienced Registered Professional Engineer of Queensland (RPEQ), in accordance with Attachment 1 - *Guidelines for Preparation of Flood Studies and Reports*, will likely be required.

As a minimum, evaluating the impacts on floods up to the defined flood event will require a flood modelling study to evaluate the minor drainage system capacity event and the defined flood event for the catchment-wide critical duration and the site-specific critical duration. In addition, certain areas of the Townsville Local Government area will require evaluation of other frequency floods to assess adverse impacts on flooding. Attachment 2 – *Adverse Flooding Impacts Assessment – Additional Design Floods for Assessment* outlines areas where impact assessment and flood mitigation works will need to consider additional design floods to the minimum requirements.

To confirm adverse impacts on flood levels/depths, flow velocities and time of inundation are contained to the site; a pre- and post-development scenario will need to be assessed. Where possible, council requires the base-line flood modelling study that was used for deriving the flood hazard overlay to be used for evaluating development impacts. The RPEQ undertaking the impact study will need to determine if there is a need to update the base-line flood modelling with site specific survey/detail to adequately describe the hydrologic or hydraulic controls.

Performance outcome 7

Development within high and medium flood hazard does not directly, indirectly or cumulatively worsen flood characteristics outside the development site, having regard to:

(a) increased scour and erosion; or

(b) loss of flood storage; or

(c) loss of or changes to flow paths; or

(d) flow acceleration or retardation; or

(e) reduction in flood warning times.

To adequately assess the impacts of development on flooding regimes may require a hydrological and hydraulic assessment to be carried out by a suitably qualified and experienced hydrologist or engineer in accordance with Attachment 1 - *Guidelines for Preparation of Flood Studies and Reports.*

As a minimum, evaluating the impacts on floods up to the defined flood event will require a flood modelling study to evaluate the minor drainage system capacity event and the defined flood event for the catchment-wide critical duration and the site-specific critical duration. In addition, certain areas of the Townsville Local Government area will require evaluation of other frequency floods to assess adverse impacts on flooding. Attachment 2 – *Adverse Flooding Impacts Assessment – Additional Design Floods for Assessment* outlines areas where impact assessment and flood mitigation works will need to consider additional design floods to the minimum requirements.

To evaluate the potential for worsening flooding outside the development site; a pre- and postdevelopment scenario will need to be assessed. Where possible, council requires the baseline flood modelling study that was used for deriving the flood hazard overlay to be used for evaluating development impacts. The RPEQ undertaking the impact study will need to:

(a) determine if there is a need to update the base-line flood modelling with site specific survey/detail to adequately describe the hydrologic or hydraulic controls; and

(b) undertake analysis to adequately assess the potential for directly, indirectly or cumulatively impacting on flooding.

Figure SC6.7.1 – Flood modelling study areas of this PSP identifies which flood study has derived the flood hazard overlay in given areas.

Performance outcome 8

Facilities with a role in emergency management and vulnerable community services are able to function effectively during and immediately after flood events.

It is appropriate to have a higher level of flood immunity for critical community infrastructure. Table 8.2.6.3(b) within the Flood hazard overlay code outlines the required immunity for critical community infrastructure with a role in emergency management. The identified flood immunities within Table 8.2.6.3(b) should be used for setting flood levels as well as designing building services associated with the facility.

Performance outcome 9

Public safety and the environment are not adversely affected by the detrimental impacts of flooding on hazardous materials manufactured or stored in bulk.

The delineation of the low, medium and high flood hazard areas are shown the Flood hazard overlay maps OM-06.1 and OM-06.2 and allows for clear identification of areas where performance outcome 9 is applied.

Other than in the medium hazard – further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer to SC6.7.2.1.1).

Alternatively, council's online flood mapping service can be used to obtain the height of flood levels for any particular locations.

SC6.7.4 Attachment 1 - Guidelines for preparation of flood studies and reports

Abbreviations

AEP	Annual exceedance probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff (1998)
DEM	Digital elevation model
DFE	Defined flood event
DRAINS	Urban hydrology and hydraulics software
HAT	Highest Astronomical Tide
HEC-RAS	Steady State One Dimensional Hydraulic Model
ISIS	Fully Dynamic One Dimensional Hydraulic Model
LiDAR	Light Detection and Ranging (Aerial Laser Survey)
MHWS	Mean High Water Springs
MIKE11	Fully Dynamic One Dimensional Hydraulic Model
MIKE21	Fully Dynamic Two Dimensional Hydraulic Model
MIKE FLOOD	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
MLWS	Mean Low Water Springs
QUDM	Queensland Urban Drainage Manual
RAFTS	Runoff Routing Software
RORB	Runoff Routing Software
SWMM	Fully Dynamic One Dimensional Hydraulic Model
TUFLOW	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
URBS	Runoff Routing Software
WBNM	Runoff Routing Software

SC6.7.4.1 Introduction

A flood study consists of the following parts:

(1) the hydrological determination to calculate the likely volume of water that results from the storm under consideration;

(2) the hydraulic determination to calculate the inundation levels and flow velocities that will most likely occur from the flow of water determined in the hydrological determination; and

(3) subsequent modelling to determine development impacts for the proposed development along with evaluation of works to mitigate the impacts of development.

Flood studies will be accepted based on approved inundation estimation calculation procedures and on observed historical records that can be quantified and related to an Average Recurrence Interval (ARI) by the use of the appropriate statistical flood frequency analysis procedure. It should be noted, use of historical records may allow for determination of inundation levels, however, will not be able to quantify the impacts on flooding of a development.

For analysis purposes a specific storm event is nominated as the benchmark event or standard to which council requires immunity against inundation for a development. That event is called the Defined Flood Event (DFE).

This guideline provides guidance on the appropriate use of given methods as well as some guidance on parameter values within the Townsville Local Government Area. There are numerous industry technical documents that detail the methods that should be consulted when completing flood studies including:

(1) Australian Rainfall and Runoff (AR&R); and

(2) Queensland Urban Drainage Manual (QUDM).

SC6.7.4.2 Catchment land use

Catchment land use is an important consideration for flood studies. The level of urbanisation within a catchment influences the volume of runoff and magnitude of peak discharges by:

(1) increasing the impervious fraction of the catchment which reduces the volume of infiltration and increases the total volume of runoff; and

(2) decreasing the time to peak discharge due to construction of open drains and stormwater networks which

concentrates flows and may increase the magnitude of peak discharges.

Strategies to avoid and increase in flooding as a result of any works may include:

(1) mitigation of flows at the individual development;

(2) catchment wide approach to mitigation of flows; or

(3) allowance for additional flow capacity within flow paths.

The strategy for accommodating flows will depend on existing land uses within the catchment and the environmental value of the watercourse. In preparing a flood study, **council must be consulted to identify the proposed approach to flood mitigation within the catchment.** The flood study may require assessment beyond the planning horizon in the current planning scheme, and make a determination of potential ultimate possible development or at least into the future for a period of 50 years, and even possibly 100 years.

As a general principle, drains are an opportunity to have several functions including providing flood mitigation for an area, however for the rest of the time they can be quite an effective open space for the community.

SC6.7.4.3 Hydrological determination

SC6.7.4.3.1 General

The hydrological process that is to be used for determining the design flows for the hydraulic modelling is to be cognisant of the proposed land uses. When calibration is being undertaken based on historical events, then the model being calibrated is to be based on the land use at the time of the storm event under calibration.

The choice of hydrologic method must be appropriate to the type of catchment and the required degree of accuracy. Simplified hydrologic methods such as the Rational Method should not be used whenever a full design hydrograph is required for flood mapping or to assess flood storage issues. Instead the more reliable runoff-routing techniques presented in publications such as Australian Rainfall & Runoff (ARR) should be adopted. Chapter 4 of the Queensland Urban Drainage Manual (QUDM) provides detailed guidance on the selection of an appropriate hydrologic method.

SC6.7.4.3.2 Hydrologic method

The hydrologic method adopted for the required analysis should be appropriate to the type of catchment and the design problem being assessed. Designers should be aware of the limitations, for each of the methods.

Approach	Applicability	Notes
Rational method	• Regular shaped catchment; • Homogenous catchments (generally uniform land use within the catchment); • Storage or timing issues are not relevant; • Rural catchments smaller than 25km^2; • Urban catchments smaller than 5km^2; • Time of concentration is likely to be less than 30 minutes; • **Rational method should only be used for drainage design as it is not appropriate for impact assessment at master planning stage.**	An appropriate method for calculating the time of concentration is essential to applying the rational method.
Synthetic unit hydrograph procedure	• Rural catchments; • Larger flood events where overbank flows are developed; • Rainfall can be assumed to be uniform across the catchment; • **Synthetic Unit Hydrograph Procedure has limited practical application in development assessment.**	Use of synthetic unit hydrograph procedures is not preferred and should preferably be undertaken by an experienced hydrologist with an extensive knowledge of the catchment.

Non-linear runoff-routing models (RORB, RAFTS, WBNM, URBS)	• Rural and Urban catchments (Rural only for RORB and all others should be used with caution in urban areas); • Storage or timing issues are relevant. • **Non-linear Runoff Routing Models are appropriate for drainage design or impact assessment at master planning stage, particularly for areas comprising both rural and urban land uses.**	Council uses RAFTS and requires any flood studies completed within the Townsville LGA to be completed using RAFTS. Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.
Time area runoff-routing models (DRAINS, ILSAX)	• Urban catchments with significant underground pipe network; • Storage or timing issues are relevant. • **Time Area Runoff Routing Models are appropriate for drainage design or impact assessment at master planning stage, particularly for areas only urban land uses.**	Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.
Direct rain on grid application in hydraulic model (MIKE FLOOD, TUFLOW)	• Flatter areas to prevent instabilities forming from flows down steep surfaces; • Study area needs to be small enough so that the model grid cell is not too large. • Storage or timing issues are relevant. • **Rain on Grid approach is appropriate for drainage design or impact assessment at master planning stage, and can represent areas comprising both rural and urban land uses.**	Although these methods are a component of hydraulic determination, they supplement the need for hydrologic determination and are gaining wider acceptance within the industry. Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.

Any hydrologic method using emerging technologies needs to clearly demonstrate:

(1) The approach and the principles it employs;

(2) Assumptions and limitations; and

(3) Appropriate calibration or verification.

SC6.7.4.3.3 Catchment parameters

Discussion on catchment parameters is required in particular:

(1) Overall catchment area and sub-catchment areas;

(2) (Sub-) catchment roughness and how the roughness or retardance was developed (may include a photographic record);

(3) Fraction impervious and how values have been derived including reference to what date values represent;

(4) Rainfall losses; and

(5) (Sub-) catchment slopes and how these have been derived.

All information used to define catchment parameters should be clearly referenced. A site assessment in the selection of some parameters is essential.

Catchment roughness

Catchment roughness or surface retardance accounts for the influence of vegetation and surface roughness on the generation of flows from sub-catchments. Ideally, values should be determined from calibration of the hydrological model to stream gauging. Values should be in the ranges presented below:

Catchment land use	Roughness coefficient (n*)
Urban impervious areas	0.010-0.030
Bare soil	0.010-0.050
Sparse vegetation	0.050-0.130
Heavily vegetated areas	0.080-0.200

Note that a sub-catchment may consist of numerous surface types that need to be accounted for in the specification of the catchment roughness.

Rainfall Losses
Rainfall losses account for rainfall which does not contribute to stormwater runoff because of infiltration and storage in surface depressions. Rainfall losses can vary from event to event and depend on antecedent rainfall conditions. Loss values for historical floods should be determined from calibration with loss values within the range of values as follows:

Surface type	Loss values
Pervious	Median initial loss 15 – 35 mm Median continuing loss – 2.5 mm/h Initial loss 0 – 140 mm Continuing loss 0.1 to 8 mm/h
Impervious	Initial loss 1mm Continuing Loss 0 mm/h

It should also be noted that loss values can vary between design storms of different frequencies. Guidance on appropriate loss values for different ARI storms can be obtained by matching peak discharges with peak flows determined from flood frequency assessment.

Sub-catchment slope
Sub-catchment slope can be derived from topographic maps or survey. Slopes applied should be representative of the sub-catchment and the modeller should ensure:

(1) The appropriate slope schematisation is applied when assigning values (equal area slope, vectored slope,); and

(2) Limitations of slope within the hydrological calculation method (i.e. Laurensen's method – minimum slope 0.3-0.5%, maximum slope 15%).

SC6.7.4.3.4 Rainfall intensities
Design Intensity-Frequency-Duration (IFD) Rainfall - IFD relationships shall be derived in accordance with the methodologies outlined in Australian Rainfall & Runoff, for the particular catchment under consideration. Input parameters shall be shown in the calculations submitted to council.

SC6.7.4.3.5 Partial area effects
If the Rational Method is being used, then there should always be checks to ensure that flows of greater magnitude are not apparent for partial catchment areas with faster runoff characteristics. These partial areas should be checked with the higher intensities relating to the shorter times of concentration.

Likewise, when using hydrograph techniques (such as runoff routing or Rain on Grid procedures), a range of storms of different duration for the same ARI should be checked to ensure that the worst event for the ARI is calculated and adopted. It should be noted that a range of storm durations may be required to evaluate sites that cover longer reaches of watercourses or numerous watercourses.

SC6.7.4.3.6 Calibration and verification of hydrological models
Calibration of results based on observed inundation events is desired. There are many pluviograph stations located within and adjacent to the City. Information from these is generally available from the Bureau of Meteorology or relevant Queensland Government department(s). Records from stream gauging stations will be required to match to hydrologic calculations and are generally available from the relevant Queensland Government department(s).

If observed data is not available to assist in the study, then it is suggested that the estimation of discharge flows from several methods will be considered with greater confidence in the result than the estimation of flows from one method alone.

SC6.7.4.3.7 Assessment of development impacts

When undertaking an assessment of the potential for development impacts on flooding, the development must be appropriately accounted for in the hydrological assessment including:

(1) Changes to imperviousness and expected rainfall losses;

(2) Changes to catchment layouts or extents;

(3) Changes to catchment roughness;

(4) Changes to slopes; and

(5) A re-evaluation for the potential for partial-area effects.

SC6.7.4.3.8 Preparation of reports

Reporting requirements

The method chosen should be adequately referenced and values derived should be substantiated by defining procedures used in their derivation. Where parameters are chosen or assumed, references and reasons should be supplied. The preferred method of setting out the hydrology is to describe in the text of the report the method to be used, and then to set the calculations out in a clear and concise table with sufficient data to enable quick verification of the results. The time of concentration or critical duration storm from the hydrological assessment should be clearly identified for areas relevant to the site.

Where computer methods for calculation of flows are used, the text of the report should describe the method that is utilised by the computer programme. Parameters that have been chosen should be referenced with reasons stated for any assumptions. A figure should be used to clearly demonstrate the layout of the model. Output from software should be tailored to produce concise tabular results to enable quick verification of the results. Where recognised computer programmes are utilised, council may require the electronic data files to be provided in acceptable format.

Where insufficient data is supplied then delays will occur while studies are returned to enable the additional data to be provided.

Catchment maps

Most hydrological techniques will require a catchment analysis and stream slope analysis. The catchment analysis should be presented on as large a scale map (smallest reduction ratio) as possible. The following scales for catchment sizes are recommended for use:

Scale	Catchment area
1:1000	up to 0.5 sq. kms (50 ha)
1:2000	up to 1.0 sq. kms (100ha)
1:5000	up to 1.5 sq. kms (150ha)
1:10000	up to 50 sq. kms (5000ha)
1:25000	limited to 300 sq. kms per sheet

Maps should be well presented with catchments contained upon one sheet where possible. Standard sized sheets should be used. Sub-catchments should be boldly defined and the contours should be clearly defined to enable easy verification of the catchments in relation to the contours. Where sub-catchments are not consistent with the contour information then reasons should be stated in the text and clearly labelled on the map. Good drafting standards should be maintained in the presentation of these maps.

SC6.7.4.4 Hydraulic determination

SC6.7.4.4.1 General

The hydraulic determination involves the calculation of flood levels and velocities for the flood flows from the hydrological determination. Australian Rainfall and Runoff and the Queensland Urban Drainage Manual set out

aspects of hydraulic calculations that can be utilised to determine the water levels for design discharges.

Unless the channel consists of long lengths of uniform section and uniform flow, the Mannings equation cannot be used in its simple form. This equation describes flow in a uniform channel at non-varying steady state flow conditions.

Australian Rainfall and Runoff describes methods for flood level determination in gradually varied flow conditions. The method for hydraulic determination will be dependent on the hydraulic controls of the study area. In general, it is appreciated that these methods will use computer applications.

SC6.7.4.4.2 Hydraulic method

The hydraulic method adopted for the required analysis should be appropriate to the hydraulic controls of the study area and the design problem being assessed. Designers should be aware of the limitations, for each of the methods.

Approach	Applicability	Notes
Steady state – one dimensional (HEC-RAS)	• Storage or timing issues are not relevant; and • Flows are one-dimensional, largely within a watercourse and the immediate overbank area.	Generally only suitable for small site scale hydraulic determination.
Fully dynamic – one-dimensional (MIKE11, ISIS, SWMM)	• Storage or timing issues are relevant; • Flows are one-dimensional, largely within a watercourse and the immediate overbank area.	Suitable for smaller onedimensional watercourses. Provides stability advantages over 2D models for steeper areas. Council uses MIKE11 and requires any flood studies completed within Townsville using a fully dynamic – onedimensional model, to use MIKE11.
Fully dynamic – two dimensional (MIKE21, TUFLOW)	• Storage or timing issues are relevant; • Flows are two-dimensional,	Flood maps are generally direct output from models. Council uses MIKE21 and requires any flood studies completed within Townsville using a fully dynamic – two-dimensional model, to use MIKE21.
Fully dynamic–coupled one & two dimensional (MIKE FLOOD, TUFLOW)	• Storage or timing issues are relevant; • Flows are combination of one and two- dimensional; • Large areas need to be represented in combination with fine detail	Council uses MIKE FLOOD and requires any flood studies completed within Townsville using a fully dynamic – one & two-dimensional model, to use MIKE FLOOD.

SC6.7.4.4.3 Topographic data

Topographic data used for the hydraulic determination will be dependent on hydraulic method:

(1) One-dimensional models employ cross-sections along branches to represent the study area topography; and

(2) Two-dimensional models employ digital elevation models to represent the study area topography.

The accuracy of the topographic data governs the accuracy of the hydraulic determination.
The accuracy of the topographic data should be clearly stated.

Cross-sections

Cross-sections are required at representative locations along a stream reach and at locations where changes occur in discharge, slope, shape, or roughness, and at bridges, culverts or control structures such as weirs. Where abrupt changes occur, several cross sections should be used to describe the change in shape regardless of the distance between sections. Cross-section spacing is also a function of stream size, slope and uniformity of cross section

shape. For one-dimensional models, the cross-sections should be wide enough so that the water surface is contained within the extent of the cross-sections. The accuracy of the hydraulic modelling will be dependent upon the spacing of cross-sections and the accuracy of the cross-section survey.

Digital elevation models

Digital elevation models used for two-dimensional models should use a grid spacing fine enough to resolve watercourses within the study area. As a general rule, a watercourse should be represented by a minimum of 5 grid-cells across the width of the watercourse. Coupled models can be used as an alternative to maintain the resolution within the watercourse.

The digital elevation model should be orientated to minimise disturbance of flows by the grid cell orientation. Aligning grid cells with streets (often part of the major drainage system) helps to achieve an appropriate orientation.

Digital elevation models are often captured from aerial surveying methods such as LiDAR or Photogrammetry. These methods can lose accuracy in areas of dense vegetation. It should be clearly demonstrated what steps (including ground survey) have been taken to improve the accuracy in areas potentially obscured by vegetation.

SC6.7.4.4.4 Roughness values

Based on the procedure developed by Cowan (1956), stream roughness values are a combination of influences from:

(1) Bed material;

(2) Surface irregularities;

(3) Variations in channel cross-section;

(4) Obstructions;

(5) Vegetation and flow conditions; and

(6) Meandering.

Different methods for hydraulic determination such as fully dynamic and fully dynamic twodimensional modelling will account for some of these influences within the underlying digital elevation model or solution scheme of the model.

Suggested ranges for roughness values based on the hydraulic method are provided below:

Land use	Roughness values (Manning's n)		
	1D Steady state	1D fully dynamic	2D fully dynamic
Natural watercourse	0.03-0.08	0.025-0.06	0.02-0.05
Riparian corridor	0.15-0.2	0.08-0.16	0.06-0.12
Open grassland	0.04-0.08	0.035-0.06	0.03-0.05
Low density vegetation	0.06-0.12	0.045-0.08	0.04-0.06
Medium density vegetation	0.08-0.18	0.06-0.1	0.05-0.08
High density vegetation	0.1-0.25	0.08-0.15	0.06-0.12
Roads	0.03-0.06	0.025-0.05	0.02-0.04
Open channels	0.03-0.05	0.025-0.05	0.02-0.04
Rural residential	0.06-0.1	0.05-0.08	0.04-0.07
Urban residential	0.06-0.15	0.05-0.12	0.04-0.1
Parks	0.04-0.18	0.035-0.1	0.03-0.08

Where possible, roughness values should be determined from calibration. Often, calibration will not be possible and sensitivity analysis to variations in roughness should be undertaken.

In the case of a one-dimensional model, roughness should be appropriately defined across the cross-sections based on the land use. In the case of a two-dimensional model, roughness should be appropriately defined using a grid to

represent the study area based on the land use.

SC6.7.4.4.5 Bridges and culverts
Australian Rainfall and Runoff and Queensland Urban Drainage Manual provide useful information and references for the determination of afflux levels and water profiles at bridges and other structures.

Head-losses across major drainage structures assessed within fully dynamic models should be verified by hand-calculations or assessment with a steady state model.

SC6.7.4.4.6 Tailwater conditions
Tailwater conditions for hydraulic models will be dependent on the location of the downstream extent of the model. Tailwater conditions may be one of the following:

(1) Sea levels for a coastal boundary;

(2) A gauged rating curve;

(3) Flood levels from the same ARI flood based on a previously accepted flood study; or

(4) Flood levels calculated from simplified means in the absence of other information (e.g. normal depth or critical depth).

In using flood levels calculated from simplified means, the method of calculation should be justified and sensitivity to input parameters should be evaluated. The downstream boundary should be located so that the boundary conditions do not influence results at the study site. Ensuring the boundary is sufficiently far enough downstream from the study site will reduce the impact on results at the site.

Requirements for some specific boundary conditions are discussed below.

Coastal boundaries
When calibrating hydraulic models, tailwater conditions should be based on observed sea levels for the event. Sea-levels are monitored at the Townsville port, with the information available through the Bureau of Meteorology.

To maintain the probability of the assessed flood event for design purposes, the tailwater condition adopted should not have a frequency of occurring any less than once a year. A fixed tailwater condition equal to the height of the Mean High Water Springs (MHWS) tide should be adopted. For storm events greater than 24 hours, a representative tidally varying water surface level between MHWS and Mean Low Water Springs (MLWS) can be adopted.

Backwater effects in tributaries from larger streams
Where a smaller stream discharges into a larger stream, it will be most probable that the larger stream will experience more severe flooding for storms of longer duration and hence lesser intensity for the same average recurrence interval. The tributary is to be checked for a storm of the same duration and intensity as that causing the peak flow in the larger stream.

The hydraulic assessment should assess the flooding for both the storm duration critical for the larger stream and the local tributary. Flood levels in the area will be based on the highest flood level determined from both storm durations. Peak velocities in the area will be based on the fastest velocity determined from both storm durations regardless of whether the storm duration that generates the fastest velocities produced the highest flood levels.

It is acknowledged that runoff routing models combined with fully dynamic hydraulic models will adequately account for these processes.

Estuary boundaries
Sometimes downstream boundary conditions for hydraulic models will be required in reaches of watercourses that are influenced by tides, but are not located at the coastline. In this instance, it is inappropriate to use neither a tidal water level boundary condition nor a rating curve boundary condition alone. The downstream boundary condition must account for both the tidal conditions and the ability for water levels to be elevated due to flood flows. Typically, this would involve the development of a rating curve with flows below MHWS set to zero and flows above MHWS to be calculated based on an appropriate water surface slope.

SC6.7.4.4.7 Impact of climate change

The impacts of climate change on flooding are likely to manifest from increased sea levels and changes in extreme event rainfall intensities. As part of understanding the risk associated with climate change, a sensitivity assessment should be undertaken as part of a flood study. The sensitivity should account for the latest projections in sea-level rise and increased rainfall intensities, specific to the area from leading authorities including relevant Queensland Government department(s), Australian Rainfall and Runoff, Commonwealth Scientific and Industrial Research Organisation, Bureau of Meteorology or Intergovernmental Panel on Climate Change. At the time of preparing this PSP appropriate values were:

Parameter	Value
Sea level rise to 2100	0.88m
Extreme rainfall Intensities to 2100	+15%

The DFE should be assessed in combination with the maximum sea-level rise applied to the MHWS level and the increase in rainfall intensities to evaluate the additional risk associated with climate change. The results from the climate change sensitivity should be assessed with commentary provided about:

(1) Areas where the floor level freeboard above the DFE would be exceeded;

(2) Any new flow paths that are formed; and

(3) What is the AEP of the climate change DFE relative to existing conditions.

SC6.7.4.4.8 Determination of impacts of development

Developments have potential to cause significant adverse impacts on flooding due to:

(1) Increasing the impervious fraction, reducing amount of infiltration and generating a larger volume of runoff;

(2) Providing more efficient conveyance of flows through the site so that flows are concentrated faster at the downstream end of the site producing larger peak flows; and

(3) Removing floodplain storage due to filling which reduces the natural flow attenuation of the floodplain and increases flood levels.

It will be necessary to carry out studies of the catchment in the pre-developed state (base case) and the developed state to determine increased amounts of flow and flood levels. The pre-developed state should represent the state of development within the catchment and floodplain immediately prior to time of construction of the proposed works.

Adverse impacts on flooding may preclude development unless appropriate flood mitigation measures are proposed as part of the development. As a result of developments:

(1) Flood levels should not increase beyond the accuracy of the method of hydraulic determination (generally 0.01 m) either upstream, downstream or adjacent to the site;

(2) There should be no significant change in flow patterns so that new flow paths on adjacent land are formed; and

(3) Any changes in flow velocities should be shown to have minimal impact on erosion potential.

Mitigation works such as levees or detention basins, involving embankments, need to be shown to have a safe overtopping failure. Such works should be modelled for the Probable Maximum Flood (PMF) to demonstrate safe passage of these flows without catastrophic failure of embankments.

Any mitigation measures recommended beyond the subject site will need to undergo the development assessment process including:

(1) Clear identification of the land parcels impacted;

(2) Development applications (material change of use, reconfiguration of a lot or operational works) - as required; and

(3) Identification of maintenance measures including responsibilities and funding sources.

Mitigation measures should generally be on the subject site unless prior discussions have been entered into with council and the landholder and there is an agreement for works outside of the subject site.

Hydraulic modelling of development

When representing development typically the hydraulic model is updated by:

(1) Changing the topography (cross-sections/DEM) to represent the development;

(2) Updating inflows to represent changes in hydrological response; and

(3) Updating roughness to represent the development.

Roughness values should only be changed to reflect the change in land use resulting from the development. These changes need to be clearly identified and justified. In assigning roughness values within new drainage channels or areas impacted by flooding, there should be consideration given to the way regrowth can occur within these areas. Areas below Highest Astronomical Tide (HAT) are likely to have mangrove regrowth occur. In areas further upstream, regrowth by tea-tree is likely to occur and can create a significant impediment to flows. Also, most flood events within Townsville occur towards the end of the wet season (January to March), when earlier rain has enabled grass in drains to grow with minimal ability to mow. Roughness values within drainage corridors for development assessment should be adopted towards the higher end of the range of values to account for regrowth, which may have minimal maintenance.

Freeboard for existing areas

Within some existing urban areas, design criteria have changed over time and have resulted in freeboard to existing buildings being less than is required in new development. To ensure the freeboard for existing areas is maintained, there should be no adverse impacts on flooding for all events floods up to the DFE. As a minimum, the assessment should demonstrate that there are no adverse impacts on flooding for the minor system drainage capacity AEP and the DFE.

SC6.7.4.5 General matters

SC6.7.4.5.1 Presentation of reports

As stated in the previous sections all reports and tabulations are to be printed on A4-sized sheets, and drawings presented on standard size sheets prepared using good drafting standards. The expected content of the reports is as discussed in SC6.7.4.2, SC6.7.4.3 and SC6.7.4.4 above. In summary the contents of a study report must include:

Hydrology section

(1) catchment Map - large as possible;

(2) report on procedure (brief), including hydrologic method, catchment characteristics, assumptions and discussions on results including critical duration /time of concentration as detailed in SC6.7.4.3 above; and

(3) calculations and model results - tabulated where possible and attached in appendix if significant in volume.

Hydraulics section

(1) report on procedure including hydraulic method, stream/floodplain characteristics and assumptions as detailed in SC6.7.4.4 above;

(2) model Results – Clearly presented as maps and tabulated values;

(3) stream Flood profile and bed profile of the study area;

(4) drawings/figures of topographic data used for the model (Digital Elevation Model map or plan of cross-section locations and cross- sections with X and Z coordinates included);

(5) a plan containing the proposed works showing any filling and excavation associated with development; and

(6) model results updated on the basis of including the development with the revised flood extents and impacts on flooding.

General

(1) discussion on sensitivity analysis for critical parameters (e.g. roughness, infiltration etc.);

(2) discussion on accuracy of inundation mapping and the resulting required flood line;

(3) recommendations as to methods of flood mitigation within the site;

(4) recommendations as to method of flood mitigation beyond the site together with development approvals,

construction proposal and funding proposals; and

(5) electronic data for both the hydrology and hydraulics in an agreed format (modelling platforms and GIS).

Drawings should be bound into the report where sizes are A3 or A4. Larger drawings are to be appropriately folded and inserted in a pocket in the back cover.

Recognition by the consultant, that the assignment of data to council, and use of the studies by council for its sole use, is a mandatory requirement before a study is commissioned and/or the results of any study will be accepted by council.

All studies, reports and submissions forwarded to council shall be prepared by, or at least certified by, a Registered Professional Engineer Queensland (RPEQ) who is registered in the specific area of engineering in which the study or report has been prepared e.g. an RPEQ (Structural) shall not certify a stormwater report.

SC6.7.4.5.2 Preference of computer models

It is acknowledged that where no modelling has been undertaken, then any modelling will provide a more accurate estimation of inundation levels than collated levels from observed inundation events.

Modelling studies where the results have been calibrated using observed levels and measured rainfalls will be recognised as providing a more representative result for the study area.

The hydrologic and hydraulic methods adopted should be suitable for purpose as indicated in SC6.7.4.3.2 and SC6.7.4.4.2. Townsville City Council requires that any flood studies completed within the Townsville Local Government Area uses software that is run internally which includes:

(1) Non-linear Routing – XP-RAFTS;

(2) 1D Steady State – HEC-RAS;

(3) 1D Fully Dynamic – MIKE11;

(4) 2D Fully Dynamic – MIKE21; and

(5) Coupled 1D/2D Fully Dynamic – MIKE FLOOD.

SC6.7.4.5.3 Copyright of reports, studies and drawings

Prepared directly for council

It is acknowledged that intellectual capacity has been demonstrated in the preparation of the report. However, the report is prepared and based on accepted engineering fundamentals and principles. In addition, the practices adopted are those developed by the engineering profession through initiative and ingenuity and ratified through the professions recognised body “The Institution of Engineers, Australia” currently trading as “Engineers Australia”.

All reports and studies (including drawings, tables, model files etc.) prepared for council under direct commission will become the sole copyright of council, and those reports will be used by council in a manner that will provide the optimum benefit to the community. All reports adopted by council will also be available for public and professional perusal on council’s website.

In any reference to the report, the author of the report will be acknowledged by council and should be acknowledged by any authorised third party user.

Submitted as part of a development application

Submitted as part of a Development Application and adopted as supporting the application only

When a technical report or study is submitted to council as part of a development application, this report/study, along with all components of the submission, can be made available to the public as part of the notification stage. The report can be provided to anyone seeking the report during this stage and following the approval. Use of the report for any third-party use will be at the complete risk of the third party. It should be noted that it will be only the approved report including any council requested amendments, which should be referred to in future.

Submitted as part of a Development Application and adopted by council as a benchmark report for future development or other purposes

From time to time, reports etc. submitted as part of a development application, or supporting an application, could provide a wider ‘regional’ significance and importance than just the development site for which they were prepared. Council may choose to open discussions with the developer to determine if obtaining all supporting digital and electronic data along with software input/output files would allow the option of adopting the report as a ‘base-line’ report for council. The decision as to whether a report has wider regional significance will be council’s alone.

Once these reports have been adopted by council as a ‘base-line’ report, the report assumes the status as if the report was prepared by or for council, and the copyright previously assigned by the author is released and the copyright provided to council. Council can use the report to achieve optimal outcomes for the wider community.

SC6.7.4 Attachment 2 - Adverse Flooding Impacts Assessment - Additional Design Floods for Asessment

Location	Design flood event
Ross River - Downstream *Within the immediate area around Ross River downstream of Ross River Dam and the lower Ross River Floodplain.*	0.2 % AEP
Ross River Upstream *Upstream of Ross River Dam*	0.5 % AEP

SC6.8 Mitigating bushfire hazard planning scheme policy

SC6.8.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Bushfire PSP.

SC6.8.1.1 Purpose

(1) The purpose of the planning scheme policy is to:

(a) support the outcomes presented in the Bushfire hazard overlay code; and

(b) provide guidance and information relating to the preparation of a Bushfire hazard assessment, and where necessary a Bushfire management plan.

SC6.8.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.8.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, in particular, the Bushfire hazard overlay code.

SC6.8.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 Definitions.

SC6.8.2 Planning scheme policy details

SC6.8.2.1 Bushfire hazard assessment

A Bushfire hazard assessment (and where necessary a Bushfire management plan) may be required as part of an assessable Reconfiguring a Lot or Material Change of Use development application as determined by assessment under the Bushfire hazard overlay code.

Where a Bushfire hazard assessment is required or is submitted, assessments are to be prepared and undertaken by a suitably qualified and experienced professional.

As a guide, the features sought by council to achieve a comprehensive Bushfire hazard assessment are addressed below.

The Bushfire hazard assessment should have regard to the following –

(1) Australian Standard AS3959 - 2009: Construction of buildings in bushfire prone areas.

(2) State Planning Policy and supporting guidelines.

Editor's note—A detailed guide on how to undertake this type of risk assessment is provided in QRA (2012) publication. Although this focuses on flooding the evaluation process can be applied for any natural hazard.

(1) A bushfire hazard assessment should provide:

(a) the name and qualifications or experience of the person(s) preparing the assessment;

(b) the use description;

(c) location of the extent and level of bushfire hazard in relation to the spatial extent of existing and forecasted land uses;

(d) details of the storage of any dangerous or hazardous goods to be kept on the site;

(e) details of existing vegetation, including slope and aspect characteristics of the site;

(f) details of weather conditions that influence bushfire intensity; and

(g) details of existing bushfire records and local knowledge.

(2) Risk appropriate development;

(a) mapping details of the proposed development through GIS overlays or comparison of hard copy mapping;

(b) a determination of the consequence of a bushfire hazard for each lot within the study area, and a qualitive assessment of

  (i) vulnerability;

  (ii) tolerability;

  (iii) a bushfire risk assessment to identify how development mitigation measures will work in conjunction with other risk management measures including building controls, mitigation infrastructure, early warning systems, community awareness and emergency managements to address the risk of bushfire, should it not be classed as a low hazard on the subject site; and

  (iv) recommendations.

SC6.8.2.2 Bushfire management plans

Where a bushfire management plan is required to respond to the risk, these are to be prepared and undertaken by a suitably qualified and experienced professional.

Where required, a Bushfire management plan is to include with the following:

(1) a discussion of proposed mitigation measures, the reduction of the hazard risk and the feasibility and reasonableness of these measures;

(2) identification of the key factors such as vegetation type, slope and aspect and include matters such as: likely direction of bushfire attack, environmental values that may limit mitigation options, location of evacuation routes and/or safety zones;

(3) an assessment of the specific risk factors associated with the development proposal, including matters such as the nature of activities and materials to be conducted or stored on the site, numbers and types of persons likely to be present, particular warning and/or evacuation requirements; and

(4) a plan for mitigating the bushfire risk. The plan should address all of the matters raised and recommend specific mitigation actions for the proposed development including:

  (a) road and lot layout and land use allocations;

  (b) firebreaks and buffers;

  (c) building locations or building envelopes;

  (d) landscaping treatments;

  (e) warning and evacuation procedures and routes;

  (f) firefighting requirements including infrastructure;

  (g) any other specific measures such as external sprinkler systems and alarms;

  (h) purchaser/resident education and awareness programs;

  (i) ongoing maintenance and response awareness programs; and

  (j) a description of the control measures that will be use to ensure compliance.

The level of detail required will vary with the nature of the development proposal and site, and with the type of development application.

The level of detail required to accompany a particular application should be determined in consultation with the assessment manager.

SC6.9 Natural assets planning scheme policy

SC6.9.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Natural assets PSP.

SC6.9.1.1 Purpose

(1) The purpose of the planning scheme policy is to:

- (a) support the use of the Natural assets overlay code;
- (b) provide background information on the derivation of the natural assets overlay maps;
- (c) outline information the council may request for a development application; and
- (d) provide guidance or advice about satisfying assessment benchmarks.

SC6.9.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.9.1.3 Relationship to Townsville City Plan

This planning scheme policy supports the assessment provisions specified in Townsville City Plan. Natural assets PSP specifically relates to the assessment of the Natural assets overlay code.

SC6.9.2 Natural assets

SC6.9.2.1 General guidance - environment protection

A healthy natural environment underpins the social and economic fabric of a sustainable city. Human modification of the natural environment interferes with physical and biological processes, natural cycles and energy flows. Natural systems can tolerate some amount of human modification however when the resilience level is exceeded, natural system break down and life support functions are diminished or damaged. In extreme cases damage may be irreparable as with endemic habitat loss, species extinction and desertification. Protecting the environment from human activities is a prerequisite for achieving ecological sustainability.

SC6.9.2.2 Land use and environment protection

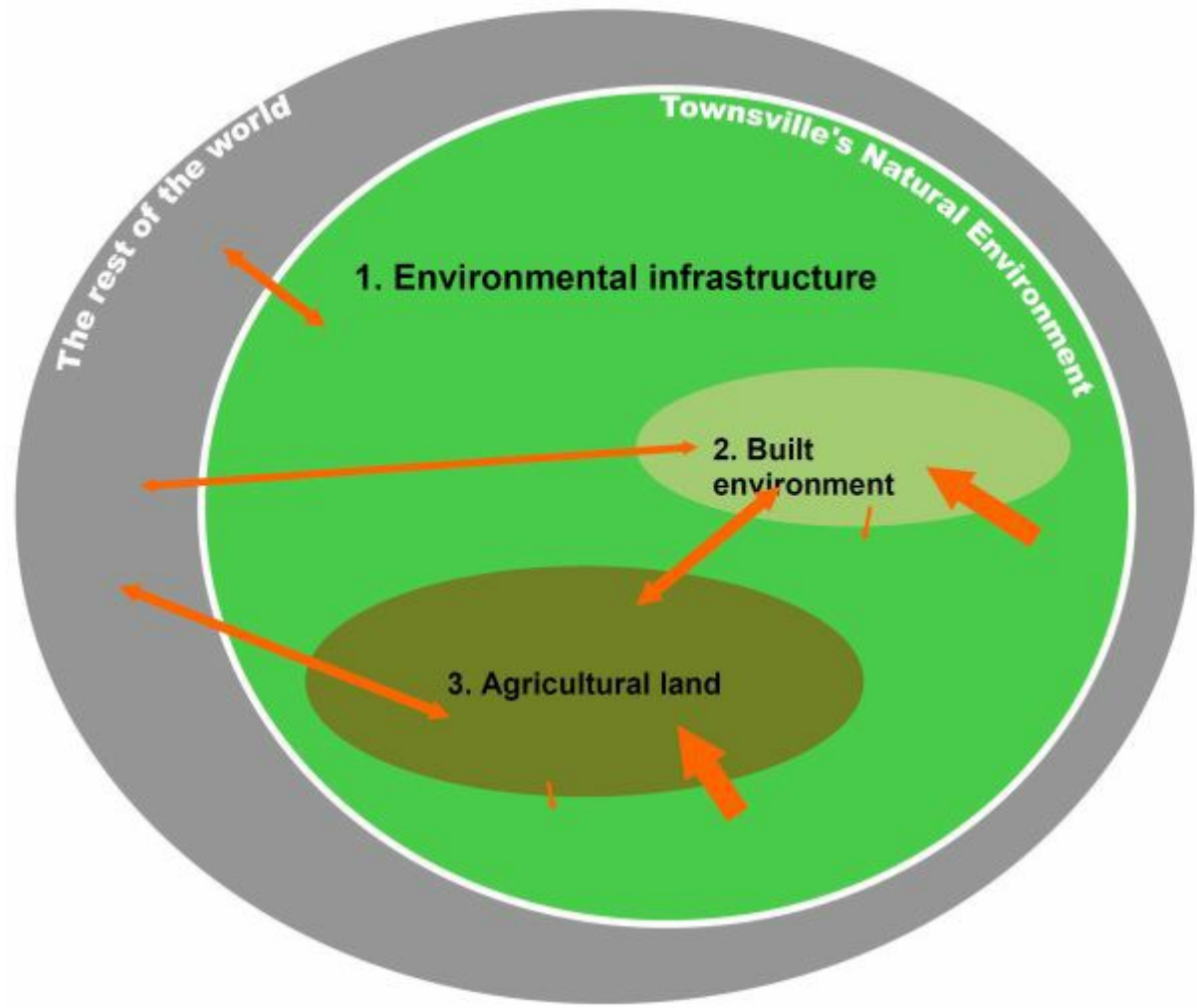
In broad terms, the three main functional land use units are:

(1) Environmental infrastructure;

(2) Built environment; and

(3) Agriculture land.

The three units are overlain on the single pillar of our existence - the natural environment, as illustrated conceptually in the diagram below.



SC6.9.2.3 Ecological planning

To seek to achieve ecological sustainability requires ecologically-based planning solutions. The underlying principle of ecological planning is the maintenance of our quality of life through the protection of our life support systems. This can best be done in a planning context through the recognition and protection of significant environmental areas.

Ecological planning takes an 'organic' approach to planning where the placement of built structures is dictated by environmental features and the need to protect and maintain natural assets and significant environmental infrastructure.

SC6.9.2.4 Environmental infrastructure

Environmental infrastructure is the basic framework or underlying foundation of the natural environment that contains the myriad of life support systems for all forms of life. Environmental infrastructure and function include:

(1) waterways/drainage systems (water drainage, water storage, seed transport, nutrient relocation, soil formation, sediment redistribution, habitat, connectivity, aquifer recharge, recreation, base flow, food source, biodiversity);

(2) wetlands (water filtering, water storage and aquifer recharge, habitat, seasonally high productivity, food source, biodiversity);

(3) riparian vegetation (shading, nutrients, ground cover; bank stabilisation, erosion prevention, water filtering, shelter/refuge, habitat, connectivity, recreation, food source, buffering, biodiversity);

(4) coastal dune systems (first line storm protection, buffering, water filtering, recreation, habitat, biodiversity);

(5) extensive forest in mid and upper catchments slopes >15% (erosion prevention, soil and slope stabilisation, soil formation, habitat, recreation, food source, aquifer recharge/intake, biodiversity, climate stabilisation);

(6) corridors and connections (wildlife movement, seed and vegetation dispersal, habitat, shade, shelter/refuge, food source, buffering, recreation, biodiversity);

(7) habitat/sustainable living space (biodiversity, connectivity, buffering, food source, recreation);

(8) native vegetation (biodiversity, habitat, wildlife movement, buffering, seed and vegetation dispersal, food source, recreation, soil health, shade, shelter/refuge, fuel, timber, erosion prevention;

(9) floodplains (habitat, biodiversity, nutrient and sediment dispersal, food source);

(10) aquifers (water storage, sub surface connectivity, hydraulic pressure); and

(11) protected areas (National Parks, Conservation Parks, Forest Reserves, Fish Habitat Areas and other socially delineated conservation areas).

Environmental infrastructure is unlikely to follow the same lines as appear on cadastral maps.

SC6.9.2.5 Ecosystem services

When planning and designing the built form we need to be aware of the intrinsic value of the surrounding environment and the ecosystem services operating in the background.

These services are provided without the need for any extra mechanical or chemical intervention and operate continually at variable rates determined by environmental conditions and climate. When we 'adjust' the environmental conditions we change the balance of ecological functions and ecosystem services at times beyond the resilience of the system to bounce back. If the change in environmental conditions is exacerbated by climate variability then a system may collapse due to the cumulative combination of natural and human impacts.

A risk management approach is adopted in ecological planning due to the uncertainties about how much of our natural assets (land, vegetation, water, soil, wildlife, soil microbes) is required to sustain an increasing human population and still maintain ecological processes at functional levels.

Determining or estimating the extent and influence of the ecological processes and ecosystem services is necessary in a planning context so that planning policies and intent can be applied to small areas (e.g. a house lot) as well as across broader landscape units such as regional ecosystems and land units.

SC6.9.2.6 Categories and components

The environmental importance ratings depicted on the Natural assets overlay map identify the likely significance of the natural environment and the likely extent of environment protection required to maintain habitat, species, vegetation communities, strategic habitat units, ecological processes, ecosystem services and hydrological function. Each of the three categories (medium, high and very high) are based on a variety of environmental and ecological components. The components associated with each category are listed in Table SC6.9.1—Environmental importance categories and components.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description
Very High	• Endangered ecological communities − semi evergreen vine thicket* − littoral rainforest and coastal vine thicket − broad leaf tea tree* • Endangered remnant vegetation (VMA vegetation management status) − Brigalow belt north bioregion − sub-regional (<10% left OR <300ha of pre-clearing extent remains) − local government area (<10% left OR <300ha of pre-clearing extent remains) • Remnant vegetation (VMA biodiversity status - endangered (dominant)) • Endangered high value regrowth (VMA) • Non bioregional ecosystems* • GBR wetland protection areas • Main connecting corridors • Mahogany glider habitat • Southern Cassowary habitat • Land units of limited extent* − Alligator Creek delta − *Eucalyptus acmenoides* lowlands − *Eucalyptus brownii* woodlands major occurrence − *Corymbia clarksoniana* alluvial fans − *Eucalyptus platyphylla — Melaleuca viridiflora* alluvial fan complex − *Eucalyptus tereticornis* on holocene deposits − *Grevillea striata* dominant − Land zone 4 grasslands − Pleistocene dunes − Terminal wetlands − *E. platyphylla — C. clarksoniana* woodlands on old levees and prior streams	This category includes endangered species habitat and vegetation communities along with the main connecting corridors (riparian, coastal and biogeographic units), land units of limited extent and Great Barrier Reef (GBR) wetland protection areas. These areas have been allocated as very high priority as they are the last examples of this type of vegetation community and/or habitat (generally less than 10% remains) and are the most vulnerable to loss and/or extinction in the short to medium term. Any further loss of these endangered elements could result in their loss from the landscape with little chance that they will recover or could result in their loss from the landscape with little chance that they will recover or could be restored.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description
High	• Of concern remnant vegetation (VMA vegetation management status) − Brigalow belt north bioregion − sub-regional (<10% left OR <300ha of pre-clearing extent remains) − local (30-50% of the pre-clearing extent remains) • Remnant vegetation (VMA biodiversity status - Endangered (sub dominant)) • High value regrowth − endangered (sub dominant) − of concern (dominant) • Wetland regional ecosystems (Estuarine, Palustrine, Lacustrine and Riverine) • Black-throated Finch habitat* • Essential habitat (regional ecosystems) • Very high ecosystem diversity (SDI >75% of the maximum value for the Bioregion) • A significant habitat for 'at risk' species • Waterways (buffered as per VMA bioregion codes) • Essential regrowth habitat (VMA)* • Wet tropics corridors* • Statewide corridors (remnant)* • Magnetic Island corridors (remnant)* • Magnetic Island lowland values(remnant)* • Land units of limited extent* − Castle Hill − (Sandy Creek and Double Barrel Creek) floodplain complex − watercourses (and associated areas subject to flooding)	This category includes the next most threatened suite of habitat, species and regional ecosystems (generally less than 30% of these components remaining in the landscape) along with strategically important connecting corridors, essential regrowth habitat, wetland regional ecosystems and endemically important landscape elements. It also includes a significant portion of the network of waterways and buffers (not included in the very high category) that are critical to the maintenance of ecological functions and ecosystem services. This category includes environmental elements close to the probable 'survival edge' as 30% is considered to be at the lower limit of ecological viability and function for habitat and vegetation communities. Any further reduction of extent is likely to result in a downward spiral that could ultimately lead to species endangerment and/or the endemic loss or degradation of vegetation communities and ecological processes. To take into account the relative importance of this category, if there are two or more environmental parameters with a high rating in a given polygon then the polygon was elevated to the very high category.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description

Medium	• Least concern remnant vegetation (VMA vegetation management status)
	  − Brigalow belt north bioregion
	• Remnant vegetation (VMA biodiversity status — Of Concern)
	• High value regrowth
	  − of concern (sub dominant)
	  − least concern
	• GBR wetland protection trigger areas (buffers)
	• Statewide corridors (nonremnant)*
	• Magnetic Island corridors (nonremnant)*
	• Magnetic Island lowland values (regrowth)*
		This category includes the widest range of environmental values from near threatened (30% remnant vegetation remaining) to relatively stable (100% remnant vegetation remaining). This category also includes some of the less tangible environmental and ecological functions, such as catchment protection, buffers, landscape connectivity and viable- sized habitat and ecosystems.
		
		This is the category that is likely to require the highest level of investigation prior to any development, as it is the least 'certain' in terms of priority for environmental protection. It is likely to have very high and high environmental value features, which have not been identified at the mapping resolution used for the categorisation. It may also include some low value features.
		
		If there are three or more environmental parameters with a medium rating in a given polygon then the polygon has generally been elevated to the high category.

Footnote—SDI is Simpson's Diversity Index

Footnote—*Denotes amendments/additions using DEHP mapping

It should not be assumed that any area has no environmental values. Areas not included in the overlay map (depicted without an infrastructure rating) generally consist of areas that have significantly less environmental value due to the level of disturbance resulting from anthropogenic activities, including clearing of native vegetation and the construction built form. The environmental values of some of these areas could be reinstated.

Applicants and landowners should be aware that other land not included in the overlay map may contain other remnant and non-remnant vegetation or other environmental value that is subject to the requirements of other state and/or federal legislative requirement.

In addition, there are provisions in some zone codes that require applicants to respond appropriately to any localised values that may exist outside the overlay area.

SC6.9.2.7 Mapping limitations

The general mapping resolution used for the environmental importance ratings map (Overlay Map OM-08) is 1:100,000. The Queensland Government's Regional Ecosystem mapping has been used as the base map for the environmental importance rating map and, while being the best available data source for this type of environmental categorisation, it is recognised that there are inaccuracies in the base map and therefore there will be inaccuracies in the resulting product - i.e. environmental importance ratings.

To overcome some of the inaccuracies, a review of the environmental importance ratings has been undertaken for the urban, rural and rural residential areas using 2011 aerial photography (the most recent available at the time of review). Further refinement of the mapping is required, for example, to accurately locate waterways, wetlands, riparian zones and buffers as the current Queensland Government mapping is not accurate at the local/urban scale and especially for order 1 and order 2 streams.

In light of these mapping limitations, it is imperative that an environmental assessment is undertaken for areas mapped with medium, high and very high environmental importance to ensure that development applications are assessed with the benefit of the best available information.

Council will continue to improve its environmental mapping, over time, to more accurately reflect environmental importance across the entire Townsville landscape, to reduce the incidence of unsustainable land use and development, and thereby contribute to the achievement of ecological sustainability and a sustainable Townsville.

SC6.9.2.8 Supporting maps

Supporting maps have been produced to assist applicants in using the Natural assets overlay code. The data presented on each of the supporting maps has been extracted from data contained on map OM-08 and are provided to assist applicants identify environmental and ecological features within the Townsville landscape.

Supporting maps may be used to assist applicants address relevant assessment benchmarks of the natural assets code.

Maps supporting the natural assets overlay code are:

(1) Figure SC6.9.1 – Natural assets – waterways represent the Queensland Government 1:100,000 waterways mapping. Waterways have been mapped to enable identification of stream orders specifically and are designed to allow applicants to identify the relevant stream order that affects a given location.

(2) Figure SC6.9.2 – Natural assets – wetlands include Great Barrier Reef wetlands of high ecological significance (wetland protection areas), riverine wetland regional ecosystems and other wetland regional ecosystems. Ramsar wetlands and wader roosts have also been shown to identify the presence of these areas at their given location.

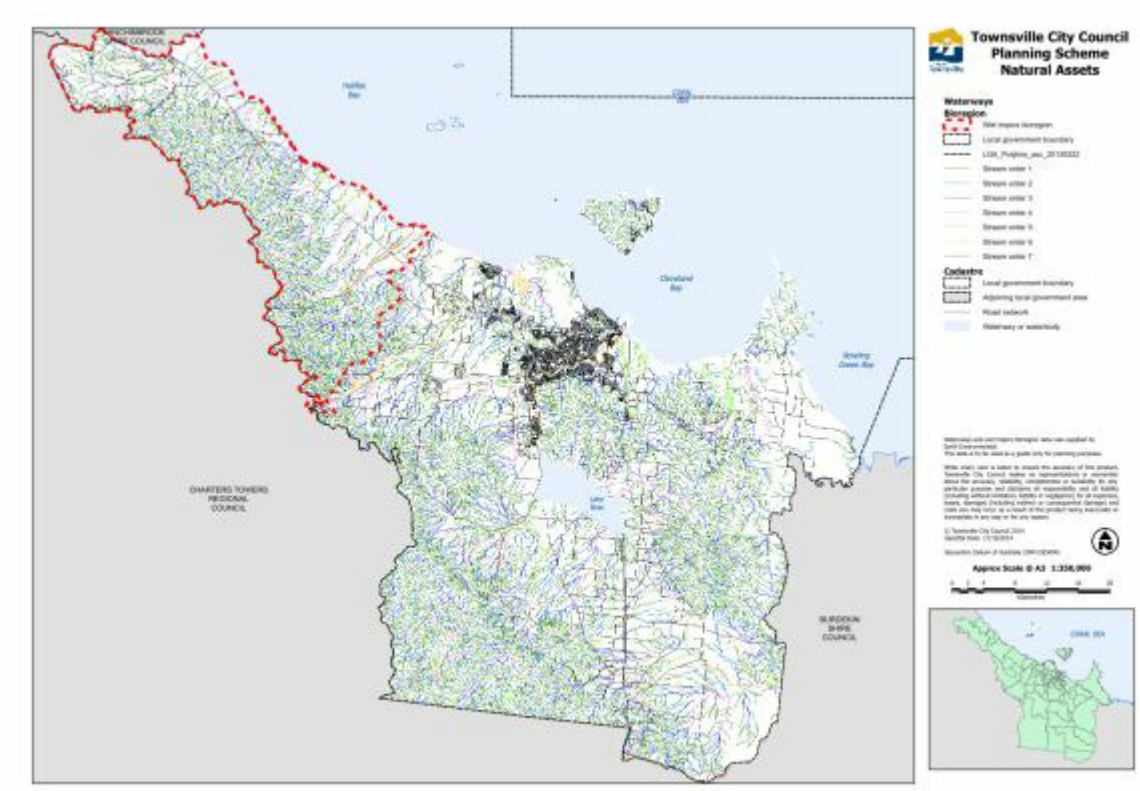
(3) Figure SC6.9.3 – Natural assets – ecological corridors include:

  (a) priority corridors from the Environment and Biodiversity Study: Final Report (Chenoweth April 2011);

  (b) state corridors from data provided by the Department of Environment and Heritage Protection (DEHP); and

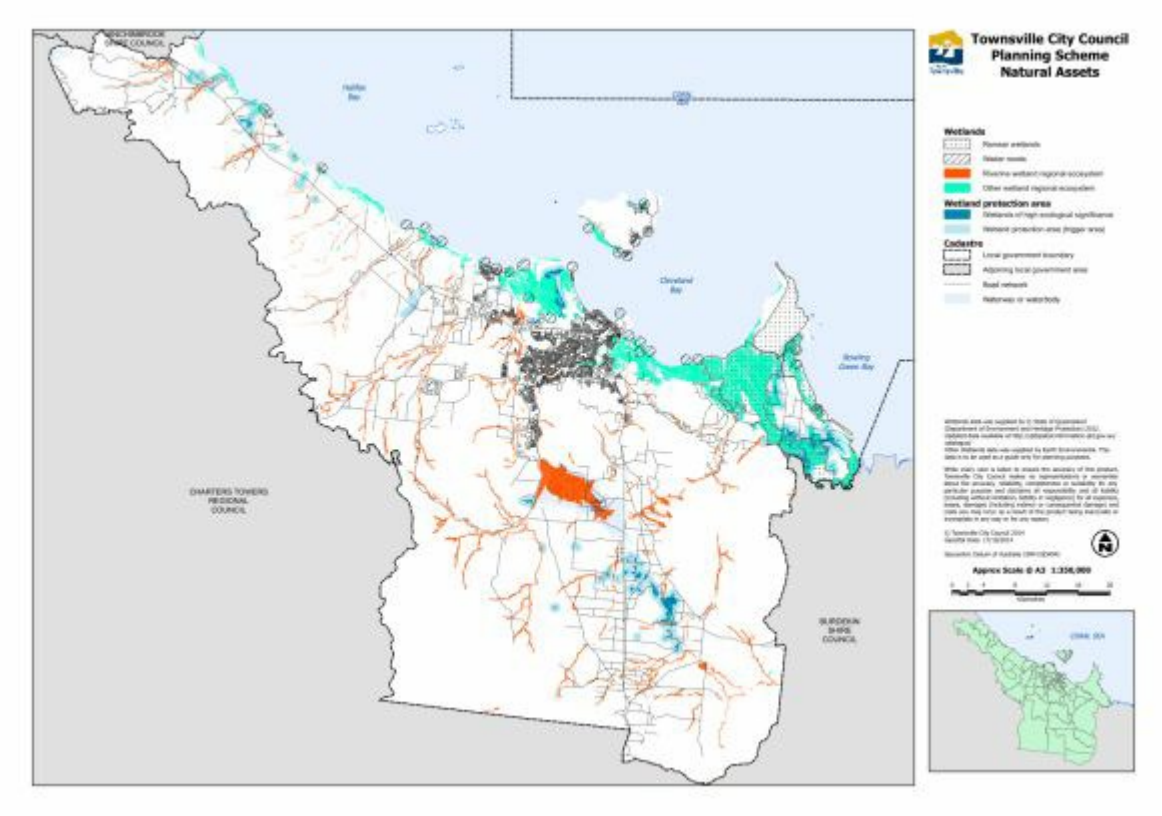
  (c) the state and priority corridors as major ecological corridors and the great eastern ranges conservation corridor. Major ecological corridors shown on the map consist of a 250m core corridor and a 50m buffer either side of the core corridor.

(4) Figure SC6.9.4 – Natural assets – core habitat includes Cassowary, Mahogany Glider and draft Black-throated Finch habitats in addition to essential habitat for other threatened species as mapped by DEHP including declared fish habitat areas.



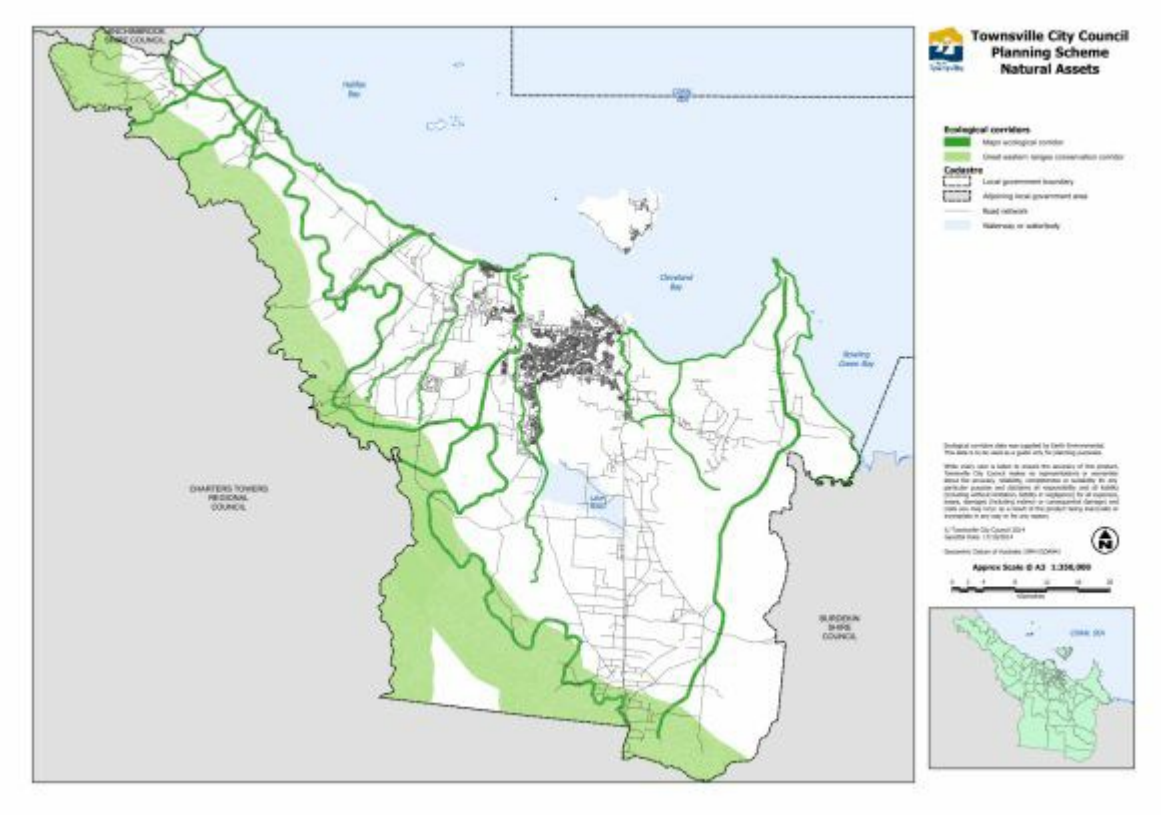
Click here to view PDF high resolution map.

Figure SC6.9.1 - Natural assets - waterways



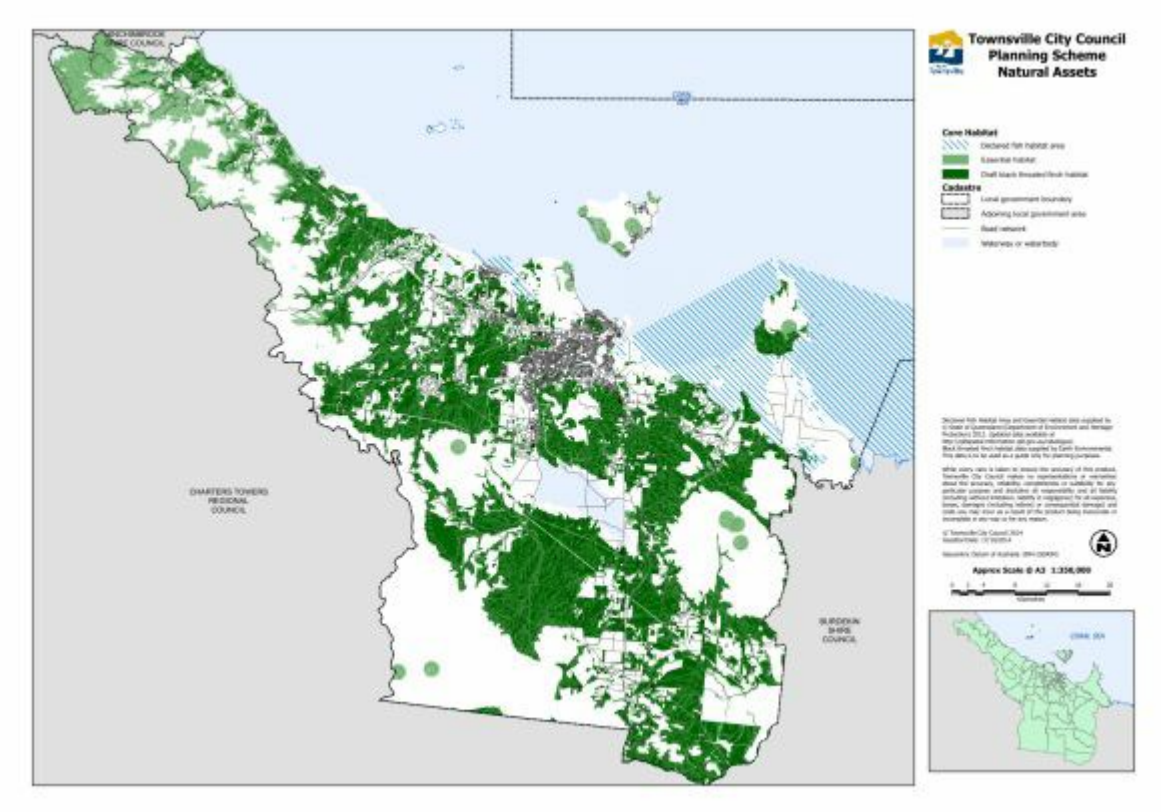
Click here to view PDF high resolution map.

Figure SC6.9.2 - Natural assets - wetlands



Click here to view PDF high resolution map.

Figure SC6.9.3 - Natural assets - ecological corridors



Click here to view PDF high resolution map.

Figure SC6.9.4 - Natural assets - core habitat

SC6.9.2.9 Environmental assessments

An environmental assessment may be required to show what impacts the development activity may have on the environment and how potential adverse impacts on the environment can be mitigated. To demonstrate compliance with the Natural assets overlay code, such an assessment may need to include a detailed ecological assessment.

The required assessments should be undertaken by a suitably qualified and experienced professional and provide a site specific investigation of the values present and their significance to ground truth the data reflected on the overlay mapping. The level of investigation required and techniques utilised should be commensurate with the scale and nature of the proposed development and the type of values present on the site. The environmental assessment should provide the appropriate level of information to assess the potential impact of a proposed development on the environment including:

(1) identification of the physical and ecological features of the site;

(2) identification of the ecological processes and ecosystem services associated with the site;

(3) identification of the physical and ecological connections between the site and the surrounding environment, including ecological processes and ecosystem services; and

(4) comparison of the environmental importance components and features identified on OM-08 to on ground findings.

The environmental assessment and reporting process also provides the development proponent with the opportunity to propose potential solutions that prevent or minimise potential environmental harm to natural assets and ecological processes associated with the proposed development. Potential solutions may include:

(1) environmental offsets;

(2) operational environmental management plans;

(3) succession plans and criteria for handover of natural assets to council;

(4) establishment of Nature Refuge areas;

(5) stormwater management plans incorporating water sensitive urban design (WSUD);

(6) resourced rehabilitation plans (in addition to or instead of environmental offsets); and

(7) innovative ideas for the progression of the development and protection of environmental values.

SC6.9.2.10 Environmental assessment report

The environmental assessment report should be set out in accordance with the framework provided below.

Physical and ecological features of the site including:

(1) Introduction providing information about:
   (a) the applicant;
   (b) tenure;
   (c) location; and
   (d) current land use and proposed land use.

(2) Site description including:
   (a) surrounding land use;
   (b) location in the water catchment;
   (c) proximity to HEV waters;
   (d) proximity to World Heritage Areas and other protected areas;
   (e) geology and soils; and
   (f) Regional ecosystems.

(3) Environmental importance components and features identified on OM-08 (Natural assets overlay).

(4) Likely ecological processes and ecosystem services associated with the site and adjoining areas.

(5) Social, physical and environmental constraints identified in other overlays including flooding, fire hazard, slope and visual amenity.

Physical and ecological features of the site (on ground site assessment results):

(6) The physical and ecological features of the site, based on on-ground assessment including:
   (a) soils and their geological derivation;
   (b) drainage and wetland features;
   (c) Other native vegetation and regrowth;
   (d) Regional Ecosystem type and extent;
   (e) habitat type and extent;
   (f) exotic species presence (terrestrial and aquatic – plant and animal); and
   (g) fauna sightings and signs (additional targeted survey work may be required where threatened species and ecological communities are likely to be present).

(7) Ecological processes and ecosystem services associated with the site.

(8) The physical and ecological connections between the site and the surrounding environment including ecological processes and ecosystem services.

Comparison of desktop review features with site assessment features:

(9) Comparison of the environmental importance components and features identified on OM-08 council's Natural assets overlay to on ground findings.

Suggestions for development impact avoidance or mitigation, including, but not limited to the following considerations:

(10) stormwater management including erosion prevention and sediment movement control;

(11) habitat management including weed control;

(12) maintenance of ecological processes; and

(13) maintenance or improvement of connectivity.

Environmental assessments and the preparation of management and rehabilitation plans are to be undertaken by a

person/people/organisation with the appropriate skills and experience. Where a person with less than four years' experience in field work is involved in the assessment, they should be supervised by an experienced environmental practitioner. Regardless of experience and qualifications, all work should be thoroughly reviewed as part of a quality assurance process prior to submission of studies, reports and plans to council.

SC6.9.2.11 Site-based management and rehabilitation plan

Where there is a requirement in the Natural assets overlay code, a site based management plan and/or a rehabilitation plan should be prepared to address the site specific situation. Generally, content should be in a format that identifies:

(1) the physical and biological condition of the site (from the Environmental assessment report);

(2) the issue/s being addressed and their location (from the Environmental assessment report);

(3) how and over what time scale the issue will be addressed (with input from Part 4 of the Environmental assessment report); and

(4) the commitment of resources allocated to implement the plan.

Plans need to provide enough information to show that the performance outcomes in the Natural assets overlay code will be met by the implementation of the plan. The use of maps and accompanying tables with management actions are encouraged to simplify the plan and reduce the size of documents.

SC6.9.2.12 Additional information

Additional material may be required as part of the environmental assessment depending on the environmental importance components and features identified in the Natural assets overlay. This involves proximity to areas of significant ecological or environmental value and requirements for vegetated buffers as well as the proximity to wader roosts. Additional information will be required if the proposed development is within:

(1) 200 metres of a wader roost area as indicated on Figure SC6.9.2 – Natural assets – wetlands;

(2) 200 metres of core habitat and endangered ecological communities;

(3) 200 metres of HEV waters;

(4) 200 metres of a wetland area;

(5) 100 metres of an ecological corridor;

(6) 100 metres of a declared fish habitat area; and

(7) 100 metres of a waterway.

Information derived from on ground investigations will be required to show:

(1) the actual distance from the environmental feature to the edge of the development and a comparison to the Natural assets overlay.

(2) the physical condition of the area between the environmental feature and the development including:

  (a) soils;

  (b) drainage patterns;

  (c) habitat type/s;

  (d) vegetation type and condition;

  (e) presence of exotic species;

  (f) observed fauna and signs of fauna; and

  (g) built infrastructure e.g. fences, drains and roads; and

(3) how buffer areas will maintain natural assets and ecological processes if a proposed buffer area/width is less than that specified in the Natural assets overlay code.

It is the responsibility of the development proponent to provide council with alternative solutions, when digressing from council's acceptable solutions, to ensure natural assets and ecological processes are not degraded as a consequence of the proposed development. Council may adopt the proponent's suggestions as conditions of development approvals.

SC6.9.2.13 Background information to assist environmental assessments

Council has compiled a range of environmental information to assist development proponents with the preparation of their environmental assessments. A list of the information is provided below with associated references:

(1) schedule of locally significant fauna, flora and vegetation/ecological communities along with those scheduled under legislation;

(2) landscaping guidelines expounding the use of local native species and excluding environmental weed species;

(3) local and regional movement requirements of wildlife (refine connectivity corridors based on species habitat location and known ecology);

(4) fauna survey techniques (e.g. types of trapping, call play back etc.) including the most appropriate targeted survey techniques and when these may be required for particular species;

(5) pest species (flora and fauna) specific to Townsville and appropriate management techniques; and

(6) Black Ross (Townsville) Water Quality Improvement Plan

SC6.9.2.14 Terminology

The following table provides a useful compendium of environmental terms, including terms used in this policy.

Word / Term	**Explanation**
Aquatic	Of the water, or living or growing in water.
Arboreal	Tree dwelling. Adapted to living in or among trees. Spending a significant part of the life cycle in trees or relying on arboreal habitats for shelter and/or food.
Avian	Birds. Of or pertaining to birds.
Biodiversity	The variety of all life forms: (1) *genetic diversity*—the variety of genetic information contained in individual plants, animals and other organisms. (2) *species diversity*—the variety of species. (3) *ecosystem diversity*—the variety of habitats, ecological communities and ecological processes. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Biodiversity values	As biodiversity is the variety of all forms of life biodiversity values are difficult to quantify. Biodiversity values are often based on a combination of biological and biophysical parameters including; habitat species richness and endemic anomalies. Some of these parameters have been included in the environmental importance rating map prepared for the Natural Assets Overlay.
Biophysical processes	Processes involving interaction between the biological (organic) world and the physical (inorganic) world e.g. soil formation and nutrient recycling.
Bioregion	As described in the *Vegetation Management Act 1999* (VMA).
BTF is Black-throated Finch	The Black-throated Finch BTF is an Endangered species under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 2000* (EPBC Act) and Queensland's *Nature Conservation Act 1992*. BTF habitat mapping is draft and will require further investigation to determine actual core habitat. A greater level of assessment will be required for development applications in BTF habitat areas.
Buffer	The threat management space between a natural or environmental asset and the threat. Buffers can also act as ecological corridors and provide habitat for wildlife. [anything serving to neutralise the shock of opposing forces (The Macquarie Dictionary (2nd Edition) 1991, p.234)]

Buffering	The practice of providing a managed ecotone between the area of environmental significance and the threatening process/es.
Connectivity	The physical linkages serving to connect dissimilar or separated patches of habitat. The name given to the concept of landscape elements being connected. The capacity of landscapes or aquatic environments to allow ecological movement and function. The broad concept can be considered to have several main elements:*landscape connectivity*—the physical connection between areas with vegetation cover across a landscape. (1) *habitat connectivity*—the connection between patches of habitat suitable to a particular species. (2) *ecological connectivity*—the ecological processes that underpin the function of landscapes; for example, the transfer of pollen or seeds and the sequestration of soil carbon. (3) *evolutionary connectivity*—populations of species are able to interact naturally, sharing genes and adapting to changing environmental conditions. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Core area, core habitat area	An area of habitat that is of a suitable size, shape and condition for an assemblage of species or a single organism. Core habitat provides nutrients and water resources, and supports successful reproduction. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45- 49).
Corridors	Corridors are passageways that facilitate the movement of organisms and serve as habitat. Corridors exist at a range of scales depending on the organism and their ecological requirements. Corridors are not confined to linear strips of vegetation or riparian zones but rather include an interconnected network of native vegetation and habitat across the landscape. Waterways and wetlands provide ecological corridors for aquatic organisms.
Degraded	In a lessor state as a result of human interaction and natural causes e.g. storms.
Ecological communities	Assemblages of species (plants, animals, bacteria and fungi) that interact with each other in a common environment and often as part of a food chain or trophic web.
Ecological functions	Functions and processes involving the interaction of organisms with each other and their environments including , nutrient cycling, pollination, animal and plant breeding.
Ecological significance	The term used to describe areas that are important for maintaining biodiversity and ecological processes.
Ecotone	The gradation or transition zone between different habitats or vegetation communities.
Ecosystem	Ecosystem is “1. a community of organisms interacting with one another and with the environment in which they live.” (The Macquarie Dictionary (2nd Edition) 1991, p.555). A complex network or interconnected system or a biological community of interacting organisms and their physical environment; for example, combinations of plant, animal and other organisms in communities and their non-living environment (soil, water, climate, and so on) interacting as a functional unit, such as forest, wetland or grassland. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Ecosystem health	A measure of the condition of ecosystems from sustainable to threatened.

Ecosystem processes	Those life processes and interactions between organisms and the environment that (generally) contribute to the overall health of the ecosystem.
Ecosystem services	The multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as ecosystem services and include products like clean drinking water and processes such as the decomposition of wastes. The term is generally applied to benefits to human beings as with the Millennium Ecosystem Assessment 2005 definition “the benefits people obtain from ecosystems”. This is a narrow, anthropogenic definition that could restrict the protection of important ecosystem services if they are not seen as beneficial to humans. The definition has been broadened in the National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012 to read; “the processes or materials provided by ecosystems. Ecosystem services benefit biodiversity, humans and society through the provision of essential goods and services such as clean air, water, food, shelter, energy, nutrients, amenity values and cultural resources”. (pp.45-49)
Endemic	Refers to organisms that are native to a particular area or region. Having a limited distribution or habitat extent or confined to a specific area.
Environmental infrastructure	Environmental infrastructure is the basic framework or underlying foundation of the natural environment that contains the myriad of life support systems for all forms of life.
Hydrological function	The function of water moving through the landscape as part of a natural drainage process. Hydrological function is shaped by geological features and influences those features over time e.g. erosion. Hydrological function can be impeded by: (1) the placement of obstacles in waterways, (2) obstructing overland flow e.g. raised roads and rail lines, (3) reduced aquifer recharge.
Migratory species	Animals, especially birds and marine species, that travel significant distances (compared to remaining in a home range) to: (1) avoid climatic extremes and resource (food) depletion, (2) find sufficient resources to maintain physical health, (3) breed in more favourable conditions.
Native habitat	Habitat that is in a relatively natural state with minimal disturbance from human activities with a low incidence of exotic plant species.
Native species	Species (plant or animal) that would normally be found in the (Townsville) natural environment.
Natural areas	Those parts of the environment that have not been significantly altered from their natural state and that retain their ecological processes, biophysical functions and suite of native species.
Naturalised	Non-native species introduced to Australia that flourish and become part of the landscape.
Non-native	Not having evolved in Australia. Introduced into Australia from another country within the last 300 years.
Pest fauna and flora	Introduced species that threaten the viability and/or productivity of native ecosystems.

Refuge/refugia	An area that provides shelter, food or water for organisms when other parts of the landscape are inhospitable. For example, rocky areas can provide shelter during bushfires, while riparian areas might provide food and water during times of drought (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Resilience	The ability to recover after being impacted by threatening processes.
Riparian areas	Areas of vegetation alongside watercourses, lakes and wetlands. They often contain vegetation that differs from that in the surrounding landscape, providing important habitat and ecological resources (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012 pp.45-49).
Significant ecological communities	Those ecological communities that are limited in extent (endemic) or population, confined to specific habitats or have characteristics that result in a vulnerability to environment changes and threatening process.
Threatened species	Threatened wildlife means native wildlife that is prescribed under the *Nature Conservation Act 1992* as— (a) extinct in the wild wildlife; or (b) endangered wildlife; or (c) vulnerable wildlife.
Threatening processes	Human activities that adversely impact the environment, natural values and ecological processes and result in adverse impacts including habitat loss, native vegetation destruction and reduced populations of native and migratory species.
Wader roosts	As defined in the Environment and Biodiversity Study: Final Report (Chenoweth 2011) and represented as a 700 metre buffer trigger area around wader roosts.
Wetland mapping and classification methodology	The "A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland (VERSION 1.2) published by the Environmental Protection Agency, Queensland Government and produced in conjunction with the Australian Government (Department of the Environment and Heritage) in 2005.

SC6.10 Parking rates planning scheme policy

SC6.10.1 Introduction

Short Title – The planning scheme policy (PSP) may be cited as the Parking rates PSP.

SC6.10.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) define the particular rates of parking that provide the relevant acceptable outcome under the Transport impact, access and parking code in the Townsville City Plan.

SC6.10.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.10.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Transport impact, access and parking code.

SC6.10.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 - Definitions. A term which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 - Definitions.

SC6.10.2.1 Planning scheme policy content -parking rates

(1) Parking rates are provided on site in accordance with the following uses or combination of uses.

(2) Where the number of parking spaces calculated in accordance with this table is not a whole number, then the minimum number of spaces to be provided is to be rounded upward to the closest whole number.

(3) The number of car parking spaces required for people with a disability is to be in accordance with Table D3.5 of the Building Code of Australia. There is no requirement to designate car parking spaces for people with a disability where the total number of car parking spaces required is five (5) or less.

Use	Parking rates
Adult store	One (1) space per 25m² of GFA.
Agricultural supplies store	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Air services	One (1) space per 80m² of GFA.
Animal keeping	One (1) space per 10 animals for which accommodation is provided for on the premises, OR 3 spaces, whichever is the greater.
Aquaculture	One (1) space per employee (FTE).
Brothel	One (1) space for each room in the brothel AND one (1) space per two employees (FTE) on the premises at any one time.
Bulk landscape supplies	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Caretaker's accommodation	One (1) space.
Car wash	Two (2) spaces, AND queuing space within the site for 4 vehicles using or awaiting use of each washing bay.
Cemetery	Thirty (30) spaces plus one (1) space per two employees (FTE) on the premises at any one time.
Child care centre	One (1) space for every 6 children, and 1 space per employee (FTE).
Club	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Community care centre	One space per 20m² of GFA
Community use	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Crematorium	Thirty (30) spaces plus one (1) space per two employees (FTE) on the premises at any one time.
Detention facility	One (1) space per 2 employees (FTE); plus a minimum of ten (10) visitor spaces.
Dual Occupancy	Two (2) spaces per dwelling unit, which may be provided in tandem, of which one (1) space is to be covered per dwelling unit.
Dwelling house	Two (2) spaces, which may be provided in tandem, of which one (1) space is to be covered.
Dwelling unit	One (1) space.
Educational establishment	Primary – one (1) space per employee (FTE) AND one (1) space per 10 students for visitor parking AND sufficient spaces for loading and unloading of passengers in addition to other requirements. Secondary – one (1) space per employee (FTE), AND one (1) space per 10 students of legal driving age, AND one (1) visitor space per 50 students, AND sufficient spaces for loading and unloading of passengers in addition to other requirements. Tertiary – point five (0.5) spaces per employee (FTE) PLUS one (1) space per 10 students (FTE), AND sufficient spaces for loading and unloading of passengers in addition to other requirements.
Emergency services	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Environment facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Extractive industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Food and drink outlet	One (1) space per 10m² of GFA available to the public (including outdoor dining); One (1) space per 50m² of GFA for food preparation; AND One (1) space per 100m² of GFA used for storage.

Function facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Funeral parlour	One (1) space per employee; AND One (1) space per hearse; AND One (1) space per 4 persons capable of being seated in any chapel or accommodated in a function area with a minimum of ten (10) spaces.
Garden centre	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Hardware and trade supplies	One (1) space per 40m² of GFA.
Health care services	One (1) space per 20m² of GFA, OR four (4) spaces per medical practitioner, whichever is the greater; AND one (1) space for ambulance vehicle pick-up and set down.
High impact industry	One (1) space per 100m² of GFA.
Hospital	One (1) space for each 4 beds, two (2) spaces for each 3 employees, AND one (1) space for each doctor.
Hostel	One (1) space for every 2 beds provided, one (1) space for every 4 employees (FTE), and an additional one (1) covered space for a resident manager, and a dedicated car washing bay (additional to visitor and tenant parking spaces). A dedicated car washing bay is not required where there are 5 or less dwelling units provided. A dedicated car wash bay may also be integrated with visitor parking to serve both functions.
Hotel	Licensed facilities: One (1) space per 2m² of bar area; and One (1) space per 5m² of the lounge and beer garden area. One (1) space for each guest suite; AND One (1) space for each resident manager or caretaker; AND For any drive-through facility, queuing space within the site for ten (10) vehicles being served or awaiting service.
Indoor sport and recreation	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Intensive animal industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Intensive horticulture	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Low impact industry	One (1) per 100m² of GFA.
Major sport, recreation and entertainment facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Marine industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Market	One (1) space per stall.
Medium impact industry	One (1) space per 100m² of GFA.
Motor sport facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.

Multiple dwelling	In the Principal centre zone: One point five (1.5) spaces per dwelling (and one (1) dedicated car washing bay* for the entire development). In the High density residential zone: One point five (1.5) spaces per dwelling (and one (1) dedicated car washing bay* for the entire development). In the Medium density residential zone: One point five (1.5) spaces per dwelling; Point two (0.2) spaces per dwelling for visitors (and one (1) dedicated car washing bay* for the entire development). All other zones: One point seven (1.7) spaces per dwelling; Point two (0.2) spaces per dwelling for visitors (and one (1) dedicated car washing bay* for the entire development). * A dedicated car washing bay is not required where there are 5 or less dwellings provided. A dedicated car wash bay also may be integrated with visitor parking to serve both functions.
Nature-based tourism	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Nightclub entertainment facility	One (1) space per 15m² for the first 1,500m² of GFA, then one (1) space per 25m² of GFA thereafter.
Non-resident workforce accommodation	One (1) space per employee (FTE).
Office	In the Principal centre zone: One (1) space per 70m² of GFA All other zones: One (1) space per 30m² of GFA.
Outdoor sales	Point seven five (0.75) spaces per 100m² of total use area AND four (4) spaces per work bay (for vehicle service facilities)
Outdoor sport and recreation	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Permanent plantation	No parking rate required.
Place of worship	One (1) space per 10 persons capable of being seated.
Port services	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Relocatable home park	One point five (1.5) spaces per relocatable home.
Renewable energy facility	No parking rate required.
Research and technology industry	One (1) space per 80m² of GFA.
Residential care facility	Subsidised developments (nursing and convalescent homes): One (1) space per 10 beds; AND one (1) space per 2 employees and one (1) space per ambulance Self-contained units: One (1) space per 10 units (residents) and one (1) space per 10 units (visitor)

Resort complex	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Retirement facility	One (1) space per 2 self-contained or service units, plus one (1) space per 5 nursing home beds of the premises.
Rural industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Rural workers accommodation	One (1) space per accommodation unit.
Service industry	One (1) space per 100m² of GFA.
Service station	One (1) space per 40m² of GFA.
Shop	In the Principal centre zone: One (1) space per 30m² of total retail area* available to the public and one (1) space for each 100m² of total storage GFA. All other zones: One (1) space per 25m² of total retail area * available to the public and one (1) space for each 100m² of total storage GFA. * The total retail area available to the public excludes: (a) building services, plant and equipment; (b) access between levels; (c) ground floor public lobby; (d) a mall; and (e) the parking, loading and manoeuvring of motor vehicles;
Shopping Centre	In the Principal centre zone: One (1) space per 30m² of total retail area * available to the public and one (1) space per each 100m² of total storage GFA. All other zones: One (1) space per 25m² of total retail area * available to the public GFA and one (1) space per each 100m² of total storage GFA. * The total retail area available to the public excludes: (a) building services, plant and equipment; (b) access between levels; (c) ground floor public lobby; (d) a mall; and (e) the parking, loading and manoeuvring of motor vehicles.

Short-term accommodation	In the Principal centre zone: 0.75 spaces per self-contained unit, and 0.25 spaces per non self-contained unit, AND one (1) space for each 10m2 of GFA available to the public and one (1) space per 50m2 of GFA kitchen and preparation areas, and point one (0.1) spaces per unit for visitors. All other zones: One (1) space for each guest suite, one (1) space for a restaurant manager or caretaker, AND one (1) space for each 10m2 of GFA available to the public and one (1) space per 50m2 of GFA kitchen and preparation areas.
Showroom	One (1) space per 40m² of GFA.
Special industry	One (1) space per 100m² of GFA.
Telecommunications facility	No parking rate required.
Theatre	One (1) space per 15m² of GFA or one (1) space for each 4 seats, whichever is the greater.
Tourist attraction	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Tourist park	One (1) space per van, relocatable home and cabin site (to be located adjacent to such site), one (1) visitor space per 10 such sites, one (1) space for each 2 staff members, and one (1) space for a resident manager.
Transport depot	Sufficient spaces to accommodate the amount and type of vehicle traffic likely to be generated by the particular use.
Utility installation	Sufficient spaces to accommodate the amount and type of vehicle traffic likely to be generated by the particular use.
Veterinary services	Five (5) spaces per veterinarian.
Warehouse	One (1) space per 100m² of GFA.
Wholesale nursery	One (1) space per 100m² of total use area.
Winery	One (1) space per 25m² of GFA.
Any other development	Sufficient spaces to accommodate the amount of vehicular traffic likely to be generated by the particular use.

Schedule 6 Planning scheme policies

SC6.1 Planning scheme policy index

The table below lists all the planning scheme policies applicable to the planning scheme area.

Table SC6.1.1 - Planning scheme policy index

Number	Planning scheme policy title
SC6.2	Character residential planning scheme policy
SC6.3	Cultural heritage planning scheme policy
SC6.4	Development manual planning scheme policy
SC6.5	Economic impact assessment planning scheme policy
SC6.6	Emerging community planning scheme policy
SC6.7	Flood hazard planning scheme policy
SC6.8	Mitigating bushfire hazards planning scheme policy
SC6.9	Natural assets planning scheme policy
SC6.10	Parking rates planning scheme policy

SC6.2 Character residential planning scheme policy

SC6.2.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Character residential PSP.

SC6.2.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) provide advice about achieving outcomes in the Character residential zone code; and

(2) identify and provide guidance about information that may be required to support a development application where assessable against the Character residential zone code.

SC6.2.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.2.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Character residential zone code.

SC6.2.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1.

SC6.2.2 Planning scheme policy details

The Character residential zone identifies and defines parts of the city with a unique mixture of architecture and overall streetscape. The Character residential zone code regulates development within identified character precincts. This code ensures that the features of these neighbourhoods that make a positive contribution to each precinct's overall character are retained and appropriately managed.

There are twelve precincts in the Character residential zone code, each with its unique features (such as Workers Cottages, Grand Queenslanders and 1960s Defence Housing). The precincts provide for specific development outcomes over and above the general zone code outcomes. Individual properties are included within a precinct. The character features are described fully in the code.

The purpose of the Character residential PSP is to provide applicants with guidance in meeting the requirements of the Character residential zone code. Appendix 1 of this policy identifies non-contributing properties in the Character residential zone. Properties and buildings identified in the Character residential zone and not listed in Appendix 1 of this policy are considered to be contributing properties and buildings. Appendix 2 of this policy identifies contributing non-residential properties.

SC6.2.2.1 Understanding your precinct and your character building

Each character residential precinct is defined in the Character residential zone code. Townsville has defined character residential precincts; these precincts are rich in diversity, unique in character, and capture Townsville's history and North Queensland lifestyle.

(1) Your precinct

The buildings in your street create the character of your precinct. Properties are defined as either contributing character buildings or non-contributing properties. Non-contributing properties must still comply with certain provisions of the Character residential zone code, however; they are not to be used for comparative assessment.

Your street will provide the majority of the information you need to better understand the types of buildings, design, developments and architectural aspects that will be relevant to any new works on your property.

SC6.2.2.2 Finding your way around the policy

The policy is divided into the following eight sections:

(1) Key contributing character elements (SC6.2.3)

(2) Non-residential contributing character buildings (SC6.2.4)

(3) Reconfiguring a lot (SC6.2.5)

(4) Information that may support a development proposal (SC6.2.6)

(5) Preparing an assessment report (SC6.2.6.2)

(6) Preparing a condition report (SC6.2.6.3)

(7) SC6.2 Appendix 1: Non-contributing properties in the Character residential zone

(8) SC6.2 Appendix 2: Contributing non-residential properties

SC6.2.3 Key contributing character elements

SC6.2.3.1 Roofs

This section of the policy provides design principles and examples that may be considered when addressing the requirements of the Character residential zone code. Applicants may refer to this section for guidance on Character residential zone code outcomes regarding roof forms and pitch, material type and colour and depth of roof overhang.

(1) Figure SC6.2.3.1 below demonstrates acceptable roof pitch in relation to neighbouring properties. This may provide guidance in addressing roof pitch related outcomes of the Character residential zone code requirements in particular, in relationship to PO18, PO21, PO28, PO33, PO40, PO45, PO51, PO56, PO63, PO69, PO74 and PO80.

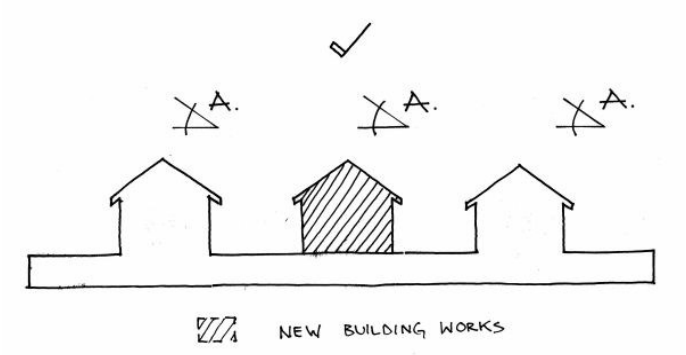


Figure SC6.2.3.1 Illustrates an example of acceptable roof pitch

(2) Figure SC6.2.3.2 below demonstrates an unacceptable roof pitch in relation to addressing roof pitch related outcomes of the Character residential zone code requirements in particular, in relation to PO18, PO21, PO28, PO33, PO40, PO45, PO51, PO56, PO63, PO69, PO74 and PO80.

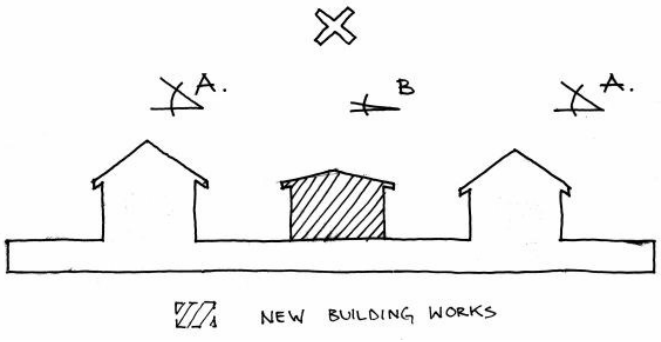


Figure SC6.2.3.2 Illustrates an example of unacceptable roof pitch

(3) Figure SC6.2.3.3a and Figure SC6.2.3.3b identifies some examples of compatible roof pitches found in various character residential precincts. These may be considered in addressing Character residential zone code requirements relating to roof pitch.

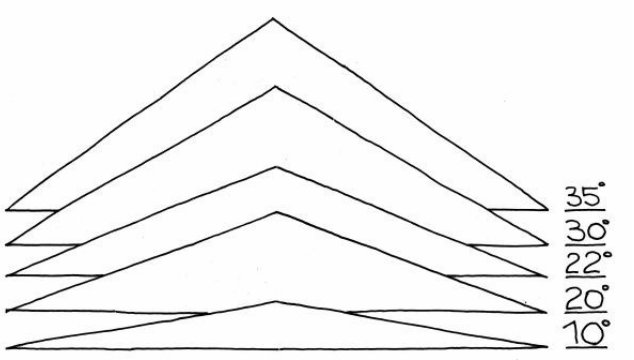
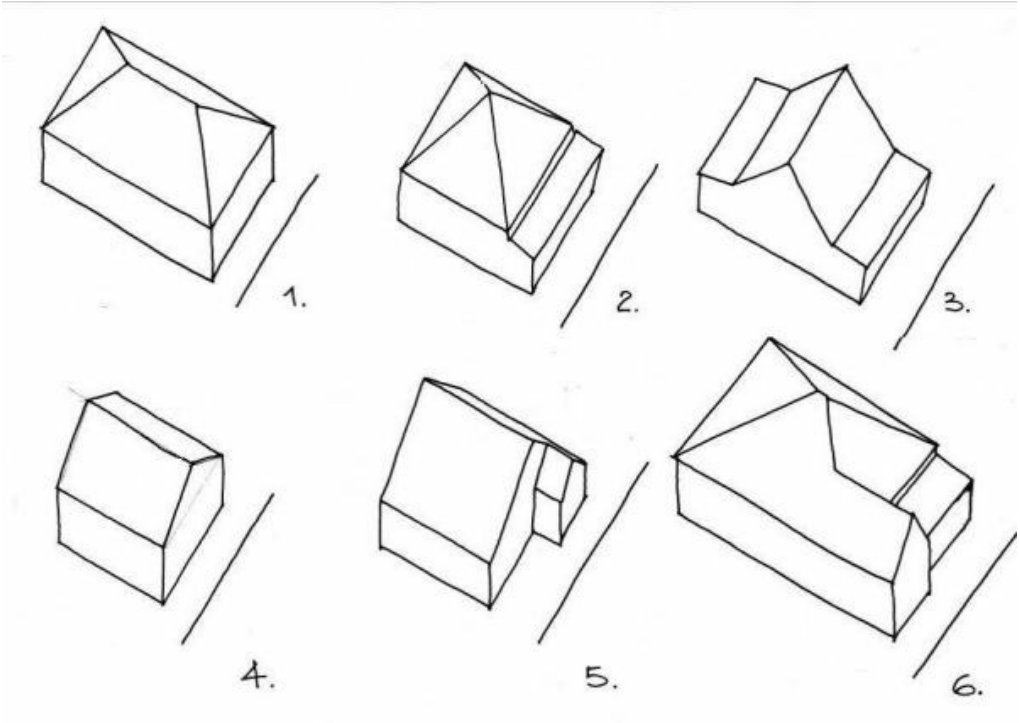


Figure SC6.2.3.3a Illustrates an example of common roof pitches in character residential precincts



Note—the resulting roof may be expressed as a combination of any number of roof forms:

(1) hip roof;

(2) pyramid roof with skillion/lean-to verandah;

(3) side gable roof with skillion/lean-to verandahs;

(4) front gable roof;

(5) double gable roof (sometimes expressed as triple gable roof); and

(6) combination of gable and hip roofs, with skillion/lean-to verandah.

Figure SC6.2.3.3b Illustrates an example of common roof forms in character residential precincts

(4) Figure SC6.2.3.4 provides guidance on the identification of roof eave depth. This figure may assist in the determination of eave depth in particular, in relation to PO19, PO22, PO57, PO64, PO75 and PO81 of the Character residential zone code.

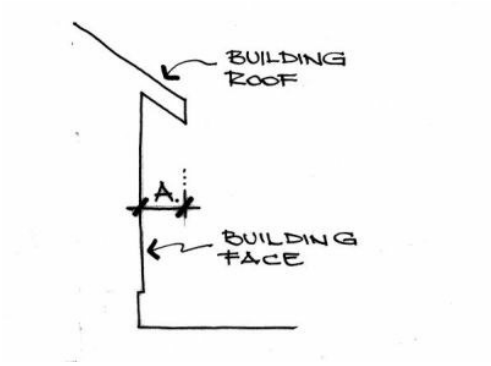


Figure SC6.2.3.4 Illustration of the roof eave depth which is shown by measurement "A"

SC6.2.3.2 Verandahs and front facades

A front verandah or an articulated front façade is commonly observed as a fundamental element of character within some precincts. This section of the policy provides examples of variation in verandah design, including scale (width, depth) enclosure, setback and height above ground level (see Figure SC6.2.3.5 for illustration of terms).

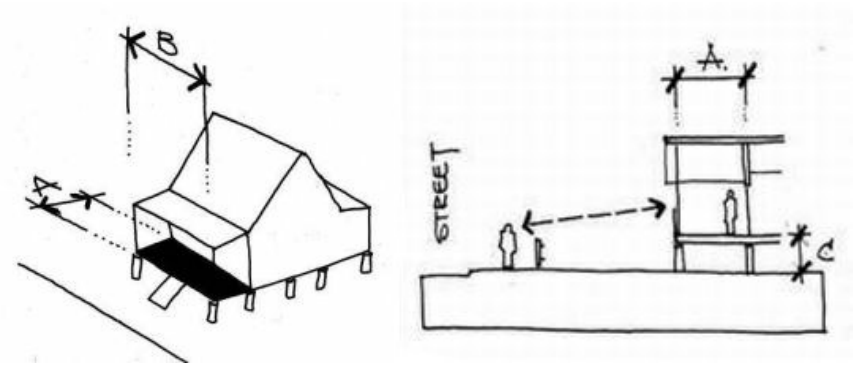


Figure SC6.2.3.5 - Demonstrating the width (B), depth (A), enclosure, setback, and height above ground level (C) of a front verandah

(1) Figure SC6.2.3.6 below illustrates 100% of the front façade width containing a verandah (left), and also an example of a property with a front façade including a verandah for a minimum 60% width of the front façade, wrapping down one side, and includes an asymmetrical projecting front gable (right). Both are open verandahs and are elevated above the natural ground level.

Figure SC6.2.3.6 Illustrates examples of a front verandah

(2) Figures SC6.2.3.7- SC6.2.3.9 illustrate examples of variation in verandah design including open, enclosed, and semi-enclosed and their supporting character elements.

Figure SC6.2.3.7 Illustrates an example of a front verandah, semi enclosed with screening and a door

Figure SC6.2.3.8 Illustrates an example of an open front verandah Workers Cottage style

Figure SC6.2.3.9 Illustrates an example of an open front verandah, Grand Queenslander style

(3) Figure SC6.2.3.10 and SC6.2.3.11 shown below, may be considered as a compatible outcome in relation to PO48, and PO71 and PO 78 of the Character residential zone code. The figures illustrate an example of projecting built forms that may be incorporated into building design in character precincts that do not include a verandah.

Figure SC6.2.3.10 Illustrates an example of a front façade with projecting gable features

Figure SC6.2.3.11 Illustrates an example of a front façade with single asymmetrical projecting gable

SC6.2.3.3 Windows

(1) Figure SC6.2.3.12 shown below, illustrates examples of sympathetic window scale and proportion. These examples provide guidance for addressing outcomes PO20, PO23, PO29 PO34, PO46,PO52, PO58, PO65, PO76 and PO82 of the Character residential zone code.

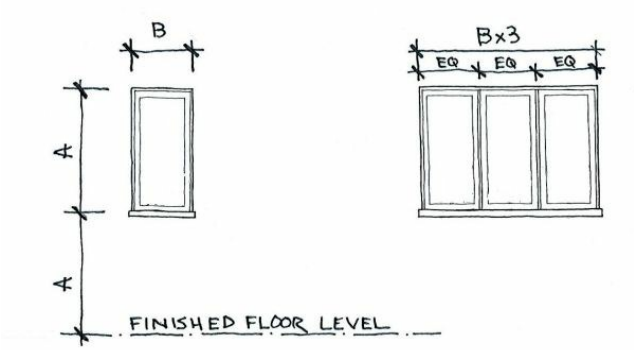


Figure SC6.2.3.12 Illustrates an example of half-height, vertically proportioned windows with one frame (left) and a set of three frames (right)

(2) Figure SC6.2.3.13 shown below, illustrates examples of window hoods in relation to the predominant character of the precinct. This information may be considered in addressing outcomes PO29 and PO34 Character residential zone code requirements regarding sympathetic window scale and proportion.

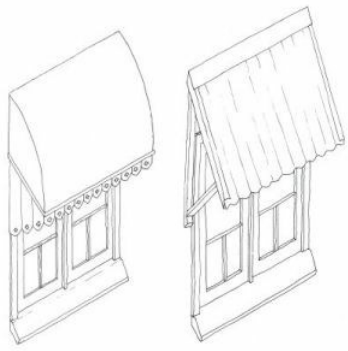


Figure SC6.2.3.13 Illustrates an example of traditional window with hood (left), and an acceptable new window with hood reflecting the same scale and proportions (right)

(3) Figure SC6.2.3.14 - SC6.2.3.17 shown below, illustrates examples of typical windows in character precincts. This information may be considered in addressing outcomes PO20, PO23, PO29 PO34, PO46, PO52, PO58, PO65, PO76 and PO82 of the Character residential zone code.

(a) casement windows and louvers;

Figure SC6.2.3.14 Illustrates an example of two vertically proportioned casements and louvers either side, centrally located under the apex of a gable projection

Figure SC6.2.3.15 Illustrates an example of five vertically proportioned casements located under the apex of a gable projection

(b) bay windows; and

Figure SC6.2.3.16 Illustrates an example of projecting bay window with four casement frames two located centrally and one either side

(c) full height windows.

Figure SC6.2.3.17 Illustrates an example of a full height window, acceptable in 1960's Defence Housing Precinct only

SC6.2.3.4 Building materials

Lightweight construction materials are typical within Townsville's character residential precincts. Lightweight construction materials are traditionally "timber and tin" products. New works within a character residential precinct can replicate lightweight construction using other materials, provided the appearance of lightweight construction is achieved. This section provides guidance on how to achieve PO15 of the Character residential zone code.

(1) Buildings and new works can use materials that are lightweight in appearance and sympathetic with the character of the streetscape. Where traditional lightweight materials are not able to used, non–lightweight materials are acceptable, provided the materials and methods used reflect the appearance of lightweight construction.

An example of an acceptable construction (Figure SC6.2.3.18, left) shows non-lightweight materials that reflect lightweight construction by referencing a raised appearance using textured cladding. An example of an unacceptable construction (right) shows a rendered wall that does not reference a lightweight appearance.

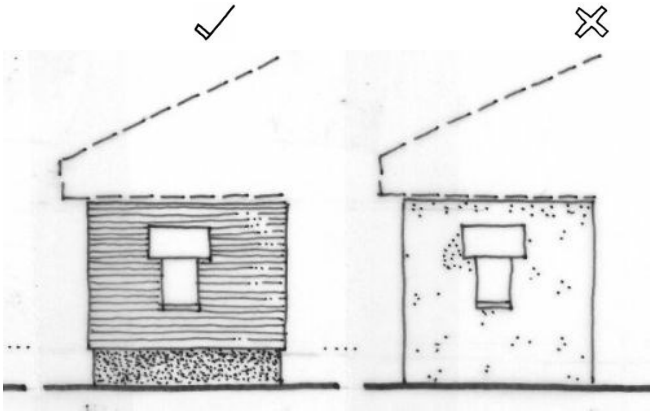


Figure SC6.2.3.18 An example of an acceptable construction (left), and an unacceptable construction (right)

(2) The design materials and principles below provide acceptable examples which can be considered for achieving PO15 of the Character residential zone code.

(a) Typical use of expressive materials in the Character residential zone precincts includes:

(i) chamferboard: A common exterior timber cladding. Several profiles of chamferboard exist, produced in several timber types, such as silky oak, cedar and hardwoods (as shown in Figure SC6.2.3.19);

Figure SC6.2.3.19 Illustrates traditional use of timber chamferboard on external walls

(ii) expressed studwork: Typical of traditional timber framed homes. A practice of fixing the weatherboards to the inner surface of the stud frame and leaving the outer surface uncovered. Evolved to be both functional and decorative (as shown in Figure SC6.2.3.20);

Figure SC6.2.3.20 Illustrates traditional use of expressed studwork walls

(iii) manufactured cladding: Exterior building veneer material. Can be used as an overlay to an existing exterior; some cladding products are known as siding. Manufactured cladding can be used to mimic traditional materials such as chamferboard (as shown in SC6.2.3.21);

Figure SC6.2.3.21 Illustrates new works using manufactured cladding in imitation of traditional lightweight materials

(iv) corrugated galvanised iron: A common roofing material in Australia (as shown in Figure SC6.2.3.22); and

Figure SC6.2.3.22 Corrugated galvanised iron is typical for roofing in Townsville Character buildings

(v) masonry is acceptable for use with external walls where it is finished in the appearance of lightweight construction, and/or used in conjunction with lightweight cladding materials (as shown in Figure SC6.2.3.23).

Figure SC6.2.3.23 Illustrates desirable outcome of a masonry constructed home with a "lightweight appearance"

SC6.2.3.5 Maintaining the street rhythm (scale and proportion)

Maintaining the street rhythm within a character residential precinct is paramount to preserving the character of any particular precinct. Street rhythm can be maintained by repeating the scale and proportions of the character buildings that are predominant in the streetscape. This can be achieved in terms of building heights, setbacks from the street, width of the front facades, and elevation of the floor levels.

Figure SC6.2.3.24 Illustrates an example of an acceptable ground floor enclosure

Figure SC6.2.3.24 illustrates an acceptable example; a raised character building that has been enclosed on the ground level, recessed the full width of the front verandah, using complementary materials and includes a valance in appropriate scale and proportion (this may be considered in addressing numerous Character residential zone code outcomes).

SC6.2.4 Non-residential contributing character buildings

SC6.2.4.1 Non-residential uses

This section of the policy provides guidance in relation to addressing outcome PO35 of the Character residential zone code. In particular, for those properties listed in Appendix 2 - Contributing non-residential properties.

In the South Townsville precinct, non-residential uses and buildings are a contributing element to the precinct's defined character. These non-residential buildings and uses reflect the early settlement and lifestyle of South Townsville.

(1) Typical elements of non-residential contributing character buildings in the South Townsville precinct include:

(a) no setback to street boundaries, and provide an awning and footpath for the full extent of the primary street frontage (as shown in Figure SC6.2.4.1 and Figure SC6.2.4.2); and

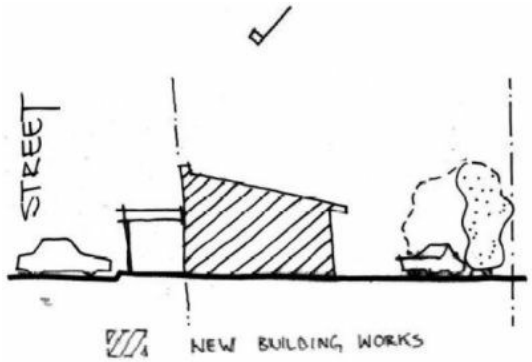


Figure SC6.2.4.1 Non-residential building with no setback to street boundary, awning over the footpath and parking on the street or behind the building

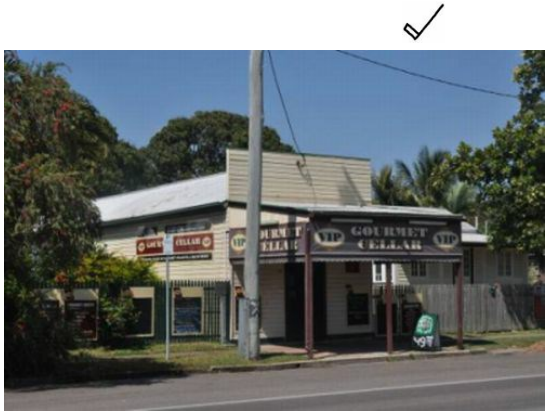


Figure SC6.2.4.2 Existing acceptable example of a non-residential use in an acceptable non-residential building (no setback to street boundary and awning over footpath)

(b) utilise on-street car parking, and/or on-site parking is behind the building and obscured by landscaping screen.

Note—where an existing non-residential non-contributing character building is not retained, the site may be converted to a residential use to match the scale and rhythm of adjacent contributing character residential buildings.

SC6.2.5 Reconfiguring a lot

The following design principle is provided as material for consideration when addressing PO11 of the Character residential zone code.

(1) To maintain the rhythm and consistency of the streetscape, the installation of a fence that is tapered in height from the street front to the front façade of the building may be considered (Figure SC6.2.5.1 illustrates an acceptable outcome).

Figure SC6.2.5.1 Illustrates access strip fencing tapered from the front façade of the building to the street boundary (measurements are provided only as an example)

SC6.2.6 Information that may support a development proposal

SC6.2.6.1 Elevations and streetscape

Development proposals should provide clear representations of the relationship between adjacent contributing character buildings and the proposed works to ensure that the design of development is undertaken with a clear understanding of the surrounding context.

Development applications should provide front/street elevations of the proposed works and of each adjoining contributing character building. References of key elements from adjoining contributing character buildings (roof type/pitch, floor elevations, windows, building materials, building height, setbacks, scale and proportions) should be made in all new works.

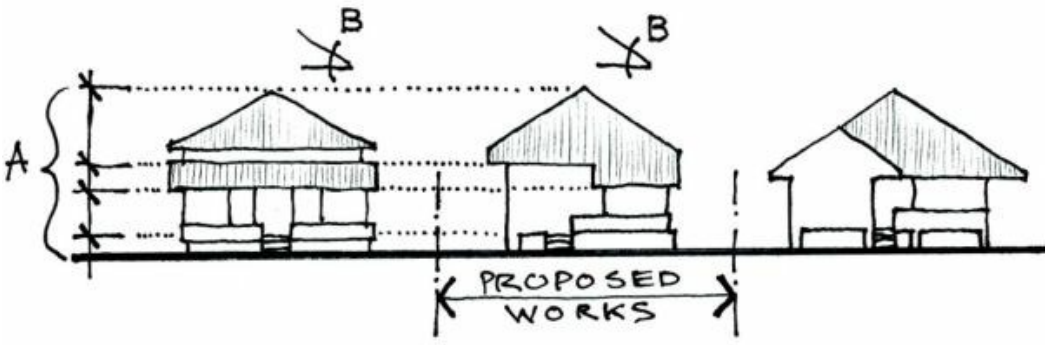


Figure SC6.2.6.1 Illustrates an example of clear elevations of the proposed works and adjoining contributing character buildings, with references made to key elements

SC6.2.6.2 Preparing an assessment report

The following is advice for preparing an assessment report for a property or building within the Character residential zone code. This may be required to demonstrate achievement with the relevant performance outcomes in the Character residential zone code.

An assessment report may provide specific information about how a proposed development will affect the character residential precinct.

The report should include the following:

(1) A brief description of the proposed development including:

- (a) type of development;
- (b) range and scope of work proposed;
- (c) timeframe for carrying out work; and
- (d) location of work in relation to the character residential precinct;

(2) A description of the setting and context of the place, including photographs and maps showing significant features that will be affected. Provide an analysis of the affect the development will have on the streetscape;

(3) A description of proposed changes to character including:

(a) what elements or aspects of streetscape are affected by the change;

(b) assessment of the proposal against the performance outcomes in the zone code;

(c) analysis of the impact of the change on the significance of the precinct;

(d) assessment of potential for detrimental impact on the significance of the precinct; and

(e) where the proposed change is assessed as having potential for detrimental impact, provide information about why the change is required, alternative solutions that were investigated, and what measures are included in the development to reduce detrimental impact that may result from the change; and

(4) References list documents referred to in the assessment report such as conservation policies, conservation management plan, condition report (i.e. demolition report), and specialist consultants' reports. (Adapted from Guideline: *Preparing a Heritage Impact Statement* Department of Environment and Heritage Protection, 2011).

SC6.2.6.3 Preparing a condition report

If an application is proposing demolition of a contributing character building, the applicant may be requested to provide a condition report. The condition report should, at a minimum, include consideration of:

(a) the structural stability of the building in the form of a structural engineer's report. The condition report must include a factual statement from an appropriately qualified structural engineer about the condition of the building; and

(b) a pest inspection report and other supporting documentation may also be provided.

Appendix 1

SC6.2 APPENDIX 1: Non-contributing properties in the Character residential zone

Precinct A – 1950's Post War Expansion

Address	Comments
79 Lancaster Street	Original house that has been re-clad with face brick, including brickwork fence. Original roof form and windows have been retained, however brickwork is out of character
18 Lockheed Street	Contemporary rendered blockwork slab on ground house with double garage facing the street and rendered masonry front fence.
62 Perroux Street	High-set house
10 McHardie Street	Blockwork house
14 McHardie Street	Blockwork house
29 Downs Street	Blockwork house

Precinct B – 1960s Defence Housing and 1960s Housing Commission

Address	Comments
55 Clements Crescent	Substantial tornado damage
2 Lancaster Street	Low-set house
3 Lancaster Street	"Ranch Style" high set house – different style to predominant character
4 Lancaster Street	Low-set house
46 Douglas Street	Oriented to other street – does not relate to rest of precinct

Precinct C – Worker's Cottages

Address	Comments
4 Fifth Street	Vacant Lot
6 Fifth Street	Vacant Lot
3 Fifth Street	High-set horizontally massed house with shallow pitched roof
2 Flowers Street	High-set horizontally massed house
16 Flowers Street	Low-set Blockwork house
26 Flowers Street	Horizontally massed with prominent carport
77 Ninth Avenue	High-set horizontally massed house
1A Doorey Street	Low-set rendered house with prominent carport to front boundary
66 Tenth Avenue	Low-set blockwork duplex
60 Eleventh Avenue	High-set horizontally massed house
63 Eleventh Avenue	High-set horizontally massed house
73 Eleventh Avenue	High-set fibre cement clad house
75 Eleventh Avenue	High-set horizontally massed duplex
12 Fourteenth Avenue	Low-set blockwork house
14 Fourteenth Avenue	Low-set blockwork house
13 Fifteenth Avenue	High-set horizontally massed house
40 Seventh Street	Low-set fibre-cement house with skillion roof
7 Third Street	Low-set blockwork house
9 Third Street	High-set horizontally massed house with shallow pitched roof
14 Third Street	Low-set blockwork house (obscured by garden)
19 Third Street	High-set horizontally massed duplex
31 Flowers Street	Low-set blockwork house
258 Boundary Street	Blockwork Duplex
288 Boundary Street	Horizontally massed high-set house
1 Cape Street	Blockwork House
2 Cape Street	Horizontally massed high-set house
2 Comet Street	Low-set fibre cement house with shallow roof pitch
6 Fourth Avenue	Low-set house with shallow roof pitch
30A Sixth Avenue	Horizontally massed house with blockwork arches
37 Sixth Avenue	Vacant Lot
26 Sixth Street East	Horizontally massed high-set house
52A Sixth Street East	Vacant Lot
53 Sixth Street East	Vacant Lot
55 Sixth Street East	Water Police Office
57 Sixth Street East	Vacant Lot
56-58 Sixth Street East	Vacant Lot
19 Eighth Avenue	Horizontally massed two storey house
26 Perkins Street	Low-set blockwork house
37 Davidson Street	Low-set block house with large setback
40 Davidson Street	Low-set coloured blockwork house
42 Davidson Street	Rendered low-set house with tiled roof and garage door on street
15 Baxter Street	Original character house – raised to two storeys and poorly enclosed front verandah.
21 Baxter Street	Low-set brick block of units
22 Baxter Street	Rendered low-set house with visually prominent garage
7A Garrick Street	High-set fibre cement house with shallow pitched front gable
12 Garrick Street	Low-set brick house
16 Garrick Street	Low-set blockwork house
9-11 Castling Street	High-set “Ranch” style fibro house with shallow pitched roof
8 Castling Street	Blockwork lowest house
15 Estate Street	Modern, unsympathetic new dwelling, inconsistent setback, subdivision not consistent with other blocks

15A Estate Street	Modern, unsympathetic new dwelling, inconsistent setback, subdivision not consistent with other blocks
17 Estate Street	Low-set house with shallow front gable
18 Estate Street	Horizontally massed house
26 Estate Street	High-set 1950s era house
28 Estate Street	Low-set masonry – only visible expression is front double carport
3 Townsville Street	High-set fibre cement clad with shallow pitched front gable
4 Townsville Street	High-set horizontally massed house
5 Townsville Street	Unsympathetically raised house
7 Townsville Street	Character house with blank blockwork wall in front
15A Townsville Street	Rendered low-set house with prominent front carport
27 Townsville Street	Vacant lot
2 Edwards Street	Low-set rendered house with very shallow roof pitch
7 Edwards Street	Recent house with disproportionate front setback and prominent front carport
7A Edwards Street	Recent house with disproportionate front setback and prominent front carport
17 Edwards Street	Gable fronted two storey units
18 Edwards Street	Low-set house with brick walls and single front gable
6 Lamington Road	Brick “six pack” unit block
12-14 Lamington Road	Blockwork units, tiled roof
13 Lamington Road	Blockwork units
6 Humphrey Street	Two storey brickwork units
14 Humphrey Street	Low-set blockwork units
15 Humphrey Street	Low-set blockwork house
25 Humphrey Street	Unsympathetically raised and renovated character house
5 Plant Street	Two storey blockwork “six-pack” units
6 Shaw Street	Oversized modern highest house with gable – out of scale
22 Shaw Street	High-set “Ranch” style
25 Shaw Street	Low-set blockwork duplex
9 Shaw Street	Blockwork units

Precinct D – South Townsville (Residential)

Address	**Comments**
66 Allen Street	Rendered two storey house with prominent carparking
75 Allen Street	Low-set blockwork house
30 Allen Street	Low-set rendered house
10 Bell Street	Low-set fibre cement house
15 Bell Street	Horizontally massed high-set house
17 Bell Street	Brick and tile house
21 Bell Street	St Andrews Villas – Brick low-set
37A Bell Street	Rendered duplex
37B Bell Street	Rendered duplex
183 Boundary Street	Horizontally massed high-set house
283-285 Boundary Street	Low-set blockwork house
1 Cannan Street	Contemporary house under construction
17 Hubert Street	Character house raised on disproportionately high stumps
41 Macrossan Street	Horizontally massed high-set house
55 Macrossan Street	Two storey blockwork house
5 Martin Street	Low-set duplex with very prominent garages
10 Martin Street	Low-set rendered duplex
7 Nelson Street	Brick and tile house
13 Nelson Street	Wide low-set rendered house
18 Nelson Street	Brick duplex with blank gable end facade
21 Nelson Street	Vacant lot
22 Nelson Street	Low-set blockwork house

43-45 Nelson Street	Brickwork units
46 Nelson Street	Contemporary skillion roofed house – lacks front verandah
50 Nelson Street	Brick and tile house
52 Nelson Street	Brick and tile house
54 Nelson Street	Low-set blockwork house
71 Perkins Street	Low-set rendered house
85 Perkins Street	Vacant lot
115 Perkins Street	Unsympathetically converted commercial building
8 Tully Street	Blockwork duplex
42 Tully Street	Two storey brickwork house
44 Tully Street	Mock heritage low-set house
73 Tully Street	Rendered two storey house – lacks shade elements
81 Tully Street	Two storey blockwork house
91 Tully Street	Low-set blockwork house
97 Tully Street	Low-set rendered house
105 Tully Street	Multiple units

Precinct D – South Townsville (Non-Residential)

Address	**Comments**
50 Allen Street	Rendered recent commercial building – built to front boundary, however lacks street activation and awnings to footpath
12-20 Bell Street	Large contemporary warehouse building – Sigma Pharmaceuticals
20A Bell Street	Shades By Prior – rendered recent commercial building built to boundaries, however lacks substantial awnings to footpath
22 Bell Street	Map to Mine – commercial offices with large front setback
8 Cannan Street	Sabre Marine – large light industrial shed with large setback to the street and front hardstand area
10 Cannan Street	Basic commercial building with large front setback and extensive front carparking area
12 Cannan Street	Basic commercial building with large front setback and extensive front carparking area
6 Hubert Street	NSS (Northern Stevedoring Services) Shed with large hardstand area to street
3-7 Macrossan Street	South Townsville Self-Storage – secure self-storage complex
11 Macrossan Street	Portside Self-Storage – secure self-storage complex
13-17 Macrossan Street	U-Store – secure self-storage complex
36 Macrossan Street	Home-grown Hardwoods – large setback to the street and prominent front hardstand and storage area
38 Macrossan Street	SSAF Sheetmetal – Light industrial shed built to front and side boundaries however lacks street activation or awnings to footpath. May be suitable for retrofitting or refurbishment to improve character values.
45 Macrossan Street	Black River Cattle Equipment – light industrial use and rear shed destroys character values of retained house.
47 Macrossan Street	Abraham Steel Fabrications – large light industrial shed.
53 Macrossan Street	C&C Motors Shed – light industrial shed
46 Morey Street	Furniture warehouse with relatively blank blockwork façade to street and lack of shade to footpath. Appears suitable for retrofitting or refurbishment to improve character values.
19 Perkins Street	Light Industrial shed setback from street with hardstand area to front
41 Perkins Street	Murphy Steel Fabrications – Open light industrial shed with general storage in fenced yard.
75 Perkins Street	Dick Yuen Wholesale – Large front setback and extensive front hardstand area
99 Perkins Street	Kirk's Automotive Service – Shed to street frontage – interrupts an otherwise consistent row of character houses. Shed to rear of site may have some character value however is not readily visible from the street.

113 Perkins Street	Hood the Sailmakers Offices – blockwork commercial building. Built to front and side boundaries however lacks street activation and awnings to footpath. Appears suitable for retrofitting or refurbishment to improve character values.
3 Tully Street	U-store – secure self-storage complex
17 Tully Street	Shed with large front setback
50 Tully Street	Commercial complex with relatively blank blockwork façade to street and prominent driveway.
58 Tully Street	Warehouse complex. Built to front and side boundaries, however blank blockwork façade and lack of shade to footpath. Appears suitable for retrofitting/refurbishment.
80 Tully Street	Woodfield Engineering – basic light industrial shed
102 Tully Street	Fenced site – otherwise vacant

Precinct E – Queenslanders

Address	**Comments**
12 The Avenue	3 storey blockwork “Six-pack” units
16 The Avenue	2 storey brick units
7 Ackers Street	Three storey blockwork units
16 Ackers Street	Brickwork units
24 Ackers Street	Blockwork units
26 Ackers Street	Blockwork units
29-31 Ackers Street	Blockwork units
32 Ackers Street	Blockwork units
39 Ackers Street	Brick and tile house
42 Ackers Street	Low-set duplex
57 Ackers Street	Blockwork units
64 Ackers Street	Low-set blockwork duplex
66 Ackers Street	Horizontally massed high-set house
68 Ackers Street	Horizontally massed high-set house
69 Ackers Street	Low-set fibre cement units
2 Ahearne Street	Vacant lot
19 Ahearne Street	Brickwork base, horizontally massed highset house
25 Ahearne Street	Horizontally massed high-set house
27 Ahearne Street	Horizontally massed high-set house
35 Ahearne Street	Blockwork units
36 Ahearne Street	Horizontally massed high-set house
38 Ahearne Street	modern duplex
47 Ahearne Street	Blockwork units
51 Ahearne Street	Two storey contemporary units – some sympathetic elements however overall bulk and prominent garages are detrimental.
52 Ahearne Street	Vacant lot
54 Ahearne Street	Blockwork Units
70 Ahearne Street	Brickwork house
7 Armstrong Street	Blockwork low-set units
16 Armstrong Street	Horizontally massed high-set house
18 Armstrong Street	Three storey blockwork units
27 Armstrong Street	Low-set brick units
28 Armstrong Street	Horizontally massed high-set house
30 Armstrong Street	Low-set brick units
39 Armstrong Street	Two storey brick units
41 Armstrong Street	Fibre cement building with shallow roof pitch – used as offices
44 Armstrong Street	Two storey blockwork with arches
50 Armstrong Street	Blockwork low-set house
54 Armstrong Street	Brickwork units

56-58 Armstrong Street	Blockwork units
64 Armstrong Street	Vacant lot
78 Armstrong Street	Low-set rendered house
36-38 Ackers Street	Two storey brick units
4 Campbell Street	Blockwork units
6 Campbell Street	Blockwork units
2 Marks Street	Horizontally massed high-set house
16 Marks Street	Two storey blockwork units
18 Marks Street	Two storey rendered units
13 Philp Street	Rendered low-set units
16 Philp Street	Blockwork low-set units
19 Philp Street	Two storey brick house
21 Philp Street	Low-set rendered house
27 Philp street	Brick two storey units
37 Philp Street	Vacant Lot, not gazetted address, part of 35 Philip but fenced off
42 Philp Street	Rendered two storey units
9 Campbell Street	Masonry rendered 2 storey house (actually rear of lot at 42 Philip St, but driveway is to Campbell & post-box has number 9 on it.
14 Summerfield Street	Vacant lot
2A Ralston Street	Low-set blockwork units
2 Ralston Street	Low-set blockwork units
16 Ralston Street	Two storey blockwork units
18 Ralston Street	Vacant lot
45 Henry Street	Two storey blockwork units
125-127 Francis Street	Church, modern brickwork
129 Francis Street	Masonry units
146 Francis Street	Low-set blockwork house with very shallow roof pitch
154 Francis Street	Low-set house with stipple render finish
36 Leigh Street	Two storey units – face brickwork with fibre cement chamfer boards
56 Leigh Street	Light industrial building
25 Stagpole Street	Prominent three storey blockwork units
30 Stagpole Street	Horizontally massed high-set house
32 Stagpole Street	Blockwork low-set house with shallow roof pitch
33A Stagpole Street	Newly reconfigured house
40 Stagpole Street	Low-set rendered units (“6 pack”)
43A Stagpole Street	Newly reconfigured house
49 Stagpole Street	Open light industrial shed
52 Stagpole Street	Low-set shallow pitched hipped roof house with high fence and low floor height
82 Stagpole Street	Horizontally massed high-set house
83 Stagpole Street	Shallow pitched skillion roofed fibre cement clad house
86 Stagpole Street	Low-set blockwork units
93 Stagpole Street	Horizontally massed 1960’s era high-set house. Front setback blocks views to “Wolverton”.

Precinct F – Interwar Gables and Queensland Bungalows

Address	**Comments**
14 Chubb Street	Rendered front parapet (addition) and tall rendered fence
16 Chubb Street	Rendered
15 Taylor Street	Horizontally massed high-set house
16 Taylor Street	Vacant lot
20 Taylor Street	Horizontally massed high-set house
12 McKillop Street	Brick house with prominent front carport
3 Mawai Street	Low-set blockwork house with high fence
8 Mawai Street	Horizontally massed high-set house

4 Mears Street	Horizontally massed high-set house
6 Mears Street	Horizontally massed high-set house
11 Mears Street	Horizontally massed high-set house
22 Mears Street	Brick and tile units
24 Mears Street	Street frontage dominated by double carport with roller doors
34 Mears Street	Two storey block of units with shallow pitched roof
30 Hammond Street	Horizontally massed high-set duplex

Precinct G – Interwar to 1950s Asymmetrical Gable

Address	Comments
34 Hooper Street	Low-set blockwork duplex
35 Hooper Street	Low-set skillion roofed house with prominent front carport
26 Hooper Street	Vacant lot
53 Princes Road	Units
14 Princes Road	Two storey units
29 Princes Road	Units
30 Princes Road	Units
16 Sussex Street	Blockwork low-set house
3 Batt Street	Modern rendered with skillion roof
9 Batt Street	Slab on ground, flagstone veneer
3 Purves Street	Slab on ground, rendered modern
21 Kenilworth Street	Low pitch mono gable horizontally massed
22 Kenilworth Street	Low-set render low pitched roof
23 Kenilworth Street	Brick veneer, two storey
24 Kenilworth Street	Not representative of character, but good tropical house
12 Kenilworth Avenue	Two storey unit development
6 Surrey Street	High-set fibre cement clad house
14 Surrey Street	Brick low-set house
16 Surrey Street	Brick low-set house
20 Surrey Street	Brick House
19A Surrey Street	High-set fibre cement clad house
21A Surrey Street	“Six pack” unit block
31 Townsend Street	Rendered blockwork house with prominent front garage
5 Burton Street	Low-set blockwork duplex
34 Townsend Street	Skillion roofed low-set house with rendered walls. Possible 1950s era
7 Burton Street	Low-set brickwork duplex
12 Burton Street	Low-set blockwork house
25 Burton Street	Low-set blockwork duplex
26 Burton Street	Horizontally massed high-set house
5 Ballard Street	Horizontally massed high-set house
11 Ballard Street	Horizontally massed high-set house
13 Ballard Street	Horizontally massed low-set house
15 Ballard Street	Rendered low-set house with shallow front gable
16 Ballard Street	Two storey, two car garage to front
40 Purves Street	Horizontally massed high-set house
51 Purves Street	Two storey unit building
55 Purves Street	Low-set blockwork house
57 Purves Street	Vacant lot
25 Mindham Street	Low-set rendered duplex

Precinct H – Churchill Street

Address	Comments
9 Churchill Street	High-set house with shallow pitched gable roof
11 Churchill Street	Low-set blockwork house with shallow pitched roof and lack of windows oriented towards street

Precinct I – Park Street

Address	Comments
22 Gladstone Street	Terrace Style Unit development. Width of building facing Park Street far exceeds character houses.
24 Gladstone Street	Pre 1946 house, however house faces Gladstone Street and does not contribute to Park Street Precinct streetscape.
20 Park Street	Unit Development. Incorporates some sympathetic features such as front verandah and fence.
21 Park Street	60's era High-set house with fake brick cladding
23 Park Street	Blockwork unit development with blank street frontage and no fence.

Precinct J – Grand Queenslanders

Address	Comment
17 Alexandra Street	3 storey brickwork units
26 Alexandra Street	Rendered house with shallow roof pitch and no front verandah
32 Alexandra Street	Low-set brick and tiled roof house
40 Alexandra Street	Two storey blockwork house
43 Alexandra Street	Two storey 1950s house with flush lower level and dominant rendered front retaining wall.
44 Alexandra Street	4 storey blockwork units
46 Alexandra Street	Rendered two storey units with tiled roof
1 Burke Street	4 storey blockwork units
2 Burke Street	Low-set masonry units
32 Paxton Street	Two storey rendered units with blank façade and prominent parking
21 Cleveland Terrace	Rendered Units – wide form/bulk, Mediterranean style
19 Cleveland Terrace	Brick unit building. Wide, horizontal massing.
11 Cleveland Terrace	Brick unit building. Setback from street does not align with neighbours
27 Cleveland Terrace	Building site – design appears to be modern house with materials that are not related to surrounding context.
34 Cleveland Terrace	Shallow gabled low-set house. Overly large front setback. Fibre cement wall cladding.
7-11 Hamilton Street	Very large site – Vacant apart from small 70s/80s era fibre cement clad dwelling.
3-5 Hamilton Street	Vacant
25 Melton Terrace	70's era fibre cement clad units. Dilapidated.
7 Victoria Street	Two storey rendered house with shallow roof pitch and prominent double garage
18-20 Victoria Street	Blockwork and tile duplex
15-19 Victoria Street	Ridgemont Motel – Blockwork and tiled roof
26-28 Victoria Street	Skillion roofed house
273 Stanley Street	Skillion roofed cottage
277 Stanley Street	Derelict cottage
279 Stanley Street	Brick units
37 Hale Street	Two storey fibre cement clad unit building – lacks front verandah.
39 Hale Street	Modest low-set house with large street setback and no front verandah.

Precinct K – French Street

Address	Comments
18 French Street	Blockwork unit block with large setback
16 French Street	Blockwork House with tiled roof
20 French Street	Modern unsympathetic units
27 French Street	Enclosed block work on ground floor and the removal of external front staircase
13 French Street	Low-set rendered masonry units

Precinct L – Mixed 1950's

Address	Comments
2 Goodwin Street	Blockwork low-set house
28 Goodwin Street	1960's era high-set house
56 Goodwin Street	Rendered contemporary low-set house
66 Goodwin Street	Horizontally massed high-set duplex
69 Goodwin Street	Blockwork low-set house
101 Goodwin Street	Blockwork low-set with tiled roof
3 McDougall Street	Horizontally massed high-set duplex
4 McDougall Street	Horizontally massed high-set duplex
27 Haig Street	3 storey unit development
3-5 Haig Street	Unit Development
2B Haig Street	Unsympathetic modern dwelling
6 Haig Street	Low-set house with prominent flat roofed extension facing Haig Street
10 Isley Street	Brick veneer, timber floor low-set house
12 Isley Street	Brick veneer on slab
146 Howitt Street	Three storey apartment complex
146 Mitchell Street	Two storey units

SC6.2 APPENDIX 2: Contributing non-residential properties

Address	Comments
38-42 Allen Street	Former Petrol Station – currently Motolec Auto Electrical. Current use of forecourt for fenced general storage is detrimental to precinct character; however, site contains former petrol station buildings that are part of the mixed precinct character. Site would benefit from refurbishment and new use with greater street activation.
39 Allen Street	Pre1941 commercial building built to front boundary with 2 shopfronts and awning over footpath.
34 Archer Street	Former basic light industrial shed – patina of weathered corrugated iron and surrounding gardens contributory.
25 Bell Street	Character house converted into two storey commercial building. No setback to front boundary and includes awning to footpath.
33 Bell Street	Pre 1941 commercial building built to front boundary. Character value reduced by added blockwork façade and lack of awning to footpath.
173 Boundary Street	Pre 1941 small chamferboard shop to street with awning. High chainlink fence to property boundary is detrimental to the character.
265 Boundary Street	Small row of shopfronts with awning to footpath. Parts appear to be pre1941. Unusual 1960's era two storey units on the same parcel of land – units appear to have potential for retrofitting/refurbishment.
32 Hubert Street	St Patrick's Catholic Church and former school building.
20 Macrossan Street	Commonwealth Hotel. Two storey corner hotel with wraparound verandahs over footpath. Very important contributor to local character.
30 Macrossan Street	St Johns Anglican Church
65 Morey Street	Bahai Community Centre
25 Perkins Street	Building materials site with pre 1941 twin gabled sheds built to Perkins Street Boundary. Current use of site for open storage is detrimental to precinct character however sheds have character value and appear suitable for retrofitting or refurbishment.
45 Perkins Street	South Side Engineering – light industrial gabled shed with some character values and appears suitable for retrofitting or refurbishment.
89 Perkins Street	Former 1950s era Art Deco influenced brick and tile house. Features curved walls and unusual plan. Currently used as offices for Family Emergency Accommodation Townsville – generally retains residential appearance.
115-147 Perkins Street	Heritage listed Warehouse building with brick components dating from 1899. Property is in relatively poor condition. Site is very large and mainly open hardstand – the heritage building occupies the Cannan Street end only. Sympathetic retrofitting or refurbishment will be required to retain the character values of this property.

SC6.3 Cultural heritage planning scheme policy

SC6.3.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Cultural heritage PSP.

SC6.3.1.1 Purpose

The purpose of the planning scheme policy is to provide applicants with additional information and guidance in meeting the requirements of the Cultural heritage overlay code and the Advertising devices code for signage in Flinders Street East.

SC6.3.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.3.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Cultural heritage overlay code and Advertising devices code.

SC6.3.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1.

SC6.3.2 Planning scheme policy details

The cultural heritage of Townsville continues to be a major contributor to the identity of the City and local communities. The Citation of Heritage Places Report provides information about each heritage place in Townsville. It highlights the criteria that were originally identified for each place and indicates its significant heritage features and eligibility for entry into Schedule 7 Places of cultural heritage value.

This planning scheme policy contains information to help individuals and groups identify, conserve and protect heritage places in Townsville. This policy provides applicants with guidance in meeting the requirements of the Cultural heritage overlay code and the Advertising devices code (where it relates to advertising devices for heritage places in Flinders Street East). The policy also details how to nominate to add a place to Schedule 7 Places of cultural heritage value and how to nominate to remove a place from Schedule 7 Places of cultural heritage value.

SC6.3.2.1 Finding your way around the policy

The policy is divided into the following nine sections:

(1) Information that may support a development proposal (SC6.3.3);

(2) Development adjoining a heritage place (SC6.3.4);

(3) Development within a heritage place, including advertising devices (SC6.3.5);

(4) Preparing a heritage impact statement report (SC6.3.6);

(5) Preparing a condition report (SC6.3.7);

(6) Preparing archival recording of a heritage place (SC6.3.8);

(7) Interpretive signage for the loss of a heritage place (SC6.3.8.3);

(8) Preparing an archaeological management plan (SC6.3.9); and

(9) Adding or removing a place to Schedule 7 Places of cultural heritage value (SC6.3.10).

SC6.3.3 Information that may support a development proposal

The information required for any development application will depend on the heritage significance of the heritage building, site or element and the proposed development. In addition to the requirements for development applications under the *Planning Act 2016* (PA) and the relevant Integrated Development Assessment System forms, the following additional information should generally be provided to council.

(1) To ensure that the design of the proposed development is undertaken with a clear understanding of the surrounding context and significance of "place", the proposed application should submit clear representations of the relationship between the heritage buildings and the proposed works.

(2) The applicant should submit a street elevation of the proposed development. The elevation is to be

(a) drawn to 1:200 scale;

(b) include the full width of the street frontage of the proposed development and the two adjacent neighbouring buildings (as shown in Figure SC6.3.3.1);

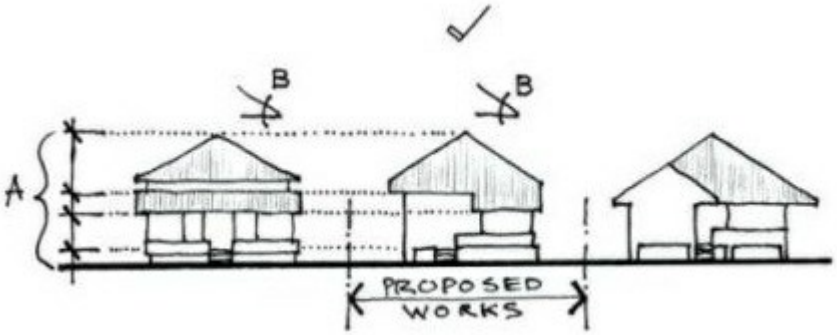


Figure SC6.3.3.1 Illustrates desirable outcome. 'A' denotes key building lines and 'B' is the referenced roof pitch. This may provide clear representations of relationship between the heritage place and the proposed works such as floor heights, dominant fascia lines, roof lines, roof pitch etc.

(c) provide accurate representations of the primary design considerations: setbacks, form, massing, height, materials, finishes, and key detail elements that contribute to the significance of the heritage place;

(d) for new buildings adjoining a heritage place, indicate key building lines in relation to the heritage place (as shown in Figure SC6.3.3.2); and

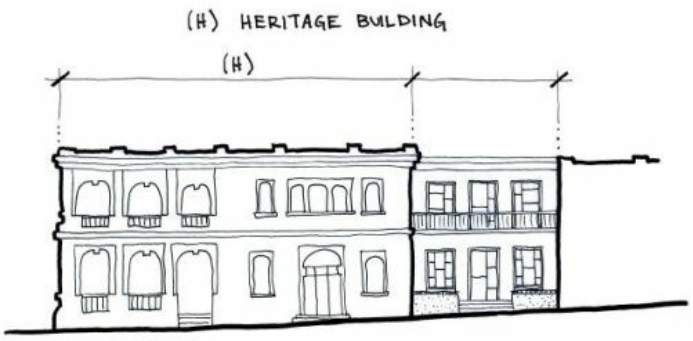


Figure SC6.3.3.2 Key building lines in relation to the heritage place

(e) for new works that are proposed to be visually obscured by a heritage feature, consider demonstrating view lines using a cross section drawing (as shown in Figure SC6.3.3.3).

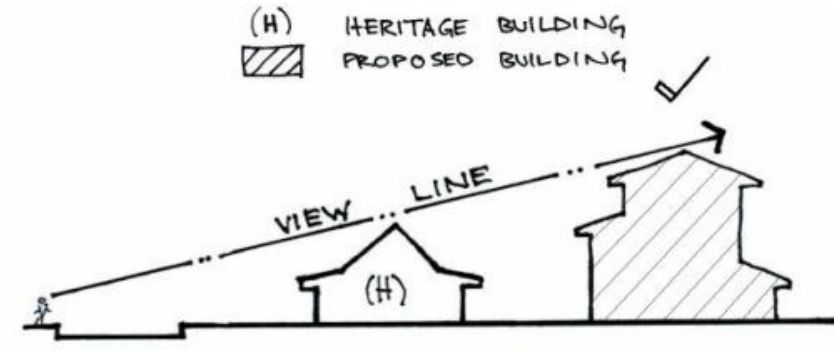


Figure SC6.3.3.3 View lines using a cross-section drawing

(3) In addition to the requirements above, for buildings with a height greater than 2 storeys, the applicant may be requested to submit:

(a) three dimensional perspective images inclusive of the adjacent neighbouring buildings; and

(b) in urban contexts in which the streetscape is of uniform height consistent with the height of the heritage place, provide an elevation drawing of the full width of the street block and nominate a "reference height".

SC6.3.4 Development adjoining a heritage place

This section of the policy provides guidance in achieving performance outcome PO13 of the Cultural heritage overlay code associated with setbacks for development, building height and scale and form of development adjoining a heritage place.

SC6.3.4.1 Setback for development

PO13 of the Cultural heritage overlay code requires that new buildings be consistent with the significant features and values of the heritage place, including, but not limited to, built form and setbacks, maintain significant views to and from the heritage place and ensure that new buildings are visually subservient.

(1) To achieve the requirements of the performance outcomes in the code and allow for significant views to and from a heritage place to be maintained, the following design guidance should be considered.

(a) in instances where the significance of the heritage place includes its setback in common with the established street pattern, the setback of new works ought to maintain this significance (as shown in Figure SC6.3.4.1);

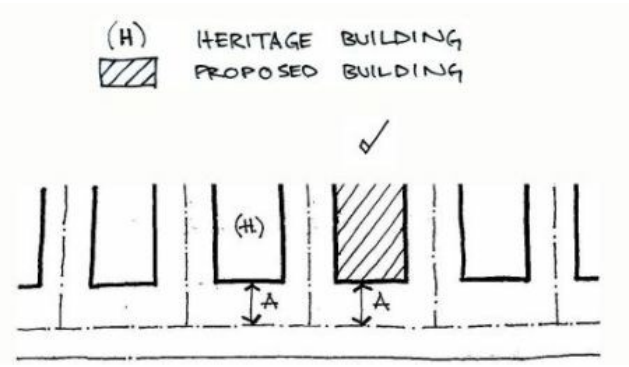


Figure SC6.3.4.1 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" is the street setback distance.

(b) in instances where the significance of the heritage place includes its difference in setback to the established street pattern, the setback of new works ought to maintain this significance (as shown in Figures SC6.3.4.2- SC6.3.4.6); and

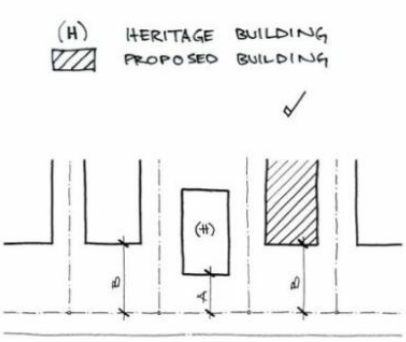


Figure SC6.3.4.2 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" and "B" is the street setback distance.

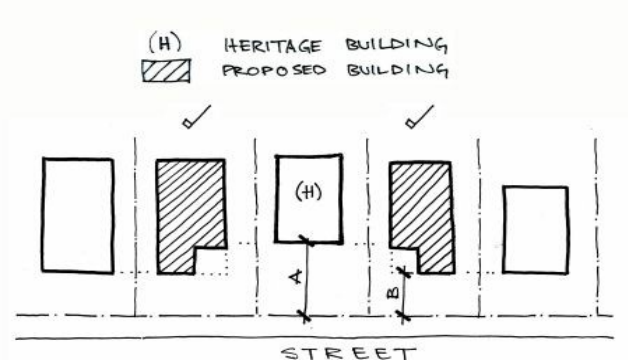


Figure SC6.3.4.3 Illustrates appropriate front setbacks for development adjoining a heritage place. "A" and "B" is the street setback distance

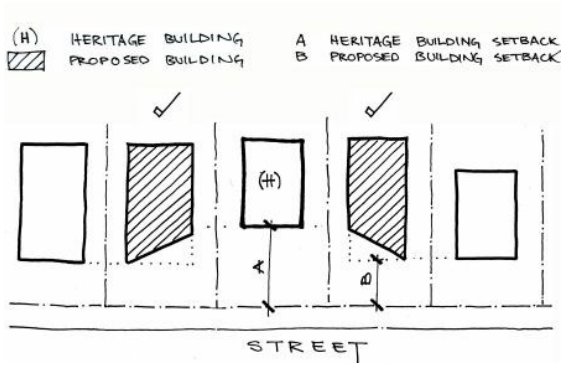


Figure SC6.3.4.4 Illustrates appropriate front setbacks for development adjoining a heritage place. 'A' and 'B' is the street setback distance

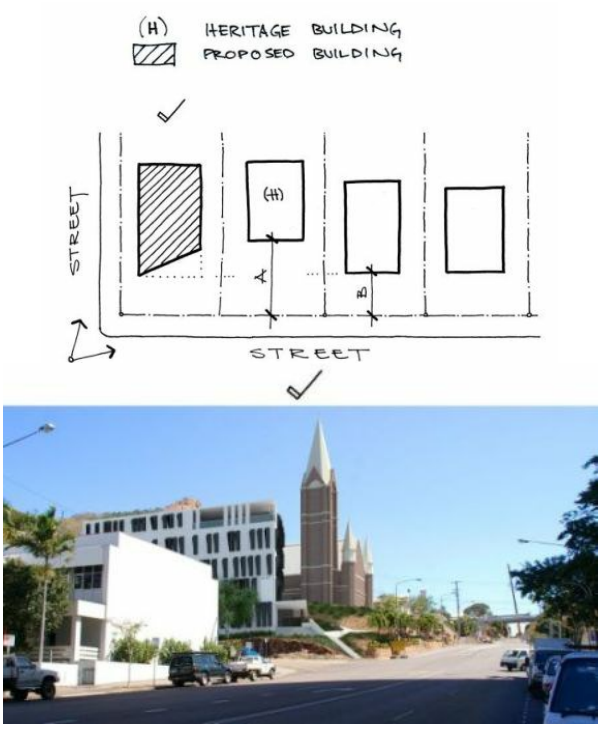


Figure SC6.3.4.5 Illustrates appropriate corner block front setback for development adjoining a heritage place. "A" and "B" is the street setback distance. The setback of new development is tapered to allow improved views to the heritage place.

(c) in order to achieve visual subservience to a heritage place in accordance with PO13, building form ought to be articulated into smaller elements to relate to scale, rhythm and spacing of the heritage place and its context (as shown in Figure SC6.3.4.6).

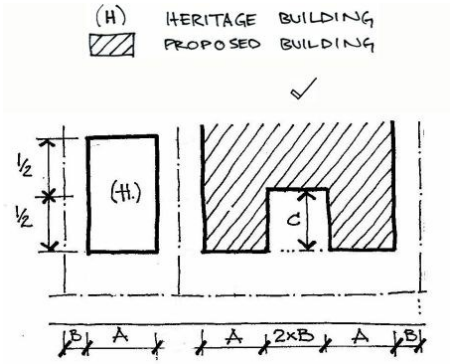


Figure SC6.3.4.6 Illustrates sympathetic building frontage rhythm. "B" is side setback; "C" (being the depth separation to get sympathetic building frontage rhythm) is 6m or ½ of "H" (heritage building depth)

SC6.3.4.2 Building height

(1) Where parts of the development are proposed to be taller than adjacent significant heritage elements, the following design guidance may be considered to demonstrate achievement of performance outcome PO13 of the Cultural heritage overlay code:

(a) proposed taller elements of the proposed new building are to be setback to diminish their impact (as shown in Figure SC6.3.4.7);

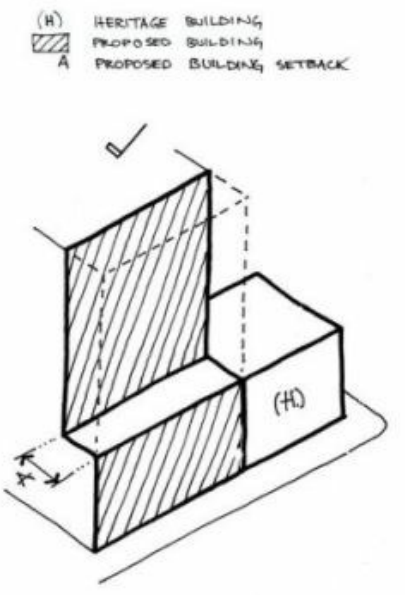


Figure SC6.3.4.7 Illustration of building setback of taller new building. "A" is equal or greater than 3m

(b) setback upper levels of the proposed new building to provide a transition between adjacent buildings of different scales (as shown in Figure SC6.3.4.8);

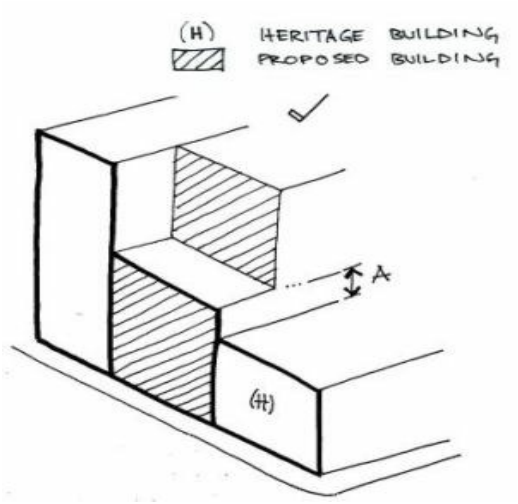


Figure SC6.3.4.8 Illustration of new building upper level setbacks. Dimension "A" is within 20% of the adjacent heritage building height

(c) provide an appropriate separation gap between the significant heritage elements and taller new elements (as shown in Figure SC6.3.4.9);

(d) building elements in the separation gap may be recessed and of lower height and/or different material than the heritage building, (as shown in Figure SC6.3.4.9); and

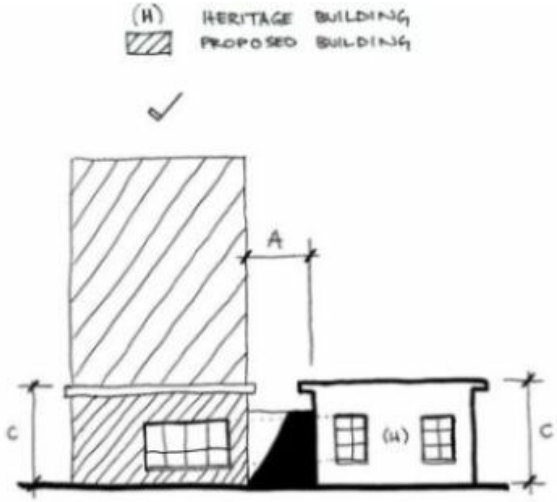


Figure SC6.3.4.9 Illustration of separation gap between contributing heritage elements and taller new buildings. "A" is Separation and "C" is the Common Reference Height

Figure SC6.3.4.10 An example of a desirable outcome – free standing tower provides a significant landscaped public piazza which acts as a separation adjacent to the heritage place

(e) new building works reflect a ‘reference height’ for the full width of the street frontage where the ‘reference height’ is consistent with the height of the adjacent heritage building (as shown in Figure SC6.3.4.11).

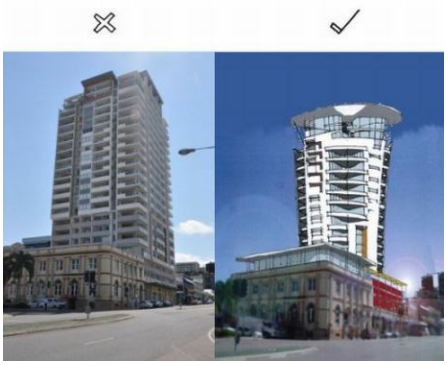


Figure SC6.3.4.11 An example of an undesirable outcome (left): tower element with no setbacks to the street boundary or adjacent heritage building which is detrimental to the otherwise uniform streetscape heights and the adjacent heritage building. An example of a desirable outcome (right): tower element setback from the street boundary and the adjacent heritage building to reduce the impact of its height and bulk. Podium element references the heights of the adjacent heritage building and streetscape.

SC6.3.4.3 Scale and form of development adjoining a heritage place

(1) The following design examples are associated with building scale and form and may be considered to demonstrate achievement of performance outcome PO13 of the Cultural heritage overlay code.

(a) in instances where the significance of the heritage place form includes its difference in scale to its setting, the scale of new works is to maintain this significance (as shown in Figure SC6.3.4.12); or

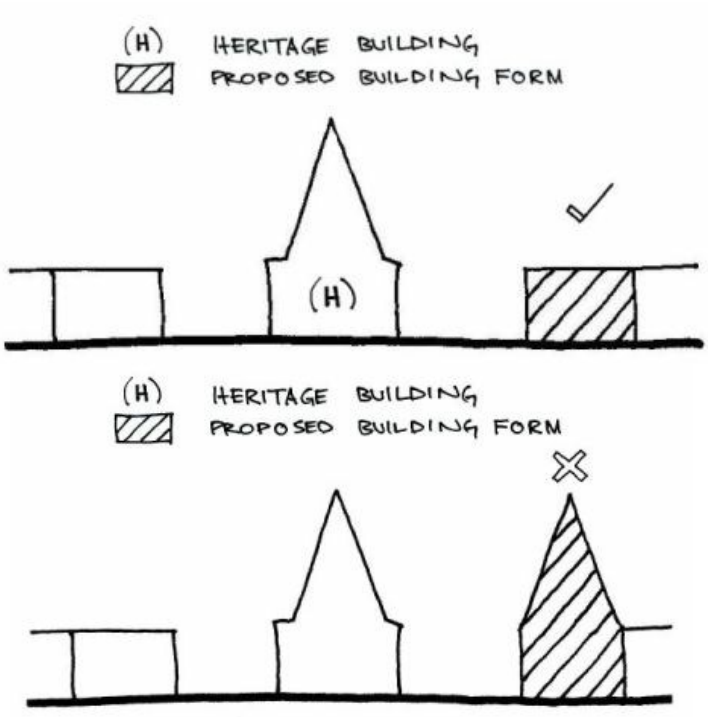


Figure SC6.3.4.12 Illustration of desirable and undesirable outcome

(b) in instances where the significance of the heritage place form includes its common scale and form to its setting, the scale and form of new works is to maintain this significance (as shown in Figure SC6.3.4.13); and

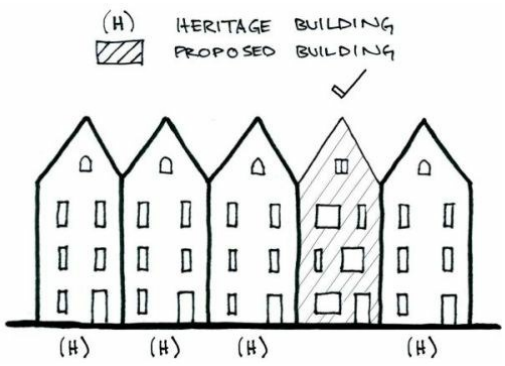


Figure SC6.3.4.13 Illustration of development maintaining common scale

(c) new building works should generally not directly copy the heritage place and as an example, should be readily distinguishable from it. Use of similar overall form, scale, proportions and materials is appropriate (as shown in Figure SC6.3.4.14 and SC6.3.4.15);

Figure SC6.3.4.14 Illustrates an example of appropriate scale and form

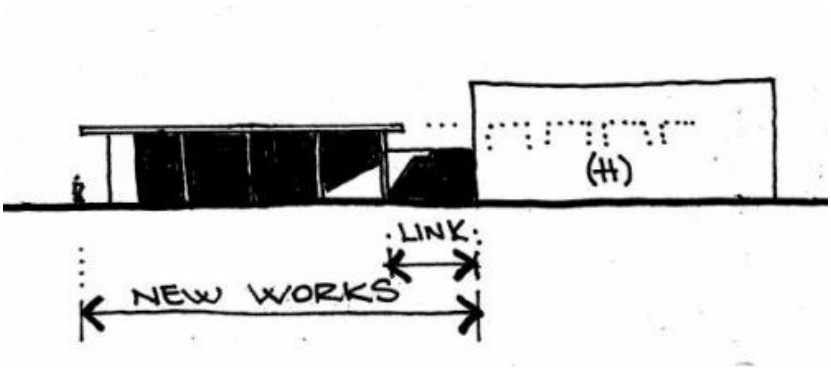


Figure SC6.3.4.15 Illustrates desirable outcome – pavilion type addition

(d) new building works should not reference non-significant features and atypical elements (as shown in Figure SC6.3.4.16 to SC6.3.4.17); and

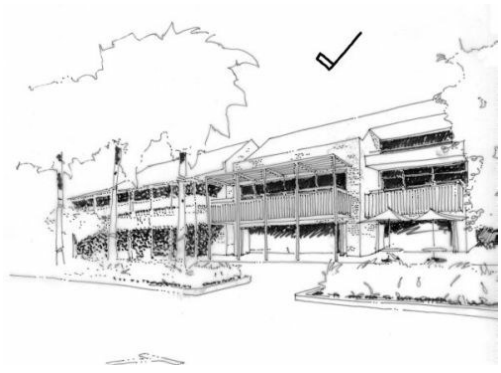


Figure SC6.3.4.16 Illustrates desirable outcome

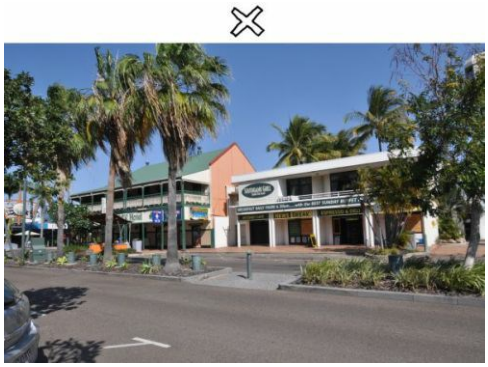


Figure SC6.3.4.17 Illustrates undesirable outcome - new building adjacent to a heritage place does not recognise characteristic articulation of materials, textures and colours (Palmer Street, Townsville)

Figure SC6.3.4.18 An example of an undesirable outcome: design of the new building referenced non-contributory features of the former streetscape, such as angled light poles that have subsequently been removed (Flinders Street East, Townsville)

(e) the quality of new materials is commensurate with those of the heritage place.

SC6.3.5 Development within a heritage place

This section of the policy provides guidance in achieving performance outcomes PO1, PO3 – PO6, PO8 – PO10 of the Cultural heritage overlay code associated with setbacks for development, building height, the scale and form of development, the heritage setting, landscaping and open space, building elements and advertising devices associated with development within a heritage place.

SC6.3.5.1 Setbacks for development

PO3 and PO4 of the Cultural heritage overlay code require that new buildings to be consistent with the significant features and values of the heritage place, including, but not limited to, built form and setbacks, maintain significant views to and from the heritage place and ensure that new buildings are visually subservient.

(1) To achieve the requirements of the performance outcomes in the code and allow for significant views to and from a heritage place to be maintained, the following design guidance should be considered.

(a) in instances where the significance of the heritage place includes its setback in common with the established street pattern, the setback of new works ought to maintain this significance (as shown in Figure SC6.3.5.1);

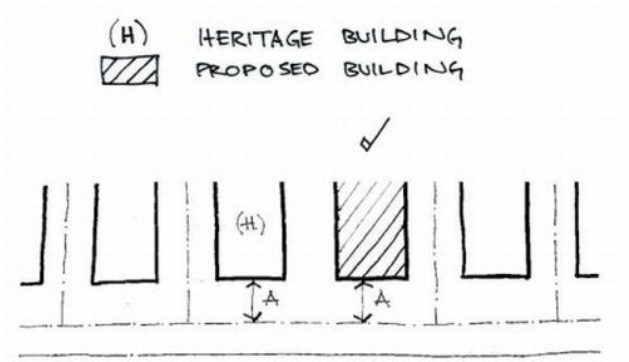


Figure SC6.3.5.1 Illustrates appropriate front setbacks for development within a heritage place, "A" is the street setbacks distance

(b) in instances where the significance of the heritage place includes its difference in setback to the established street pattern, the setback of new works ought to maintain this significance (as shown in Figures SC6.3.5.2 to SC6.3.5.3); and

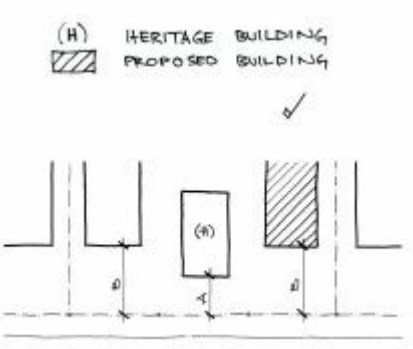


Figure SC6.3.5.2 Illustrates appropriate front setbacks for development within a heritage place, "A" and "B" is the street setback distance

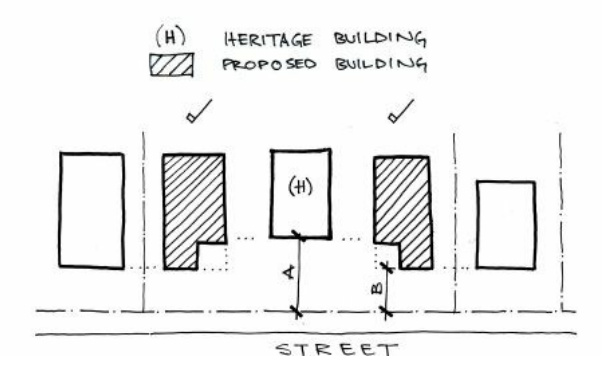


Figure SC6.3.5.3 Illustrates of appropriate front setbacks for development within a heritage place, "A" and "B" is the street setback distance

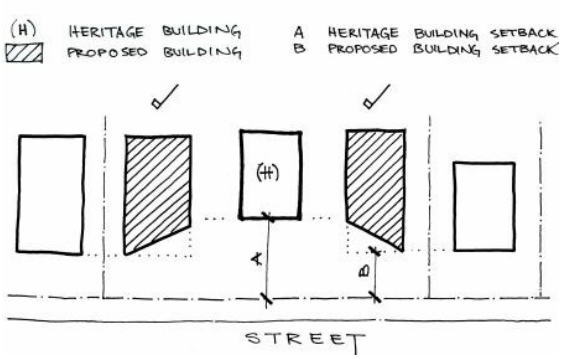


Figure SC6.3.5.4 Illustrates appropriate front setbacks for development within a heritage place and development adjoining a heritage place. "A" and "B" is the street setback distance

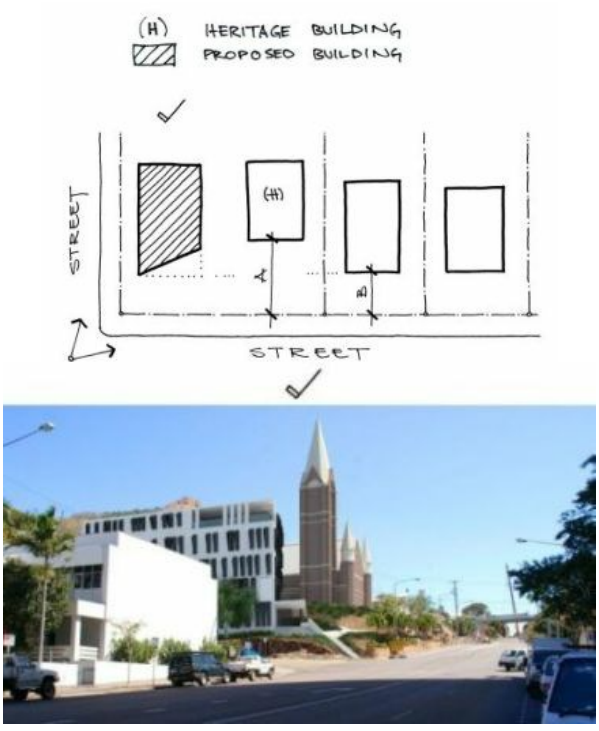


Figure SC6.3.5.5 Illustrates appropriate corner block front setback for development on a heritage place. "A" and "B" is the street setback distance. The setback of new development is tapered to allow improved views to the heritage place.

(c) new developments should adopt side setbacks that are common with the heritage place, unless this would diminish a significant feature of the heritage place (as shown in Figure SC6.3.5.6).

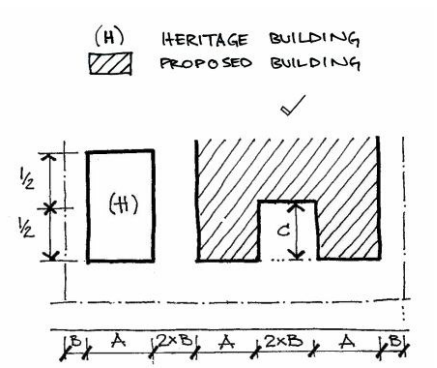


Figure SC6.3.5.6 Illustrates sympathetic building frontage rhythm, "B" is side setback and "C" (being the depth separation to get sympathetic building frontage rhythm) is 6m or ½ of "H" (heritage building depth).

SC6.3.5.2 Building height

(1) Where parts of the development are proposed to be taller than adjacent heritage elements, the following design guidance may be considered to demonstrate achievement of performance outcome PO3, PO4 and PO5 of the Cultural heritage overlay code.

(a) proposed taller elements of the proposed new building are to be setback to diminish their impact (as shown in Figure SC6.3.5.7); or

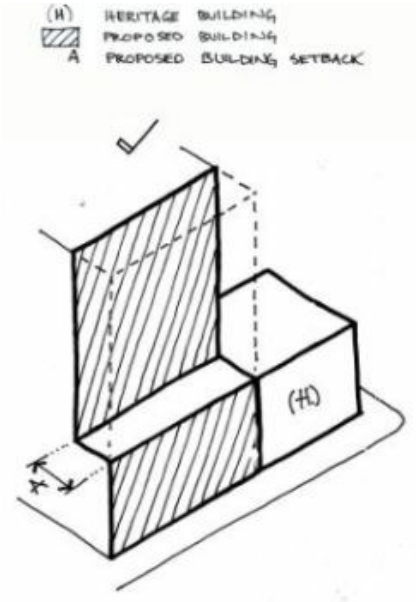


Figure SC6.3.5.7 Illustrates building setback of taller new building. "A" is equal or greater than 3m

(b) setback upper levels of the new building to provide a transition between adjacent buildings of different scales (as shown in Figure SC6.3.5.8);

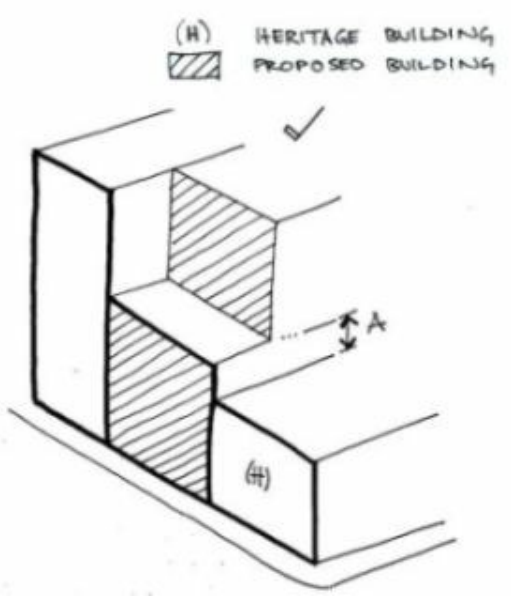


Figure SC6.3.5.8 Illustrates new building upper level setbacks. Dimension "A" is within 20% of the adjacent heritage building height

(c) provide an appropriate separation gap between the significant heritage elements and taller new elements (as shown in Figure SC6.3.5.9);

(d) building elements in the separation gap may be recessed and of lower height and/or different material than the heritage building (as shown in Figure SC6.3.5.9); and

(e) new building works may reflect a "reference height" for the full width of the street frontage where the "reference height" is consistent with the height of the adjacent heritage building (as shown in Figure SC6.3.5.9).

Figure SC6.3.5.9 Illustrates separation gap between contributing heritage elements and taller new buildings. "A" is the separation gap. "C" is the common reference height.

SC6.3.5.3 Scale and form development

(1) The following design examples are associated with building scale and form and may be considered to demonstrate achievement of performance outcome PO3 – PO6 of the Cultural heritage overlay code.

(a) in instances where the significance of the heritage place form includes its difference in scale to its setting; the scale of new works is to maintain this significance (as shown in Figure SC6.3.5.10); or

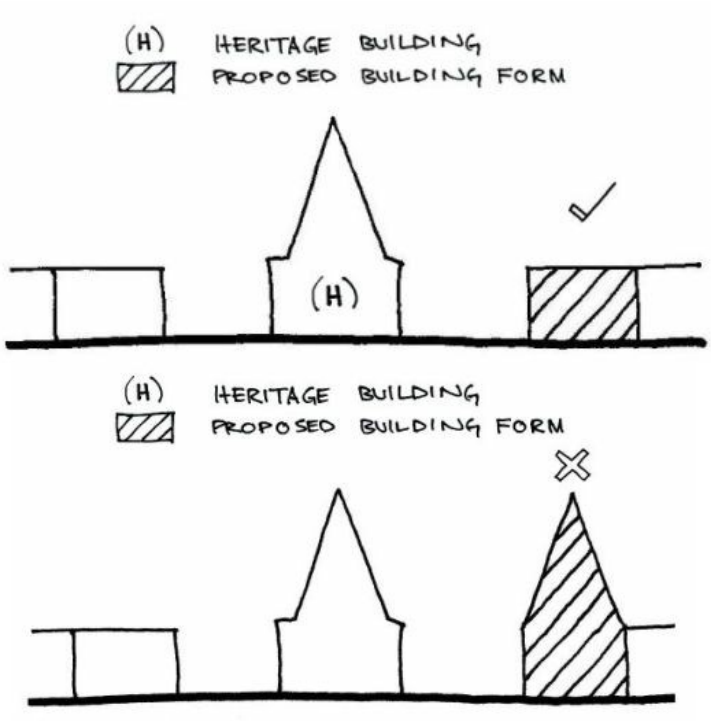


Figure SC6.3.5.10 Illustrates desirable and undesirable outcome

(b) in instances where the significance of the heritage place form includes its common scale, proportions and form to its setting, the scale, proportions and form of new works is to maintain this significance (as shown in Figure SC6.3.5.11);

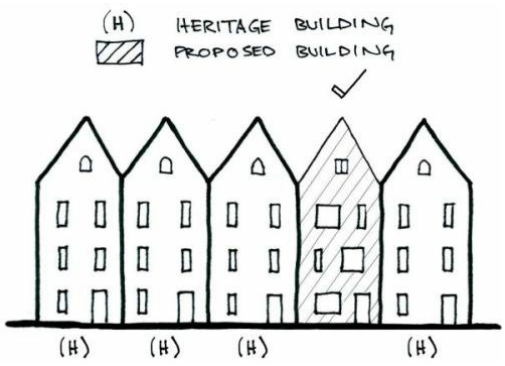


Figure SC6.3.5.11 Illustrates an example of appropriate scale and form

(c) the scale of new works should be compatible with, and not diminish the setting of the heritage place (as shown in Figures SC6.3.5.12 – SC6.3.5.14);

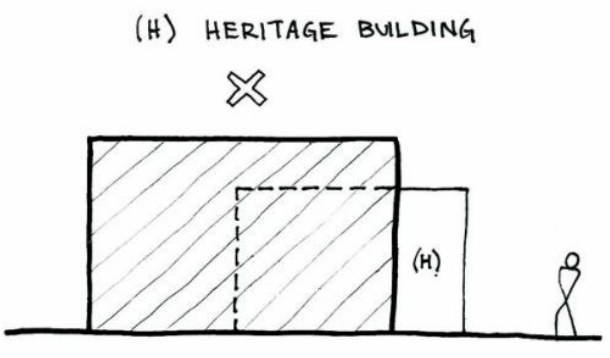


Figure SC6.3.5.12 Illustrates an example of an undesirable outcome – new works obscures the heritage place

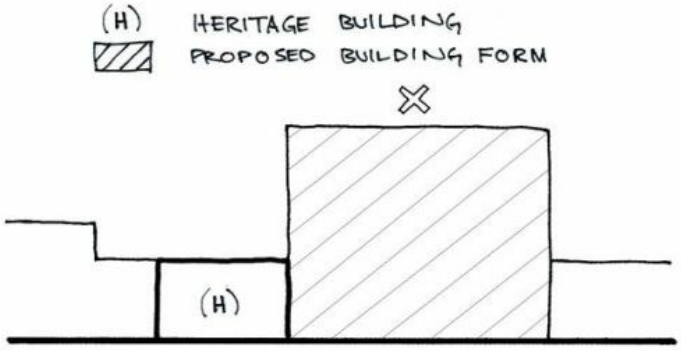


Figure SC6.3.5.13 Illustrates an example of an undesirable outcome: scale of new works dominates the heritage place and is detrimental to the settings of the heritage place

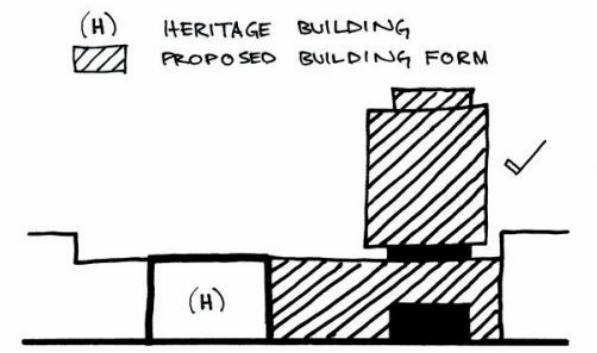


Figure SC6.3.5.14 Illustrates an example of a desirable outcome with regard to scale and form

(d) in order to achieve visual subservience to a heritage place in accordance with PO4, building form ought to be articulated into smaller elements to relate to scale, rhythm and spacing of the heritage place and its context (as shown in Figure SC6.3.5.15);

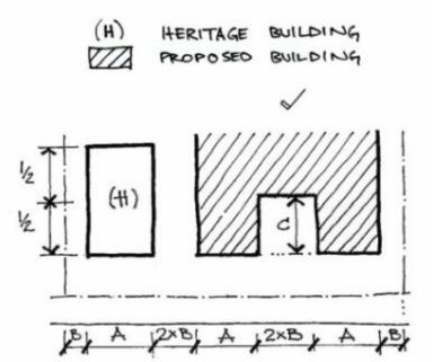


Figure SC6.3.5.15 Illustrates sympathetic building frontage rhythm, "B" is side setback and "C" (being the depth separation to get sympathetic building frontage rhythm) is 6 m or ½ of "H" (heritage building depth).

(e) new buildings should respond to existing ridge or parapet lines, roof slopes or other significant features of the heritage place (as shown in Figure SC6.3.5.16);

Figure SC6.3.5.16 Illustrates an example of an appropriate outcome. The proposed new development adopts ridge and parapet lines of the heritage place and enhances the continuity of the streetscape

(f) new building works should not reference non-significant features and atypical elements;

(g) new works should provide elements of design that are clearly distinguishable from heritage elements and that assist in representing the historical form of the heritage place (as shown in Figure SC6.3.5.17); and

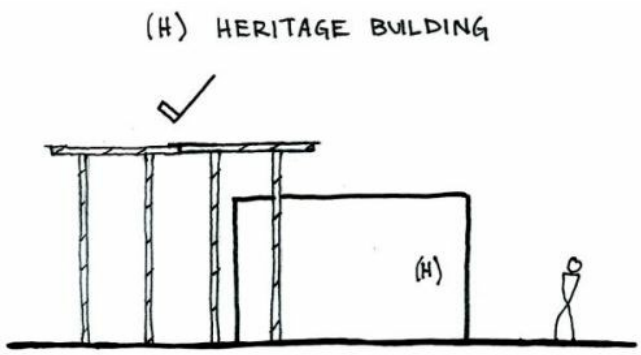


Figure SC6.3.5.17 Illustrates an example of an appropriate outcome, where new works are detached and expressed as a lightweight addition

(h) architectural expression of new works should avoid diminishing the setting of the heritage place (as shown in Figure SC6.3.5.18 and Figure SC6.3.5.19).

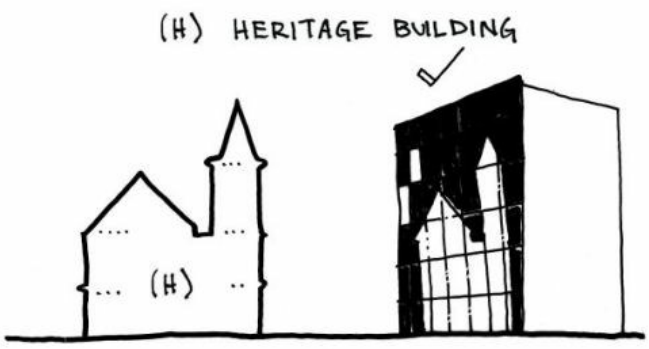


Figure SC6.3.5.18 Illustrates an example of a desirable outcome, in which a glazed or glass façade reflects the heritage place

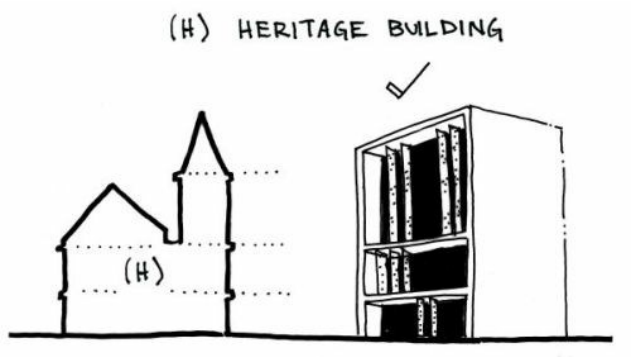


Figure SC6.3.5.19 Illustrates an example of an undesirable outcome, in which the contemporary expression of new works reference the heights of the heritage place

SC6.3.5.4 The heritage setting

The following is advice for achieving PO3, PO4 and PO5 of the Cultural heritage overlay code associated with the heritage setting.

(1) New buildings or works minimise visual impacts to the heritage place by:

(a) new buildings are set apart in a separate building (as shown in Figure SC6.3.5.20);

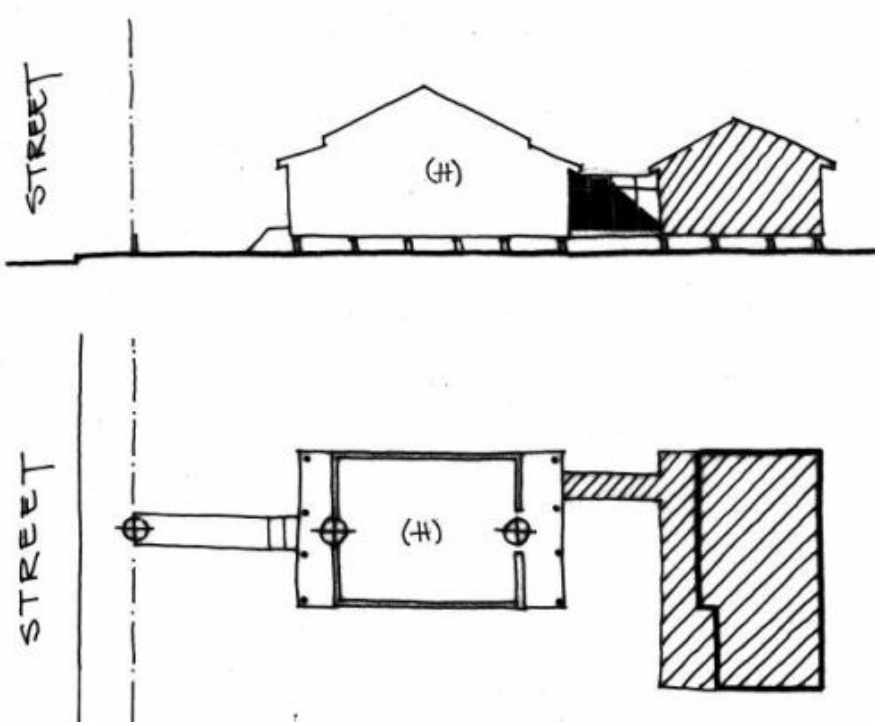


Figure SC6.3.5.20 Illustrates an example of a desirable outcome

(b) new works should design junctions between new and old fabric to be legible, reversible and may be incorporated into the overall architectural design (as shown in Figure SC6.3.5.21 and Figure SC6.3.5.22); and

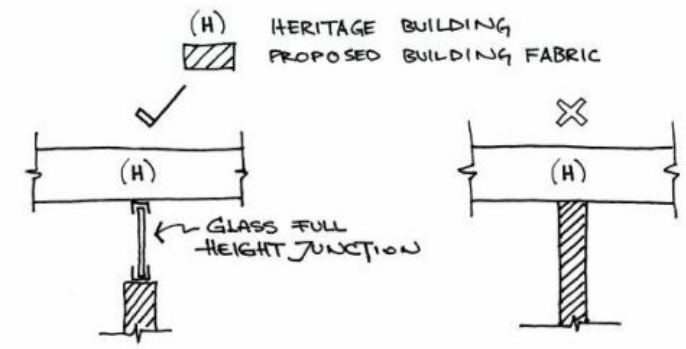


Figure SC6.3.5.21 Illustrates desirable and undesirable outcome: plan detail of old and new wall junction separation of new and old fabric using glass or other translucent light weight material

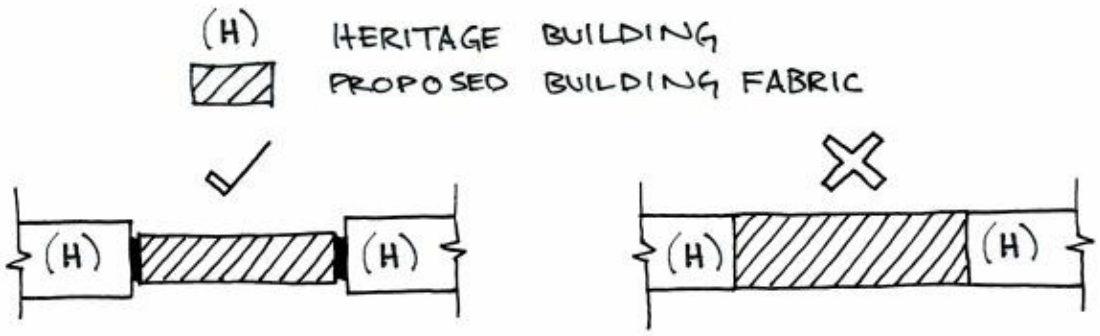


Figure SC6.3.5.22 Illustrates desirable and undesirable outcome - plan detail of the junction between the proposed/new development to the existing heritage wall opening. The new development requires a reduced wall depth to maintain the legibility of the original opening

(c) works are located within areas that are not visible from the dominant street views or other significant views, and do not diminish any significant features of the heritage place (as shown in Figure SC6.3.5.23 and SC6.3.5.24).

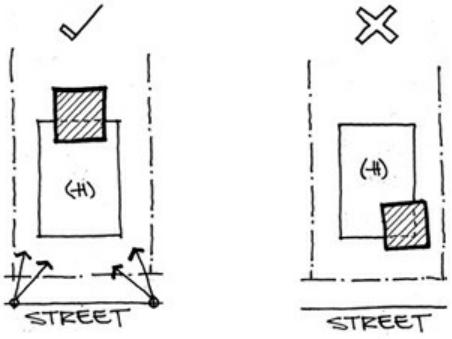


Figure SC6.3.5.23 Illustrates an example of desirable and undesirable outcome

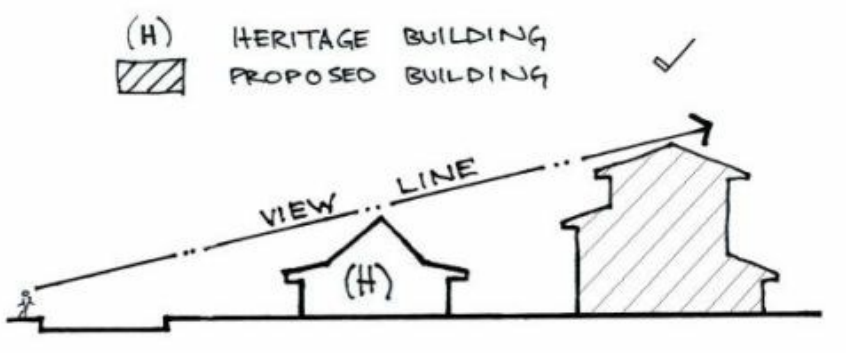


Figure SC6.3.5.24 Illustrates view line from the street. The new building at the back cannot be seen by a person standing across the street, which means that the view of the heritage building is not diminished

SC6.3.5.5 Landscaping and open space

The following advice is for demonstrating achievement of performance outcome P03 and PO8 of the Cultural heritage overlay code associated with landscaping and open space.

(1) Open space and landscaping features should maintain views to and from the significant heritage features of the heritage place (as shown in Figure SC6.3.5.25– SC6.3.5.28).

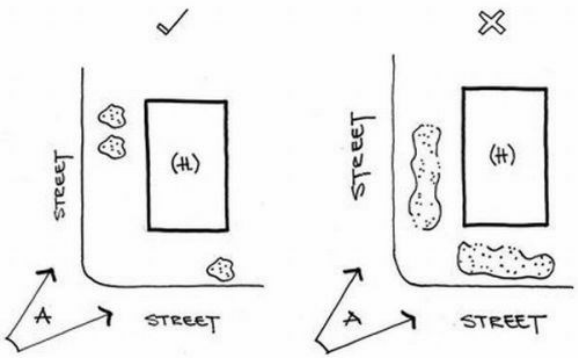
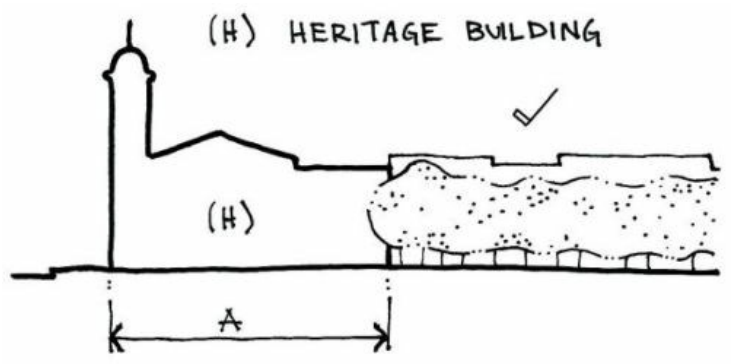


Figure SC6.3.5.25 Illustrates an example of desirable and undesirable outcome. "A" is principal view to and from heritage place



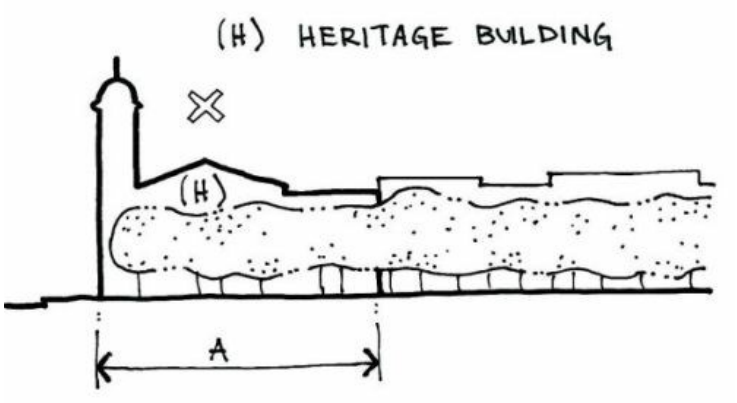


Figure SC6.3.5.26 Illustrates an example of desirable outcome "A" is street width

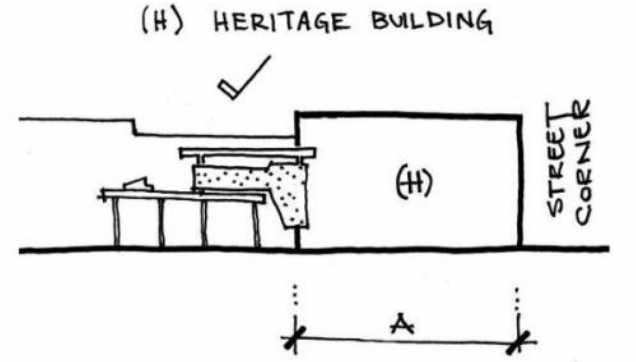


Figure SC6.3.5.27 Illustrates an example of a desirable outcome, tall street shelter element does not block views to and from the heritage place. "A" is street width of "H"

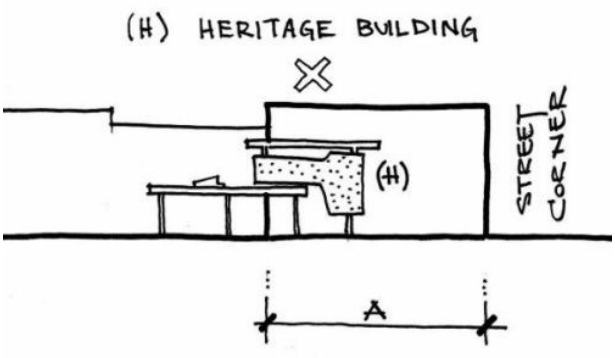


Figure SC6.3.5.28 Illustrates an example of an undesirable outcome, where a tall street shelter element blocks views to and from the heritage place. A' is street width of "H" (heritage place)

SC6.3.5.6 Heritage fabric

In order to protect the cultural significance of a heritage place, retaining the original fabric and significant fenestration patterns, finishes and decorative details should be a primary aim.

(1) The following should be considered in demonstrating achievement of performance outcomes PO1 and PO6 of the Cultural heritage overlay code.

(a) alteration or partial demolition of elements that do not contribute to cultural significance may be appropriate where there is no detrimental impact on significant features;

(b) buildings are to be retained in their three dimensional form. The inadequate retention of only the front façade may result in "facadism" and should be avoided (as shown in Figure SC6.3.5.29 and SC6.3.5.30);

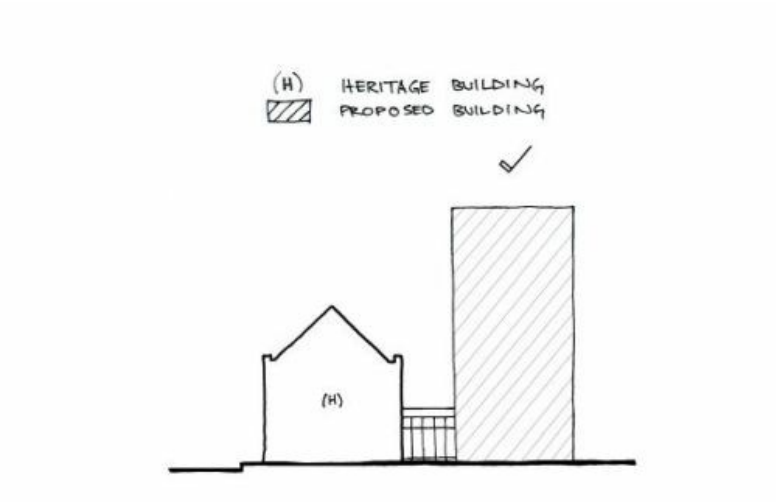


Figure SC6.3.5.29 Illustrates an example of a desirable outcome, new works with adequate retention of the three dimensional form. New works set back as a detached form.

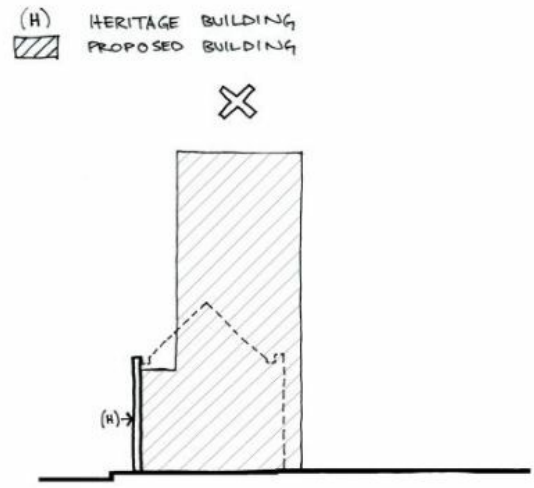


Figure SC6.3.5.30 An example of an undesirable outcome; new works have inadequate retention of the three dimensional form (only the front façade has been retained)

(c) the building fabric that contributes to the significance of the heritage place should be retained whether visible or not from the public realm (as shown in Figure SC6.3.5.31);

Figure SC6.3.5.31 "The Brewery", former Post Office (Flinders Street, Townsville). Significant features of the interior have been retained. This is an example of maintaining original building fabric.

(d) significant associations and meanings of the heritage place ought to be maintained (as shown in Figures SC6.3.5.32 and SC6.3.5.33); or

(e) new works provide interpretations for, associations and meanings of the heritage place, and its original use;

(f) where a new use is proposed for a heritage place, the new use is compatible with the cultural significance, significant features and values of the heritage place (as shown in Figures SC6.3.5.32 and SC6.3.5.33);

Figure SC6.3.5.32 Illustrates a desirable outcome: former Post Office building (Flinders Street, Townsville)

Figure SC6.3.5.33 Illustrates a undesirable outcome: former Customs House (The Strand, Townsville). Change of use to a private residence diminishes the associations and meanings of the heritage place

(g) building services may be concealed to render them not readily visible from the street or any significant views of the heritage place. If services are by necessity visible, they may be constructed using materials and details sympathetic to those of the heritage place (as shown in Figure SC6.3.5.34); and

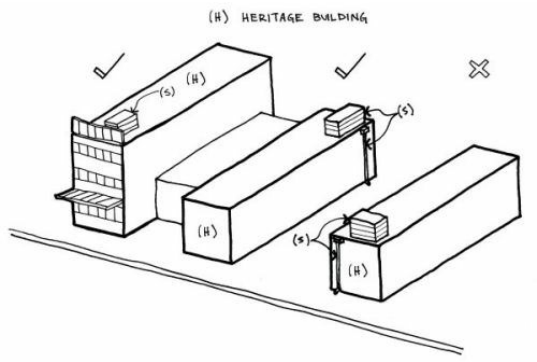


Figure SC6.3.5.34 Examples of desirable and undesirable outcome, "S" are air conditioning and drainage locations. An example of an undesirable outcome is at right, with air conditioning and drainage services positioned to the front of the building, which has a detrimental impact on visual amenity of the heritage place

(h) any changes to significant fabric necessary to accommodate a new use are reversible.

SC6.3.5.7 Building elements

This section will assist you to demonstrate achievement with PO3, PO5 and PO6 of the Cultural heritage overlay code.

Building elements refer to the components of a building which contribute to the overall character and heritage significance of the building, site or area, and may include the materials, colours and details used.

(1) Materials, colours and details used in a development should complement rather than reproduce the heritage place. The following design guidance illustrates how this might be achieved:

(a) the design of new works recognises characteristic materials, textures and colours used locally and in adjacent buildings. These may be re-interpreted and incorporated in the design of the new building (as shown in Figure SC6.3.5.35);

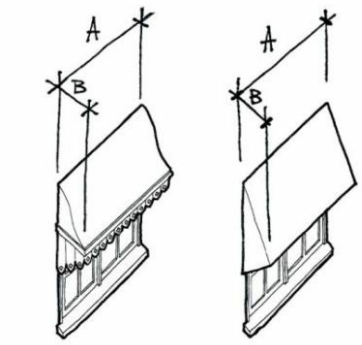


Figure SC6.3.5.35 Illustrates (left) contemporary interpretation of a typical heritage awning hood (right) where dimensions "A" and "B" have similar proportions.

(b) materials and colours of surrounding buildings generally should not be copied but used as a point of reference. Modern materials may be used if their proportions and details are sympathetic within the adjacent heritage place;

(c) colour, texture and tonal contrast of new building elements may be utilised as a unifying element with heritage features. Details that contribute to the significance of the heritage place may inform or inspire the design of new building works;

(d) modern details may be designed to reinterpret traditional details and create new relationships between new and old; and

(e) the quality of new materials is of the same quality as those of the heritage place.

(2) New materials introduced to a heritage place should generally be intentionally varied from the original and be distinguishable from the original fabric by a date stamp (as shown in Figure SC6.3.5.36).

Figure SC6.3.5.36 Illustrates an example of a desirable outcome - date stamp on new or introduced fencing panel

SC6.3.5.8 Advertising devices

(1) Advertising devices should be designed to ensure that they do not dominate the heritage place or obscure significant views or features of the heritage place. The following is advice for achieving performance outcome PO8, PO9 and PO10 of the Cultural heritage overlay code associated with advertising devices.

Note— there are specific requirements when dealing with State Heritage listed buildings. Advertising devices on heritage buildings listed on the Queensland State Heritage Register is subject to the provisions of the *Queensland Heritage Act 1992*.

(a) advertising devices should be readily removable without damaging the building fabric, (as shown in Figure SC6.3.5.37);

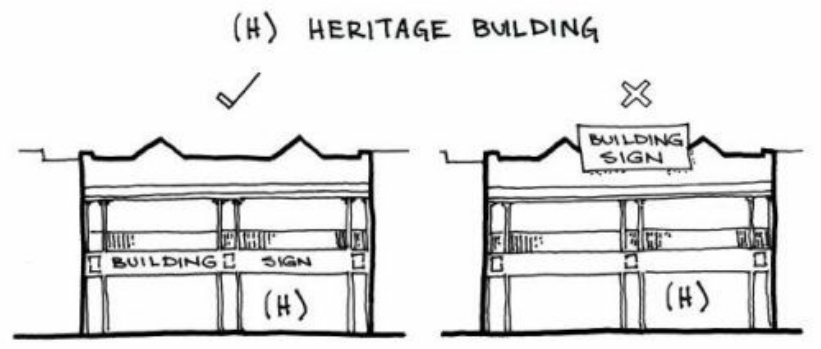


Figure SC6.3.5.37 Illustrates a desirable outcome (left) and undesirable outcome (right)

(b) advertising devices may be clearly modern yet respectful of the heritage context, associations and meanings of the heritage place;

(c) advertising devices should consider enhancing a building's architecture and setting;

(d) integrate advertising devices with architectural features of the building wherever possible;

(e) unless there is adequate evidence – physical and documentary – to reconstruct original advertising devices, new advertising devices on a heritage place should complement, not replicate, a "period" style. "Old fashioned" imitation signage would be inappropriate. Any form of signage may be considered, as long as visual and physical impacts on the heritage building are minimised;

(f) the appropriate size of signage may be relative to the specific architectural characteristics of the heritage place (as shown in Figure SC6.3.5.38); and

(g) table SC6.3.5.1 identifies advertising devices which are not suitable on a heritage building.

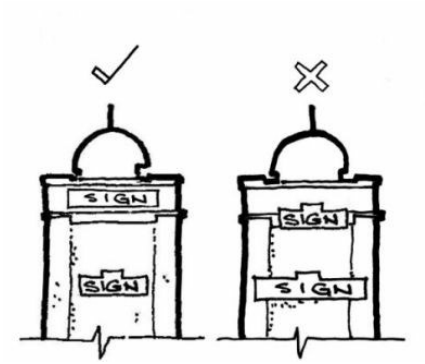
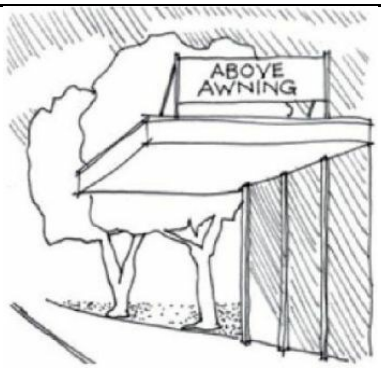
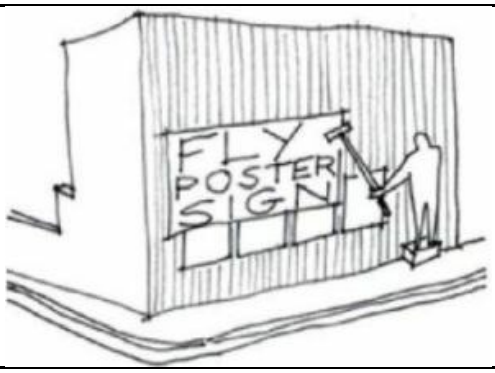
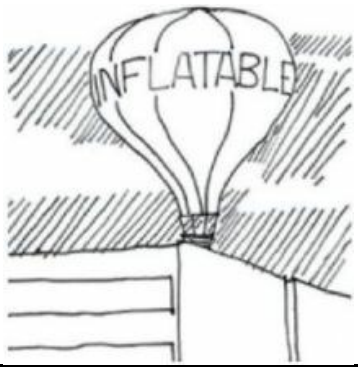


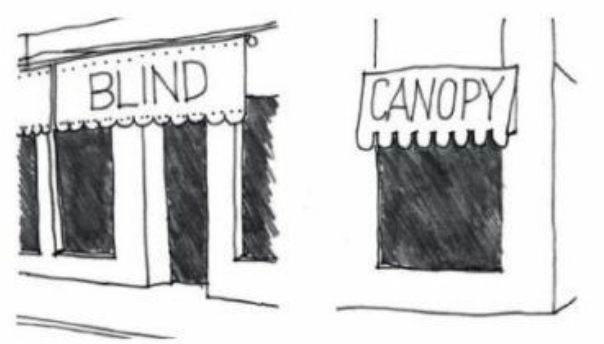
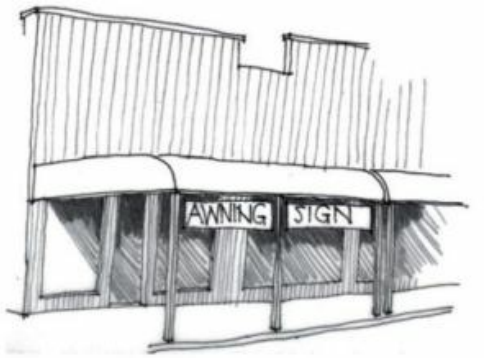
Figure SC6.3.5.38 Illustrates a desirable outcome (left) and undesirable outcome (right)

Table SC6.3.5.1 Advertising devices which are not suitable on a heritage building

Device type	An example of an undesirable outcome
Roof signs	
Above awning signs	
Wall sign	
Inflatable sign	

In accordance with AO3 of the Advertising devices code, Table SC6.3.5.2 identifies the desirable outcomes for heritage places on Flinders Street East. Advertising devices are in accordance with the advertising device types and design parameters set out within Table SC6.3.5.2.

Table SC6.3.5.2 Design parameters for supported advertising devices on Flinders Street East

Device type	Design Parameters additional to those set out in the advertising devices code	An example of an desirable outcome
Awning fascia sign		
Blind/canopy		
Under awning sign		
Under Awning sign (where an under-awning sign is affixed between posts of a footpath awning)	The under-awning sign must be contained within the spacing of posts and must not exceed 600mm in height.	

Wall sign		
Window sign		

SC6.3.6 Preparing a heritage impact statement report

A heritage impact statement may be required to demonstrate compliance with the Cultural heritage overlay code, in particular performance outcomes PO1, PO3, PO4, and PO7.

A heritage impact statement provides specific information about how a proposed development will affect the heritage place. The purpose of a heritage impact statement is to identify any potential detrimental impacts that the development may have on the significance of the place. Ultimately, a heritage impact statement should demonstrate compliance with the Cultural heritage overlay code.

A heritage impact statement is to be produced by a suitably qualified architect or cultural heritage professional, and should include the following at a minimum:

(1) Description of the proposed development
Provide a brief description of the proposed development including:

- (a) type of development;
- (b) range and scope of work proposed; and
- (c) timeframe for carrying out work.

(2) Setting and context of the place
Describe the setting or context for the place, including photographs and maps showing significant features that will be affected. Provide an analysis of the affect the proposed development will have on the setting of the heritage place.

(3) Proposed changes to the heritage place
List the changes required to the heritage place as a consequence of the proposed development and provide the following information about each change:

- (a) what elements or aspects of the heritage place are affected by the proposed change;
- (b) list the work required to effect the proposed change;
- (c) analysis of the impact of the change on the cultural heritage significance of the place;
- (d) assessment of potential for detrimental impact on the cultural heritage significance;

(e) if the proposed work will directly affect a heritage element of the place – provide details of proposed work methods; and

(f) where the proposed change is assessed as having potential for detrimental impact, provide information about the following:

(i) why the proposed change is required;

(ii) alternative solutions that were investigated; and

(iii) what measures are included in the proposed development to reduce detrimental impact that may result from the change.

(4) Applicable conservation policies

(a) some heritage places already have conservation management plans that include conservation policies. Where a heritage building has a current conservation management plan, the heritage impact statement will need to list the conservation policies that relate to the proposed development and describe how they have guided the development;

(b) where conservation policies have not been followed, give reasons why the conservation policies were not used and describe the process that is proposed to be followed; and

(c) where conservation policies are not already available, an architect or heritage consultant can provide conservation advice to help inform the planning and guide development of places.

(5) References
List documents referred to in the heritage impact statement such as conservation policies, conservation management plans, condition report (i.e. demolition reports), and specialist consultants' reports.

(Adapted from *Guideline: Preparing a heritage impact statement' Department of Environment and Heritage Protection*, 2011).

SC6.3.7 Preparing a condition report

If an application is proposing the demolition of a structure of heritage significance the applicant may be requested to provide a condition report. The condition report should, at a minimum, include consideration of:

(1) the structural stability of the building in the form of a structural engineers report. The condition report must include a factual statement from an appropriately qualified structural engineer about the condition of the building; and

(2) a pest inspection report and other supporting documentation may also be provided.

SC6.3.8 Preparing archival recording of heritage place

Archival recording may be required to demonstrate achievement of performance outcome PO2 of the Cultural heritage overlay code. Where demolition, change or relocation of a heritage building is allowed, a photographic record and measured drawings in accordance with the following of the place should be submitted to council prior to the commencement of the demolition works or relocation of the heritage building.

SC6.3.8.1 Guideline for photographic recording

The following guidelines are intended as a checklist for making an accurate photographic record of sites, buildings, objects, gardens or structures of heritage significance prior to major alterations or demolition. The recording process must be comprehensive and cover the parts specified in the approval conditions.

(1) Aim
The aim of the photographic record is to provide a sufficient number of photographs to fully illustrate the subject for which the photographic archival record is required. The purpose of the record is to provide permanent documentation of places so that future generations can benefit from and gain an understanding of Townsville's cultural history that is no longer possible to pass on to them.

(2) Method
The photographer should be informed by any available plans and documentary evidence and should have an

understanding of the history and operations of the place. If necessary the photographer should be accompanied on the site by a person familiar with the site's heritage significance and the processes related to it. The project should be planned before commencement and the photographer aware of the appropriate sequence.

The preferred shooting method is to proceed from the overall or general through to the detailed or specific. The photographic record should consist of:

(a) general views of the place.
Note—to provide its context and overall coverage of all slides – oblique shots are useful for general reference;

(b) elevation of all sides;

(c) details of all key elements including windows, doors, eaves, cornices, rainwater goods, skirtings and decorative elements;

(d) interior elevations of each space to include floor and ceiling finishes;

(e) the relationship of the elevations to any equipment or relics housed in each space;

(f) any significant items should be photographed;

(g) any features particular to the place internally and externally should be fully recorded; and

(h) when photographing landscape elements:

(i) an overall photograph is required; and

(ii) any unusual or distinguishing features should be fully recorded.

(3) Key plans
The photographic record shall include a plan or plans indicating the direction in which the photographs were taken. The positions, with a direction arrow, should be numbered and cross referenced to the photographs.

(a) The following information should be included:

(i) date of record production;

(ii) name of photographer; and

(iii) description of place (e.g. building, name, species of tree, etc.).

(b) Form

(i) photographs are to be colour and of professional quality. Digital format will be accepted. An electronic copy on CD, USB or of the like format acceptable to council, are to be submitted;

(ii) archival quality ink should be used for annotation and cross referencing. A 6B pencil should only be used for annotating on the back of prints; and

(iii) the photographic record should be submitted in an A4 archival album with photographs in archival quality plastic sleeves or pockets.

(c) Size

(i) minimum size of prints should be 100 x 150 mm, to a maximum A4 size.

(d) Report

(i) a very brief report or introduction explaining the purpose of the report, a brief description of the subject and detailing the sequence in which the photographs were taken should be included;

(ii) the report may also address the limitations of the photographic record and make recommendations for future work; and

(iii) sources of original work should be acknowledged.

SC6.3.8.2 Guideline for measured drawings
Measured drawings provide an accurate record of buildings, structures or objects and depict the physical features that contribute to their heritage significance. Measured drawings should be easy to read and suitable for reproduction. Australian Standard AS 1100 *Technical Drawing*, Part 301 and *Supplement 1*, *Architectural Drawing* provides a guide to suitable graphics.

The following guidelines are intended as a checklist for making an accurate record of a building, part of a building, or other subject at the time of production. The recording process must be comprehensive and cover the parts specified in the approval conditions.

(1) Aim

The aim of producing a measured drawing is to provide a record that is measured and drawn accurately to scale. It should be a true reflection of the existing condition and not an interpretation of a previous state (i.e. missing elements should not be included and elements which are not plumb should be recorded as such).

(2) Drawings:

(a) the measured drawings should be cross-referenced to each other, clearly titled and show scale, orientation and date of execution;

(b) drawings should not include any conjectural detail such as inaccessible elements that cannot be measured such as footings or framing;

(c) the drawings can also be annotated or hatched to reveal more about the heritage significance of the site or object – to differentiate between dates of construction, materials and finishes;

(d) record to the same standard all major fixtures such as machinery or building services; and

(e) for industrial sites, recording the position, relationship and function of all fixtures, machinery and services is particularly important and maker's names, model numbers etc. should be included.

For further information refer to *Measure for Measure: A Practical Guide for Recording Buildings and Landscapes*, published by the RAIA in 1990.

(3) Requirements

A typical measured drawing package for a build structure should include:

(a) location plan;

(b) site plan (1:500 or 1:200);

(c) floor plan/s (1:1:100 or 1:50) including basement or mezzanine levels;

(d) roof plan/s (1:100 or 1:50);

(e) elevations – showing all sides of the building (1:100 or 1:50);

(f) sections – two sections, through the building in different planes (not parallel) (1:100 or 1:50);

(g) ceiling and joinery details (1:20 or 1:10) – cornice, verandah posts, skirtings, mouldings;

(h) other significant details (rainwater heads, construction joints); and

(i) machinery and services details.

(4) Sheet sizes

Drawings should be on standard metric sheet sizes – A1, A2, A3 or A4.

SC6.3.8.3 Interpretive signage for the loss of a heritage place

In addition to archival recording, where a heritage place is to be lost, interpretive signage is to be provided. In particular:

(1) the sign should be placed at the front of the property boundary, integrated with a wall or fence;

(2) the sign should provide a photographic record and brief history of the heritage place;

(3) the sign should have a 330 mm diameter, a 3 mm thick aluminium plate with weatherproofed finish, refer to Figure SC6.3.8.57; and

(4) sign production i.e. colours used and branding should be consistent with the Townsville Heritage Trail Signage.

Figure SC6.3.8.1 Illustrates an example of a desirable outcome, an example of a Heritage Trail sign (Flinders Street, Townsville)

SC6.3.9 Preparing an archaeological management plan

The following is advice for demonstrating achievement of performance outcome PO11 of the Cultural heritage overlay code associated with archaeology.

(1) Any development with potential impact on archaeological values should provide for the following at a minimum:

- (a) the potential impact on archaeological deposits on the site is to be monitored and assessed during earthworks by an appropriately qualified person;
- (b) where archaeological deposits are identified, an archaeological management plan is to be prepared by an appropriately qualified person and approved to the satisfaction of the relevant authority, prior to the commencement of ground works; and
- (c) any archaeological management plan that is prepared should follow best practice.

SC6.3.10 Adding or removing a place from Schedule 7 Places of cultural heritage value

(1) The places of cultural heritage value in Townsville are contained in Schedule 7 Places of cultural heritage value and overlay map OM04.1 – OM04.4 of the Townsville City Plan. The process of entering and removing a heritage place from Schedule 7 and the overlay involves:

- (a) identification;
- (b) application;
- (c) assessment; and
- (d) notification.

(2) Council assesses a place based on the place fulfilling one or more cultural heritage criteria listed below. There are approximately 325 places in Townsville that meet one or more of the cultural heritage criteria stated below. These places have been incorporated into Schedule 7 Places of cultural heritage value of the Townsville City Plan. The Citation of Heritage Places Report provides information about each heritage place in Townsville. It highlights the criteria that were originally identified for each place and indicates its heritage significance and eligibility for entry into Schedule 7 Places of cultural heritage value. It should be noted that a building, site or place may be entered into Schedule 7 Places of cultural heritage value of the Townsville City Plan if it meets one or more of the cultural heritage criteria listed below.

- (a) It is important in demonstrating the evolution or pattern of Townsville's history.
- (b) It demonstrates rare, uncommon or endangered aspects of Townsville's cultural heritage.

(c) It has potential to yield information that will contribute to the knowledge and understanding of Townsville's history.

(d) It is important in demonstrating the principal characteristics of a particular class or classes of cultural places.

(e) It is important because of its aesthetic significance.

(f) It is important in demonstrating a high degree of creative or technological achievement at a particular period.

(g) It has a strong or special association with the life or work of a particular community or cultural group for social, cultural or spiritual reasons.

(h) It has a special association with the life or work of a particular person, group or organisation of importance in Townsville's history.

(i) It was constructed prior to 1910.

(3) For a heritage place to be removed from Schedule 7 Places of cultural heritage value of the Townsville City Plan the applicant must highlight that there is evidence to sufficiently demonstrate that a place has no cultural heritage significance, based on the Criteria listed Schedule 7 Place of cultural heritage value in the Townsville City Plan.

Following the lodgement of the application form titled, "Application form to add or remove a place from Schedule 7 Places of cultural heritage value of the Townsville City Plan," council will make a decision as to whether to enter, not enter, or remove a place from Schedule 7 Places of cultural heritage value. It should be noted that if a place is nominated to be included on, or to be removed from Schedule 7 Places of cultural heritage value, council will be required to undertake an amendment to the Townsville City Plan as required by the *Planning Act 2016*.

For more information refer to:

(a) Application Guide: Entering a place to Schedule 7 Places of cultural heritage value.

(b) Application Guide: Removing a place from Schedule 7 Places of cultural heritage value.

(c) Application form to add or remove a place from Schedule 7 Places of cultural heritage value of the Townsville City Plan.

SC6.4 Development manual planning scheme policy

SC6.4.1 Introduction

Short title -The planning scheme policy may be cited as Development manual PSP.

SC6.4.1.1 Purpose

The purpose of the Development manual PSP includes:

(1) specifying standards for the design and construction of development infrastructure;

(2) providing guidance and advice regarding administrative arrangements for development and development infrastructure;

(3) providing information the council may request for development applications, including standards and guidance on the preparation of specialists reports; and

(4) providing guidance or advice about satisfying an assessment benchmark in the Townsville City Plan which identifies this planning scheme policy as providing that guidance and advice.

SC6.4.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.4.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan. This planning scheme policy applies to the whole of the Townsville City Council planning scheme area and specifically relates to the assessment of any relevant development application.

SC6.4.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions of Townsville City Plan. A term used in this planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 Definitions of Townsville City Plan.

In addition to the definitions presented in Part 1.3.1 of the Townsville City Plan, each sub-section of the Development manual PSP may contain a list of terminology that is referenced in support of that specific policy sub-section.

For clarity, a reference in Development manual PSP to any act includes any regulation or instrument made under it and where amended or replaced, means the amended or replaced act. A reference in the Development manual PSP to a specific resource document or standard means the latest version of the resource document or standard.

SC6.4.1.5 Structure

The policy is arranged around seven major sections. Each major section is designed to group common themed sub-sections to improve usability of the entire document.

The seven major sections are:

SC6.4.1 Introduction – an introduction to the policy, including the purpose of the policy and relationship to the Townsville City Plan;

SC6.4.2 Development application guidelines – contains information for the preparation of reports that may be requested by council in support of development applications;

SC6.4.3 Design standards – a series of policy sub-sections that establish specific design standards, advice and guidelines for development;

SC6.4.4 Design specifications and standard drawings – technical standards for the design of infrastructure and development;

SC6.4.5 Construction management – this section sets out the broad auditing responsibilities of council, setting out procedural matters of development and the standards for construction management for development works, covering pre-construction, construction and quality management systems for the construction of development works;

SC6.4.6 Construction standards – the construction technical specifications of council; and

SC6.4.7 Acceptance of completed works – this section sets out the standards, advice and guidance to manage the donation of completed assets and works.

SC6.4.1.6 Contents

SC6.4.1 Introduction

SC6.4.2 Development application guidelines

SC6.4.2.1 Introduction
SC6.4.2.2 General requirements
SC6.4.2.3 Design checklists
SC6.4.2.4 Well-made application checklists
SC6.4.2.5 Details on drawings

SC6.4.3 Design standards

SC6.4.3.2 Building over or adjacent to services
SC6.4.3.3 Footpath treatment policy
SC6.4.3.4 Outdoor dining design
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscape policy
SC6.4.3.7 Steep land development design guidelines
SC6.4.3.8 Stormwater management plans for development
SC6.4.3.9 Water sensitive urban design guidelines
SC6.4.3.10 On-site sewerage facilities
SC6.4.3.11 On-site water supply
SC6.4.3.12 Constructed lakes
SC6.4.3.13 Townsville road hierarchy
SC6.4.3.14 Traffic impact assessment guidelines
SC6.4.3.15 Noise and vibration assessment guidelines
SC6.4.3.16 Rear lane design
SC6.4.3.17 Driveways
SC6.4.3.18 Geotechnical investigations
SC6.4.3.19 Road and street naming
SC6.4.3.20 Public lighting and utility services
SC6.4.3.21 Townsville Water planning and design guidelines
SC6.4.3.22 Waste management guidelines
SC6.4.3.23 Water and sewer network modelling guidelines

SC6.4.4 Design specifications and standard drawings

SC6.4.4.1 Geometric road design
SC6.4.4.2 Pavement design
SC6.4.4.3 Bridges and other structures
SC6.4.4.4 Stormwater drainage design
SC6.4.4.5 Earthworks (design)
SC6.4.4.7 Bicycle, pedestrian and shared path design
SC6.4.4.8 Standard drawings

SC6.4.5 Construction management

SC6.4.5.1 Pre-construction
SC6.4.5.2 Construction
SC6.4.5.3 Quality management system

SC6.4.6 Construction standards

SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.2 Water supply
SC6.4.6.3 Sewerage system
SC6.4.6.4 Stormwater drainage
SC6.4.6.5 Drainage structures
SC6.4.6.6 Pipe drainage
SC6.4.6.7 Precast box culverts
SC6.4.6.8 Drainage mats
SC6.4.6.9 Open drains
SC6.4.6.10 Earthworks (construction)

SC6.4.6.11 Clearing and grubbing
SC6.4.6.12 Flexible pavements
SC6.4.6.13 Asphaltic concrete
SC6.4.6.14 Mass concrete subbase
SC6.4.6.15 Plain and reinforced concrete base
SC6.4.6.16 Sprayed bitumen surfacing
SC6.4.6.17 Bituminous microsurfacing
SC6.4.6.18 Segmental paving
SC6.4.6.19 Stabilisation
SC6.4.6.20 Subsoil, foundation and pavement drains
SC6.4.6.21 Subsurface drainage
SC6.4.6.22 Pavement markings
SC6.4.6.23 Guide posts
SC6.4.6.24 Signposting
SC6.4.6.25 Non-rigid road safety barrier system
SC6.4.6.26 Landscaping
SC6.4.6.27 Irrigation
SC6.4.6.28 Minor concrete works
SC6.4.6.29 Boundary fencing
SC6.4.6.30 Control of traffic
SC6.4.7 Acceptance of completed works
SC6.4.7.1 Release of the plan of survey
SC6.4.7.2 On maintenance/final completion/off maintenance requirements
SC6.4.7.3 Sewer pump-out agreements

SC6.4.2 Development application guidelines

SC6.4.2.1 Introduction

This section provides standards, advice and guidelines for development applications, including well made application details along with design requirements to assist applicants in achieving council's design objectives.

SC6.4.2.1.1 Definition of major and minor developments

(1) A major development consists of a combination or some or all of the following:

(a) more than six residential, commercial or industrial lots; or

(b) a single or multi-storey mixed/high density dwelling unit complex of more than six dwellings; or

(c) a multi-storey development of more than three stories; or

(d) a commercial structure where the ultimate Gross Floor Area (GFA) exceeds 2,000m^2 and is two equivalent stories or more; or

(e) a development where site filling and/or excavation exceeds 2,500m^3; or

(f) a development where site filling impacts on a known or designated 'floodplain' and requires compensatory earthworks to cater for the flows from the defined flood event in the adjacent or nearby watercourse without increasing flood levels upstream and downstream of the development site; or

(g) a development that requires more than 300 carparking spaces.

(2) A minor development consists of a combination of some or all of the following:

(a) more than two and less than six residential, commercial or industrial lots; or

(b) a single storey (or higher) mixed/high density dwelling unit complex of six or less dwellings; or

(c) a mulit-storey development of not more than three stories of approved use; or

(d) development where site filling and/or excavation is less than 100m^3; or

Editor's note—where the site filling/excavation exceeds 100m^3, but is less than 2500m^3, the combination with other criteria will determine whether the development is classified as major.

(e) a development where twenty or less carparking spaces are required.

Editor's note—where required carparking spaces exceeds 20, but is less than 300, the combination with other criteria will determine whether the development is classified as major.

Editor's note–where a development does not meet any or only one of the criteria listed in major or minor development above, council retains the prerogative to determine whether the development is major or minor.

SC6.4.2.2 General

Council's general procedures when lodging development applications are set out below.

SC6.4.2.2.1 Pre-lodgement advice guidelines

(1) Council will facilitate pre-lodgement meetings when requested to discuss development proposals prior to lodgement. Pre-lodgement meetings can comprise of informal discussions or alternatively a formal response can be arranged for more complex applications. The latter will require advanced lodgement of details including reports, drawings and any information pertinent to the proposal to ensure an effective response to an applicant. A team of specialists will attend a formal meeting followed by written minutes of the proceedings.

Editor's note—A sliding fee will be applicable where stated in council's applicable fees and charges schedule.

Editor's note—Planning and Development's Schedule of fees and charges can be found on council's website.

Pre-lodgement discussions may include, but is not limited to, consideration of the following matters:

(a) environmentally significant areas;

(b) stormwater discharge (legal point of discharge);

(c) impacts of flooding/inundation;

(d) conceptual stormwater quality requirements and tailwater conditions/levels;

(e) overall water supply and pressure;

(f) overall sewerage reticulation;

(g) existing site conditions/constraints such as steep slopes, proximity to identified watercourses, existing utilities;

(h) lot and road layout design including existing traffic issues;

(i) traffic management strategy;

(j) landscape/streetscape;

(k) building setbacks and access requirements;

(l) relevant development permit conditions e.g. preliminary approvals or identify other required approvals e.g. referral to other agencies;

(m) variation to council standards and guidelines to explore possible solutions to design issues;

(n) design and layout; and

(o) building form and layout.

It is expected that resolving the above matters may significantly reduce the time for council officers in assessing the application and expedite the approval of the designs, presupposing all other requirements are submitted in order.

The pre-lodgement process is a without prejudice meeting designed to allow an exchange of information in respect to the intended development prior to submitting a formal development application. It is not intended to provide a detailed assessment audit against applicable planning scheme codes, planning scheme polices, or to determine the likely outcome of the proposed development. Furthermore, pre-lodgement meetings cannot take into consideration other third party interests such as referral agencies or anticipate possible adverse comments received from submitters in the notification stage.

(2) Meeting minutes will normally be taken at the meeting by a council officer, which can be forwarded to the applicant after the meeting (upon request) and registered in council's records system. However, attendees are encouraged to make their own notes.

(3) Pre-lodgement meetings are conducted by appointment only and would normally be of 1-2 hours duration depending on the complexity of the proposal. To request a pre-lodgement meeting, the applicant must complete a Pre-Lodgement Meeting Request Form (refer to SC6.4.2.2 Attachment A Pre-lodgement meeting request form), which can be submitted either by email or to the Planning and Development Counter, Level 2, Council Administration Building – Walker Street. The request must be accompanied with all relevant material including concept, layout or design plans and a brief covering letter or report detailing any specific issues.

SC6.4.2.2.2 Design requisites and quality assurance guidelines

(1) The developer/applicant is encouraged to engage and nominate appropriately qualified consultants/individuals with the required expertise to undertake design work on their behalf. The consultants are expected to have systems in place to assure the quality of the designs and the reports that they produce. It is the consultant's responsibility to ensure that the design complies with and has satisfied all relevant council requirements and conditions of the associated development approval.

Concept and detailed designs must comply with the relevant conditions of the Development Approval, council policies, Townsville City Plan and relevant provisions of this Development manual planning scheme policy. All designs must be prepared and certified by an appropriately qualified professional with relevant experience.

Quality assurance personnel shall be:

(a) engineering works - Registered Professional Engineer of Queensland (RPEQ) as defined under the *Professional Engineers Act 2002*;

(b) landscape works - Registered Landscape Architect with the Australian Institute of Landscape Architects (AILA) or a Landscape Designer with the Australian Institute of Landscape Designers and Managers (AILDM); and

(c) irrigation works - Certified Irrigation Designer or Certified Irrigation Agronomist where irrigation works are within the public realm.

(2) The Consultant must retain appropriate design records including calculations in a format such that they can be understood readily by design staff with no prior knowledge of the particular design. The design file must be maintained by the developer/applicants or the developer/applicant's consultant containing records of calculations, approvals and decisions, geotechnical data and other design data which could be relevant in reviewing aspects of the design or planning future maintenance responsibilities. Copies of records are to be made available to council on request and without charge.

(3) Council retains the right to audit all processes and documents related to the development design. The developer/applicants and the developer/applicant's consultant must provide council officers all reasonable

assistance in inspecting records of designs submitted to council for acceptance.

SC6.4.2.2.3 Documentation guidelines

To further assist developers in the process of lodging development applications, a well-made application checklist has been prepared by council and the completion of a particular checklist, and submission of all relevant accompanying information, will expedite the assessment process (refer to SC6.4.2.4 Well-made application checklists).

(1) Portable long service leave (PLSL)

Development Approvals for Operational Works cannot be issued by council until appropriate evidence of payment of the Portable Long Service Leave fees are provided as prescribed by the B*uilding and Construction Industry (Portable Long Service Leave) Act 1991*

(2) Certification and design reports

All designs to be accompanied with certification and design reports which must be signed by a qualified professional with relevant experience (see SC6.4.2.2.2(1)). The Certification Report will comprise the Certificate (SC6.4.2.2 Attachment B – Certification Report) and Design Report. The Design Report must contain documentation as required by SC6.4.2.2.3(4) and SC6.4.2.2.3(5) below.

The certification and design reports will be required with preliminary designs and will require resubmission with updates when final drawings are submitted. Certification is not required with sketch plans or concept plans.

The consultant must provide a detailed justification for each variation to or non-compliance with council's design and construction requirements, local laws, Townsville City Plan planning scheme policies and Townsville City Plan and relevant development approval conditions, as part of the Certification Report.

(3) Design drawings and work specifications

The consultant on behalf of the developer must present all design drawings and specifications for the development works to council for audit purposes.

The design drawings must be complete and clearly set out so as to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built. Unless noted otherwise, the submission should comprise a full set of plans for proposed works (1 x A3 drawings and a digital copy in PDF format correctly scaled as per council-preferred sheet size).

All work specifications must be prepared by the consultant and submitted to council for review, specifying requirements not covered by council's standard work specifications.

Full design drawings and work specifications covering all aspects of the proposed works must be submitted to council for acceptance. Standard drawings and works specifications (if available) from the following sources are to be included in order of preference:

(a) Standard drawings (SC6.4.4.8);

(b) Council design specifications (SC6.4.4) and Construction standards (SC6.4.6); and

(c) Department of Transport and Main Roads.

Where council's standard specifications are used unaltered, they may be referenced as such in the documents and may be omitted from the submitted set of specifications.

All Design drawings and work specifications must be certified by an appropriately qualified professional with relevant experience (see SC6.4.2.2(1)).

(4) Design documentation for material change of use applications

Applicants should submit the following documentation where necessary in support of the proposal:

(a) site analysis plan;

(b) elevation plans, floor plans (if necessary);

(c) traffic impact assessment, hydraulic report, geotechnical reports, acoustic report, stormwater quality

management plan, waste management safety in design report and other specialist reports necessary to support the development application;

(d) water and sewer modelling (if necessary) refer to SC6.4.3.23 Water and sewer network modelling guidelines; and

(e) landscape and irrigation plans.

(5) Design documentation for reconfiguring a lot applications
Applicants for staged developments should submit master plan documentation where necessary showing a subdivision's overall design concept for:

(a) sewer and water (including pump stations);

(b) stormwater quantity and stormwater quality (SC6.4.3.8 Stormwater quality management plans for development);

(c) earthworks including conceptual erosion and soil control plan (refer to SC6.4.4.5 Earthworks (design));

(d) road network (includes hierarchy, road and carriageway widths, noise impact and traffic studies);

(e) acoustic report, geotechnical report and any specialist report necessary to support the development application;

(f) public transport;

(g) servicing details (utilities);

(h) pedestrian and cycle network;

(i) Safety in design reports for all infrastructure that does not comply with relevant sections of the Development manual; and

(j) landscape and irrigation.

For non-staged developments; applicants should submit:

(k) lot layout;

(l) proposed road and access network;

(m) servicing details (utilities);

(n) stormwater management;

(o) Safety in design reports for all infrastructure that does not comply with relevant sections of the Development manual;

(p) Safety in design reports that demonstrate that sewer connection points and maintenance structures located at rear of lots are still accessible at all times; and

(q) any specialist report necessary to support the development application.

(6) Documentation for operational works and compliance applications
Applicants should submit where necessary to support the application the following documentation as part of the application (depending on scope of development works):

(a) design drawings (1x A3 size and an electronic copy in PDF);

(b) work specifications (one copy);

(c) copy of the associated Development Approval (if any);

(d) certified detailed Schedule/Bill of Quantities by a suitably qualified and experienced professional (see SC6.4.2.2.2(1));

(e) landscape statement of intent (see SC6.4.2.5(7)(1)(c) Landscape statement of intent);

(f) landscape and irrigation plans (see SC6.4.2.5(7) Landscape drawings and SC6.4.2.5(8) Irrigation drawings);

(g) stormwater drainage design calculations including design of structures (e.g. open drains, detention basin), catchment plans (internal and external);

(h) stormwater quality management plan including the design criteria and details;

(i) water network analysis (refer to SC6.4.3.23 Water and sewer network modelling guidelines);

(j) sewer network analysis (refer to SC6.4.3.23 Water and sewer network modelling guidelines);

(k) subgrade test results and pavement designs;

(l) engineering certification of structural designs;

(m) preliminary erosion and sediment control plan (refer to SC6.4.2.2.7 Conceptual and preliminary erosion and sediment control plan);

(n) traffic management plan (if required);

(o) traffic report (if required);

(p) geotechnical reports (where relevant);

(q) conduit assessment of existing infrastructure (refer to SC6.4.2.2.6 Conduit assessment) Safety in Design; and

(r) any other information required by the associated development approval and under relevant legislation, or relevant to support the assessment of the application.

SC6.4.2.2.4 Council's acceptance of design - advice

Council does not guarantee that the submitted designs for the proposed development have been checked in detail. Upon council's acceptance of designs for the proposed development, it is assumed that the certifying professional has performed sound judgement in preparing the designs taking into consideration existing site conditions and council requirements.

Council does not accept any responsibility for the accuracy of the submitted design and that any deficiencies and non-complying works identified by council must be rectified at the cost of the developer, notwithstanding council's prior approval.

If council's audit of the design reveals the Design Certificate Report to be inaccurate or incomplete, the submission may be returned to the consultant for resubmission. A resubmission review fee may be charged.

SC6.4.2.2.5 Preparation of design drawings guidelines

The information set out in SC6.4.2.3 Design checklists, SC6.4.2.4 Well-made application checklists and SC6.4.2.5 Details on drawings should be used as a guide to prepare design drawings. The information should be used in the preparation of plans for each group of drawings to assist council in the assessment process.

SC6.4.2.2.6 Conduit assessment

Any development which proposes to construct a structure, building or undertake earthworks in the vicinity of or within the "zone of influence" of an existing conduit may be required to identify the condition of the conduit for assessment of serviceability and structural compatibility with the proposed development work. Any upgrading or replacement determined by council will be carried out at the developer's expense prior to the commencement of any development works.

(1) CCTV inspection criteria - general criteria for closed circuit television (CCTV) sewer and stormwater assessments for operational works/compliance permits are as follows:

(a) sewer:

(i) major developments (refer to SC6.4.2.1.1(1)):

(A) prior to commencement of the defects liability period; and

(B) if defects are identified they must be rectified, and the sewer, for the entire length between the upstream and downstream maintenance holes (MHs),must be assessed again prior to completion of the defects liability period.

(ii) minor developments (refer SC6.4.2.1.1(2)):

(A) systems containing two or more sewer lengths, or systems containing sewer lengths that exceed a combined service length of 60 m measured centre to centre between manholes require assessment prior to commencement of the defects liability period;

(B) if defects are identified they must be rectified, and the sewer, for the entire length between the upstream and downstream maintenance holes (MHs),must be assessed again prior to completion of the defects liability period; and

(C) where a defects liability period does not apply, CCTV assessment is mandatory prior to acceptance.

(b) stormwater:

(i) inter-allotment systems located on private property are exempt;

(ii) rubber ringed jointed pipe systems with flexible joints immediately outside chambers (includes PVC and Polythene pipe systems) will be visually assessed and are exempt subject to the system presenting defect free;

(iii) CCTV assessment of flush end RCP pipe systems is mandatory;

(iv) major developments (refer to SC6.4.2.1.1(1)):

(A) prior to commencement of the defects liability period; and

(B) prior to completion of the defects liability period.

(v) minor developments refer to SC6.4.2.1.1(2)):

(A) systems exceeding a service length of 60 m require assessment prior to commencement of the defects liability period; and

(B) where a defects liability period does not apply, CCTV assessment of the system is mandatory prior to acceptance.

(2) Qualification and training of CCTV operators and supervisors - the assessment must be undertaken by a suitably trained and qualified contractor, in accordance with the relevant sections of the current version of Water Services Association of *Australia's Conduit Inspection Reporting code of Australia* (WSA05) and the results are to be submitted to council in CD, DVD or any digital storage device acceptable to council accompanied by a written condition assessment report to be approved in writing by council prior to the issuance of any Development Approvals.

In the event of non-compliance in preparation and submission of the conduit assessment, council may require the developer to re-perform the inspections and re-submit. All costs incurred conducting these additional conduit assessments will be the responsibility of the contractor.

(3) Site establishment – the contractor is responsible for the following requirements:

(a) any necessary approvals from statutory authorities in order to complete the required work;

(b) any temporary electric light, power installations and water supply including all charges incurred;

(c) public notification if necessary – contractor must notify affected residents/adjacent property owners/commercial business owners and council (including if the area to be closed is public open space). Additional requirements may be necessary if closures are to be over an extended period of time. Notification is required prior to commencement of work;

(d) plans of existing services are to be verified by the contractor. Council does not guarantee the accuracy of the information on these plans;

(e) environmental management plan – if necessary, the contractor must prepare and implement a site specific environmental management plan, for inspections which would involve interference to live services e.g. sewer line which poses an environmental risk. The Plan must detail activities and measures to ensure that the inspection is performed in a manner which minimises risk of causing environmental nuisance or harm;

(f) reinstatement – clean-up, repair and reinstate any areas affected or impacted by the works, at their own cost;

(g) maintaining the service in all conduits being inspected;

(h) pipe cleaning – conduits being inspected must be sufficiently clean to allow proper visual identification of existing defects. The proper disposal of debris from the cleaning shall be the responsibility of the

contractor;

(i) traffic management – where the diversion of vehicular and pedestrian traffic is required, the contractor is responsible for implementing an appropriate traffic management plan; and

(j) occupational health and safety – the contractor is required to comply with all statutory and other current regulations relating to occupational health and safety.

(4) Inspection report – The production of reports (including mandatory information), detailing the condition of surveyed conduits, all coded and scored to standards that satisfy the requirements of current WSA 05 Code.

(5) Inspection software – The preferred software for use in reporting on conduit inspections is the current of WinCan, set up to report as per the current WSA 05 code. If a contractor proposes to use alternative software, a full detail of the software must be provided to council for approval which includes the capabilities must be provided and must be fully compatible with the WinCan software.

(6) Data ownership – Full ownership of the survey and report data including intellectual property rights to the digital visual records and its contents must be with council.

SC6.4.2.2.7 Conceptual and preliminary erosion and sediment control plan

Soil disturbance is inevitable in any development; it is fundamental to develop measures to reduce the impact of soil erosion in every stage of construction to an acceptable level of sediments leaving the development site.

For reconfiguring a lot, material change of use, operational works and compliance assessment applications, depending on the scope of development, associated environmental impacts, site constraints (e.g. land use, lot layout site topography, proximity to bodies of water) and other factors, the developer should identify the erosion risk level of the proposed development, which can be determined by assessing the erosion hazard of the intended development site outlined in SC6.4.3.8 Stormwater management plans for development and *Appendix F – Erosion Hazard Assessment* of the International Erosion Control Association's *Best Practice Erosion and Sediment Control (IECA BPESC).*

Where a development site of a development application was assessed as being a high-risk site, the developer should provide a conceptual erosion and sediment control plan (CESCP). The conceptual document should take into consideration the key principles of erosion and sediment control detailed in this clause, and the site planning aspects and guideline in preparing conceptual plans in SC6.4.3.8 Stormwater management plans for development.

Where a development site was assessed as being a low-risk site and where a CESP has been accepted by council, a preliminary erosion and sediment control plan (PESCP) must be submitted to council as part of the operational works or compliance applications. The PESCP must be prepared in accordance with the design standards and technique selection outlined particularly in:

(1) Chapters 2 – Principles of erosion and sediment control;

(2) Chapter 4 – Design standards and technique selection;

(3) Chapter 5 – Preparation of plans; and

(4) also including the appropriate Model Code of Practice and Specific Guidelines in:

(a) Appendix G – Model code of practice;

(b) Appendix H – Building sites;

(c) Appendix I – Instream works;

(d) Appendix J – Road and rail construction;

(e) Appendix K – Access tracks and trails; and

(f) Appendix L – Installation of services of *IECA BPESC.*

During the Pre Start Meeting, the applicability and appropriateness of the PESCP will be reviewed on-site and revisions will be required if necessary.

For general guidance in implementation of erosion and soil control plan refer to SC6.4.3.8 Stormwater management plans for development.

SC6.4.2.2 Attachment A – Pre-lodgement meeting request form
Click here to view Pre-lodgement meeting request form.

SC6.4.2.2 Attachment B – Certification report
Click here to view Certification report

SC6.4.2.3 Design checklists

SC6.4.2.3.1 - Design Checklist 1 - Base plot of existing features
Click here to obtain a copy of the following form

SC6.4.2.3.2 - Design Checklist 2 - Horizontal road alignment
Click here to obtain a copy of the following form

SC6.4.2.3.3 - Design Checklist 3 - Vertical road alignment
Click here to obtain a copy of the following form

SC6.4.2.3.4 - Design Checklist 4 - Road cross sections
Click here to obtain a copy of the following form

SC6.4.2.3.5 - Design Checklist 5 - Road and interallotment drainage
Click here to obtain a copy of the following form

SC6.4.2.3.6 - Design Checklist 6 - Signs and markings
Click here to obtain a copy of the following form

SC6.4.2.3.7 - Design Checklist 7 - Pavement design
Click here to obtain a copy of the following form

SC6.4.2.3.8 - Design Checklist 8 - Bridge major culvert design
Click here to obtain a copy of the following form

SC6.4.2.3.9 - Design Checklist 9 - Landscape and Irrigation Plans
Click here to obtain a copy of the following form

SC6.4.2.3.10 - Design Checklist 10 - Erosion and sedimentation control plans
Click here to obtain a copy of the following form

SC6.4.2.3.11 - Design Checklist 11 - QAF0477 Sewage pump station and pressure main checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.12 - Design Checklist 12 - QAF0477 Sewer reticulation checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.13 - Design Checklist 13 - QAF0478 Water reticulation checklist
Click here to obtain a copy of the following form.

SC6.4.2.3.14 - Design Checklist 14 - QAF0479 Water and sewer model checklist
Click here to obtain a copy of the following form.

SC6.4.2.4 Well-made applications checklists

SC6.4.2.4.1 - Material Change of use - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.2 - Reconfiguring a lot - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.3 - Compliance - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.4.4 - Operational Works - Development Assessment Checklist
Click here to obtain a copy of the following form

SC6.4.2.5 Details on drawings guidelines

SC6.4.2.5.1 General requirements guidelines

(1) The information shown on the drawings must be logically collected on discrete sheets to avoid illogical and onerous effort in cross referencing between sheets in order to find information. This policy section details

minimal information requirements for plans and drawings submitted for assessment.

(2) Drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information.

(3) The preferred submission method is uploading to the Townsville Online Lodgement System (TOLS). The preferred sheet sizes of drawing sheets are:

(a) A1 size (841 mm x 594 mm); and

(b) A3 size (420 mm x 297 mm).

(4) The preferred scales for use should generally conform with the recommendations of AS 1100.101 *Technical Drawing – General principles*. Generally the following scales are to be used 1:10, 1:20, 1:50 and multiples of 10 of these scales.

(5) Electronic and hard copies of drawings should be true to scale A1 size sheets and be suitable for black and white printing, copying and photo reduction to A3 size without loss of clarity.

(6) The drafting should be of a standard generally in accordance with the requirements of AS 1100.

(7) Title block – All drawings must, within the boundaries of the title block, clearly indicate the following:

(a) project title e.g. estate name (if any);

(b) real property description;

(c) locality;

(d) developer's name;

(e) details on contents of drawings e.g. sewer reticulation;

(f) scales – bar scales;

(g) plan and sheet number;

(h) schedule and date of revisions;

(i) survey datum;

(j) street names;

(k) date of initial issue;

(l) legend and north point; and

(m) signed design certification.

(8) Typical scales – the following scales are suggested for particular uses but these may be varied as appropriate to the works concerned:

(a) plans – 1:1000 (rural) and 1:500 (urban);

(b) longitudinal section horizontal – 1:1000 (rural) and 1:500 (urban);

(c) longitudinal section vertical – 1:100 (rural) and 1:50 (urban);

(d) intersection details - 1:250 or 1:100; and

(e) cross sections – 1:100.

(9) Survey datum – Level information should be referenced to the Australian height datum (AHD). Position coordinates should be tied to the GDA94 datum based on the Mapping Grid of Australia (MGA) coordinate system.

(10) Dimensioning

(a) Units - All units should be expressed in metric units. Linear dimensions on all roadworks plans, with the

exemption of some details of small structures and standard details which may be in millimetres.

(b) Chainages – Chainages on plans should be expressed to three decimal places of a metre e.g. 0.123 m.

(c) Cross section intervals – Road cross sections should be provided at 20 metre intervals, with further subdivision to 10 metre or 5 metre intervals where necessary due to horizontal or vertical curvatures.

(d) Grades – Road and pipe grades should be shown to three significant figures in percentage e.g. 1.234%.

SC6.4.2.5.2 Layout and stage plan guidelines

(1) For large developments, the layout plan shows the relationship of all new roads to each other, and to existing roads adjoining the development.

(2) Where development is planned in stages, the boundaries of proposed stages are shown on the plan, and the stages identified by numbering.

(3) Existing and proposed streets which are adjacent to or fronting the proposal are included on the layout plans.

(4) All services, natural features, significant trees and the like are shown on existing road reserves.

(5) Details of the permanent survey mark, including the AHD level from which the levels were transferred, are included.

SC6.4.2.5.3 Roadworks and associated drainage drawings

(1) Plan – drawing should include the following details:

(a) road reserve boundaries;

(b) lot boundaries, both existing and proposed (levels provided at each boundary corner) and easements;

(c) centreline or other construction line;

(d) chainages on centreline or construction line or set out co-ordinates;

(e) bearings of the centreline or construction line;

(f) offsets (in tabular form) if the construction line is not the centreline;

(g) tangent point chainages or co-ordinates of each curve;

(h) radius and tangent length and superelevation of each curve;

(i) road reserve boundaries, centreline, and bearing of each intersecting road;

(j) chainage or co-ordinates of the intersection point of road centrelines;

(k) kerb lip lines, kerb types, kerb face (setout) radii and chainage or co-ordinates of all tangent points of kerb face (setout) lines;

(l) edge of pavement, where no kerb and channel is proposed;

(m) dimensioned road reserve, verge, concrete footpath and pavement widths, where these differ from the standard cross section;

(n) location and details of signs and road markings proposed;

(o) drainline locations(including interallotment drainage), diameters and class of pipes or size of box culverts, open drains and easements and invert levels;

(p) the defined flood event levels;

(q) manhole locations, chainage and offset or co-ordinates and invert and kerb levels;

(r) stormwater flow arrows;

(s) inlet pit and manhole locations tabulated to include type, type of jointing chainage;

(t) culvert/channel and other structures details;

(u) location of existing utilities or other existing works within the site;

(v) limits and levels of lot filling or grading;

(w) cut or fill depths and earthwork quantities;

(x) co-ordinates of all set out points;

(y) retaining wall (including details);

(z) location and levels of bench marks and reference pegs;

(aa) service conduits locations;

(ab) details of all existing construction on or adjoining the proposed works; and

(ac) longitudinal and cross sections with invert levels and the required flood levels including existing and proposed surface contours of constructed or natural open channels (e.g. table drains) and waterways (including landscape, construction details and maintenance).

(2) Detail plans of intersections, turnaround areas, property accesses, cul-de-sac, traffic calming (LATM) devices (if required) and the like.

(a) Intersection detail plans include all relevant information required for plans together with additional details such as tangent point chainages, kerb lip levels on all kerb returns, pavement contours and channelisation works.

(b) The plans should also include relevant information as listed for standard cross section SC6.4.2.5(3)(4)).

(3) Longitudinal sections of roads – the longitudinal section of each road includes:

(a) chainages;

(b) datum RL, existing surface and peg levels;

(c) design road centreline and lip of kerb levels and grades;

(d) cut or fill depths and earthwork quantities;

(e) design grades, length and radii of vertical curves;

(f) chainage and level of grade intersection points and tangent points of vertical curves;

(g) sight distance diagram for each direction of travel for collector or higher order roads only;

(h) line marking (where applicable);

(i) details of superelevation (where possible);

(j) drainage lines and manholes intersecting centre line;

(k) table drain grading and levels where no kerb and channel;

(l) sight distance diagram for each direction of travel;

(m) horizontal curve details;

(n) existing and proposed services; and

(o) pavement design and design speed.

(4) Type cross sections of road - a standard cross section is shown for each road, including:

(a) road reserve width;

(b) pavement widths (lip to lip dimension);

(c) road verge widths;

(d) concrete footpath and cycle paths;

(e) crossfalls of pavement and road verges;

(f) pavement depth (including subsoil drainage);

(g) type of kerb and channel;

(h) type of pavement surfacing;

(i) batter slopes; and

(j) pegged or shift centre line.

(5) Cross sections of roads – a cross section is shown for each chainage on each road.

(a) A cross section should be shown at a minimum spacing of 20 m. Where roads are in steep terrain, cross sections may be required at closer intervals. Cross sections are to be extended into the allotments for the limit of batters. The cross-section plans are to include:

(i) road reserve boundaries;

(ii) pavement centreline, and shift centre line or other construction lines;

(iii) natural surface;

(iv) design cross section;

(v) crossfall of pavement and road verge, pavement and road verge widths, and pavement depths, wherever these differ from the standard cross section, e.g. superelevation and curve widening;

(vi) pavement and subsoil drainage; and

(vii) chainages.

(b) When existing bitumen sealed roads are widened, cross sections include the full existing sealed pavement cross section at not more than 10 m intervals.

(c) Each cross section shows the percentage crossfall on the existing bitumen surface and the design crossfall to the lip of the proposed kerb and channel.

(d) Notations on drawings also require the Supervising Engineer to check for any errors between the design and the set out of the kerb and channel before the kerb and channel is constructed.

(6) Traffic signs and pavement markings plan – all required signage and pavement markings (including temporary works) are to be provided in accordance with the current version of the MUTCD, Queensland.

(7) Longitudinal sections of drainlines – a longitudinal section of each drainline should be drawn along the centre line of the drainline and should show:

(a) chainages;

(b) existing and proposed surface levels;

(c) design invert levels, hydraulic grade lines, velocity, discharge;

(d) manhole chainages, inlet and outlet invert levels, and finished surface levels of structures;

(e) distances between manholes;

(f) grade in percent, diameter, type and class of each pipe or size of each box;

(g) references to the Council's current standard drawings;

(h) class of each pipe, length and type of pipe;

(i) existing and proposed service locations and levels;

(j) all piped drainlines and constructed or natural channels used to convey run-off as part of the development are shown on drawings;

(k) longitudinal sections and cross sections of all channels show the calculated hydraulic grade line for the design frequency; and

(l) piped drainlines are included either on the road longitudinal sections where applicable or detailed separately.

(8) Stormwater drainage catchment plan – the catchment plans should indicate all catchments including external catchments contributing to the stormwater drainage design and the following:

(a) full external catchment;

(b) development layout plan showing the roads and allotment boundaries;

(c) existing and finished surface contours (in different line types). Contour intervals are to be sufficient to enable sub-catchments to be defined;

(d) contours must be extended external to the site to enable the limits of all external catchments to be fully defined;

(e) subcatchment boundaries, labels and areas;

(f) location of drainlines, manholes, inlet/gully pits, outlets, open drains etc.; and

(g) labelling of stormwater structures.

SC6.4.2.5.4 Bicycle, pedestrian and shared path drawings guidelines

(1) All plans for bicycle, pedestrian and shared paths are to be presented at the reduction ratio 1:500 minimum or 1:200 preferable. The plans are to include details of the signs and pavement markings to be used and any barriers, fences, holding rails, ramps, etc. The landscaping treatment should also be included in the plans.

(2) The cycleway bicycle path plan sheet may be incorporated into the road plan where clarity permits. Specific details are to be provided at reduction ratio 1:200.

(3) Longitudinal sections will be required for all off-road pathways where grades are greater than or equal to 3%.

(4) Longitudinal sections will have reduction ratios of 1:500 horizontal and 1:50 vertical.

(5) Cross sections will be presented at 1:100 reduction ratio (natural) and transition tables will be required where cross falls vary or superelevation is provided.

(6) A typical cross section will be detailed to indicate pavement materials and layer depths.

SC6.4.2.5.5 Sewerage drawings guidelines

(1) Sewerage layout plan - the sewerage layout plan includes:
For development consisting of two or more stages, a preliminary master layout plan showing boundaries of all stages. The plan shows proposed locations and sizes of all trunk mains, pumping stations and sewage treatment plants, where relevant.
In addition, the sewerage layout includes:

(a) boundary of the development, lot layout and numbers, easements (if required), finished surface contours;

(b) non-sewered areas;

(c) references to the council's current standard drawings;

(d) location, grades of all sewer lines, manholes (numbered) and other services where they cross;

(e) indicate trunk mains;

(f) pumping stations, maintenance structure numbers and sewer diameters;

(g) site plan for sewerage pump stations; and

(h) details of water and electricity supply, landscaping, access and control buildings, if applicable.

(2) Sewerage longitudinal sections - the longitudinal section of each sewer line includes:

(a) upstream and downstream invert levels;

(b) existing and finished surface levels, depth to invert;

(c) grade expressed as 1 in XX;

(d) diameter, type and class of pipe;

(e) chainage;

(f) distance between maintenance structures;

(g) concrete stops, where required;

(h) manhole and/or shaft number;

(i) manhole type and drop type;

(j) location and depth of all underground services; and

(k) the design invert level of each house connection branch, type and invert level of the branch.

SC6.4.2.5.6 Water drawings guidelines

(1) Water reticulation layout plan
For developments consisting of two or more stages, a master layout plan showing stage boundaries should be provided. Locations of existing or proposed trunk mains, treatment plants or reservoirs are to be shown on plan.

In addition, a water reticulation layout plan showing:

(a) pipe location;

(b) pipe material, diameter, type, class and joints, including fittings;

(c) fire hydrant, valve, bends, junction locations;

(d) size and location of all concrete anchor blocks, thrust blocks, and diaphragm walls;

(e) cut-in details;

(f) cross-road conduit locations;

(g) specific notes and instructions;

(h) boundary of the development, lot layout and numbers, including easements;

(i) proposed location for any pump stations, showing access details;

(j) references to council's current standard drawings (SC6.4.4.8 Standard drawings);

(k) dimension from road alignment boundary/property boundary;

(l) minimum clearances to other services;

(m) pipe and fitting, internal and external protection details including at road pavement crossings;

(n) trench cross section detail showing the pipes as well as bedding and filling materials for each size and type of pipe;

(o) pump curves if appropriate;

(p) complete pipe work and structural details of any pump stations, including complete details of valves and other fittings and electrical details; and

(q) technical specifications for pumps and pump stations.

SC6.4.2.5.7 Landscape drawings guidelines

(1) Applications including landscape works, detailed plans and documentation containing the following minimum amount of information should to be provided, as applicable and in support of the proposal:

(a) Demonstration of design preparation and certification by qualified personnel (refer SC6.4.2.2.2(1)).

(b) Landscape plans, providing the following minimum amount of information, as applicable:

(i) specification notes for plant establishment period and maintenance;

(ii) existing site information, boundaries, contours, underground/overhead services, easements, drainage lines, or the like;

(iii) adjoining structures that overshadow the site;

(iv) details of protected vegetation, significant trees that are proposed for retention and trees proposed for removal due to the development;

(v) the canopy height and spread of any major tree or building footprint on adjoining property which the proposed development may affect in any way. The incorporation of a qualified arborist's findings may be relevant where adjoining tree root zones or canopy extends into the development site;

(vi) specification notes either on the drawings or in an associated report that adequately outlines the quality of construction materials, and all other relevant information;

(vii) proposed location of buildings/structures including finished floor levels;

(viii) roadways, car parks, footpaths, driveways with description of materials and finishes;

(ix) all areas and their proposed treatment such as surface treatments, planting layout, planting schedule, including botanical names, stock sizes, quantities, staking and planting details;

(x) fences and screens indicating materials, heights and construction details;

(xi) location and details of street or park furniture, fixtures and lighting;

(xii) indicative cross-sections of important features or areas of the site such as entrances, waterways and retaining walls;

(xiii) details of irrigation system;

(xiv) proposed design levels and original ground levels/contours;

(xv) design details and materials of all surfaces, retaining walls, edging, embankments, furniture,

planting, lighting and other structures including entry statements;

(xvi) typical cross sections through the site; and

(xvii) construction details for planting, paving, edging and retaining structures.

(c) Landscape statement of intent, describing:

(i) how the proposed landscaping meets the intent of the (SC6.4.3.6 Landscape policy) ;

(ii) how the proposed landscaping address the sites opportunities and constraints; and

(iii) the underpinning concepts incorporated into the landscape design and how these relate to and deliver cost-effective sustainable outcomes.

(d) locality map illustrating surrounding reserves/natural areas, roads and local features.

(e) existing site conditions and base information including:

(i) site boundaries, levels and contours;

(ii) description and location of built elements, including “off street car parking”;

(iii) site analysis identifying opportunities and constraints;

(iv) description of all remnant vegetation present and any landforms (for example dunes, gullies, wetlands, waterways, rock formations);

(v) location of existing trees and identified vegetation to be retained including Vegetation Protection Zone/s and protection and management provisions as per SC6.4.5.2.1(18) Work adjacent to trees and protection of environmentally significant vegetation;

(vi) canopy height and spread of any major tree or building footprint on adjoining property which the proposed development may affect in any way. The incorporation of a qualified arborist’s findings and implementation Vegetation Protection Zone of may be relevant where adjoining tree root zones or canopy extends into the development site;

(vii) location of existing trees and identified vegetation for removal;

(viii) existing driveways, footpaths, adjoining driveways etc. including finished surface/s;

(ix) adjoining structures that overshadow the site;

(x) significant features pertaining to the application e.g. the location of refuse collection areas;

(xi) existing grading and drainage in relation to the landscaping (overland flows to be identified) with inlet and discharge points clearly shown; and

(xii) underground and overhead services (water, power, telecom and gas) easements and drainage lines.

(f) landscape details and schedules including:

(i) proposed design levels and original ground levels/contours;

(ii) typical cross sections through the site including surface grades;

(iii) method of erosion control for slopes steeper than 1:4;

(iv) grading and drainage in relation to the landscaping (overland flows to be identified) including surface and subsurface drainage, collection points, and discharge points clearly shown;

(v) surface treatment for hardscape areas including accurate location, dimensions, construction notes, details and finishes of concrete footpaths, paving, roadways, car parks, driveways, boardwalks and the like;

(vi) existing and proposed levels of building slab, hard surfaces, drainage grates and landscaped areas, especially adjacent to trees to be retained;

(vii) indicative cross-sections of important features or areas of the site such as entrances, waterways and retaining walls;

(viii) location and details of furniture, fixtures and lighting, where applicable;

(ix) fencing and screening locations including height, material and finish, to boundaries and pool area (if applicable);

(x) details and soil depth of planter boxes and podiums including inlet and discharge points for drainage;

(xi) location, dimensions and construction details for any other proposed works or structures or external elements;

(xii) calculation of the square metre area of landscape and recreation area;

(xiii) surface treatment for all softscape areas including accurate location, dimensions, planting notes, details and methods of establishment or transplanting for garden beds, lawn areas, and other softscape elements;

(xiv) planting bed preparation details/notes including excavation, cultivation, imported topsoil depths, mulch type and depth, fertiliser or soil additive type and application rate where the council specification is not being applied;

(xv) planting plan including planting layout, plant code, stock sizes, quantities, staking and planting details;

(xvi) plant schedule containing plant code, plant species, location, quantity and spacing and size of container (and approximate size of the plant if requested as part of a condition) as per Table SC6.4.2.1 below;

Table SC6.4.2.1 Example of plant schedule

Plant code	Plant name	Location	Qty	Spacing	Container size
1	Rhoeo spathacea	Garden 1	30	500mm centres	140mm
2	Carpentaria acuminata	Garden 2	3	As per plan	25 Litre
3	Callistemon Capt Cook	Garden 1 & 2	10	1 metre centres	150mm

(xvii) specification notes (either on the drawings or in an associated report) that adequately outline the quality of construction materials, and all other relevant information; and

(xviii) specification notes for the plant establishment period and maintenance including responsibility for plant replacement and maintenance.

(2) For public open space, streetscaping or works that will become council assets, council may request more detailed information including:

(a) General details such as:

(i) demonstration of design preparation and certification by qualified personnel (see SC6.4.2.2.2(1));

(ii) designer's name and/or company;

(iii) drafter's name and/or company; and

(iv) surveyor's name and/or company.

(b) Additional details pertaining to open space or streetscaping (existing and proposed) including but not limited to:

(i) geotechnical and soil test results;

(ii) site plan, including relationship to existing infrastructure and details and responsibilities relating to removal or modification of council assets;

(iii) details of type, manufacturer, materiality, and warranty of furniture, equipment and structures (such as play equipment, park furniture, shade shelters) including compliance with relevant standards where applicable;

(iv) the location and details of any stormwater quality management infrastructure to be constructed including maintenance access to the infrastructure;

(v) calculation of the square metre area of landscaping to be planted, broken down into turfed and mulched and planted areas;

(vi) other works proposed in the location/public open space, which do not form part of the detailed landscape plan, but may impact the landscape works or council assets (such as vegetation management, rehabilitation and environmental management plans);

(vii) the location and details of any stormwater discharge through or into a public open space or

waterway; and

(viii) where plantings are proposed in the road reserve, the provision of a plan showing an accurate footprint, including trunk diameter (at 1.2 m from ground level) and canopy spread of all existing trees and expected diameter at maturity for proposed street trees adjacent to the property and roads concerned, including any trees that are proposed to be removed.

(c) Maintenance plan pertaining to ongoing maintenance of public open space infrastructure or streetscaping, including but not limited to:

(i) schedule that lists the assets and associated maintenance activities, including locations, season of visit, schedule frequency and number of visits per year;

(ii) statement demonstrating alignment with council public open space management specifications;

(iii) Bill of Quantities (BOQ) that identifies the relevant types and quantities of each asset;

(iv) detailed specifications for specialist activities and/or infrastructure including, but not limited to, playground and fitness equipment, public art, ablution facilities, water features, stormwater quality infrastructure, bridges, and revegetation areas;

(v) that the landscape maintenance plan has been prepared by a suitably qualified horticulturist or landscape designer (or irrigation designer for any irrigation system component of the landscape management plan); and

(vi) an approved traffic management plan relating to all ongoing maintenance activities that will be required within the road reserve or require ongoing traffic management.

(d) Other applicable (written) approvals, including but not limited to:

(i) asset owner approval of works, including buildings and structure, where the works are within a designated parkland or affecting other council assets; and

(ii) all other approvals or certifications necessary for the completion of works in accordance with the Laws of Australia, Laws of the State of Queensland, Townsville City Council Local Laws and Ordinances.

SC6.4.2.5.8 Irrigation drawings guidelines

(1) For all irrigation works, detailed plans and documentation containing the following minimum amount of information are to be provided, as applicable:

(a) standard plan legend as shown in SC6.4.4.8 Standard drawings (Irrigation drawings).

Note—the symbols and line types shown in the Legend are the acceptable convention for design plans to be used to represent the components of the design. Additional symbols and line types may be introduced provided they are shown in the Legend on the drawing.

(b) valve key displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(c) sprinkler key displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(d) locality plan outlining the location of the site appropriately labelled with the suburb and street names;

(e) name of all adjacent roadways;

(f) location of water meter, backflow device, automatic controller, valve boxes;

(g) details of irrigation system and connection (town supply or bore water);

(h) irrigation design data displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings);

(i) irrigation cabling/wiring schedule displaying the relevant information as shown in SC6.4.4.8 Standard drawings (Irrigation drawings); and

(j) design notes detailing relevant design criteria e.g. Sprinkler Type A is to be Hunter PGP; all Solenoid valves are to be Hunter ICV; descriptions of the Symbols and Line Types used from the Plan Legend.

(2) For all irrigation in public open space works, streetscapes or works that will become council assets, council may request more detailed information in addition to the general irrigation works requirements previously outlined, including:

(a) general details such as:

(i) demonstration of irrigation design preparation and certification by qualified personnel being a Certified Irrigation Designer or Certified Irrigation Agronomist including certification number;

(ii) designers name and/or company;

(iii) drafters name and/or company; and

(iv) surveyors name and/or company;

(b) additional details pertaining to irrigation within public open space or streetscapes (existing and proposed) including but not limited to:

(i) details and responsibilities relating to removal or modification of council irrigation assets;

(ii) details of type, manufacturer, materiality, and warranty of irrigation system component including compliance with relevant standards where applicable;

(iii) the location and details of any irrigation associated with stormwater quality management infrastructure to be constructed including maintenance activities and access to the irrigation infrastructure;

(iv) calculation of the square metre areas of irrigation against the irrigation system type and profile levels;

(v) other works proposed in the location/public open space, which do not form part of the detailed irrigation plan, but may impact the irrigation works or council assets; and

(vi) where irrigation is proposed in the road reserve, the inclusion of offset details from lanes of traffic to irrigation infrastructure;

(c) maintenance plan pertaining to ongoing maintenance of irrigation infrastructure or streetscaping, including but not limited to:

(i) leak and blockage checks in irrigation lines and emitters;

(ii) reprogramming the irrigation controller and restationing of emitters as plants grow, die out and are replaced;

(iii) inspection of moisture sensors;

(iv) maintenance of tanks and cisterns;

(v) checking of water pumps; and

(vi) an approved traffic management plan relating to all ongoing maintenance activities that will be required within the road reserve or require ongoing traffic management; and

(d) other applicable (written) approvals, including but not limited to:

(i) asset owner approval of works, where the works are will affect council irrigation systems or other council assets; and

(ii) all other approvals or certifications necessary for the completion of works in accordance with the Laws of Australia, Laws of the State of Queensland, Townsville City Council Local Laws and Ordinances.

SC6.4.3 Design standards

SC6.4.3.2 Building over or adjacent to services

SC6.4.3.2.1 Introduction

(1) Purpose

This sub-section outlines council's standards and guidelines for building over or adjacent to council's services. This document will supplement the Queensland Development Code *Mandatory Part 1.4 – "Building over or near relevant infrastructure"* and identifies and provides additional guidance about any information that may be required to support a development application. This section does not replace or override any aspect of the QDC.

(2) Scope

This sub-section applies to all building work proposed to be carried out over or near to a council service or underground asset.

(3) Principles

The construction and erection of a structure or the creation of a residential allotment over or near to a council service must be carried out in a way that ensures that:

(a) the function of the service is not adversely affected;

(b) no additional load is placed on the service without council approval; and

(c) maintenance access (at all times) to the service is not interfered with or restricted.

SC6.4.3.2.2 Restricted development

(1) Without exception, council will not permit building a structure over or near to:

(a) sewer pressure mains and overflow pipework; or

(b) gravity sewer trunk mains; or

(c) sanitary drainage connection points; or

(d) water supply mains; or

(e) stormwater drainage conduits (pipes or culverts) with a capacity of less than 2% average exceedence probability (AEP) or stormwater pipelines with an internal diameter of less than 375 mm; or

(f) open drainage channels or overland drainage paths.

SC6.4.3.2.3 Allowable development over or adjacent to sewerage services

(1) Council may permit building a structure over or near to the following sewerage services:

(a) gravity sewer mains, other than gravity trunk mains excluded under section SC6.4.3.2.2. The applicant is to carry out an internal closed-circuit television inspection of the main and submit it to council, prior to commencing any construction activities over or adjacent to the sewer.

If the main is assessed to be in poor condition or liable to damage from the proposed construction, the applicant may be required to replace the main to the satisfaction of council prior to commencement of any construction activities over or adjacent to the sewer; and

(b) sewer maintenance holes in commercial or industrial buildings:

If approved, the chamber is to be raised to the floor level of the building. Maintenance holes must be sealed against gas leaks, bolted down and kept clear of obstructions for maintenance access by council at all times.

SC6.4.3.2.4 Allowable development over or adjacent to stormwater services

(1) Council may permit building a structure over or near to the following stormwater services:

(a) drainage conduit with a minimum 2% AEP and with an internal diameter greater than 375 mm. The applicant must carry out an internal closed-circuit television inspection of the stormwater conduit and submit it to council, prior to commencing any construction activities over or adjacent to the stormwater conduit. If the stormwater conduit is assessed to be in poor condition or liable to damage from the proposed construction, the applicant may be required to replace the main to the satisfaction of council

prior to commencement of any construction activities over or adjacent to the stormwater conduit. Council may permit a driveway or temporary or light steel framed structure to be constructed over a storm water drain where:

(i) maintenance access to the drain can be retained;

(ii) the drain does not also form part of an overland flow path; and

(iii) no other option is available.

SC6.4.3.2.5 Clearances

The following minimum clearances apply for structures permitted to be built over or adjacent to a service:

(1) a minimum clearance of 250 mm must be maintained between the outside edge of the service footprint and the nearest projection of the foundation of the proposed structure, excluding swimming pools. Swimming pools must be located to achieve a minimum clearance of 600 mm vertically and 1 m horizontally to the outer edge of the service footprint;

(2) a minimum horizontal clearance of 1.2 m must be maintained between the outer face of the service and the nearest point of the foundation of the structure;

(3) the foundation of any structure, excluding a swimming pool, located within the zone of influence must extend a minimum of 150 mm below the projected zone or on solid rock. Pier and beam footings are generally acceptable;

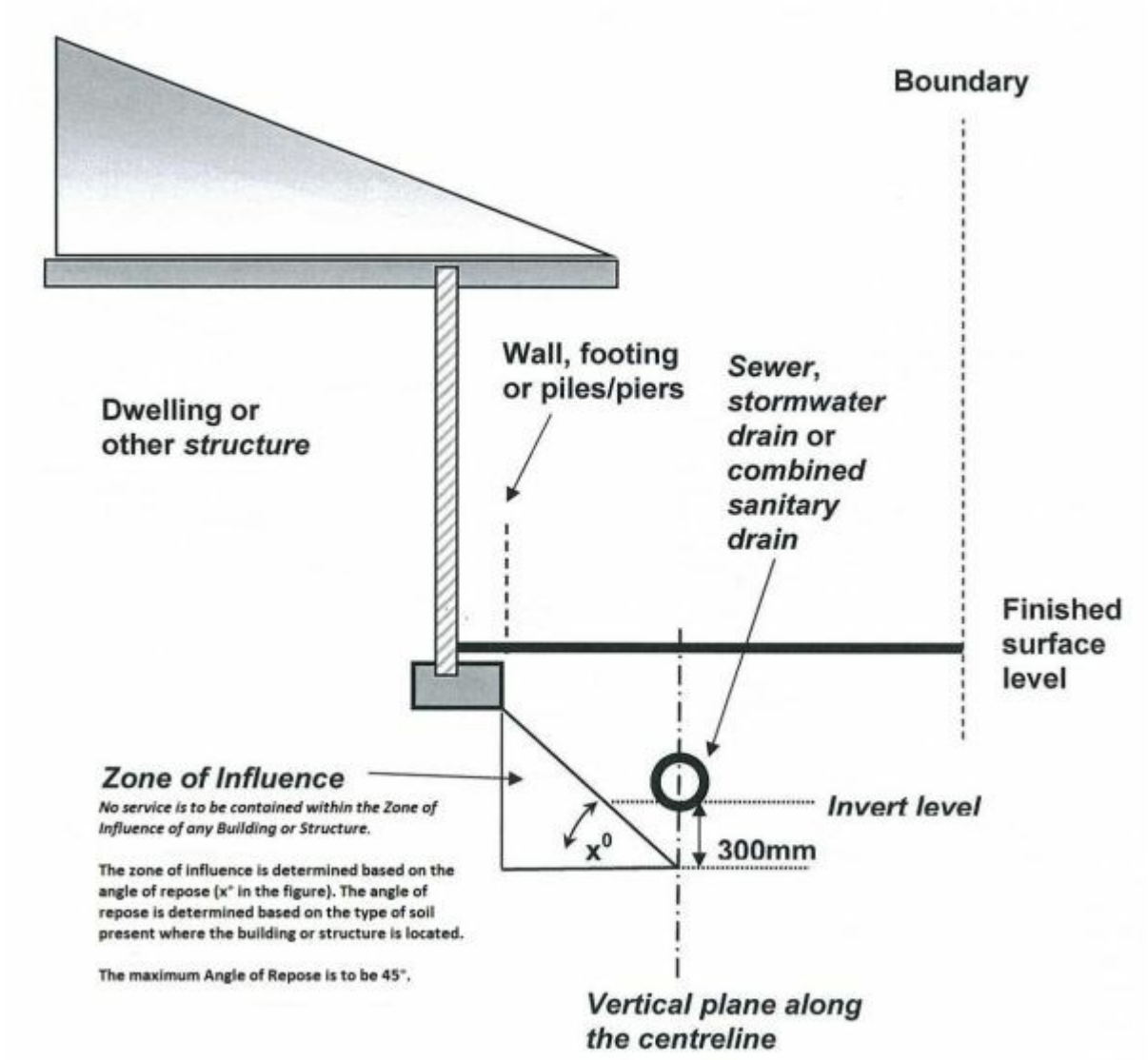


Figure SC6.4.3.2.1 Zone of influence

(4) a minimum clear vertical space above a sewer manhole of 2.4 m must be maintained above the finished ground

surface level for access purposes;

(5) a minimum horizontal clear space of 2.0 m must be maintained between structure and connection point on sewer, connection point on sewer refers to oblique branch (OB), vertical jump-up (VJU) and sewer maintenance structure; and

(6) a minimum horizontal clear space of 2.0 m must be maintained between structure and outside face of gravity trunk sewer.

SC6.4.3.2.6 Relocation of services

(1) Council will require that a service is relocated at the developer's expense where:

(a) no other site is reasonably available for the location of the proposed structure;

(b) the proposed structure is in conflict with, or likely to cause damage to, a council service.

(2) If council in its absolute discretion considers it necessary for a service to be relocated as a consequence of a proposed development, the re-design must consider:

(a) the feasibility of redesign or relocation;

(b) terrain;

(c) cost;

(d) importance of the service; and

(e) suitability for future maintenance access.

SC6.4.3.3 Footpath treatment policy

SC6.4.3.3.1 Purpose

(1) The purpose of the Footpath treatment policy is to achieve an appropriate footpath treatment and installation to achieve consistency of surfacing material located in key areas across Townsville, commensurate with the streetscape intent having regard to:

(a) the projected level of usage in a given location, such as shared-use or heavy traffic movements;

(b) activities anticipated to occur within the verge at the given location and safety requirements; and

(c) the desired streetscape character of the location, giving particular attention to the relevant zone code.

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of treatments.

(2) Reference and source documents:

(a) This subsection should be read in conjunction with other sections of the Townsville City Plan and Development manual planning scheme policy including, but not limited to:

Part 4 Priority infrastructure plan
Part 9.3.3 Landscape code
Part 9.3.4 Reconfiguring a lot code
Part 9.3.6 Works code
SC6.4.2 Development application guidelines
SC6.4.3.4 Outdoor dining design
SC6.4.3.6 Landscape policy
SC6.4.3.20 Public lighting and utility services
SC6.4.4.1 Geometric road design
SC6.4.4.2 Pavement design
SC6.4.4.7 Bicycle, pedestrian and shared path design
SC6.4.6 Construction standards

(b) The following Australian Standards are also referenced and should be read in conjunction with this sub-section:

AS/NZS 1158.3.1 Lighting for roads and public spaces
AS 1170 Structural design actions (set)
AS 1428 Design for access and mobility (set)
AS 2890.3 Parking facilities – Bicycle parking facilities
AS 3996 Access covers and grates
AS 3727 Guide to residential pavements
AS/NZS 4586:2004 Slip resistance classification of new pedestrian surface materials

(c) Other:

The following documents are also referenced and should be read in conjunction with this subsection:
Austroads, Guide to Road Design (Set):
Aust Roads – Road Design Part 4 Intersections and Crossings, section 8 Pedestrian Crossings
Aust Roads – Road Design Part 4 Intersections and Crossings, section 9 Cyclist Crossings
Aust Roads – Road Design Part 6A Pedestrian and Cyclist Paths

Department of Transport and Main Roads, Manual of uniform traffic control devices (MUTCD), Queensland.
Department of Transport and Main Roads, Traffic and Road Use Management Manual, Volume 1 – Part 6: Intersections, Interchanges and Crossings, Section 3.4-1 Pedestrian crossing facility guidelines and prioritisation system user guide Queensland Government, Crime Prevention through Environmental Design, Guidelines for Queensland, Parts A and B, 2007.

SC6.4.3.3.2 Footpath treatment

(1) The standards and requirements of this policy sub-section will achieve compliance with Townsville City Plan where the planning scheme code notes this policy as providing compliance.

Editor's note— Part 9.3.3 Landscape Code, Part 9.3.4 Reconfiguring a lot code and Part 9.3.6 Works Code each have outcomes that can be achieved by this policy sub-section, in addition to the relevant zone code.

(2) The locations where footpath treatment standards of this policy are to be met are shown in SC6.4.3.3.7 Footpath treatment location maps. In general, the following locations require footpath treatment in accordance with this policy sub-section:

(a) the Principal central (CBD) and key development areas supporting the CBD;

(b) other key activity centres (generally those in the Centre zones category and Specialised centre zone), in particular along the supporting roads and streets where attractive pedestrian streetscapes are intended by the zone and precinct;

(c) key infill areas, including medium density and higher density residential areas where there is an emphasis on creating attractive and pedestrian-oriented streetscapes;

(d) facilities with high levels of public use warranting improved footpath treatment such as: educational establishments (schools, TAFE colleges), places of worship etc., the finish of the footpath treatment shall be at the discretion of the Townsville City Council;

(e) mixed use areas that have frequent pedestrian use have a highly visible frontage or where attractive pedestrian environments are intended by the zone and precinct;

(f) special footpath type areas such as Magnetic Island, The Strand, Palmer Street and Sir Leslie Thiess Drive; and

(g) any new centres, commercial, mixed use and community uses that are not identified in SC6.4.3.3.7 Footpath treatment location maps. In such instances, the above criteria shall be used to determine the most similar development to inform the particular treatment to be applied.

Editor's note—for any other areas not covered by SC6.4.3.3.7 Footpath treatment location maps see SC6.4.4.7 Bicycle, pedestrian and shared path design.
Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for location of proposed treatments.
Editor's note—for land with the Townsville City Waterfront Priority Development Area (PDA) additional criteria applies, see the Townsville City Waterfront Priority Development Area Development Scheme.

SC6.4.3.3.3 Footpath treatment standards

(1) Footpath treatment standards for each of the nominated locations identified in SC6.4.3.3.7 Footpath treatment location maps are set out in the following Tables.

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT1 – Footpath Treatment 1	
Statement of intent - FT1	
Footpath treatment 1 serves the core retail and entertainment areas of the Principal centre (CBD). The treatment provides the highest finish intended to support high levels of pedestrian use and may provide for on street dining, and informal and formal recreational and civic spaces.	
Body of footpath and driveway crossings: FT1	
Description:	• footpath treatment FT1 shall be full width from building line to the road kerb alignment. • two kinds of stone pavers of varying length and width set in mortar on mass concrete base (see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving) • facing: split face finish to top (saw cut other edges) • image: refer to Figure SC6.4.3.3.2 Image FT1.

Pattern:	• staggered pattern as shown in Figure SC6.4.3.3.1 Conceptual diagram: FT1, and Figure SC6.4.3.3.2 Image FT1. • pavers shall be laid alternatively 200mm and 100mm wide with the basalt (darker) paver towards the building line and the granite (lighter) paver towards the kerb. • a staggered transition between the pavement types shall occur at approximately 70 per cent basalt 30 per cent granite, see Figure SC6.4.3.3.1 Conceptual diagram FT1.
Grout:	• product: CTA Polyblend G15 or approved equal. • colour: ‘Mid Grey’.
Pavers:	• basalt: 100% grey range (darker stone in Figure SC6.4.3.3.1 Conceptual diagram FT1) • granite: ‘Sindoor Brown’ (lighter stone in Figure SC6.4.3.3.1 Conceptual diagram FT1) • width: 200 mm or 100 mm (refer varying widths in Figure SC6.4.3.3.1 Conceptual diagram FT1) • length: 300 mm or 500 mm • depth: 40 mm
Driveway and pedestrian crossing point	
Description:	• driveway access through footpath shall be monolithic poured colored concrete slabs, colour to be matched to the basalt paver, with saw cut detailing to match adjacent paver pattern (scoring cuts only 5mm deep). See Figure SC6.4.3.3.3 Image FT1 driveway option. • driveway crossover shall be “plain natural” concrete with surface : broom finish. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.

Figure SC6.4.3.3.1 Conceptual diagram: FT1

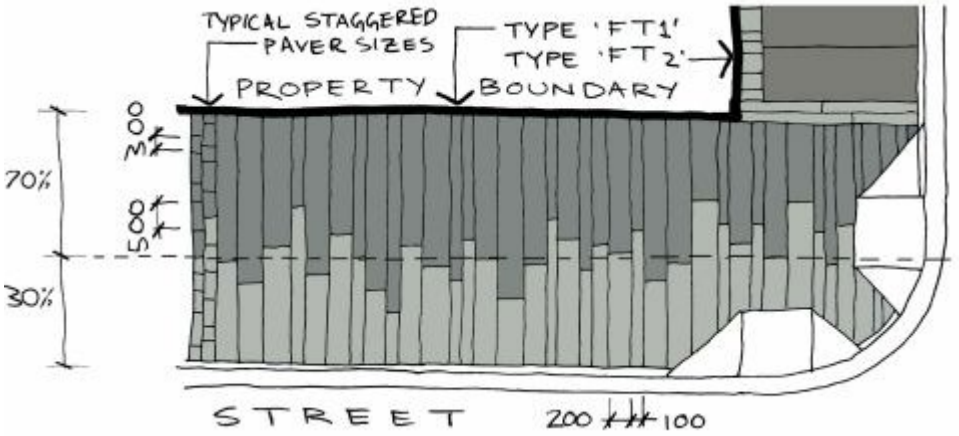


Figure SC6.4.3.3.2 Image: FT1

Figure SC6.4.3.3.3 Image FT1 driveway option

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT2 – Footpath Treatment 2	
Statement of intent	
Footpath treatment 2 serves the remainder of the Principal centre (CBD), key areas which support the CBD and areas intended for medium and higher residential densities nearby the CBD. The treatment provides a nexus with FT1 and is of a high quality to support high levels of pedestrian use and may provide for the integration of civic spaces. A reduced width option may be permitted in the medium density residential areas as indicated on SC6.4.3.3.7 Footpath treatment location maps.	
Body of footpath: FT2	
Description:	• footpath treatment FT2 shall be full width from building line to the road kerb alignment. • monolithic poured concrete slabs in approximately 5 m lengths with decorative scoring pattern and perimeter stone paver banding on mass concrete base, see SC6.4.6.14, Figure SC6.4.3.3.4 Conceptual diagram: FT2, and Figure SC6.4.3.3.5 Conceptual diagram FT2, and Figure SC6.4.3.3.5 Image: FT2. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water-based chemical retarder, see Figure SC6.4.3.3.8, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • standard drawings as noted in SC6.4.3.3.3(3)(b). • decorative scoring, see Figure SC6.4.3.3.4, Figure SC6.4.3.3.5, and noted in SC6.4.3.3.3(3) and SC6.4.3.3.3(3)(i). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Description reduced width option areas:	• reduced width which allows for a planting zone from back of curb and/or property boundary see Figure SC6.4.3.3.7 Conceptual diagram FT2 – Reduced width option. • monolithic poured concrete slabs with decorative scoring pattern and stone paver banding at approximately 5m intervals on a mass concrete base, see Figure SC6.4.3.3.7. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water based chemical retarder, see Figure SC6.4.3.3.8, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • standard drawings as noted in SC6.4.3.3.3(3)(b). • decorative scoring: see Figure SC6.4.3.3.7, and noted in SC6.4.3.3.3(3) and SC6.4.3.3.3(3)(i). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.

Pattern:	• see Figure SC6.4.3.3.4 Conceptual diagram FT2 and Figure SC6.4.3.3.5 Conceptual diagram F2 and Figure SC6.4.3.3.7 Conceptual diagram F2 reduced width option for saw cut pattern.
Colour:	• concrete colour: CCS "Onyx" at 4% dose in a grey cement base. • aggregate: Hanson “salt and pepper” or approved equivalent.
Banding: FT2	
Description:	• granite stone pavers of varying length and width on mass concrete base, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving, SC6.4.3.3.5 Banding details. • facing: split face to top, saw cut finish to all other sides. • standard drawings as listed in SC6.4.3.3.3(3)(b).
Pattern:	• staggered pattern as shown in Figure SC6.4.3.3.4 Conceptual diagram FT2, Figure SC6.4.3.3.5 Conceptual diagram FT2, Figure SC6.4.3.3.6 Image FT2 and Figure SC6.4.3.3.7 Conceptual diagram FT2 reduced width option.
Grout:	• product: Polyblend G15 sanded grout from Construction Technologies Australia or approved equal. • colour: "Mid Grey".
Pavers:	• granite: "Sindoor Brown". • width: 200 mm or 100mm. • length: 300 mm or 500mm. • depth: 40 mm.
Driveway and pedestrian crossing points: FT2	
Description:	• driveway access through foothpath shall be monolithic poured concrete slabs with decorative scoring, see Figure SC6.4.3.3.3. • finish: light wash finish 1 mm – 2 mm deep (2 mm max), using a water-based chemical retarder (CCS "reveal" 1 mm or approved equal, do not use sugar), see Figure SC6.4.3.3.5, Figure SC6.4.3.3.9, and Figure SC6.4.3.3.10. • driveway crossover shall be “plain natural” concrete with surface: broom finish. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b)
Pattern:	• see Figure SC6.4.3.3.4 Conceptual diagram: FT2 and Figure SC6.4.3.3.5 Conceptual diagram: FT2 for sample crossover layout and decorative scoring pattern.
Colour:	• concrete colour: CCS "Onyx" at 4% dose in a grey cement base. • aggregate: Hanson "salt and pepper" aggregate or approved equivalent.

Figure SC6.4.3.3.4 Conceptual diagram: FT2

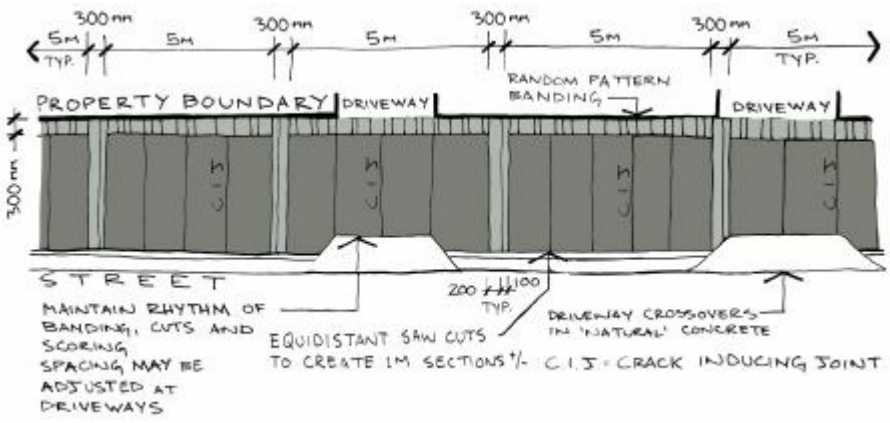


Figure SC6.4.3.3.5 Conceptual diagram: FT2

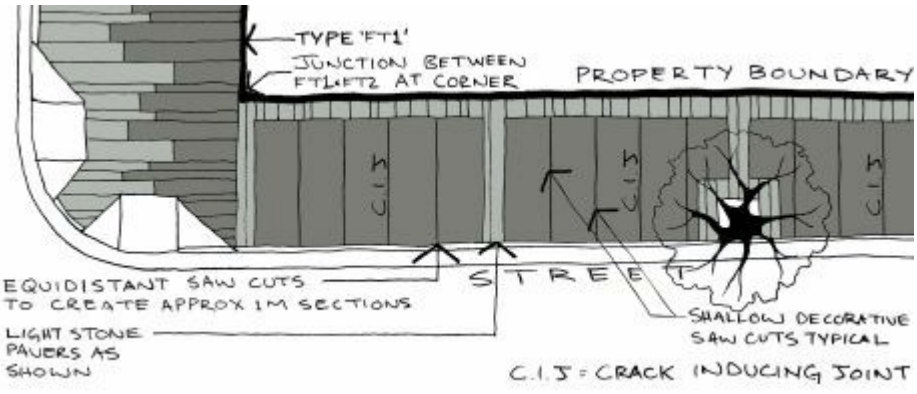


Figure SC6.4.3.3.6 Image FT2

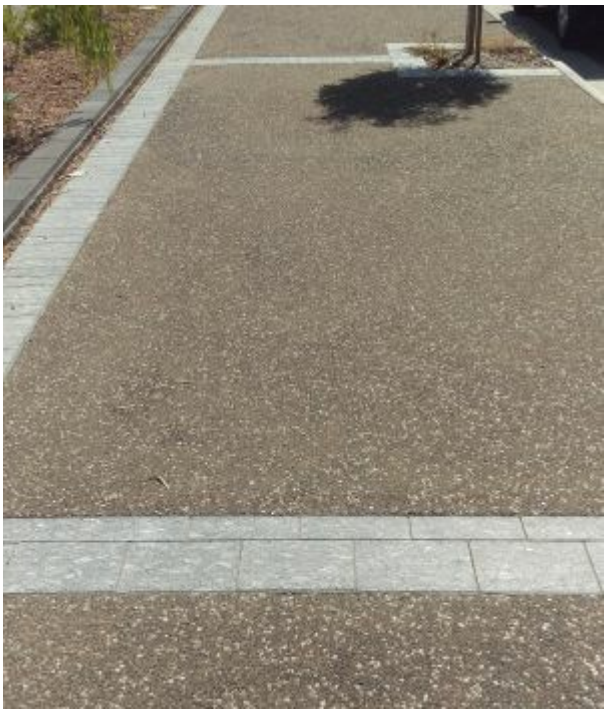


Figure SC6.4.3.3.7 Conceptual diagram FT2 reduced width option

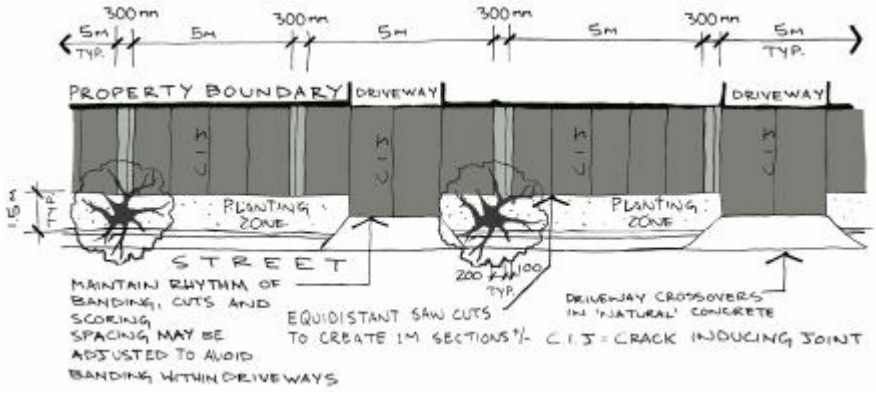


Figure SC6.4.3.3.8 Image FT2 (2 mm maximum exposure acceptable)

Figure SC6.4.3.3.9 Image FT2 (1 mm exposure - unacceptable - underexposed)
Figure SC6.4.3.3.10 Image FT2 (3 mm exposure – unacceptable - overexposed)

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments.

FT3 – Footpath Treatment 3	
Statement of intent	
Footpath treatment 3 serves many of the city activity centre areas, including major, district and local centres and some neighborhood centres, mixed use areas and specialised centres, where regular pedestrian use is anticipated for commercial and recreational purposes	
Body of footpath: FT3	
Description:	• footpath treatment FT3 shall be full width from building line to the road kerb alignment. • monolithic poured coloured concrete slabs in 5 m lengths with decorative scoring and perimeter cobble banding. • conceptual image: see Figure SC6.4.3.3.11 Conceptual diagram FT3. • finish: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i).
Description reduced width option areas:	• reduced width which allows for a planting zone from back of kerb and/or property boundary see Figure SC6.4.3.3.13 Conceptual diagram FT3 Reduced width option. • monolithic poured coloured concrete slabs with decorative scoring and cobble banding at approximately 5m intervals on a mass concrete base. • conceptual image: see Figure SC6.4.3.3.13 Conceptual diagram FT3 Reduced width option. • finish: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i).
Pattern:	• conceptual scoring pattern: see Figure SC6.4.3.3.11 and Figure SC6.4.3.3.13, • for variations such as corners, trees, doorways etc, refer: Figure SC6.4.3.3.22, Figure SC6.4.3.3.23, Figure SC6.4.3.3.24, Figure SC6.4.3.3.25, Figure SC6.4.3.3.26 and Figure SC6.4.3.3.27, • align scoring pattern with adjacent footpath scoring and/or saw cuts where applicable **Editor's note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), and SC6.4.3.3.3(3)(i)
Colour:	• CCS "paperbark" at 4% dose in a grey cement base
Banding: FT3	
Description:	• pressed concrete cobbles set in mortar on mass concrete base (see SC6.4.6.14 Mass concrete subbase, SC6.4.6.18 - Segmental Paving and SC6.4.3.3.5 Banding details) • finish: proprietary non-slip finish

Pattern:	• cobbles 3x wide in stack bond pattern • conceptual image: see Figure SC6.4.3.3.11 and Figure SC6.4.3.3.13,. • for variations such as corners, trees, doorways etc. refer: Figure SC6.4.3.3.22, Figure SC6.4.3.3.23, Figure SC6.4.3.3.24, Figure SC6.4.3.3.25, Figure SC6.4.3.3.26, Figure SC6.4.3.3.27, and Figure SC6.4.3.3.29.
Colour:	• CCS "ghost gum".
Pavers:	• 100mm x 100mm square x 60 mm to 65 mm deep.
Driveway and pedestrian crossing points: FT3	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slabs. • driveway crossover shall be “plain natural” concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor’s note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), SC6.4.3.3.3(3)(i).
Pattern:	• for pattern integration of driveways, refer: Figure SC6.4.3.3.24. • align driveway scoring pattern with adjacent footpath decorative scoring and/or crack control saw cuts. **Editor’s note —**for decorative scoring, see SC6.4.3.3.4, SC6.4.3.3.3(3)(g), SC6.4.3.3.3(3)(i).
Colour:	• CCS "paperbark" at 4% dose in a grey cement base, kerb transition: "natural" concrete colour.

Figure SC6.4.3.3.11 Conceptual diagram FT3

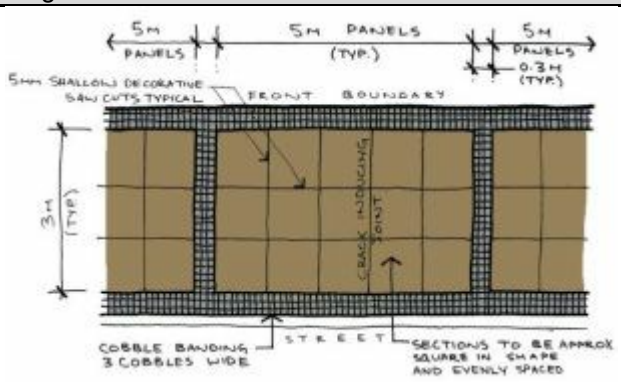


Figure SC6.4.3.3.12 Image: FT3

Figure SC6.4.3.3.13 Conceptual diagram FT3 reduced width option

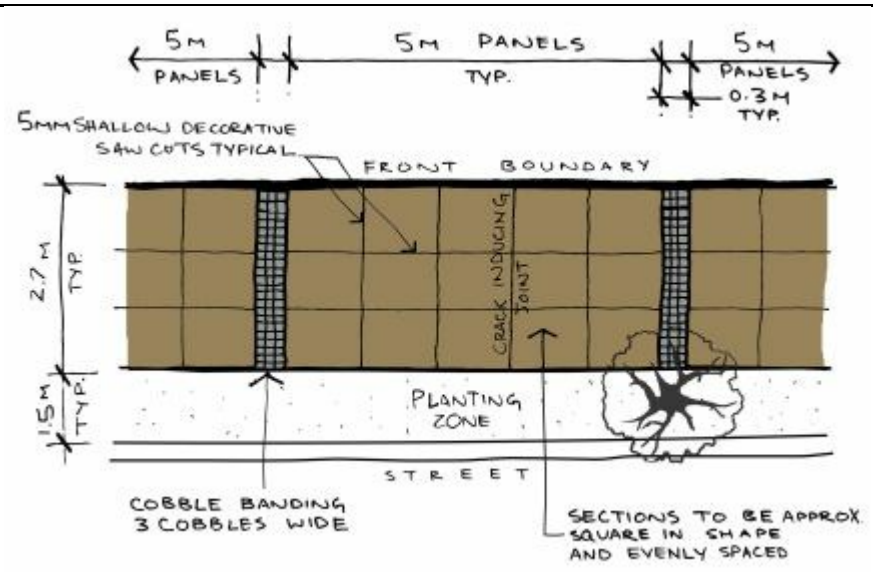


Figure SC6.4.3.3.14 Image FT3 reduced width option

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments.

FT4 – Footpath Treatment 4	
Statement on intent	
Footpath treatment 4 serves many of the city's lower order activity centre areas, mixed use areas, key corridors and key infill areas intended for increased residential densities and attractive streetscape.	
Body of footpath: FT4	
Description:	• Footpath treatment FT4 shall be full width from building line to the road kerb alignment. • monolithic, poured, full depth coloured concrete finish: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b).
Description reduced width option areas:	• Reduced width which allows for a planting zone from back of kerb and/or property boundary. • monolithic, poured, full depth coloured concrete finish: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b).
Colour:	• CCS "paperbark" at 4% dose in a grey cement base.
Pattern	• divided by crack control joints as required and decorative scoring into equal sections of approximately 1 m wide throughout the length of the footpath.
Driveway and pedestrian crossing points: FT4	

Description:	• driveway access through footpath shall be monolithic, poured, full depth coloured concrete. • driveway crossover shall be “plain natural” concrete with surface broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish. • standard drawings: see standard drawings noted in SC6.4.3.3.3(3)(b)
Colour:	• CCS "paperbark" at 4% dose in a grey cement base.

FT5 – Footpath Treatment 5	
Statement of intent	
Footpath treatment 5 is a specialised treatment which serves the Palmer Street dining area.	
Body of footpath: FT5	
Description:	• footpath treatment FT5 shall be full width from building line to the road kerb alignment. • "Bluestone" stone pavers set in mortar on mass concrete base, see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving • Pattern: staggered pattern, see Figure SC6.4.3.3.15 and Figure SC6.4.4.3.16 facing: split face finish to top surface (all other sides sawn). • standard drawings: as noted in SC6.4.3.3.3(3)(b).
Pavers:	• stone type: "Bluestone" • size 1: 750 mm x 495 mm. • size 2: 495 mm x 495 mm. • size 3: 495 mm x 245 mm. • size 4: 495 mm x 155 mm. • depth: 40 mm.
Colour:	• natural stone colour.
Grout:	• product: CTA Polyblend G15 or approved equal colour: "Mid Grey".
Driveway and pedestrian crossing points: FT5	
Description:	• driveway access through footpath shall be ‘Bluestone’ cobble pavers set in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving. • facing: split face finish to top with all other sides sawn. • pattern: continuous staggered pattern, see Figure SC6.4.3.3.15 and Figure SC6.4.3.3.16. • driveway crossover shall be “plain natural” concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish.
Pavers:	• 100 mm x 100 mm square x 60 mm to 65 mm deep.
Colour:	• natural "Bluestone" colour.
Grout:	• product: Polyblend G15 sanded grout from Construction Technologies Australia or approved equal. • colour: "Mid Grey".

Figure SC6.4.3.3.15 Pattern FT5

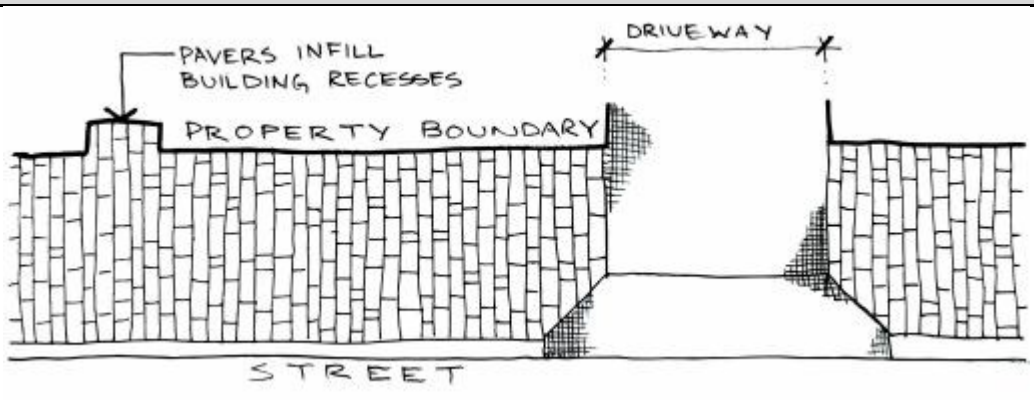


Figure SC6.4.3.3.16 Image FT5 body of footpath

Editor's note—refer to SC6.4.3.3.7 Footpath treatment location maps for locations of proposed treatments.

FT6 – Footpath Treatment 6	
Statement on intent	
Footpath treatment 6 is a specialised treatment area which serves the southern side of The Strand through to Ross Creek.	
Body of footpath and driveway crossings: FT6	
Description:	• footpath treatment FT6 shall be full width from building line to the road kerb alignment. • pressed concrete pavers set in stack bond pattern in mortar on mass concrete base see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • image: see Figure SC6.4.3.3.18 • standard drawings: as noted in SC6.4.3.3.3(3)(b). • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28
Pattern	• laid in stack bond parallel to the kerb line, see Figure SC6.4.3.3.17, and Figure SC6.4.3.3.18
Pavers:	• Havenpave 50. • width: 200mm. • length: 200mm. • depth: 50mm. • colour: "Charcoal"
Banding to footpath: FT6	
Description:	• pressed concrete pavers in soldier course pattern set in mortar on mass concrete base, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28
Pattern:	• laid in soldier course perpendicular to the kerb line, see Figure SC6.4.3.3.17 and Figure SC6.4.3.3.18 below.
Pavers:	• Havenbrick 50. • length: 200 mm • width: 100 mm • depth: 50 mm • colour: CCS "Sunstone".
Driveway and Pedestrian Crossing Points: FT6	
Description:	• driveway access through footpath shall be pressed concrete pavers set in stack bond pattern in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving. • Standard drawings: as noted in SC6.4.3.3.3(3)(b). • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.
Figure SC6.4.3.3.17 Pattern: FT6	

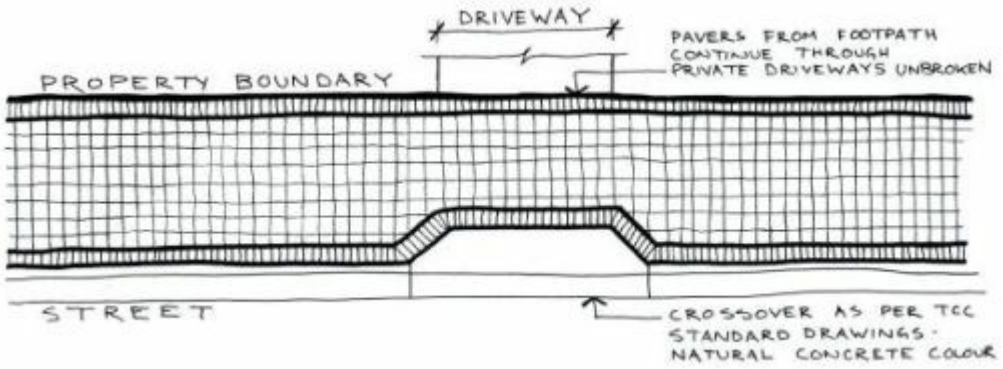


Figure SC6.4.3.3.18 Image FT6

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

FT7 – Footpath Treatment 7	
Statement of intent	
Footpath treatment 7 is a specialised treatment area which serves the Sir Leslie Thiess Drive area and the east end of the southern side of The Strand.	
Body of footpath: FT7	
Description:	• monolithic poured concrete slabs in 5 m lengths • finish: lightly exposed aggregate, refer texture only of Figure SC6.4.3.3.8 • image: see Figure SC6.4.3.3.19. • standard drawings: refer to the standard drawings noted in SC6.4.3.3.3(3)(b).
Colour:	• CCS "Coco" 4% dose in a grey cement base • aggregate: Hanson "Burdekin Red" or approved equivalent.
Driveway and Pedestrian Crossing Points: FT7	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slabs. • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.

Figure SC6.4.3.3.19 Image FT7

Editor's note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

Editor's note—FT8 – Footpath Treatment 8 table describes the existing treatment, as noted on SC6.4.3.3.7 Footpath treatment location

maps this area is an investigation area. An alternate treatment is under development.

FT8 – Footpath Treatment 8	
Statement on intent	
Footpath treatment 8 is a specialised treatment area which serves the Gregory Street area in North Ward.	
Body of footpath: FT8	
Description:	• footpath treatment FT8 shall be full width from building line to the road kerb alignment. • pressed concrete pavers set in mortar on mass concrete base with perimeter banding, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving • for property boundaries not parallel to kerb refer: Figure SC6.4.3.3.28 image: see Figure SC6.4.3.3.20. • finish: proprietary non-slip finish. • sealant: two coats of penetrating sealer.
Pattern:	• stack bond as per existing adjacent pattern with alternating bands of coloured pavers separated by a 350 mm band of "natural" concrete • image: see Figure SC6.4.3.3.20.
Pavers:	• width: 400 mm. • length: 400 mm. • depth: 40 mm. • colours: CCS "Morocco", CCS "Onyx 21"
Banding: FT8	
Description:	• pressed concrete pavers set in mortar on mass concrete base see SC6.4.6.14 Mass concrete subbase and SC6.4.6.18 Segmental paving.
Pattern:	• 1x wide soldier course, see Figure SC6.4.3.3.20 • stack bond as per existing adjacent pattern with alternating bands of coloured pavers separated by a 350 mm band of "natural" concrete.
Colour:	• colour of banding pavers match colour of banded square pavers colours: CCS "Morocco", CCS "Onyx 21", natural grey concrete.
Pavers:	• length: 220 mm. • width: 110 mm. • depth: 40 mm.
Supplier:	• Boral or approved equal.
Driveway and Pedestrian Crossing Points: FT8	
Description:	• Driveway access through footpath shall be pressed concrete pavers set in mortar on mass concrete base with perimeter banding, see SC6.4.6.14 Mass concrete sub-base and SC6.4.6.18 Segmental paving. • Driveway crossover shall be “plain natural” concrete, with surface broom finish, see Figure SC6.4.3.3.24. • Pedestrian kerb ramp shall be “plain natural” concrete with surface: broom finish.
Figure SC6.4.3.3.20 Image FT8	

Editor’s note—refer to SC6.4.3.3.7 - Footpath treatment location maps for locations of proposed treatments

FT9 – Footpath Treatment 9	
Statement of intent	
Footpath treatment 9 is a specialised treatment occurring only on Magnetic Island.	
Body of footpath: FT9	
Description:	• monolithic poured coloured concrete slabs. • primarily in eucalypt with the secondary colour black used to highlight special features such as premises entries, dining areas, etc. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water-based chemical retarder. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Description reduced width area:	• reduced width which allows for a planting zone from back of kerb and/or property boundary. • monolithic poured coloured concrete slabs. • primarily in eucalypt with the secondary colour black used to highlight special features such as premises entries, dining areas etc. • finish: 'light wash' 1 mm – 2 mm deep (2 mm max) using a water based chemical retarder. • standard drawings: as noted in SC6.4.3.3.3(3)(b). **Editor's note**—refer to Figure SC6.4.3.3.8 for maximum acceptable aggregate exposure and Figure SC6.4.3.3.9 and Figure SC6.4.3.3.10 for unacceptable, under and over, aggregate exposure.
Colour:	• primary - CCS "eucalypt" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • secondary - CCS "black" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • aggregate: Hanson "salt and pepper" or approved equivalent.
Pattern:	• divided by crack control joints as required.
Driveway and Pedestrian crossing Points: FT9	
Description:	• driveway access through footpath shall be monolithic poured coloured concrete slab. • driveway crossover shall be "plain natural" concrete with surface: broom finish, see Figure SC6.4.3.3.24. • pedestrian kerb ramp shall be "plain natural" concrete with surface: broom finish.
Colour:	• primary - CCS "eucalypt" at 4% dose in a grey cement base see Figure SC6.4.3.3.21 Image FT9. • Secondary - CCS "black" at 4% dose in a grey cement base Figure SC6.4.3.3.21 Image FT9. • aggregate: Hanson "salt and pepper" or approved equivalent.
Figure SC6.4.3.3.21 Image FT9	

(2) All concrete cobbles (border banding) and field pavers are to have a:

(a) depth of 60 mm to 65 mm for cobbles, 40mm for field pavers;

(b) compressive strength of 32 MPa for concrete cobbles and pavers;

(c) mass concrete subbase integral with adjacent concrete, see SC6.4.6.14 Mass concrete subbase;

(d) slip resistance in accordance with AS/NZS 3661.1, Table 5;

(e) 3 mm chamfer on the surface edges with a pressed finish for concrete pavers and cobbles; and be in accordance with AS1428.1 – Construction tolerances for abutment of surfaces;

(f) two coats of low VOC, water-based, 7-15 year recoat penetrating sealer system designed to repel grease and oil stains;

(g) cobbles and pavers are to be placed on concrete mortar; and

(h) edge of paver banding shall be filled with 10mm thick compressible filler board for full depth of slab and 20mm polyurethane based sealant.

(3) All concrete slabs shall be:

(a) integrally coloured for the full depth of the slab where colouring is noted in SC6.4.3.3.3 Foothpath treatment standards;

(b) Engineer Certified design drawings must be submitted to council for acceptance prior to approval being given showing site specific construction details of paver band designs and integrated construction joints at intervals that are generally in accordance with TCC Standard drawing SD-070. Pavements are to be constructed as per SC6.4.4.8 Standard drawings:
SD-015: Verge Service Corridors General Type Sections;
SD-020: Concrete Kerbing;
SD-025: Kerb Ramp;
SD-030: Driveway Access Urban Residential Properties;
SD-031: Driveway Access Commercial and Industrial Properties;
SD-032: Driveway Crossovers Urban Residential Properties;
SD-055: Road Crossing and Footpath Reinstatement for Trench Laid Services;
SD-060: Traffic Sign Installation;
SD-065: Street Name Sign and Installation Details;
SD-070: Concrete Pathway Reinforced Concrete (Mesh) Alternative;
SD-075: Concrete Pathway Reinforced Concrete (Fibre) Alternative; and
SD-500: Standard Bus Shelter and Footing Details,

(c) sealed with two coats of low VOC, water-based, 7-15 year recoat penetrating sealer system designed to repel grease and oil stains;

(d) proportioned in terms of 'width to length' as '1 to 1.5' between crack control joints as per standard drawings listed in SC6.4.3.3.3(3)(b);

(e) laid in accordance with standard drawings listed in SC6.4.3.3.3(3)(b);

(f) constructed so that all runoff, slurry and excess materials must be captured and disposed of appropriately, and all surrounding surfaces are protected from staining;

(g) constructed so that all decorative scoring cuts are five mm deep for the full length of the slab continuous through the end of the slab;

(h) constructed so that all crack inducing saw cuts are continuous through to the end of the slab;

(i) constructed so that all saw cuts:

  (i) are made approximately 24 hours after finishing (preferably the morning after the pour);

  (ii) are cut with a "Early Cut Saw" only;

  (iii) are cut with a "Dry Cut" method only (this requirement is to override conflicting specifications on standard drawing SD-070 (for coloured concrete only);

  (iv) are aligned where possible with any service penetrations, on at least one side of the penetration, or services to be located wholly within one saw cut square (see Figure SC6.4.3.3.32);

  (v) are constructed in accordance with standard drawings listed in SC6.4.3.3.3(3)(b) with the exception of SC6.4.3.3.3(3)(i)(iii);

  (vi) for footpath treatment type FT3, create a pattern comprised of:

    (A) both decorative scoring and crack inducing joints (as required) to create sub-panels approximately 1x1 m square or otherwise closely proportioned rectangular shapes evenly spaced throughout the panel (see Figure SC6.4.3.3.22);

    (B) minimum sub-panel dimensions of 0.8 m either width or length, generally creating rectangular, regularly spaced sub-panels evenly spaced through the primary panel; and

    (C) maximum sub-panel dimensions of 1.2 m either width or length, generally creating rectangular, regularly spaced sub-panels evenly spaced through the primary panel.

  (vii) for footpath treatment type FT2, create patterns comprised of both decorative scoring and crack inducing joints (as required) creating sub-panels approximately 1 m wide (4 cuts in 5 m lengths) evenly spaced throughout the panel (see Figure SC6.4.3.3.22, Figure SC6.4.3.3.23 and Figure SC6.4.3.3.24).

(j) coloured concrete slabs shall be grade S32 minimum. Where concrete is located in an aggressive environment (e.g. salt exposure, aggressive soils, etc.), concrete strength design shall be in accordance with AS3600;

(k) fibre reinforced concrete footing under banding shall be grade S20 minimum;

(l) concrete slab thickness shall be 100mm minimum. In areas where maintenance vehicular loading is expected, concrete thickness shall be 125mm minimum;

(m) concrete cover to steel reinforcement shall be 40mm unless otherwise noted;

(n) concrete shall be laid on minimum 50mm of compacted crusher dust / sand bedding with moisture barrier;

(o) all concrete shall be cured in accordance with the following:

  (i) AS3600;

  (ii) aliphatic alcohol must be used. The aliphatic alcohol shall be applied after screeding &and bull floating operations;

  (iii) no water shall be added to concrete;

  (iv) an impermeable membrane shall be applied. All joints in membrane are to be taped and the edges secured to prevent the ingress of air;

  (v) minimum curing period shall be not less than 7 days for strength grade S32 and not less than 4 days for high early strength concrete;

(p) exposed edges of formed concrete elements shall have a 20mm chamfer unless otherwise noted;

(q) all concrete shall be mechanically vibrated. Hand held vibrators must be held upright. Concrete must not be spread using vibrator; and

(r) all other requirements shall be in accordance with SC6.4.6.28 Minor concrete works.

(4) Tactile ground surface indicators (TGSI) where required shall:

(a) be stainless steel studs (CTA SureSteel or approved equal) with bright yellow plastic insert for type FT1, FT2, FT5 installed as per AS/NZS1428.4.1 providing slip resistance of R13 (wet/oil ramp);

(b) all other types not covered by SC6.4.3.3.3(4)(a) shall be yellow Polyurethane tactile indicator studs (warning tactiles), and bars (directional tactiles), drill and lock installation; and

(c) be supplied and installed in accordance with AS/NZS1428.4.1 providing correct illuminance contrast, and AS1428.1 and AS4586 Slip Resistance of Pedestrian Surfaces, and as per manufacturers specifications and in accordance with AS1884. Also to be in accordance with SC6.4.4.7(4) Bicycle, pedestrian and shared path design.

(5) footpath treatment shall not impede into private property.

(6) for all footpath treatment types the ground surface on the continuous accessible path of travel – construction tolerances for abutment of surface shall be in accordance with AS 1428.1. to eliminate the possibility of tripping hazards and non-compliance levels of abutting surfaces occurring.

SC6.4.3.3.4 General guidelines

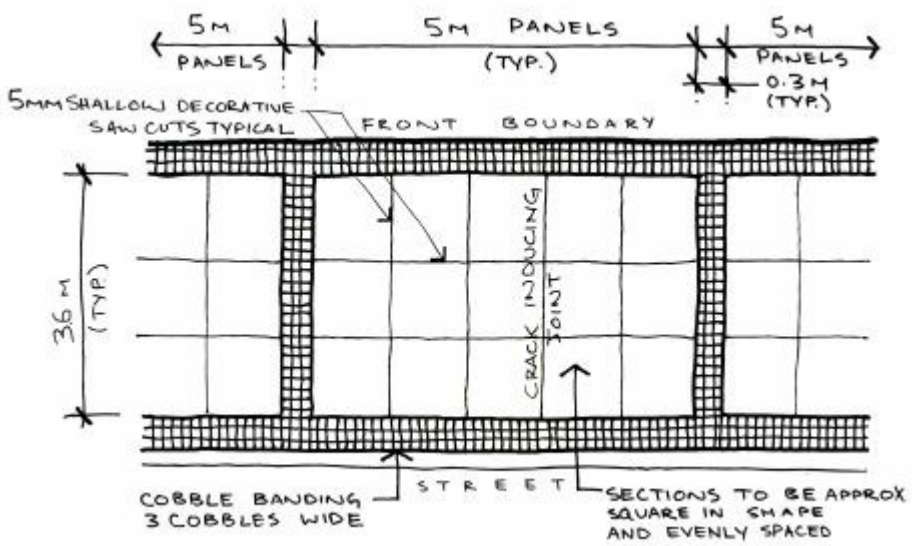


Figure SC6.4.3.3.22 Typical footpath treatment FT3

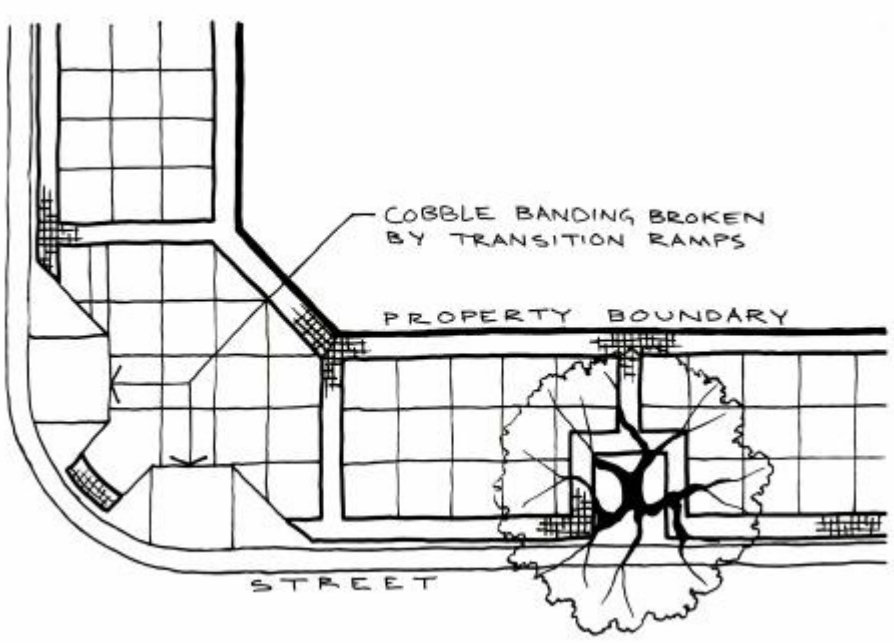


Figure SC6.4.3.3.23 Typical footpath treatment at street corners - banding is broken by kerb ramps

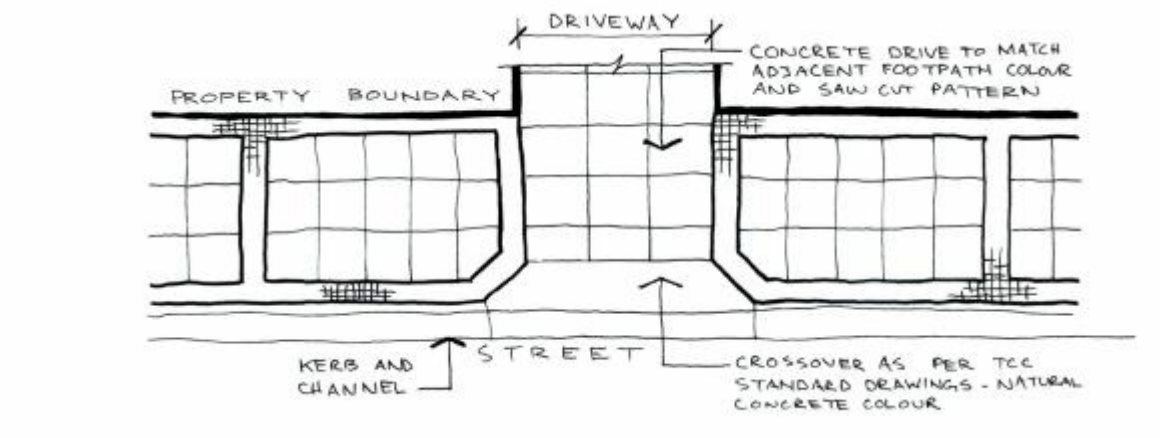


Figure SC6.4.3.3.24 Typical driveway treatment - banding to match angle of crossover

SC6.4.3.3.5 Banding details

(1) Banding is to be:

(a) continuous across tenancy or property boundaries at regular 5 m intervals (see Figure SC6.4.3.3.21 and Figure SC6.4.3.3.22) and is to retain a rectilinear alignment as illustrated in Figure SC6.4.3.3.25, Figure SC6.4.3.3.27 and Figure SC6.4.3.3.28;

(b) broken by minor built form intrusions, allowed to infill minor built form recesses, (see Figure SC6.4.3.3.25;

(c) continued around existing streetscape and landscape elements (see Figure SC6.4.3.3.26); and

(d) run parallel to property boundaries and kerb where property boundaries are not parallel to kerb, with cross-banding remaining perpendicular to line of kerb (see Figure SC6.4.3.3.27 and Figure SC6.4.3.3.28).

(2) Where banding is broken by driveways in footpath treatment types FT2, FT3, FT6 and, banding returns to the property line as per Figure SC6.4.3.3.24, Figure SC4.4.3.3.34 and Figure SC6.4.3.3.35.

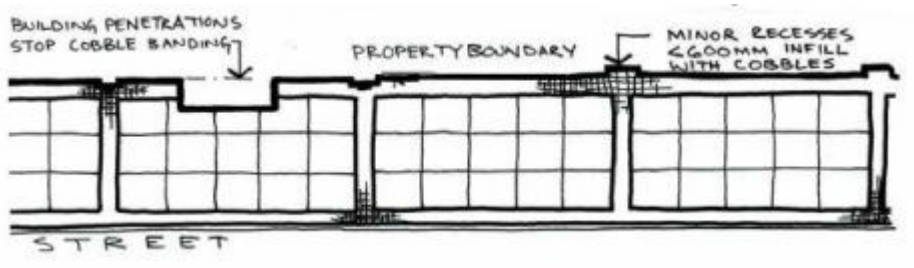


Figure SC6.4.3.3.25 Continuous footpath at uneven building lines

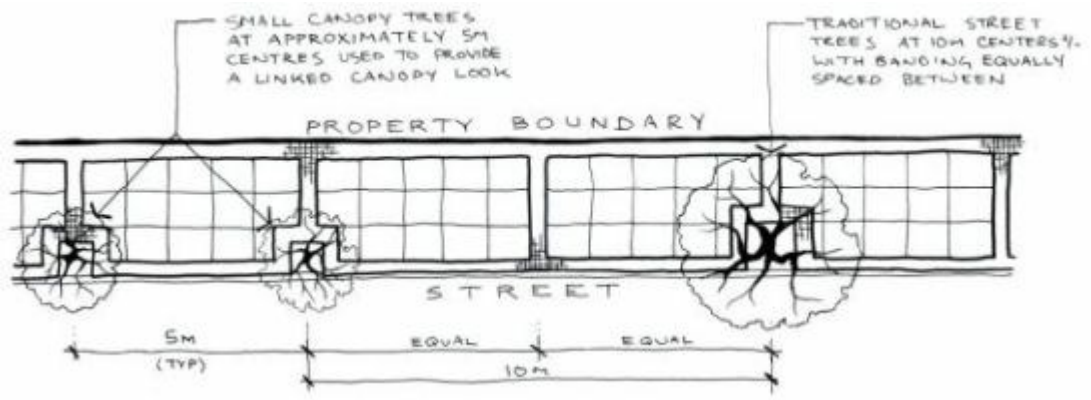


Figure SC6.4.3.3.26 Banding around landscape element

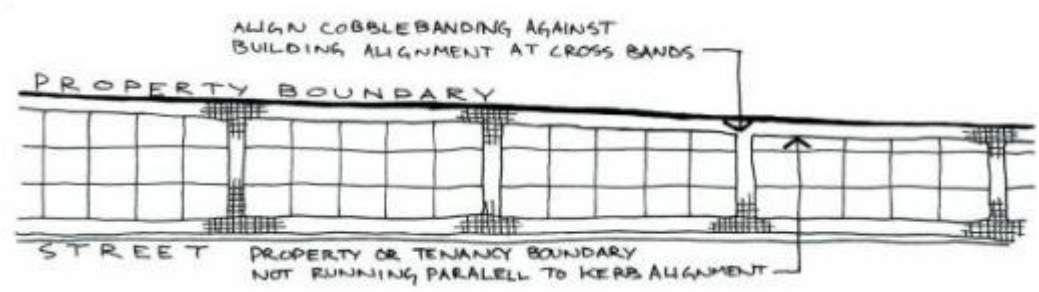


Figure SC6.4.3.3.27 Banding around poured concrete against property boundary where property boundary is not parallel to line of kerb

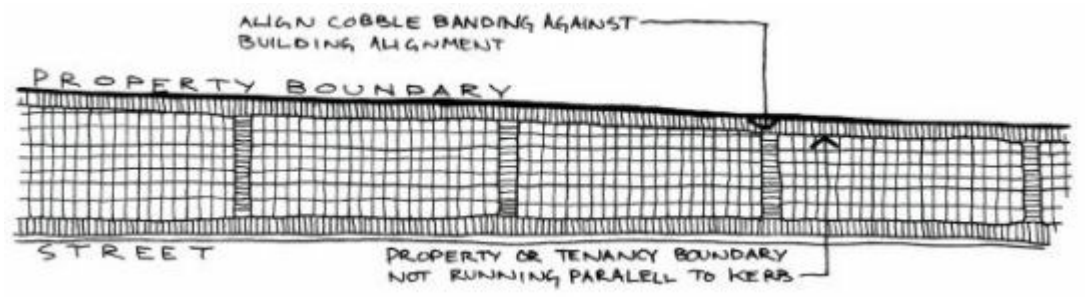


Figure SC6.4.3.3.28 Banding around pavers against property boundary where property boundary is not parallel to line of kerb

SC6.4.3.3.6 Footpath details

(1) Joint lines and trim courses are to be straight and as continuous as is practical along the footpath length regardless of individual property boundaries (see Figure SC6.4.3.3.29). Protect existing buildings as per Figure SC6.4.3.3.29.

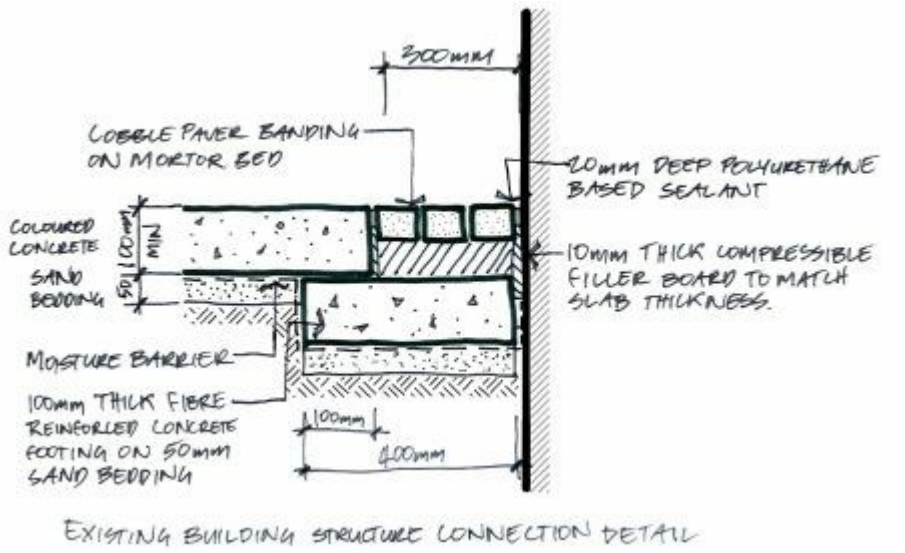


Figure SC6.4.3.3.29 Existing building structure connection detail

(2) Service access lids and inspection pits:

(a) installed within the footpath zone shall be finished and matched to the finished surface levels of the footpath treatment;

(b) which are manufactured shall be installed in accordance with manufacturer's installation instructions, having regard to the footpath pattern of the selected footpath treatment type;

(c) in footpath treatment areas FT1, FT5:

(i) be housed within an angle surround frame, which enables adjacent footpath treatments to be placed to the edge of the service penetration. The lid is to allow for matched pavers to be placed within, matching the adjacent paver material, colours and patterns flush with the top of the adjacent treatment (see Figure SC6.4.3.3.31);

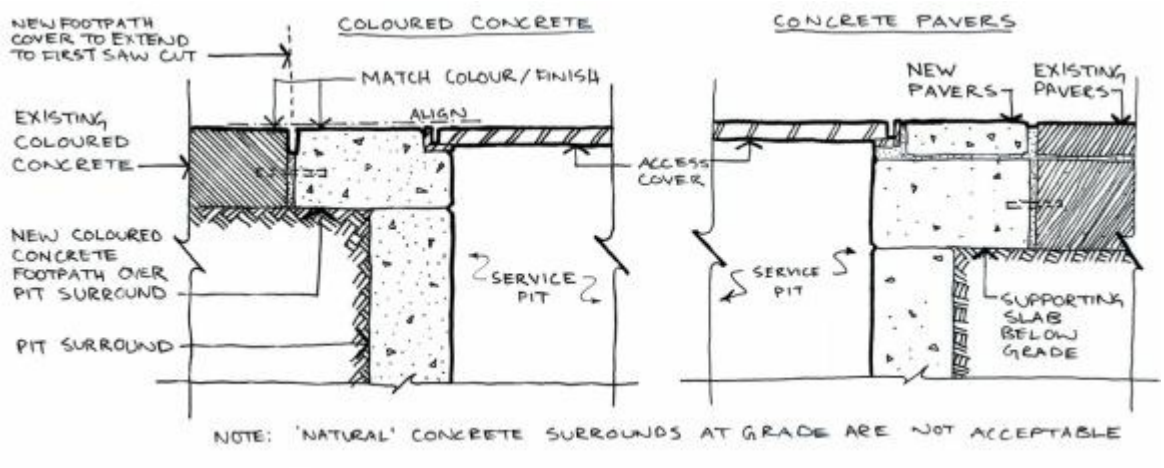
(d) in footpath treatments FT2, FT3, FT6, FT7 and FT8, have their perimeter supports resting on concrete slabs that are integral with the adjacent concrete slab without a separate surround (see Figure SC6.4.3.3.30):

(i) be housed within an angle surround frame, which enables concrete to be laid to the edge of the service penetration;

(ii) be located in and integrated with adjacent concrete slabs so service access structures limit or control cracking in surrounding concrete (see Figure SC6.4.3.3.32); and

(iii) are located where possible so future replacement or alteration of service access structures minimises disruption to adjacent concrete panels, and are aligned with existing or proposed concrete crack control saw cuts where possible, or are located wholly fully within the saw-cut panel (see Figure SC6.4.3.3.32); and

(e) when penetrating a cobbled area of FT3, be installed such that the cobbles continue to the edge of the new service access lids and inspection pits (see Figure SC6.4.3.3.31).



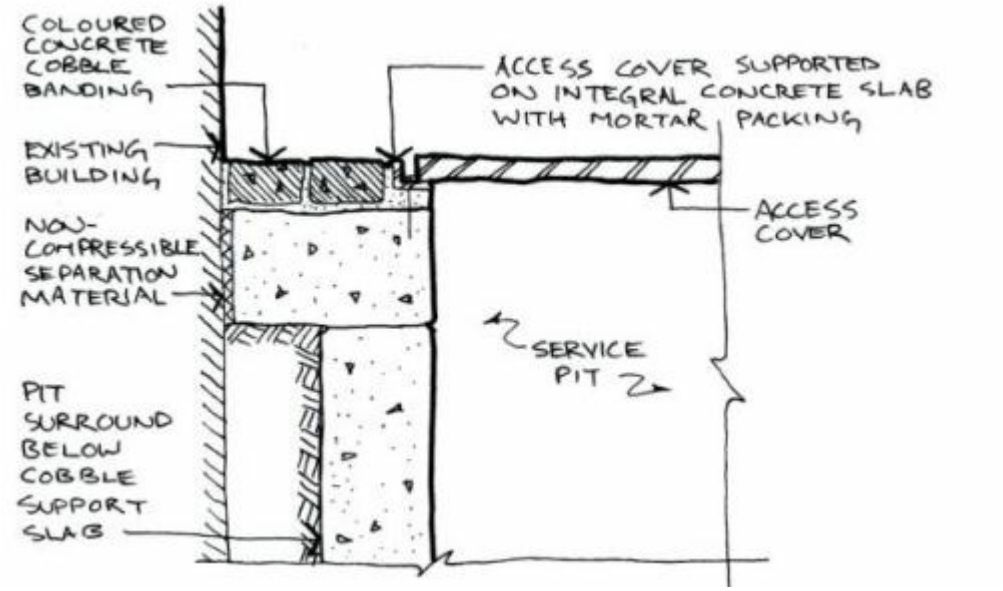


Figure SC6.4.3.3.30 Edge treatments to service access lids and inspection pits for footpath treatment areas FT2, FT3, FT4, FT6, FT7and FT8

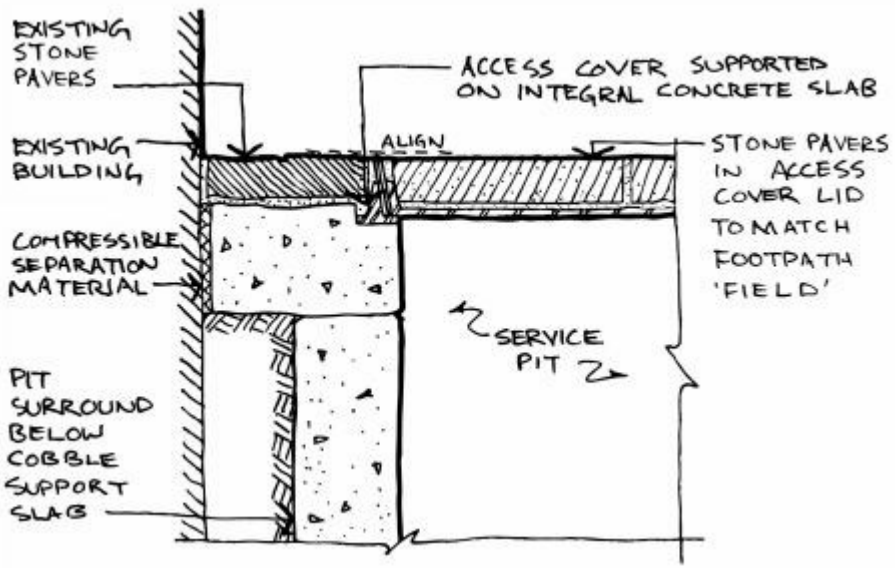


Figure SC6.4.3.3.31 Edge treatment to service access lid and inspection pits adjacent to pavers for type FT1 and FT5

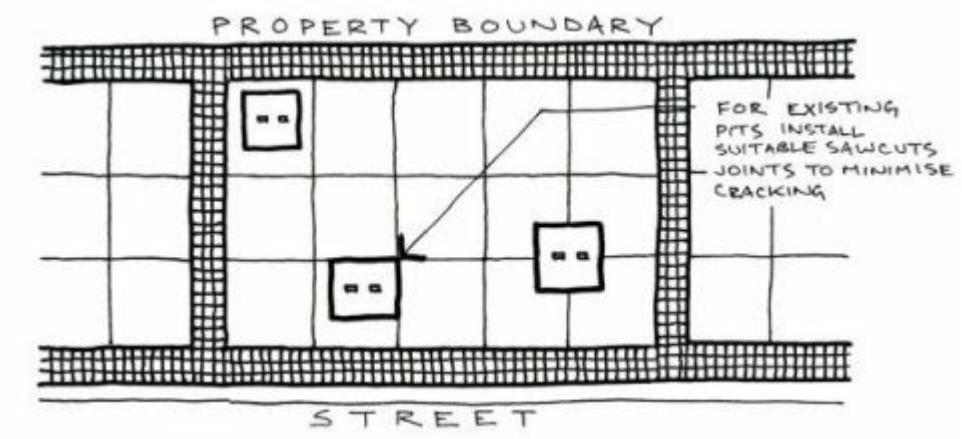


Figure SC6.4.3.3.32 Incorporate service access lids and inspection pits into decorative saw cut pattern

(3) All footpaths (see Figure SC6.4.3.3.33) shall have maximum:

(a) cross fall of 1:40 (for cross fall greater than 1:40 liaise with council); and

(b) slope of 1:20 (for slopes greater than 1:20 liaise with council).

(4) Kerb and channelling is to be provided if not currently installed for all footpath treatments covered by this policy, and shall be constructed in accordance with standard drawings listed in SC6.4.3.3.3(3)(b).

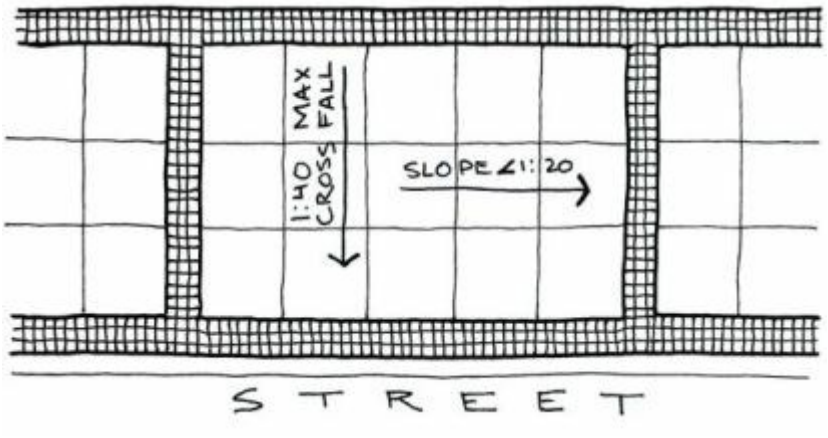


Figure SC6.4.3.3.33 Slope and cross fall

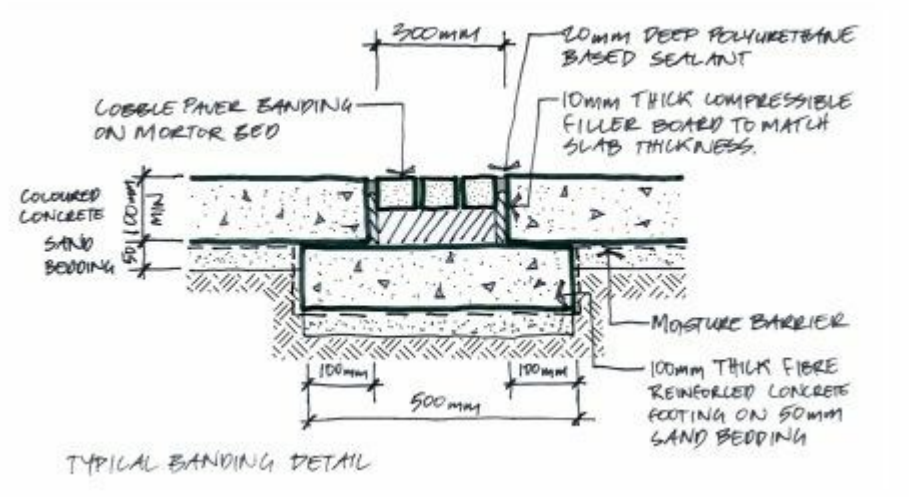


Figure SC6.4.3.3.34 Typical banding details

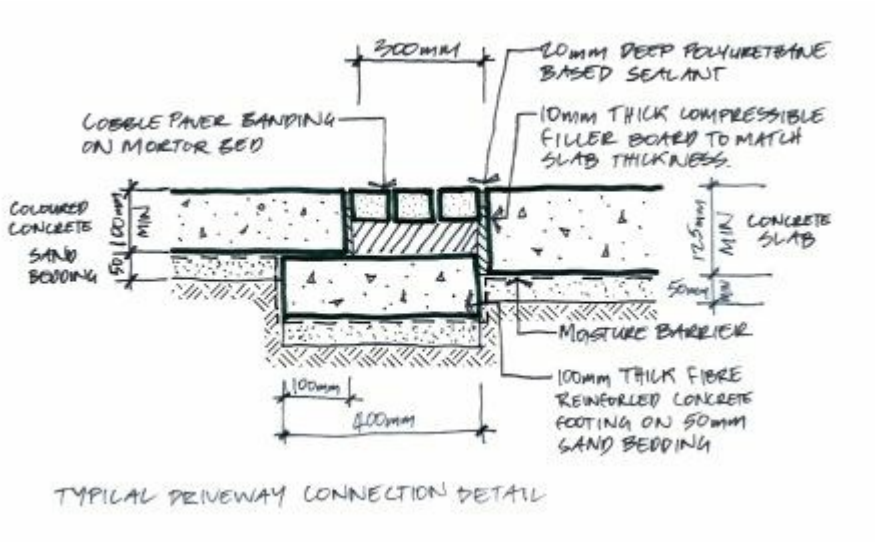


Figure SC6.4.3.3.35 Typical driveway connection detail

(5) Kerb ramps are to be:

(a) in accordance with the standard drawings see SC6.4.3.3.3(3)(b) - SD025 – Kerb Ramp,

(b) in accordance with AS1428.1 *Design for Access and Mobility, Part 1: General requirements for access – New Building Works;*

(c) installed facing the direction of travel and aligned parallel and perpendicular with opposite kerb ramp;

(d) located to suit the flow of pedestrian traffic and the position of the signal button;

(e) constructed of surface broom finished plain natural concrete;

(f) installed with sharp transitions between adjacent surfaces (top and bottom); and

(g) installed with Tactile Ground Surface Indicators (TGSIK) in accordance with AS/NZS1428.4.1 Design for Access and Mobility Part 4.1: Means to assist the orientation of people with vision impairment – Tactile ground surfaces indicators.

(6) Where the existing kerb edge is uneven:

(a) the cobble banding is to be set along a straight line. A cementitious infill material shall be used to make up for the irregularities of the kerb, as indicated in Figure SC6.4.3.3.36;

(b) ensure suitable concrete admixture (Fosroc Renderoc or approved equal) is used to create a straight and true edge if irregularity in kerb is less than 50 mm deep, see Figure SC6.4.3.3.36 and standard drawing SD-020: Concrete Kerbing; and

(c) infill is not to be formed so a tripping hazard occurs. In accordance with AS1428.1 Construction tolerances for abutment of surfaces.

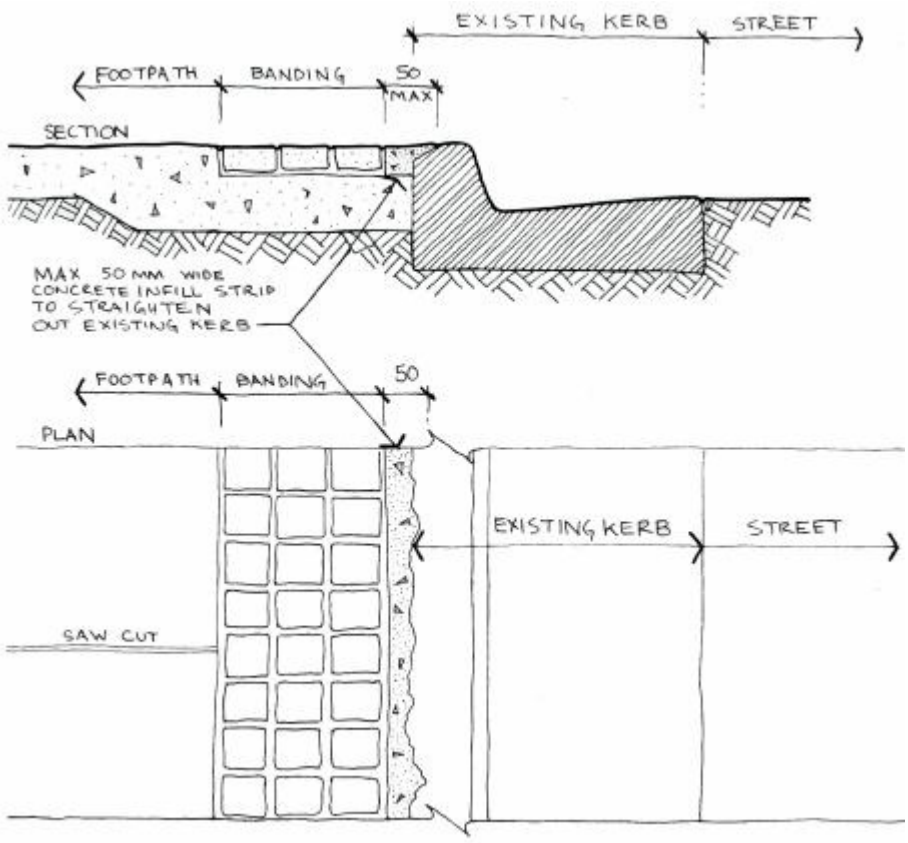


Figure SC6.4.3.3.36 Concrete infill strip for uneven existing kerb lines

(7) When providing reinstatement from trenching:

(a) where trench passes through segmented paver footpath treatment areas:

(i) remove intact pavers and store securely and safely on site;

(ii) allow for replacement and installation of any broken, cut or otherwise damaged pavers or deteriorated;

(iii) ensure paving support slabs removed for trenching purposes are reinstated in accordance with standard drawings noted in SC6.4.3.3.3(3)(b) flush with adjacent support slabs to allow level reinstatement of pavers over; and

(iv) replace original and/or new pavers over reinstated slab.

(b) where trench passes through concrete footpath treatment areas:

(i) reinstate new concrete in accordance with standard drawings listed in SC6.4.3.3.3(3)b) flush with adjacent support surface/slabs to allow level reinstatement;;

(ii) ensure new concrete matches adjacent slab colour: refer to relevant footpath type in Tables SC6.4.3.3.3, for concrete colour, aggregate, finish, etc. for types as identified in SC6.4.3.3.7 - Footpath treatment location maps; and

(iii) allow for replacement and installation of any broken, cut or deteriorated or otherwise damaged footpath treatment caused by the removal.

(8) When incorporating existing trees into new works, installing new trees, or other landscape features:

(a) incorporate elements into the paving pattern, as shown in Figure SC6.4.3.3.37;

(b) modify installation where practical in accordance with the construction detail indicated in Figure SC6.4.3.3.38; and

(c) refer to SC6.4.3.6 Landscape policy for street tree spacing, selection, root barrier treatments, root development zone, tree grates or other tree surround treatments and lighting.

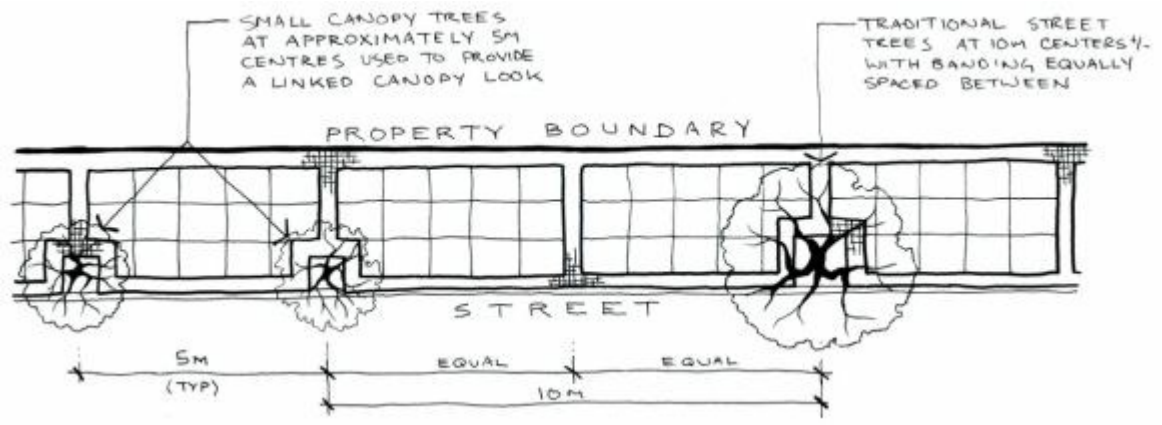


Figure SC6.4.3.3.37 Banding around tree planting

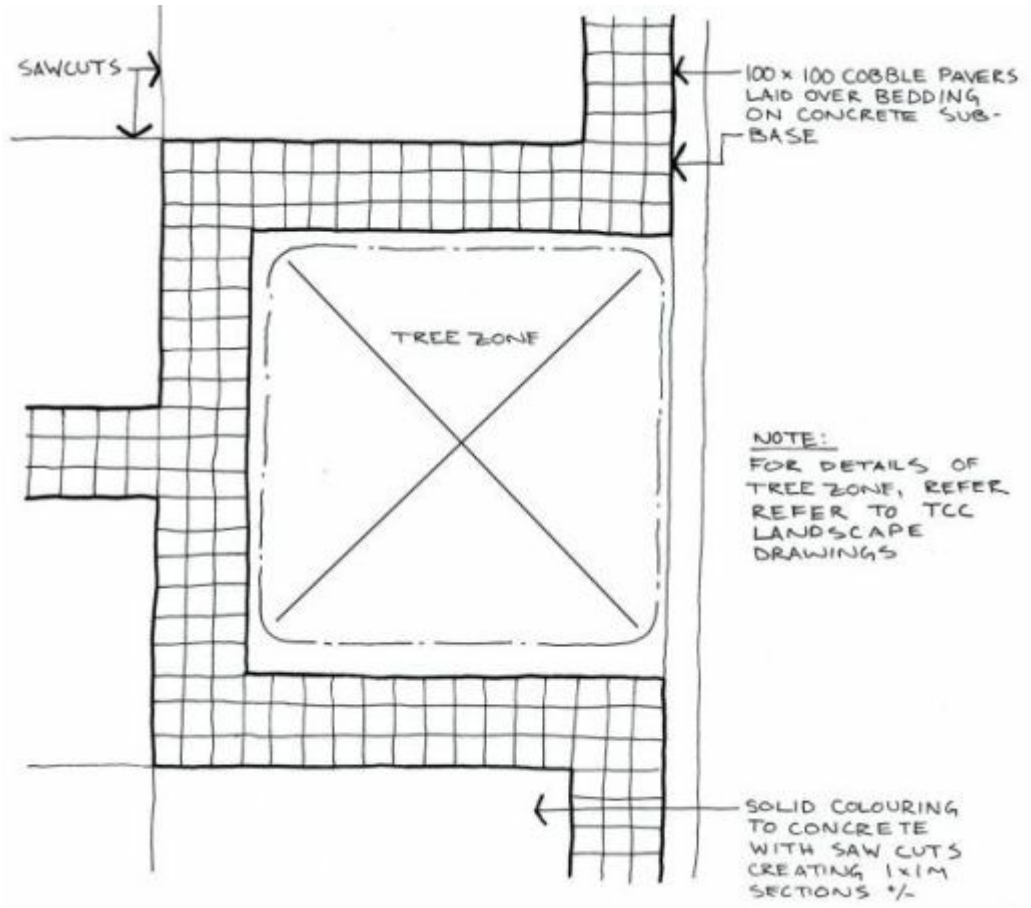


Figure SC6.4.3.3.38 Paver banding plan at tree surround

(9) When incorporating existing road transport- related infrastructure (such as bus stops, street signs and traffic signals) or providing for the placement of new road related infrastructure into any of the footpath treatment types:

(a) safety and visibility requirements shall be in accordance with the Manual of Uniform Traffic Control Devices (MUTCD) for the placement of new such infrastructure;

(b) footpath treatments and patterns shall be modified around existing elements in order to reduce disturbance to established infrastructure;.

(c) bus stops shall be in accordance with standard drawings listed in SC6.4.3.3.3.(3)(b). Bus stop concrete slab is a reinforced solid object supporting a large size structure, therefore required to be one whole slab undisturbed. Footpath treatment to be made flush with adjacent support slabs to allow level reinstatement;

(d) street signs and traffic signals shall be in accordance with Australian Standards and guidelines; and

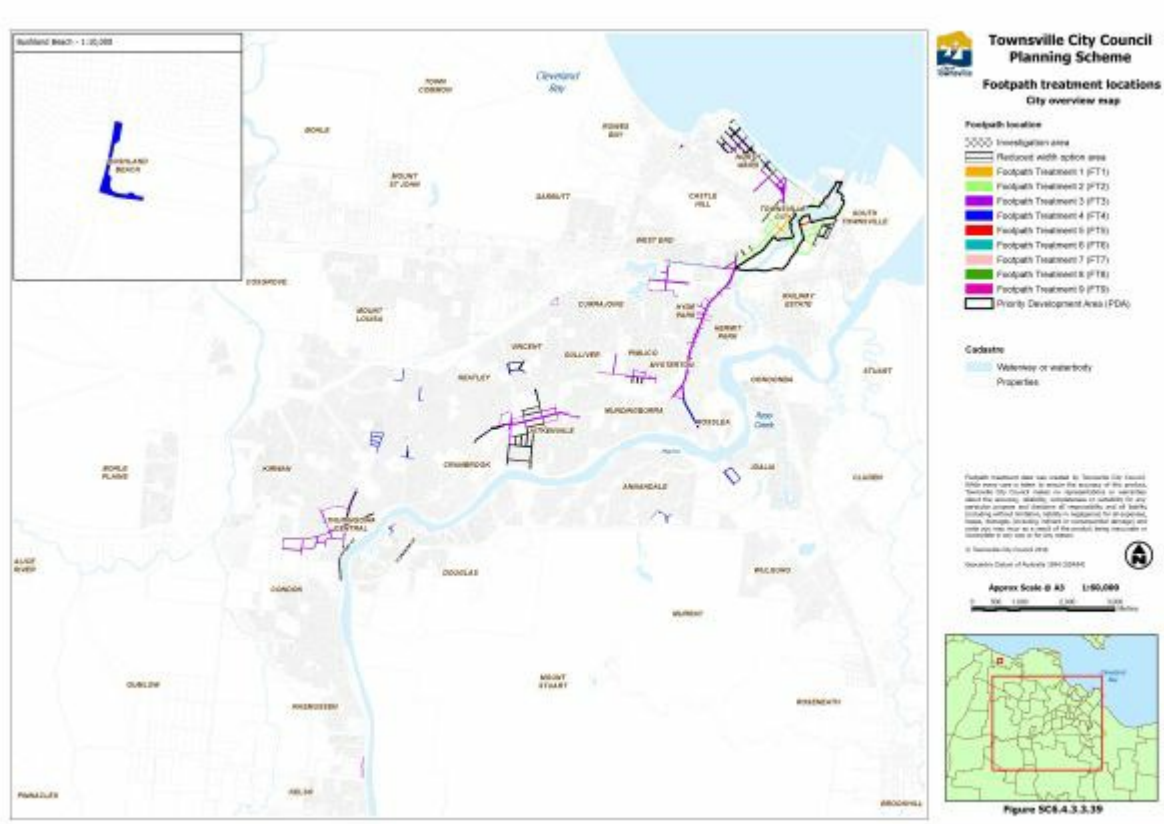
(e) street signs shall be in accordance with standard drawings listed in SC6.4.3.3.3(3)(b).

(10) When incorporating the placement of street furniture (such as , seating, rubbish bins and bollards) :

(a) installation should not impede pedestrian movement along the footpath. There shall be a 1800mm minimum clear width for the continuous accessible path of travel along the building property line, building façade and fence lines for pedestrians, especially people with a vision impairment, .in accordance with AS2890.3; and

(b) the placement of street furniture shall give consideration to minimizing the disturbance to the footpath treatment type and paving patterns.

SC6.4.3.3.7 Footpath treatment location maps



Click here to view PDF high resolution map.

Figure SC6.4.3.3.39 City overview map

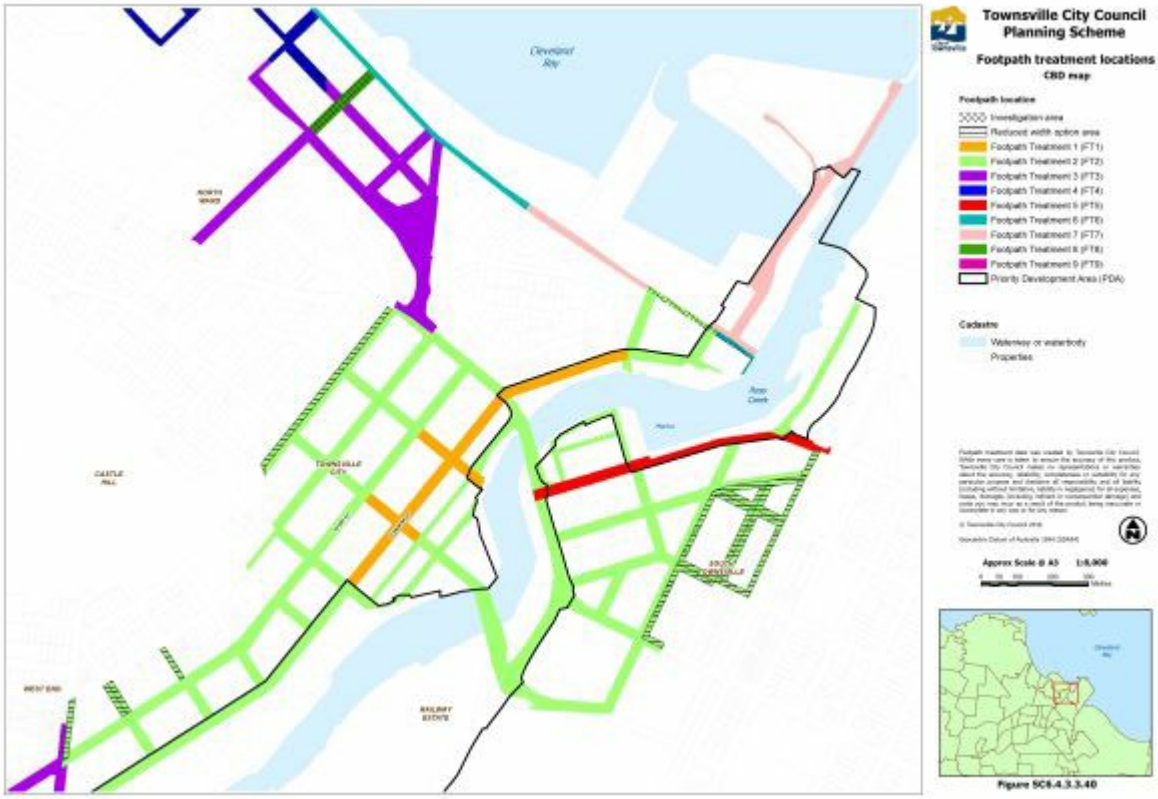


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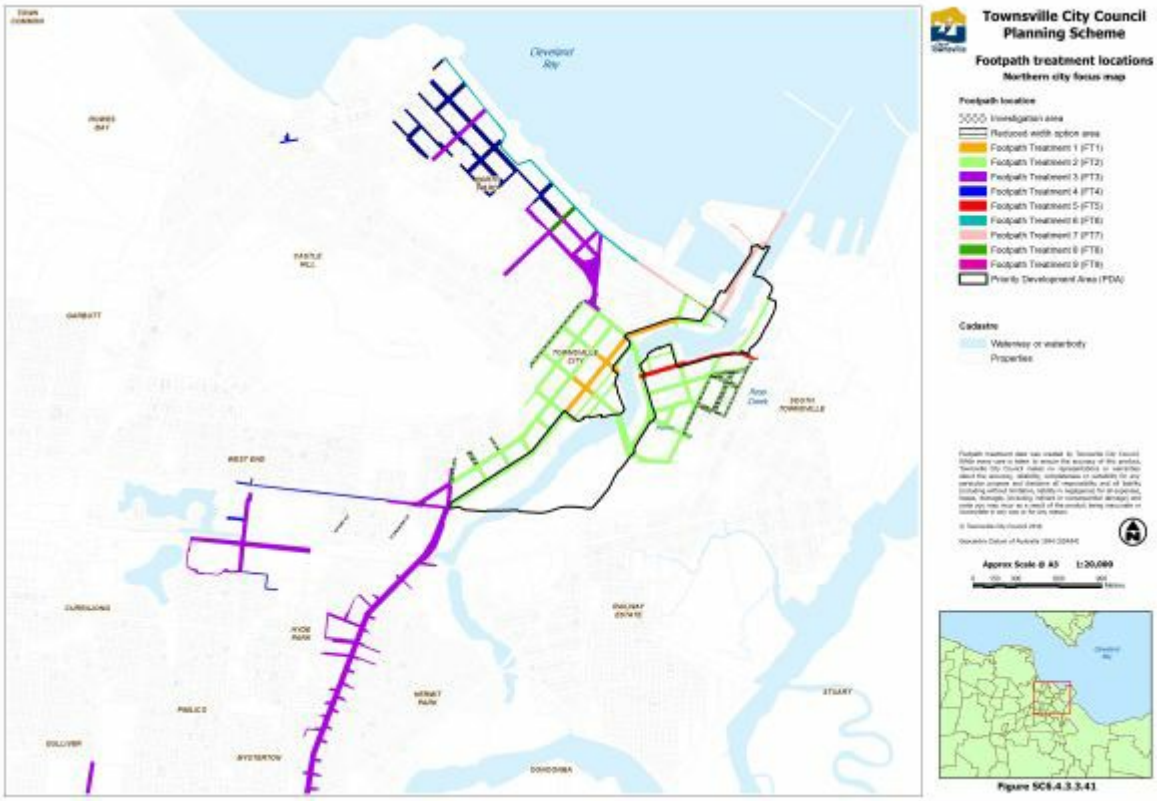
Figure SC6.4.3.3.40 CBD map



Click here to view PDF high resolution map.

Figure SC6.4.3.3.41 Northern city focus map

Figure SC6.4.3.3.42

Click here to view PDF high resolution map.

Figure SC6.4.3.3.42 Central city focus map

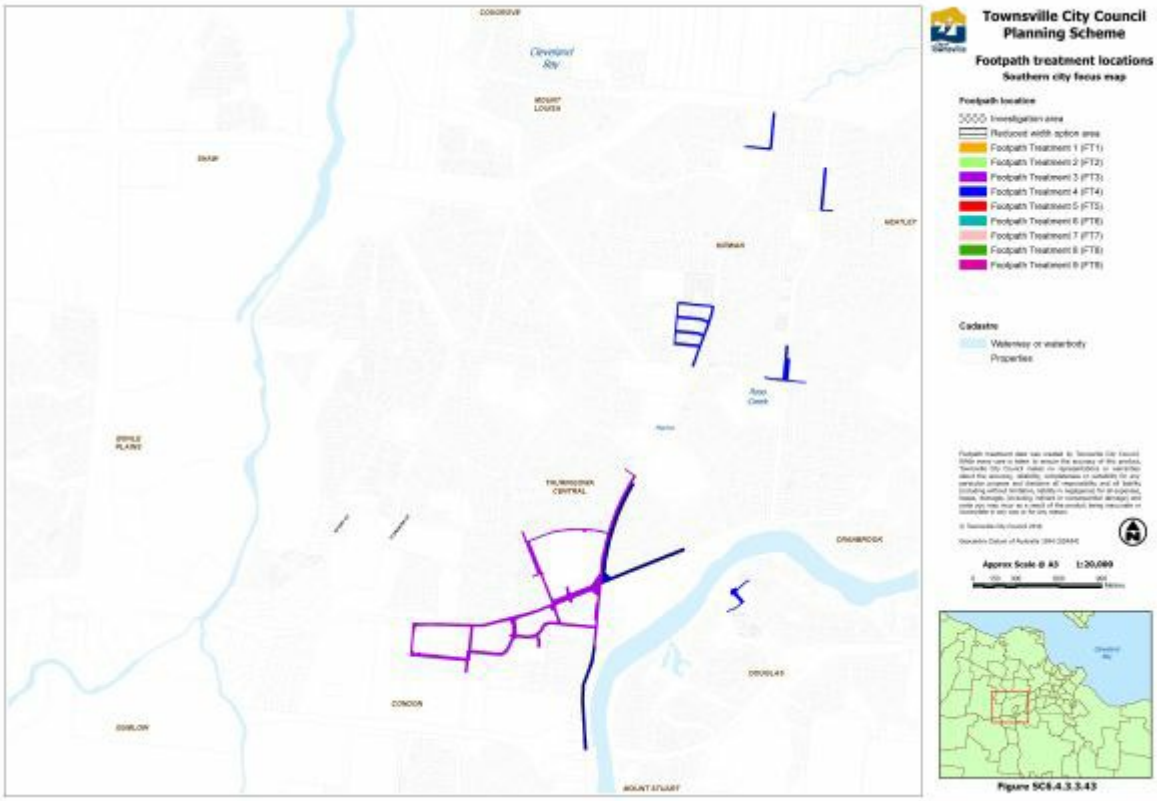


Figure SC6.4.3.3.43

Click here to view PDF high resolution map.

Figure SC6.4.3.3.43 Southern city focus map

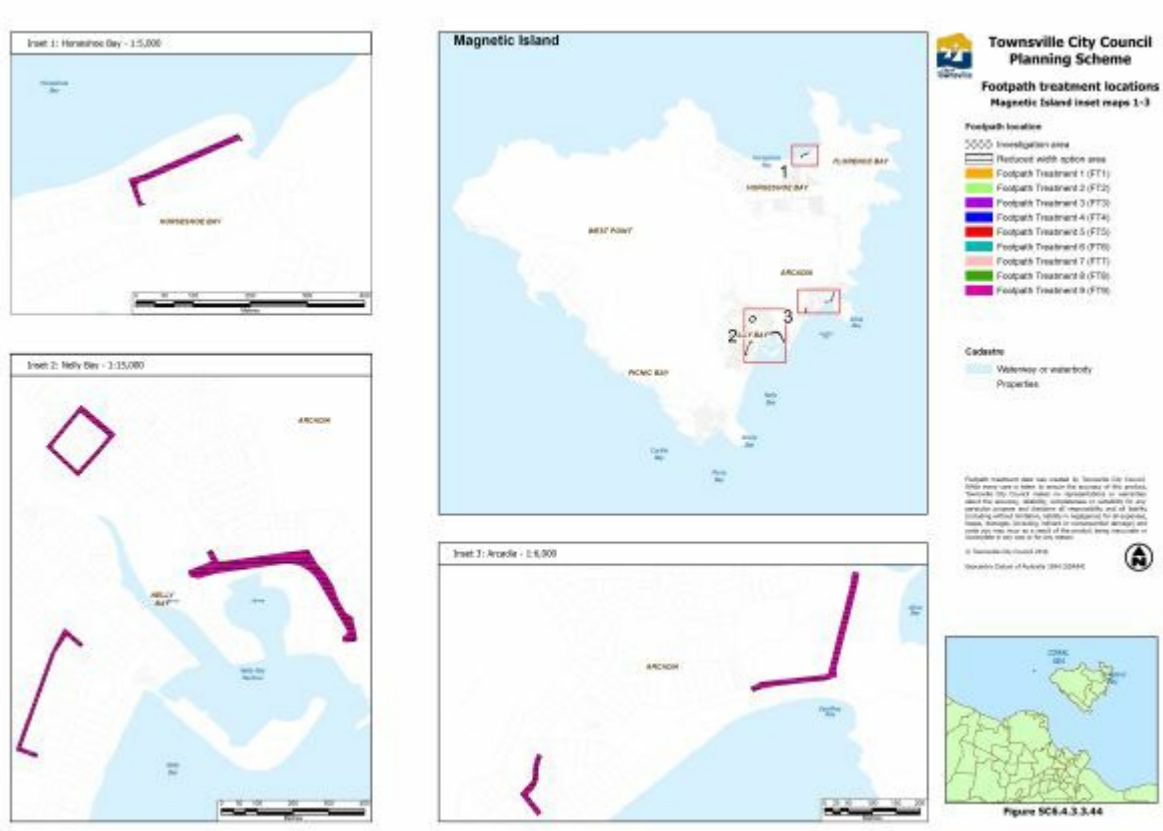


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Figure SC6.4.3.3.44 Magnetic Island inset maps 1 - 4

SC6.4.3.4 Outdoor dining design

SC6.4.3.4.1 Introduction

(1) Purpose

(a) To protect pedestrian traffic by the introduction of shared footpath management guidelines for the purpose of providing for improved use of the area and business opportunity.

(b) To effectively address risk management issues to facilitate which relate to the introduction of additional uses, cross pedestrian traffic, and items of infrastructure or street furniture, as well as the potential interaction with vehicles as outlined in SC6.4.3.4.2.

(2) Scope

(a) When assessing an application involving outdoor dining, council will consider all relevant issues, including, but not limited to:

(i) whether the proposed outdoor dining area is located immediately adjacent to the applicant's existing premises and/or connectedness to the development;

(ii) pedestrian usage of the area, including safety and passage;

(iii) vehicular usage of the area, including separation and safety matters;

(iv) the general safety of patrons of the proposed outdoor area;

(v) the contribution towards a high amenity area and creation of active and integrated spaces and places as identified by the relevant zone code; and

(vi) how the outdoor dining integrates with the character of the locality/zone and existing or intended streetscape, including specific footpath treatments.

Editor's note—Applicants should also refer to section 9.4.1 Advertising devices code of the Townsville City Plan for additional design requirements and Table 5.8.2 Operational work being placing an advertising device on premises for application requirements regarding the control of advertising devices in outdoor dining spaces.

Editor's note—Applicants should also be aware that there may be additional related approvals required, including Outdoor Dining Licence Applications from Townsville City Council (Subordinate Local Law No. 1.2 (Commercial Use of Local Government Controlled Areas and Roads) 2011), Food Premises Licence and any liquor licencing requirements required by the Queensland Government office of Liquor, Gaming and Racing and if the outdoor dining area is on state controlled land, including road, that the applicant shall lodge other necessary documentation to the required entity.

Editor's note— Any person wishing to use any council-controlled land for outdoor dining must lodge an application for an outdoor dining licence under council's Outdoor Dining Policy, which can be found on council's website.

(b) Outdoor dining is considered to include the following:

(i) the use of the council-controlled public land for the purpose of extending the services of premises whose main function is the provision of food and/or beverages to the public; and

(ii) premises may include restaurants, cafes, bars, deli and other food outlets, but does not include roadside stalls.

(3) Terminology

Back of kerb	The point of the kerb profile away from the road, as illustrated in Figure SC6.4.3.3.6.

Crash barrier	A longitudinal or roadside barrier that has the primary function of preventing penetration by a vehicle and for which the primary purpose is to prevent or reduce the injury to occupants of an errant vehicle and restaurant patrons by safely redirecting an errant vehicle away from a roadside hazard. All roadside crash barriers must be designed to meet AS3845:1999.
Kerbside zone	The area between the trading zone and the back of kerb.
Kerbside use zone	The area between the back of kerb and the vehicle through lane. Uses within the kerbside use zone may include parking, accessible parking, bus bays, taxi ranks, drop-off zones, loading zones, no standing zones, shoulders and bike lanes. Fencing legs should not create a tripping hazard.
Pedestrian fence	A fence provided to restrict the movement of pedestrians and restaurant patrons. This can include a permanent structure or may be a portable café-style fence. Pedestrian fences must be: • A minimum height of 800 mm; • Designed and constructed so that the fence does not present a spearing hazard and is of a level of quality and design acceptable to council.
Pedestrian zone	A 1.8m wide section of footpath for the through movement of pedestrians located adjacent to the property building line (shoreline).
Trading zone	The formally defined area within which outdoor dining is permitted by council. All furniture and commercial activities relating to outdoor dining must occur within this area. Pavement markers will be installed by council to define the extents of the approved dining area (trading zone).
Traffic lane	The area of the road that is used for the through passage of vehicles in normal driving conditions. The traffic lane does not include the shoulder, parking lane or other kerbside use area.

The relationship between the key terms above is shown in Figure SC6.4.3.4.1 - Summary of guidelines and requirements.

SC6.4.3.4.2 Risk considerations associated with outdoor dining

With respect to outdoor dining, risk is increased by four significant events. Risk management through design guidelines is provided for the following four risk events:

(1) a vehicle running off road when diners are present, without sufficient separation to allow the driver of the vehicle to recover (or for diners to react and clear the path of the vehicle);

(2) a vehicle running off road when diners are not present, without sufficient separation to allow the driver of the vehicle to recover, and the outdoor dining furniture penetrates the vehicle causing injury to vehicle occupants;

(3) a vehicle running off road at a location where a crash barrier has been provided for the specific purpose of protecting footpath diners, and the crash barrier has not been designed to safely and effectively redirect the impact of a vehicle, causing either injury to outdoor diners or injury of the vehicle occupants; and

(4) a diner/staff stepping or falling onto path of vehicle due to proximity of trading zone to the traffic lane (with no fence or barrier in place), for example due to placement of a chair too close to the kerb.

SC6.4.3.4.3 Design guidelines for kerbside risk management and use

In addition to risk management issues, the guidelines include recommendations for the separation of the trading zone to accommodate the various roadside elements such as parking, and access to public infrastructure and services. Table SC6.4.3.4.1 below summarises the content of these guidelines.

Table SC6.4.3.4.1 Summary of guidelines and requirements

Guidelines	Requirements
Speed zones	See Table SC6.4.3.4.2
Barriers and fences	See Table SC6.4.3.4.3
Intersection corner	Outdoor dining should not occur within an intersection corner as defined in Figure SC6.4.3.5
Kerbside uses	See Table SC6.4.3.4.4, Figure SC6.4.3.6
Public infrastructure clearances	In general, 1 m clearance from public infrastructure unless demonstrated otherwise. See SC6.4.3.4.8
Pedestrian access though trading zone to access kerbside uses	See clause SC6.4.3.4.7

SC6.4.3.4.4 Design guidelines for risk management

Because of the increase in risk associated with higher speed limits, different levels of outdoor dining protection and separation have been recommended to manage risk appropriately. In some speed zones, outdoor dining is generally not appropriate. In lower speed zones, outdoor dining is generally always appropriate provided suitable measures are taken to separate diners from traffic by distance or a physical barrier or fence. Table SC6.4.3.4.2 below summarises the recommendations for risk management in different speed zones.

Table SC6.4.3.4.2 Summary of recommendations for risk management

Speed zone (km/h)	Appropriate for outdoor dining	Provide crash barrier guidelines	Provide pedestrian fencing guidelines
Above 60	No	-	-
60	Yes	Yes	Yes
50	Yes	Yes	Yes
40	Yes	No	Yes

Table SC6.4.3.4.3 provides the detailed design guidelines for different speed zones. Note that in the majority of cases, the need for a crash barrier can be avoided by increasing the separation distance between the trading zone and traffic. Figures SC6.4.3.4.2 – SC6.4.3.4.4 illustrate these design guidelines.

Table SC6.4.3.4.3 Guideline for crash barriers, pedestrian fencing and separation distance

Speed zone (kph)	Trading zone 3m or more from traffic lane	Trading zone 1.2m to 3m from traffic lane	Trading zone less than 1.2m from traffic lane
Above 60	Not recommended for outdoor dining	Not recommended for outdoor dining	Not recommended for outdoor dining
60	No crash barrier or pedestrian fence required	Pedestrian fence required	Crash barrier required
50	No crash barrier or pedestrian fence required	Pedestrian fence required	Crash barrier required
40	No crash barrier or pedestrian fence required	No crash barrier or pedestrian fence required	Pedestrian fence required

SC6.4.3.4.5 Design guidelines for trading zones at an intersection

In general, outdoor dining is not appropriate in the vicinity of an intersection corner. This allows corners to be used by pedestrians and cyclists, and allows access to public infrastructure and services to be maintained at all times. In some circumstances it may however be appropriate to support the zone intent and specific demonstration for intersection driving will be required.

Figure SC6.4.3.4.5 shows the area at a corner that should not be used for a trading zone.

SC6.4.3.4.6 Trading zone setbacks for kerbside use

Different kerbside uses have different spatial requirements to facilitate the movement of vehicles and pedestrians. Table SC6.4.3.4.4 summarises the recommended separation distance between the back of kerb and the trading zone for each kerbside use. Figure SC6.4.3.6 illustrates these distances.

Table SC6.4.3.4.4 Setbacks for kerbside use

Kerbside use	Minimum setback from back of kerb
No Standing/traffic lane	0.3m (if no pedestrian fence provided)
Parking - angle	0.8m
Parking - Parallel	0.8 m
Accessible Parking (Parallel)	1.5m

SC6.4.3.4.7 Pedestrian access to kerbside use and through trading zones

The design of a trading zone and any required pedestrian fencing should accommodate access through or around the trading zone for pedestrians, including persons with a disability. Where a pathway is required through the trading zone, a minimum width of 1.2 m is required. Where the kerbside use has an accessible parking bay and kerb ramp to access vehicles in the kerbside zone, a 1.5 m wide access through the trading zone must be provided. In addition, the design should consider the need for the crossing of pedestrians where the proposed outdoor dining facility is not within 20 m of a pedestrian crossing or intersection. A minimum width of pedestrian zone of 1.8 m is recommended located adjacent to the property building line. This width should be increased to a minimum of 2.4 m at locations where high pedestrian volumes are expected.

SC6.4.3.4.8 Clearances to public infrastructure

It is recommended that with the exception of service pits, in general a clearance of 1 m is desirable from all public infrastructure with the following exceptions:

(1) where a pedestrian fence is provided which separates the infrastructure and the trading zone; or

(2) where the owner of the public infrastructure asset (including council) provides written permission to relax the minimum clearance requirement.

In the case of service pits, a minimum clearance is not specified. However, it is recommended that the applicant obtains the permission of the asset owner if the applicant wishes to install outdoor dining furniture over or in the immediate vicinity of the service pit.

SC6.4.3.4.9 Risk assessment for non-conforming designs

Outdoor dining proposed within a speed zone higher than 60 km/h, or if the applicant believes that the requirements of the design guidelines are not applicable to the specific location, a risk assessment will be required by council.

The risk assessment must be prepared by a person considered by the council to have appropriate expertise in traffic engineering, and will need to demonstrate that the proposed design meets the intent of this sub-section and the relevant provisions of the Townsville City Plan, particularly the relevant zone code.

SC6.4.3.4.10 Permanent outdoor dining structures

In the case where a permanent structure (for example concrete walls, decking, awnings) are proposed, details are to be provided on plans submitted for approval.

Structures, and associated services, must be designed and constructed by suitably qualified persons in accordance with the relevant Australian Standards and the requirements of the Townsville City Plan (i.e. relevant zone code) to maintain public safety, good amenity and ease of cleaning and maintenance.

Electrical supply should have an isolating switchboard to enable the operator of the outdoor dining service to isolate the electrical supply.

Editor's note—Works within council's road reserve will require separate approvals under the relevant local laws (e.g. Road Work Permit).

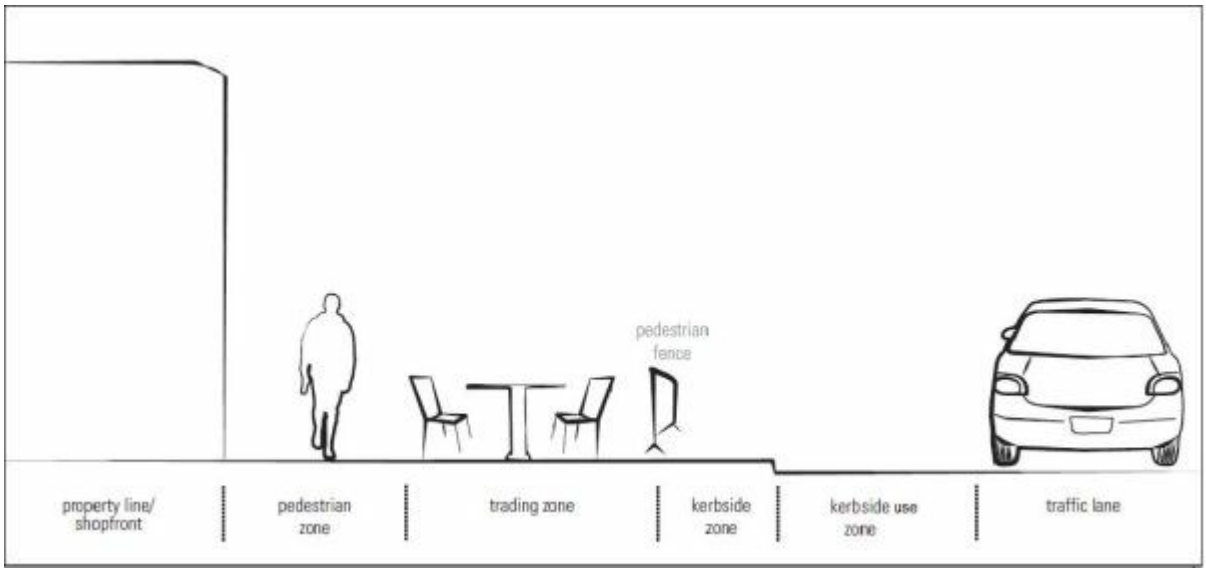


Figure SC6.4.3.4.1 Trading zone definitions

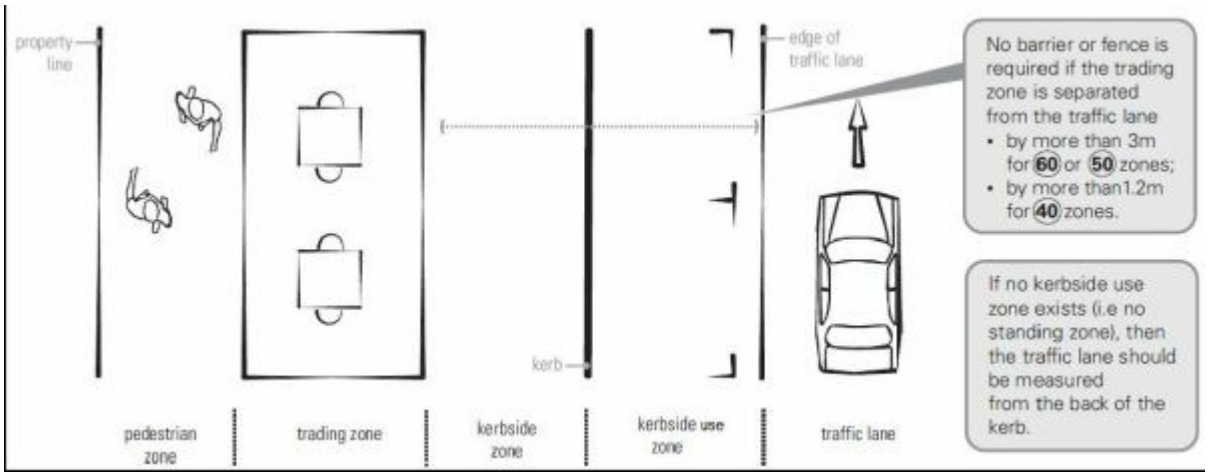


Figure SC6.4.3.4.2 Separation requirements (no barrier or pedestrian fence)

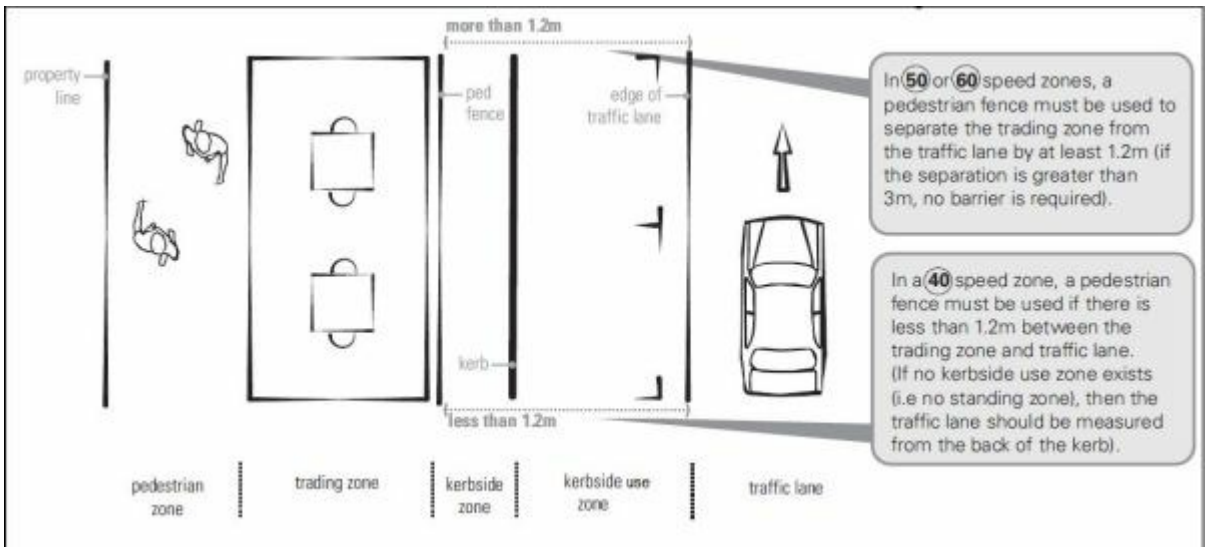


Figure SC6.4.3.4.3 Pedestrian fence requirements

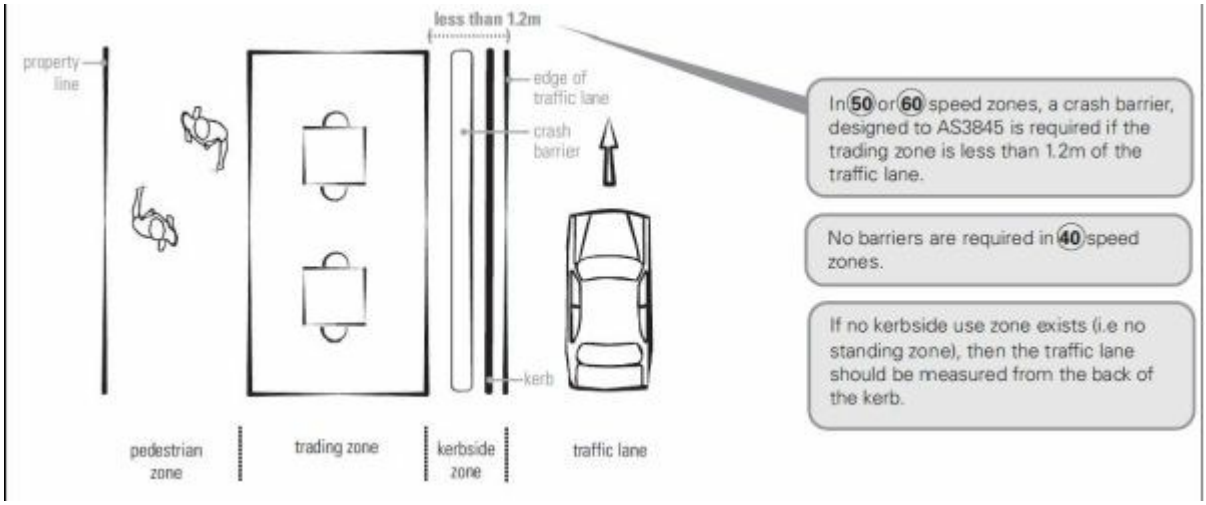


Figure SC6.4.3.4.4 Crash barrier requirements

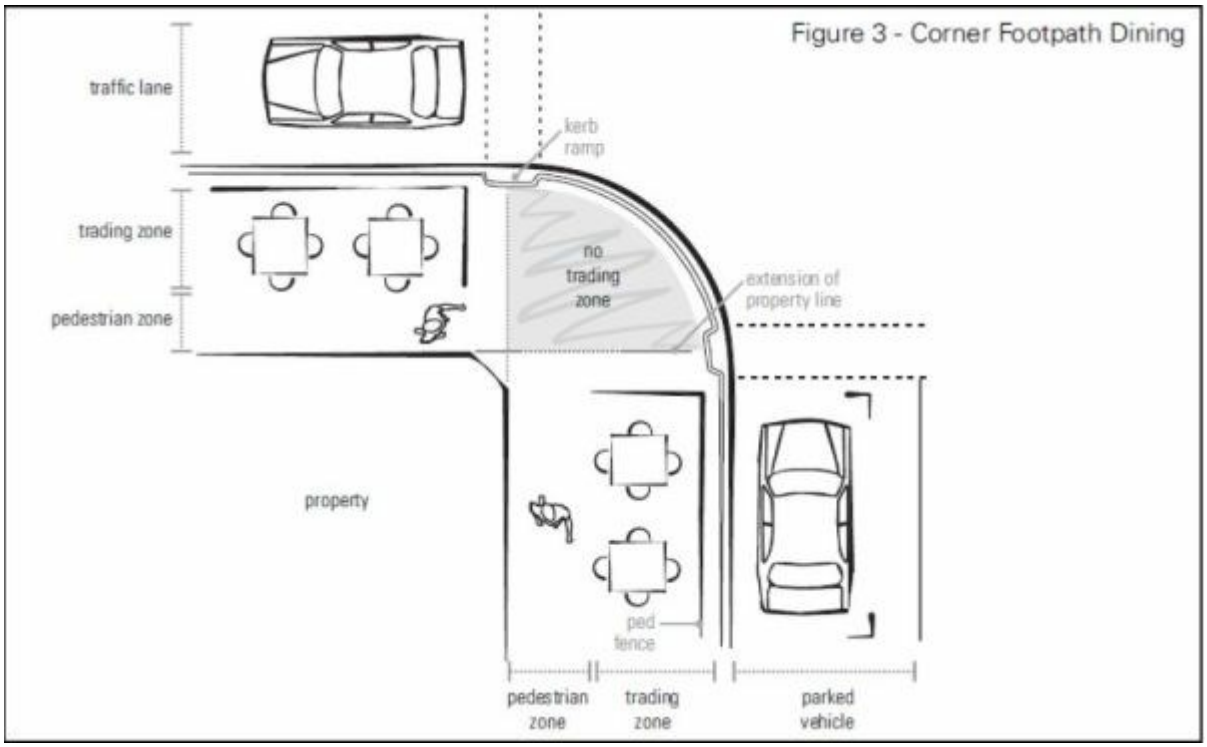


Figure SC6.4.3.4.5 Outdoor dining at intersections

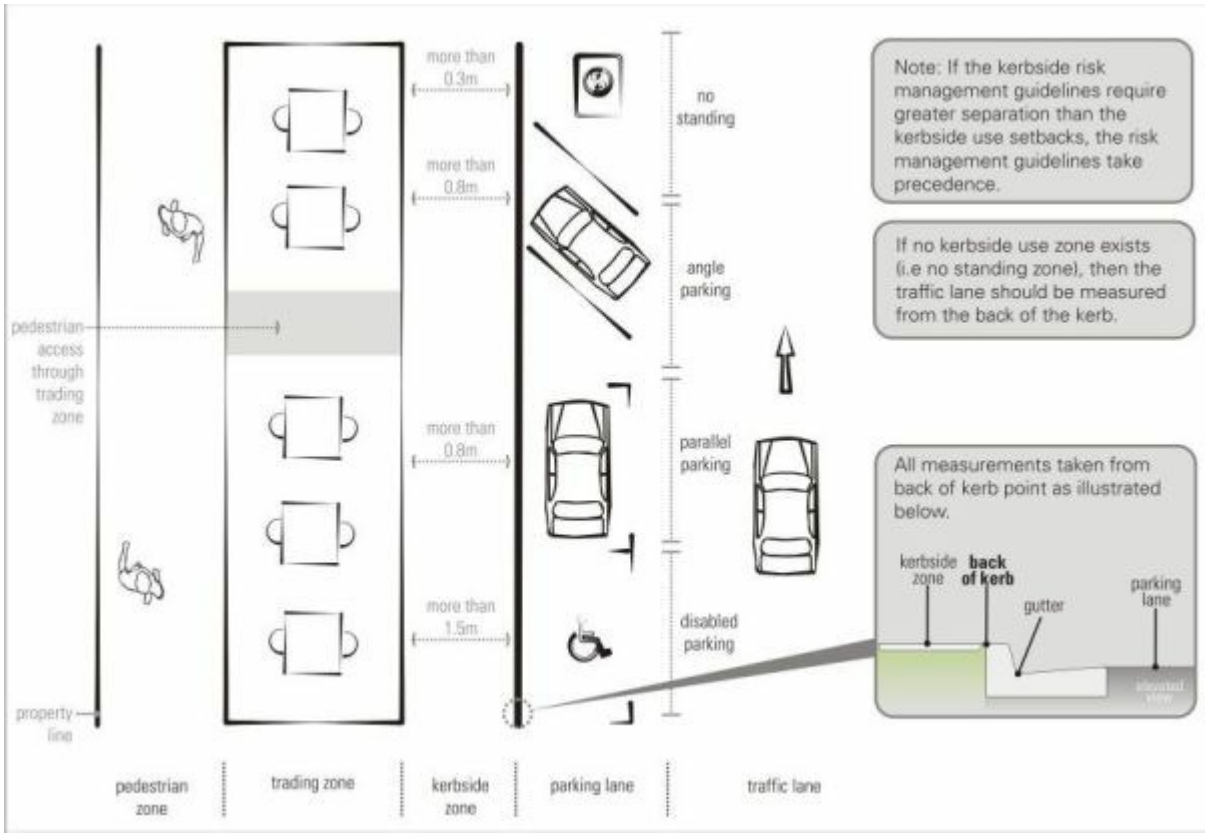


Figure SC6.4.3.4.6 Kerbside use setback requirements

SC6.4.3.4.11 Design and layout principles

(1) To ensure the safety of patrons using the indoor and outdoor areas of the business.

(2) To ensure safety and convenient passage of all pedestrians when using public footpaths.

(3) To ensure the maintenance of clear sight lines for both pedestrians and motorists, particularly near pedestrian crossings, street corners and key intersections as sought by the relevant zone code.

(4) To provide an active and integrated street front.

(5) To ensure adjoining premises are not adversely affected by any business use of footpath areas.

SC6.4.3.4.12 Plan of layout

(1) For any application involving outdoor dining, the applicant is required to provide a layout plan identifying the zones nominated in SC6.4.3.4.1(3) Terminolgy (and Figure SC6.4.3.4.1) above to a scale of 1:100.

The plan of layout must clearly identify the following:

(a) pedestrian zone - a clear pedestrian thoroughfare of not less than 1.8 m in width adjacent to the property building line;

(b) trading zone – an outline of the area intended to be used, including its dimensions;

(c) kerbside zone – area between trading zone and back of kerb;

(d) kerbside use zone – area between back of kerb and traveled path of vehicle;

(e) traffic lane – area of the road used for through passage of vehicles;

(f) any pedestrian fences that are proposed to be used;

(g) any crash barriers that are proposed to be installed;

(h) the access and exit points of the building near the intended outdoor dining area;

(i) details of any loading zones, bus zones, trees, planter boxes, fire hydrants, transformers, telephone booths, mail boxes, bus stops, bus seats and shelters, rubbish bins, pillars, posts and other obstructions; and

(j) If any structures are proposed the structures and, the location of any underground services (such as

water, electricity, etc.).

(2) In addition to submitting a plan of layout, the applicant is also required to submit:

(a) a colour photograph of the site frontage of the area; and

(b) details of all proposed signage and advertising.

SC6.4.3.4.13 Access guidelines

Outdoor dining should enrich the pedestrian experience and public life and support the purpose of the relevant zone. It is therefore important that they present an open, inviting image and are easily accessible from the public way. The layout and access must be ergonomically designed to allow safe operation of outdoor dining.

The streetscape must provide safe, equitable and dignified access for all, enabling all people to move around independently, safely and without restriction within an outdoor space. The edge of the building permits people who are visually impaired to easily locate entrances to buildings without encountering hazards. Hence, where possible and practical, the trading zone should be located on the kerb-side of the footpath, and the pedestrian zone should be located on the building side of the footpath adjacent to the property building line to provide a continuous accessible path of travel for all pedestrians.

In some locations, conditions may make siting of the trading zone on the kerb-side impractical, seriously disadvantageous or an unreasonable impediment to pedestrian traffic. In such situations, council will consider allowing the location of the trading zone adjacent to the building rather than against the kerb.

In all locations, an outdoor dining area must stay within the area identified as trading zone on the approved layout plan.

Details of required clearances to public infrastructure are provided in SC6.4.3.4.11.

Outdoor dining areas must be easily accessible from the footpath and must present an open and inviting image to entice participation. Pedestrians should not be forced onto the roadway by outdoor dining activities or other non-permanent items/structures on the footpath.

SC6.4.3.4.14 Furniture guidelines

Permanent outdoor furniture should make a positive contribution to the street environment. A furniture style that is practical and integrates well with the surrounding cityscape is encouraged.

(1) Outdoor furniture should enhance the character of the street.

(2) Outdoor furniture should be robust to withstand the wear and tear of outdoor commercial usage.

(3) Outdoor furniture should be safe in its design, compliant with Australian Standards, and not cause any hazards to the patrons, shopkeepers or pedestrians.

(4) Barricades, safety rails, bollards etc. may be required for safety reasons. All such barriers must be provided and maintained in accordance with this sub-section.

(5) The use of framed fabric or any other style of low-height barriers, including planter boxes, within public domain must be carefully designed and selected to ensure minimal impact on the use, enjoyment and safety of pedestrians and patrons.

(6) Removable furniture are to be removed when business is not open.

(7) No part of the footpath is to be used for storage.

SC6.4.3.4.15 Umbrellas/shade structure guidelines

(1) Fixtures that penetrate or damage the pavement on public footpaths will generally not be permitted. However, assessments will be undertaken on a case-by-case basis.

(2) In some cases, the applicant may wish to undertake streetscape works to accommodate an outdoor café. Such works may include footpath widening, paving, street tree planting, installation of permanent umbrellas/shade structures, pedestrian lighting and where such woks are in support of the relevant zone code of the Townsville City Plan.

(3) Umbrellas and other shade structures should not encroach upon, nor interfere with pedestrian movement or services.

(4) Umbrellas and other shade structures must have not less than 2.5 m clearance above the footpath within the obstruction free zone (AS1742.2 – 2009) from the lowest point of the extended arms (spokes) and not cause a hazard to pedestrians within a pedestrian zone.

(5) Umbrellas and other shade structures must be maintained in sound and aesthetically acceptable condition to the council's satisfaction.

(6) Umbrellas and other shade structures must be secured against high winds.

(7) Umbrellas and other shade structures must be removed when the outdoor seating area is not in use.

(8) Any advertising on umbrellas and other shade structures must comply with section 9.4.1 Advertising devices code (any relevant approval obtained for the placement of an Advertising device) and the relevant local law (*Local Law No. 1.4 Installation of advertising devices 2011)*.

SC6.4.3.4.16 Advertising guidelines

The Advertising devices code found in section 9.4.1 of the Townsville City Plan provides applicants with information regarding the placement of advertising devices. In some instances, separate approval for operational works for the placement of an advertising device may be required. Refer to Table 5.8.2 of the Townsville City Plan to determine levels of assessment for the placement of an advertising device.

SC6.4.3.4.17 Lighting

Any outdoor dining establishment approved to operate outside daylight hours must provide adequate lighting to Australian Standards, to ensure the safety and amenity of patrons and the general public. The use or reliance on council infrastructure is not permitted and the cost of maintaining, running and installing the lighting shall be the responsibility of the applicant/operator of the outdoor dining space. Any outdoor lighting must also comply with any light spillage requirements so as not to cause nuisance to adjoining properties or traffic movement areas. Lighting shall be safe and not cause obstruction or pose a hazard to pedestrians or traffic.

SC6.4.3.5 Car parking and public transport facilities

SC6.4.3.5.1 Introduction

(1) Purpose

This sub-section provides advice, guidance and standards with respect to car parking and public transport facilities to support an integrated safe, efficient and sustainable transport network.

(2) Scope

This sub-section includes the consideration of:

(a) transport impacts, including:

(i) demands for private and public transport, pedestrian and cycle usage;

(ii) impacts of future development on existing transport networks and infrastructure and the need for any improvements; and

(iii) assessment of the public transport services and the provision of facilities both on and off-site and specific high generator needs;

(b) pedestrian and cycle facilities integration with existing networks and for the provision of facilities both on and off-site;

(c) site access - accesses and driveways;

(d) parking area design provision of adequate and appropriately designed parking and circulation areas; and

(e) servicing - provision of appropriate loading/unloading facilities and manoeuvring areas both on and off-site and provision for emergency and service vehicle access.

(3) Relationship to codes

(a) Where a development application is assessable against Part 9.4.6 Transport impact, access and parking code, the application of this sub-section will assist the applicant to address the performance outcomes and acceptable solutions of that code as it contains advice, guidelines and standards.

(b) This sub-section can also be used as guidance and advice for other assessment criteria and codes including Part 9.4.4 Reconfiguring a lot code, Part 9.4.7 Works code, Part 9.4.5 Accepted works requirements code and Part 9.4.3 Landscape code.

(4) Reference and source documents that must be read in conjunction with this sub-section are as follows:

(a) Development manual planning scheme policy sub-sections
SC6.4.3.3 Footpath treatment policy
SC6.4.3.4 Outdoor dining design
SC6.4.3.6 Landscape policy
SC6.4.3.14 Traffic impact assessment guidelines
SC6.4.3.13 Townsville road hierarchy
SC6.4.3.20 Public lighting and utility services
SC6.4.3.22 Waste management guidelines
SC6.4.4.1 Geometric road design
SC6.4.4.2 Pavement design
SC6.4.4.3 Bridges and other structures
SC6.4.4.7 Bicycle, pedestrian and shared path design
SC6.4.4.8 Standard drawings

(b) SC6.10 Parking rates planning scheme policy

(c) Australian Standards
AS/NZS 2890 set *Parking Facilities*
AS1428 *set Design for Access and Mobility*

(d) Department of Transport and Main Roads Queensland
Manual of Uniform Traffic Control Devices (MUTCD)

Traffic and Road Use Management Manual (TRUM)
Guidelines for Assessment of Road Impacts of Developments, 2006
Road planning and design manual
Transport Planning and Coordination Regulation 2005
Planning for Safe Transport Infrastructure at Schools, April 2011
Public Transport Infrastructure Manual (PTIM) - TransLink Division

(e) Austroads Guides
Austroads Design Vehicles and Turning Path Templates Guide
Guide to Road Design – set
Guide to Traffic Management – set
Cycling Aspects of Austroads Guides AP-G88-14 and Quick Reference

(f) Other
Australian Government, *Disability Standards for Accessible Public Transport 2002* (DSAPT)
Australian Government, *Disability Standards for Accessible Public Transport Guidelines*
Australian Government, *Disability (Access to Premises - Buildings) Standards 2010 Premises Standards*
Disability Discrimination Act 1992 (DDA)
Australian Building Codes Board, *National Construction Code (NCC)*
Queensland Government, *Crime Prevention through Environmental Design: Guidelines for Queensland* (CPTED)
Institute of Public Works Engineering Australia, Qld Division, *Complete Streets – Guidelines for Urban Street Design,* 2010
Queensland Government, *Queensland Development Code* (QDC)

SC6.4.3.5.2 Public transport

(1) Transport network impact

(a) Applicants should assess the additional transport demands generated by the development and the capacity of the infrastructure to accommodate the additional demands by way of a traffic impact assessment report where all impacts, upgrades and alterations to the road infrastructure, including line marking and signage are identified.

(b) SC6.4.3.14 Traffic impact assessment guidelines must then be applied to the extent outlined in that report and information and plans provided on any new infrastructure or the proposed alterations/additions to the existing infrastructure for the consideration/approval of council which may be required as a result of this development. Provision should be made for the utilisation or extension of existing networks and services where required. The recommendations of the traffic impact assessment must be implemented with regard to the advice, guidance and standards identified in this sub-section. End of Trip facilities (on-site or off-site) must be provided as part of the development where identified by the relevant code and must take account of the particular characteristics of the user and service provider.

(2) Public transport

(a) Public transport demands should be assessed and consideration given to upgrading the existing transport network, services and facilities in accordance with the current and future demands.

(b) The developer is to provide council with a comprehensive assessment of the current and projected public transport demands for any new facility to be constructed as part of these works. This assessment is to be in the form of a detailed transport report and will include the particulars of any proposed upgrade to the existing transport services, routes and systems that adjoin the proposed project development. Taxi services are also considered a form of public transport and are to be considered in the model assessment of the site (if applicable). Taxi services should be integrated with other transport node facilities wherever it is possible to do so.

(c) Information and guidelines for providing public transport are provided in SC6.4.3.5 Attachment A of this sub-section. SC6.4.3.5 Attachment B of this sub-section provides advice on the consultation process with the necessary statutory authorities and service providers.

(3) Major developments

(a) Major developments which will result in high levels of public transport demand should give particular consideration to the provision and integration of services and the detail design of associated facilities on

or near the site. Facilities should be designed so as to be convenient and encourage public transport, walking or cycling. Generators may include uses such as schools, hospitals, event venues, shopping or employment centres, and high-density residential developments, aged care facilities, medical centres and retirement villages.

(b) If a development is a high level generator under SC6.4.3.14 Traffic impact assessment guidelines, a modal interchange should be provided which may include taxis. A set-back from the main road/route should be provided to ensure the site is serviced safely and directly for these facilities. Developments should present an active frontage to the transport interchange facility with wide footpaths and no conflicting vehicular accesses to ensure pedestrian and user safety is a priority.

SC6.4.3.5.3 Driveways

(1) Developments must provide for safe effective vehicular site access to and from the site, appropriate for the volume, frequency and type of vehicle usage and the function and characteristics of the surrounding road network. Separate, and clearly distinguishable, access for pedestrians should be provided where practicable.

(2) The location and characteristics of the access should be in accordance with the following documents:

(a) SC6.4.4.1 Geometric road design

(b) SC6.4.3.17 Driveways

(c) SC6.4.4.8 Standard drawings

(d) SC6.4.6 Construction specifications

(e) AS 2890 - *Parking Facilities Set*

(f) Austroads Guides

(3) The location and capacity of accesses must provide for safe and efficient pedestrian, cyclist and vehicular movement on adjacent and nearby road, and be appropriately designed so as to consider sight distances, grades, queuing, manoeuvring requirements, drainage and services. Any access must be structurally sound and built of aesthetically appealing materials for the circumstance. The impact of the access on neighbouring properties in terms of safety, streetscape and noise should also be considered.

SC6.4.3.5.4 Pedestrians and cyclists

(1) Developments are to make appropriate provision for the safe and convenient movement of pedestrians and cyclists, both on-site and to and from surrounding networks. Design should include the provision of suitable routes and end-of-trip facilities so as to encourage and facilitate these forms of movement.

(2) Major developments should provide end-of-trip facilities in accordance with the QDC Mandatory Part 4.1 *Sustainable Buildings* within the building or on-site.

(3) As well as to ensuring the safety of pedestrians, cyclists and other transport users, the design of pathways, roads, car parks and associated infrastructure (including lighting, landscaping etc) should in turn encourage overall public safety. The principles found in *Crime Prevention through Environmental Design Guidelines (Queensland)* must be given appropriate consideration for the specific development circumstances in addition to requirements of the relevant code.

SC6.4.3.5.5 Parking

(1) Parking on-site

(a) On-site parking must be provided to meet the demands of the development, including open space areas and meet the minimum rates set out in SC6.10 Parking Rates planning scheme policy (Table SC6.10.2.1 Parking rates). SC6.4.3.6 Landscaping policy provides further direction on the provision of parking to service open space areas.

(b) Any associated change to existing on-street parking controls or loading bays must also be appropriately addressed by the development. A parking layout plan must be submitted for the approval of council which accounts for the loss of any existing on-street parking bays to accommodate loading zones, bus

stops, taxi ranks or driveways required for the orderly operation of the proposed development.

(c) The design of the car park, its accesses and associated aisles are to be in accordance with AS/NZS 2890.

(d) Accesses must be designed in accordance with SC6.4.3.17 Driveways and SC6.4.4.8 Standard drawings.

(e) Where car parks are accessed through security barriers, doors or lifts, sufficient queuing space must be provided on site to accommodate all expected traffic during peak demand periods.

(f) Access ways adjacent to car park entries should have sufficient internal queuing space to prevent vehicles queuing into the street whilst waiting for a vehicle to manoeuvre into-out of a parking bay.

(g) Turning paths for cars and service vehicles must be provided in accordance with the Austroads' *Design Vehicles and Turning Path Template Guide*. Council may require the preparation of plans that demonstrate adequate turning paths in accordance with Austroads.

(h) Pavements must be sealed, line marked and constructed to a design appropriate for the anticipated vehicular loading.

(i) Parking for schools must comply with *Planning for Safe Transport Infrastructure at Schools*.

(j) Car parks must provide adequate manoeuvring and parking areas for the type of vehicles and functions served. They must be clearly signed and marked, accessible, safe and contribute aesthetically to the internal user and the streetscape character. Landscaping associated with parking facilities must be in accordance with the Landscape Code and with SC6.4.3.6 Landscape policy.

(k) All car parking spaces for people with a disability must be designed in accordance with AS/NZS 2890-6. Car parking spaces for people with a disability are to be largely located as close as possible to the point of entry into the proposed development. Provision for off-site parking may also be required. In this circumstance, the ability to safely provide this within the road reserve must also be demonstrated.

(l) Pedestrian access and movements within the car park should be separate from vehicular access and should be appropriately marked and signed and accessible by all abilities.

(m) Carwash bays must be clearly marked and signed, even though this may also be utilised as a visitor space. Run-off from the car washing bay must not discharge into the stormwater drainage system. Stormwater quality treatment for the car park run-off must be considered as part of the treatment for the whole site.

(n) Bicycle storage racks must be provided on-site in accordance with AS/NZS 2890.3.

(o) Provision of lighting in off-street car parks is to comply with AS1158.

(2) Parking on-street

(a) Developers must undertake all works identified in the traffic impact assessment report required in SC6.4.3.5.2(1) Transport network impact.

(b) If a new driveway is to be constructed in a street where parallel parking exists and it is necessary to remove parking bays and install a driveway, the remaining parallel parking bays must be remarked such that at least 3 m is left clear from the edge of the driveway on the approach side of the driveway and at least 2 m is left clear on the other side of the driveway. Remarking of the remaining on street bays and any relocation/alteration to parking control signs must be undertaken as part of this works. A parking layout plan must be submitted for the approval of council.

(c) Where a loading zone, bus stop or a taxi zone is required as a result of a development, the infrastructure, line marking and signage must be provided by the developer. The design must be submitted to council for approval prior to works commencing on site.

Editor's note—a loss of parking may occur due to access requirements by Queensland Fire and Rescue at hydrant boosters.

SC6.4.3.5.6 Servicing

(1) The development must make adequate on-site provision for the access, loading, unloading and manoeuvring of service vehicles sufficient to cater for the demand generated by the development and the service vehicles

utilised. The design must ensure the safety of other vehicles, pedestrians and cyclists and that other users are not inconvenienced. The design must also consider any adverse effect on the amenity of the development and its surroundings including the effects of visual amenity, operating hours, the generation of noise odour and dust, and proximity to sensitive uses. The design of this layout must conform to AS 2890.2.

(2) The development must make adequate internal provision within the site to allow all vehicles servicing the development to enter and exit the site in a forward direction only. In demonstration of this requirement, council may request a turning path plan to show how the intended vehicle types that are expected to use the development can enter and exit the site in a forward gear.

(3) Entry of B-double or other multi-combination vehicles servicing a proposed development will be considered by council on a case-by-case basis. In making this assessment, council will:

(a) assess the status of the roadway fronting the development;

(b) consider the zoning of the adjoining properties;

(c) design particulars of the vehicle entry and exit layout – with particular attention to the footway/verge crossing details;

(d) the internal manoeuvring capacity of the development site; and

(e) safety implications to the public and other road users.

Editor's note—road manager consent is required for travel on the road network. Applications are coordinated by the National Heavy Vehicle Regulator.

(4) Provision for refuse collection must be in accordance with SC6.4.3.22 Waste management guidelines.

SC6.4.3.5 Attachment A: Information and guidelines for public transport

(1) Bus routes are preferred along the shortest route, or up to 120% of the shortest length, between destinations.

(2) Preferred bus routes are generally located along arterial, sub-arterial and collector roads. Passenger bus services will not service an estate with only one entry/exit; as existing passengers are taken on a tourist trip through the estate without getting closer to their destination.

(3) The main criteria in determining the location of a bus route is that no more than 10% of residents should have to walk more than 400m to catch a bus within the urban area. Council may request a public transport route plan as part of the development to demonstrate this requirement. Bus services operate to a published timetable, so routes with minimal delays at intersections are preferred; routes with multiple traffic signals can cause delays to timetable service.

(4) To minimise resident objection to the placement of bus stops in front of houses, any public open space (e.g. drainage or recreational reserve) should be considered to accommodate a bus stop. This is particularly pertinent if the public open space contains a pathway. Other options include high-density residential or commercial developments where off-street parking is a component of the development. It is most desirable to establish the location of future bus stops during the design process to ensure that future development proposals recognise the implications of this infrastructure and its location. A layout plan showing the proposed locations must be submitted for the approval of council.

(5) New bus stops will be one of four standards:

(a) Minimum boarding point - bus stop sign with timetable displays (TDC), platform with tactile ground surface indicators (TGSI); or

(b) regular stop - bus stop sign with TDC, platform with (TGSI) and seat (inbound definite, outbound optional); or

(c) intermediate stop - bus stop sign with TDC, platform with TGSI and shelter with seat (inbound definite, outbound optional) – site specific; or

(d) premium stop - generally limited to high route volume locations and stops at shopping centres. As per intermediate stop, with greater care to the infrastructure finish standards and capacity requirements.

(6) New regular and intermediate bus stops are to be designed and constructed in accordance with council's standard drawings (SC6.4.4.8 Standard drawings) and meeting disability compliance standards (DSAPT and Premises Standards) or set out under the Disability Discrimination Act 1992.

(7) Bus stops should be located where there is no conflict with the location of (drainage pits/surrounds, poles, items of street furniture), street trees or driveways to properties. Drainage pits must be located away from the bus platform (concrete slab) to avoid creating a safety hazard. They are generally located in residential areas at side boundaries of adjoining properties to avoid resident concerns about loss of amenity and view, by having a stop directly in front of their property. Bus stops are generally preferred to include a location near an intersection to pick up passenger from the side streets; however, it should not impact on intersection functionality or operation. Bus stops are preferred on the departure side of intersections and major driveways.

Bus stop facilities within private property must comply with the DSAPT and associated guidelines, the Premises Standards or under the DDA. The developer must provide documentation to demonstrate consultation with the Department of Transport and Main Roads and the all impacted bus operators about future passenger bus routes servicing the facility during the design phase. A layout plan showing the proposed location with details must be submitted for the approval of council.

(8) Pathways servicing bus stops must form an integral part of a pathway network servicing the entire estate, and not just be a short connection to the corner of the nearest street.

(9) The in-bound and out-bound bus stops along the same route should be in proximity to each other on opposite sides of the street, although the bus stops do not have to be directly opposite each other (especially at intersections).

(10) All new bus stops being constructed must comply with the requirements of the DSAPT and associated guidelines (including any bus stop relocations), the Premises Standards or under the DDA. It must also have a clear continuous accessible path of travel; that is be serviced by a smooth, level and impervious surface with a 1500mm minimum width. One aspect of compliance is that the preferred cross-fall on the bus stop platform slab is 2%, and absolute maximum of 2.5%. School bus stops (mostly in a rural environment) do not need to comply with this requirement at this time.

(11) A standard bus stop is 3 m wide by 12 m long, (see SC6.4.4.8 Standard Drawings) plus entry/exit tapers on roads with a posted speed limit of 60km/h or less. A bus bay (with associated parking restrictions) is approximately 42m long (allowing for a 15m in taper and 15m egress taper). These dimensions can vary and may severely impact on the required street width (especially where no indents are to be provided), driveway access to properties and the availability of visitor/customer parking.

(12) Consideration must be also given as to how elderly and young passengers (especially school children) will safely cross the street to access the bus service. This may require the installation of a nearby refuge crossing or traffic signals, or similar measures.

(13) Bus routes should avoid having vertical or horizontal deflection traffic calming measures along the route. Any vertical deflection devices that are to be used by a bus service intended to operate in high pedestrian environment must be flat-top road humps. Council may support a bus route where speed cushions are installed.

(14) Any roundabout along a bus route must be able to accommodate a turning bus without mounting the kerb and channel or encroaching onto any landscaping on the centre island, including during a right hand turn.

(15) The developer is to prepare a draft Master Plan for the proposed development together with a traffic impact

assessment in accordance with SC6.4.3.14 Traffic impact assessment guidelines.

(16) The Master Plan will identify (as a minimum):

(a) proposed residential development lot sizes and densities;

(b) any proposed commercial development, including approx. GFA;

(c) any proposed education facility or other significant bus passenger service attractor (e.g. retirement village, hospital etc.);

(d) location, type and hierarchy of open spaces areas;

(e) the proposed road hierarchy for the development, and how it connects to the existing road network;

(f) the location of proposed footpaths and shared paths and bicycle paths throughout the development, and how they connect to the existing, and future, networks; and

(g) the route of all existing passenger bus routes within 1 km of the proposed development and through the development; and

(h) The Master Plan must be submitted for the approval of council.

(17) As part of the information required in obtaining a development approval, the developer must provide evidence of feedback from consultation with all the following stakeholders on the feasibility of potential passenger bus service route/major bus corridor through the new development:

(a) Department of Transport and Main Roads (TransLink Division);

(b) Department of Transport and Main Roads (Northern Region);

(c) local contract bus operator (Sunbus Townsville) and if necessary school bus operator/s;

(d) local taxi operator (Townsville Taxis); and

(e) council's Infrastructure Services Division.

(18) The outcome from the engagement with the stakeholders will be:

(a) advice if the development is ever likely to be serviced by a passenger bus service or school bus service;

(b) agreement of the most likely route(s) through, or servicing, the proposed development;

(c) the need and likely location of bus stops necessary to service the development;

(d) general agreement on the location and route of footpaths and shared paths servicing any future bus service along the agreed bus routes;

(e) advice on the need for any bus stop to be constructed as part of any proposed commercial centre, and the likely required standard of the facility; and

(f) the need for the developer to provide any other additional facilities to ensure the operation of an efficient and effective public transport services, including taxis. This may include required intersection treatment, bus stop locations, the possibility of joint use bus stops and the like.

SC6.4.3.5 Attachment B: Guidelines - Authority consultation for public transport, taxis, buses and school buses

(1) Taxi operations
Contact the Department of Transport and Main Roads Northern Region and the local taxi operator about taxi service operations.

(2) Taxi infrastructure

(a) Contact Townsville City Council about existing and proposed taxi rank infrastructure in the area.

(b) Any existing or new infrastructure undergoing substantial refurbishment or alteration must comply with the *Disability Standards for Accessible Public Transport 2002* and associated guidelines, the Premises Standards or under the DDA, and be in accordance with SC6.4.4.8 Standard drawings at the time of the refurbishment or alteration. It must have clear continuous accessible path of travel; that is, be serviced by a smooth, level and impervious surface.

(3) Bus routes

(a) Contact the Department of Transport and Main Roads Northern Region and the local bus operator (Service Contract holder) about current and future passenger bus routes.

(b) The developer will need to be aware of, and make provision for, future bus routes as determined through the consultation process with DTMR, council and the local bus operators.

(4) Bus stop infrastructure

(a) Contact Townsville City Council in the first instance about existing and proposed bus stop infrastructure on the road reserve, then contact the Department of Transport and Main Roads about interchange-type infrastructure.

(b) Any existing or new infrastructure undergoing substantial refurbishment or alteration must comply with the DSAPT and guidelines, the Premises Standards or under the DDA, and be in accordance with SC6.4.4.8 Standard drawings at the time of the refurbishment or alteration.

(c) Townsville City Council has prepared standard drawings for bus stop infrastructure. Also, new or relocated bus stops must have the specified branding (J Pole/ Blade signing), an identifying name approved by council's Technical Services Unit and be in accordance with SC6.4.4.8 Standard drawings and the bus stop position identified by easting and northing.

(5) School buses services

Contact the Department of Transport and Main Roads Northern Region and the local bus operator about current and future school bus route operations.

(6) School bus stop infrastructure

Contact Townsville City Council about existing and proposed school bus stop infrastructure on the road reserve.

(7) Intercity buses (long distance)

Contact Townsville City Council about existing and proposed intercity bus stop infrastructure on the road reserve, but also contact the Department of Transport and Main Roads TransLink Division about bus stop infrastructure and bus stop operations.

SC6.4.3.6 Landscape policy

SC6.4.3.6.1 Introduction

(1) Purpose

The purpose of this sub-section is to:

(a) support the purpose of Part 9.3.3 Landscape code and other elements of the Townsville City Plan and Development manual planning scheme policy;

(b) identify the application of this sub-section to landscape and irrigation design across all types of open space; and

(c) provide detailed design and construction standards, advice and guidelines for landscaping on private and public land ensuring a high standard, strong contribution to the city image and local character that are suited to site and climatic conditions and will remain fit for purpose over the long-term.

(2) Scope

This sub-section provides direction on landscape and irrigation design within open space, both within the public and private realm.

The scope of this sub-section includes:

(a) overarching design, sustainability and management principles that should be applied to open space development including:

(i) general design principles, master plans and identified design outcomes;

(ii) principles of sustainability economic, environmental, and social; and

(iii) management frameworks for public open space Public Open Space (POS) Hierarchy, Public Open Space Management (POSM) Framework and Irrigation Profile Level (IPL) Framework;

(b) the types, functions and development objectives for open space:

(i) private open space;

(ii) streetscapes; and

(iii) public open space recreation parks, sporting parks and other public open space; and

(c) design and embellishment guidelines for application in open space development.

(3) Reference and source documents

(a) This sub-section should be read in conjunction with other sections of the Townsville City Plan and Development manual planning scheme policy including, but not limited to:

Part 4 – Priority infrastructure plan
Part 8.2.5 – Natural assets code
Part 9.3.3 – Landscape code
Part 9.3.4 – Reconfiguring a lot code
SC6.4.3.3 – Footpath treatment policy
SC6.4.3.4 – Outdoor dining design
SC6.4.4.1 – Geometric road design
SC6.4.4.7 – Bicycle, pedestrian and shared path design
SC6.4.3.20 – Public lighting and utility services
SC6.9 Natural assets planning scheme policy

(b) The following Australian Standards are also referenced and should be read in conjunction with this sub-section:

AS/NZS 1158.3.1	*Lighting for roads and public spaces*
AS 1170	*Structural design actions (set)*
AS 1428	*Design for access and mobility (set)*
AS 1926.1	*Swimming pool safety – safety barriers for swimming pools*
AS 2156	*Walking tracks*

AS 2890.3	*Parking facilities – Bicycle parking facilities*
AS 3996	*Access covers and grates*
AS 4373	*Pruning of amenity trees*
AS 4422.2016	*Playground surfacing – Specifications, requirements and test methods*
AS/NZS 4486.1	*Playgrounds and playground equipment – Development, installation, inspection, maintenance and operation*
AS 4685.1	*Playground equipment – General safety requirements and test methods (and Amendment 1 – 2006, and Amendment 2 – 2008)*
AS 4685.2	*Playground equipment – Particular safety requirements and test methods for swings (and Amendments 1- 2006 and 2 - 2008)*
AS 4685.3	*Playground equipment – Particular safety requirements and test methods for slides (and Amendment 1- 2006)*
AS 4685.4	*Playground equipment – Particular safety requirements and test methods for runways*
AS 4685.5	*Playground equipment – Particular safety requirements and test methods for carousels (and Amendment 1 – 2006)*
AS 4685.6	*Playground equipment – Particular safety requirements and test methods for rocking equipment (and Amendment 1 – 2008)*
AS 4685.11	*Playground equipment – Additional specific safety requirements and test methods for spatial network*
AS/NZS 4456.9	*Masonry units and segmental pavers and flags – Methods of test – Determining abrasion resistance*
AS/NZS 4586	*Slip resistance classification of new pedestrian surface materials*

(c) Other

The following documents are also referenced and should be read in conjunction with this sub-section:

Austroads, *Guide to Road Design* (Set)

Building Code of Australia

Department of Transport and Main Roads, *Road landscape manual,* 2013

Department of Transport and Main Roads, *Manual of uniform traffic control devices* (MUTCD), Queensland

Department of Transport and Main Roads, *Traffic and Road Use Management Manual*, Volume 3.13: *Pedestrian Cross Facility Guidelines* and *Prioritisation system User Guide*.

Queensland Government, *Crime Prevention through Environmental Design*, *Guidelines for Queensland*, Parts A and B, 2007

Queensland Government, *Census of the Queensland Flora*, 2013, edited by Peter D.Bostock and Alisa E.Holland.

Western Australian Department of Sport and Recreation, *Sports Dimensions Guide for Playing Areas*

SC6.4.3.6.2 Landscape design

(1) Introduction

Landscape and irrigation outcomes should demonstrate consideration and application of the overarching principles, as described within this sub-section, Part 9.3.3 Landscape Code and other parts of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the “Landscape Statement of Intent”, as detailed in Section SC6.4.2 Development application guidelines.

(2) Master plans

For certain sites or localities, council may formally adopt Master Plans that identify specific strategies and plans to deliver key design and construction outcomes in the built environment.

At sites or locations where these Master Plans apply, any landscape design outcomes must be in accordance with the requirements for that site or area.

The following plans contain site specific outcomes that must be complied with:

(a) Thuringowa Riverway Master Plan (2003); and

(b) Riverway Sustainable Development Policy (2003).

Details of the above listed plans are contained in SC6.4.3.6 Attachment B – Adopted Master Plans

Editor's note—applicants should refer to all applicable sub-sections within the Development manual planning scheme policy which identify specific design principles and outcomes required across individual open space typologies as well as other infrastructure.

Editor's note—outcomes identified in an adopted master plan take precedence over all other design guidelines, unless approved otherwise. Where proposals deviate from the desired outcomes of the adopted master plan, applicants must justify this deviation for council's assessment and approval.

(3) Identifiable character and/or identified design outcomes
For key sites or localities where council has **not** formally adopted area specific plans and strategies but there is an identifiable character and/or desired design outcome, planning and design for new open space development in these areas should seek to be consistent or complementary to this established direction.

Identifiable character and/or design outcomes may include:

(a) an established colour or furniture palette;

(b) a dominant tree, plant species or planting style;

(c) heritage features or an identifiable character;

(d) significant natural features, materials, or environmental setting (e.g. natural bushland or coastal settings); and

(e) a consistent, hierarchical-based landscape design style (e.g. all "main roads" to be developed in "tropical boulevard" style).

Editor's note—statements pertaining to identifiable character or design outcomes for particular locations or land uses are contained within Townsville City Plan. Where applicable, landscape design outcomes are to comply with these statements and must be addressed within the "Landscape Statement of Intent". Where proposals will deviate from the desired outcomes, applicants must justify this deviation for further assessment and approval by council.

SC6.4.3.6.3 Economic sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of economic sustainability principles, as described within this sub-section, Part 9.3.3 Landscape code and other areas of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(1) General principles
Principles for consideration should include, but are not limited to:

(a) promoting opportunities for business and investments by:

(i) designing quality streetscapes that promote local business and attract patrons; and

(ii) creating opportunities for marketing initiatives such as festivals, events and community based activities (e.g. provision of event spaces within public open space areas);

(b) developing and implementing an integrated and strategic approach to the long term provision of open space infrastructure by:

(i) aligning new public open space development with council's Public Open Space Embellishment Framework and priority infrastructure plans; and

(ii) designing and developing new infrastructure and open space that improves the quality and value of the built environment within both the public and private realm (e.g. creating more liveable spaces that promote the city as an attractive place to live and invest); and

(c) establishing economically sustainable infrastructure outcomes by:

(i) identifying the lifecycle costs of open space infrastructure (e.g. the costs to plan, develop,

maintain, replace and demolish a recreational facility are established); and

(ii) identifying and developing new infrastructure with consideration of the ongoing operational requirements (e.g. identify and design a new open space development in line with defined maintenance resources).

(2) Lifecycle costing

Editor's note—currently, no framework or standard format for establishing lifecycle costs is developed. Applicants requested to submit lifecycle costing information should refer to best-practice examples until a formal framework is established.

(3) Ongoing operational requirements

(a) Where requested, applicants are required to identify the ongoing operational requirements in a maintenance plan, as detailed in Section SC6.4.2 Development application guidelines.

(b) For public open space, maintenance plans should be aligned with Public Open Space Management (POSM) Framework, as outlined in SC6.4.3.6.9(2)(b) POSM Framework and developed with consideration of the Public Open Space Embellishment Framework, as per Table SC6.4.3.6.1.

SC6.4.3.6.4 Environmental sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of environmental sustainability principles, as described within this sub-section, Part 9.3.3 Landscape Code, other areas of the Townsville City Plan and council's Corporate Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

Editor's note—currently, no framework has been developed for identifying and documenting outcomes against the environmental sustainability objectives listed. Until a formal framework or best-practice examples are identified, applications will be considered on a case by case basis. This includes recognition of independent certification under incentive-based branding and certification frameworks (e.g. EnviroDevelopment) designed to increased sustainability in developments.

(1) Principles for consideration should include, but are not limited to:

(a) conservation and substitution of non-renewable resources, by:

(i) responsible use of finite resources; and

(ii) implementation of efficiency mechanisms and strategies, (e.g. reduction of potable water use through water wise landscape and irrigation design);

(b) efficient and sustainable use of renewable resources, such as:

(i) prioritising and promoting innovative use of new, renewable materials or substitutes (e.g. plantation timber); and

(ii) transitioning to renewable energy sources and infrastructure where practicable (e.g. solar powered lighting);

(c) direct and indirect reduction in resource consumption and waste generation, by:

(i) implementing opportunities for waste reduction and reuse (e.g. concrete recycling for gabion walls);

(ii) prioritising and promoting use of recycled materials (e.g. recycled plastic composites);

(iii) promoting means for reducing carbon emissions and improving opportunities for carbon offsets and sequestration (e.g. reducing land clearing by promoting protection of existing trees and vegetation areas and incorporation of natural areas into public open space design); and

(iv) promoting environmentally sustainable design principles to directly and indirectly reduce resource consumption (e.g. increased street tree plantings to support passive cooling of streetscapes and buildings whilst improving amenity to promote pedestrian and cyclist activity); and

(d) protection, rehabilitation or enhancement of existing natural assets and systems through methods such as:

(i) responsive planting design and species selection;

(ii) protection of remnant vegetation, significant trees and habitat areas;

(iii) promotion of ecological design and responsible urban forestry management; and

(iv) implementation of integrated water cycle management practices.

(2) Responsive planting design principles and species selection
The following are provided as general guidelines for responsive planting design and species selection for all types of open space.

(a) Aesthetic requirements

(i) Planting design principles such as scale, proportion, repetition, balance, contrast, focal points and transition should be applied in the development of all planting designs.

(ii) The design qualities of the plant species including size, scale, form, line, texture and colour should be considered and maximised through the planting design process.

(iii) Plant selection and design should promote urban landscapes that reflect Townsville's climate, its natural environment, the existing local character, and any specific vegetation themes of a local area.

(b) Suitability and functional requirements

(i) Plant selection based on the biophysical attributes of the plant, the ideal growing conditions of the species and its appropriateness for the site conditions and the region's dry tropics climate.

(ii) The intended function and location of the plant species should be appropriate to its growing habit, size and other design qualities, in particular ensuring the expected size of the mature specimen can be support in the available planting space.

(iii) The quantity and density of planting proposed should consider the expected mature plant size, the density required to achieve the desired effect, account for expected die out during establishment, and avoid any foreseeable maintenance issues.

(iv) Planting location and/or species selection should not create any foreseeable, adverse impacts on access, circulation or critical sightlines.

(v) Plant habit and location should not have any foreseeable, adverse impact on adjacent properties, built assets, services, roads, drainage or other infrastructure.

(vi) The irrigation, maintenance and other resource inputs necessary to maintain the functionality and longevity of planting design outcomes and species should be sustainable, cost-effective and analogous with the available resources.

(c) Ecological requirements

(i) Plant selection and design should promote the use of local native and non-invasive introduced plant species.

(ii) Additional considerations and specifications applicable to plantings are detailed in sub-section SC6.4.6.26 Landscaping and other requirements of this sub-section.

(3) Retention of remnant vegetation and significant trees

(a) Site planning and landscape design should be used to protect and integrate significant vegetation or trees of the site including, but not limited to:

(i) large, existing mature trees;

(ii) vegetation in intact natural areas;

(iii) trees or vegetation protected by heritage listing;

(iv) trees or vegetation not formally protected by heritage listing but where the size and/or quantity present has a significant character impact;

(v) marine plants including mangroves;

(vi) vegetation in riparian zones or on slopes, especially where the vegetation is performing a stabilisation role; and

(vii) vegetation external to the development site but where activities within the site may impact its long-term sustainability.

(b) Where species/areas are identified as significant, all applicable tree and vegetation protection requirements are to be implemented, as per clause SC6.4.5.2(16) Work adjacent to trees and protection of environmentally significant vegetation.

(c) Additional detail on how the retained species will be protected and integrated into the proposed landscape works may need to be addressed in a vegetation protection plan, the "Landscape Statement of Intent" and included on the associated landscape plans.

Editor's note—refer Section SC6.4.2 Development application guidelines and clause SC6.4.5.2(14) Work adjacent to trees and protection of environmentally significant vegetation.

(4) Ecological buffers

(a) All buffer works to environmentally significant areas should be provided in accordance with Part 8.2.5 Natural assets code and SC6.9 Natural assets planning scheme policy.

(b) All buffers and ecological designs should be prepared in consultation with an appropriate specialist for the local region.

Editor's note—due to the variable nature of ecological design, no further guidelines or specifications are currently developed for the establishment of ecological buffers within open space. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable ecological, landscape and irrigation standards, legislation, and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal of this nature.

(5) Integrated water cycle management and water efficiency

Editor's note—currently, no framework or standard principles for establishing integrated water cycle management and water efficiency objectives are developed specifically for open space. Applicants should refer to other requirements within the planning scheme, this sub-section and other sub-sections of the Development manual planning scheme policy.

SC6.4.3.6.5 Social sustainability

Landscape and irrigation outcomes should demonstrate consideration and application of social sustainability principles, as described within this sub-section, Part 9.3.3 Landscape Code and other areas of the Townsville City Plan.

Alignment with applicable principles should be expressed in the landscape and irrigation design outcomes and addressed in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(1) General principles

Principles for consideration should include, but are not limited to:

(a) community development principles, such as:

(i) promoting social interaction and inclusion (e.g. well-designed civic spaces that promote social activities and community gatherings);

(ii) design for universal access where possible (e.g. applying universal design principles in the design and construction of recreation facilities to promote inclusion of users of different abilities);

(iii) equitable distribution of open space opportunities and resources (e.g. equitable distribution of different open space facilities throughout the city);

(iv) designing for community diversity (e.g. promoting open space design that responds to the varying needs of the community and creates a diversity of experiences suitable for different cultures and demographics); and

(v) engaging with the community on design proposals (e.g. working with the local community/groups in the design or development of facilities within open space); and

(b) public health and safety principles, such as:

(i) creating opportunities for community health and well-being activities (e.g. provision of outdoor activity elements that promote physical activity for all ages through structured or unstructured recreation);

(ii) applying principles for crime prevention through environmental design (CPTED), refer to SC6.4.3.6.6 Crime prevention through environmental design; and

(iii) complying with all standards and safety requirements to ensure safe open space for the community and maintenance personnel.

(2) Universal access

Unless not practicable or cost prohibitive, open space development, embellishment provision and location must cater for accessibility and mobility requirements in accordance with AS 1428 Design for access and mobility (Set of standards), and as required by Part 9.3.3 Landscape Code. This should include, but is not limited to:

(a) providing an appropriate number of certified accessible items at key activity areas/locations;

(b) providing appropriate surface treatments that enhance safety, mobility and accessibility, whilst also being aesthetically pleasing and promoting sensory stimulation where required;

(c) providing appropriately sized concrete slabs that are designed to facilitate wheelchair and pram access around open space furniture and other infrastructure items;

(d) providing all ancillary infrastructure such as ramps and pathways to ensure access and compliance with applicable standards; and

(e) incorporation of all other universal design principles, as applicable.

SC6.4.3.6.6 Crime prevention through environmental design

Crime Prevention Through Environmental Design (CPTED) provides a common-sense approach to designing environments (new or redevelopment) in ways that help to create safer spaces and reduce crime. CPTED may be applied to any built environment or facility. For example, parks, toilet blocks, public areas, shopping centres, car parks and even residential dwellings. Implementing CPTED principles will not always eliminate crime but it is one of many different techniques that Council employs in a holistic approach to reduce and prevent criminal activity.

The design and landscaping associated with development for, parks, gardens, streetscapes or other public open space areas, shall be considered against the key CPTED elements.

Editor's note—further guidance on implementing CPTED principles can be found in the following locations: Queensland Government, *Crime Prevention through Environmental Design, Guidelines for Queensland, Parts A and B*, 2007 and CPTED Association website.

SC6.4.3.6.7 Private open space

Private open space is considered to be a usable outdoor area within a private development. It may include back and front yards, courtyards, gardens, balconies, terraces, decks, and communal areas in multi-unit developments. These spaces provide important private places for residents and other users to play, entertain, relax or seek respite from urban living.

Landscaping and irrigation within private open spaces assists in creating a shaded and attractive setting that is comfortable and usable, whilst also improving residential amenity and character. The significant environmental benefits of private open space are also recognised, noting the potential positive contribution of the spaces to reducing runoff, increasing biodiversity, heat amelioration and passive cooling.

Private open space does not include fully enclosed spaces, vehicle parking areas and verges. Open space contribution from roof gardens and vertical gardens will assessed on a case-by-case basis and with consideration of other on-site open space and landscaping provision.

Editor's note—further details of design outcomes for private open space are contained with the relevant development codes of the

SC6.4.3.6.8 Streetscapes

Streetscapes refer to the street or road landscape including all public open space within the road reserve. The design and development of streetscapes will vary according to the road or street hierarchy, its associated function, as well as the surrounding land use and built environment.

Editor's note - Applicants should refer to SC6.4.4.1 Geometric road design for more information.

It is noted, however, that there is interdependency between elements within the private realm and the overall streetscape. Critically, elements with the private realm (e.g. residential or commercial frontages) contribute to the appearance and function of a streetscape. It is important, therefore, that any streetscape design proposal is integrated and responsive to the surrounding context.

SC6.4.3.6.9 Public open space

The landscape and character design outcomes associated with the development of public open space are required to demonstrate alignment with the standards set out in this sub-section and addressed in accordance with Section SC6.4.2 Development Application Guidelines.

(1) General

Public open space includes all areas of open space that are publically owned and/or accessible. Public open space includes parks and land that has been reserved for the purpose of sport and recreation, ecological function and natural environment protection, infrastructure corridors and stormwater management and the general provision of green space.

Public open space and the provision of dedicated parks contribute significantly to community well-being, urban place-making and the general amenity and liveability of a city. Parks and other open space typologies also perform dual or multifunctional roles. This includes supporting the provision and buffering of roadways, detention basins and other infrastructure networks such as bikeways, and utility services, particularly within corridor parks.

Public open space excludes open space not publically accessible, not for community use or within the road reserve. However there are some areas that are designated Special Use Parks or Facilities, these parks provide specialised recreation use. This includes where the nature of the recreation activity only allows controlled access and precludes free, unrestricted access to members of the public, or where the land and facility result in a single use activity.

(2) Public Open Space Frameworks

(a) Public Open Space (POS) Hierarchy

The public open space hierarchy refers to the size, form and function of public open space which will vary significantly across different park types and other public open space typologies. As such, public open space networks are usually defined by various open space typologies that are rationalised, planned and designed against a “Public Open Space Hierarchy”.

This approach ensures the distribution, development and management of public open space occurs in a strategic and structured manner that reflects the differing classifications and importance of the each open space typology

Group and individual typologies within the Public Open Space Hierarchy reflect the diversity of functions and uses between different open space typologies within the city. Council’s open space hierarchy has been divided into three functional groups:

(i) recreation parks;

(ii) sports parks; and

(iii) other public open space.

Importantly, it should be recognised that one area of public open space may contain more than open space typology function across the different functional groups.

For example, a park may contain two formalised sports fields (district sporting function), a local recreation node (local park function) and a drainage corridor (utility function). In instances such as this, the public open space may be:

- classified based on the most dominant function (e.g. classified a district sports park, with the presence of a local recreation node recognised but not separately designated), or
- split into different functional areas, where each area is separately recognised and designated.

Classification of public open space against the hierarchy is reached through a strategic audit and evaluation of the open space, its characteristics and the standards of embellishment. Profile, accessibility and usage catchments are also a key determinant in hierarchy classifications, with typologies generally being categorised on a local, district or regional basis.

The POSM classifications subsequently inform council's management, development and all future planning for the public open space and the wider open space network.

To support these classifications, council has developed a Public Open Space Embellishment Framework that defines what level of embellishment and infrastructure is "essential" to different public open space typologies. The purpose of this framework is to support equitable, cost-effective and sustainable development of public open space that is functional and meets the needs of the community.

The Public Open Space (POS) Embellishment Framework is further defined in Table SC6.4.3.6.1 Open space embellishments and the balance of this sub-section.

Editor's note—Open Spaces classified as being of District or Regional significance have been determined as priority trunk infrastructure. (Refer Part 4 Priority infrastructure plan of the Townsville City Plan).

The proposed landscape design and character outcomes associated with the development of public open space are required to demonstrate alignment with the standards set out in this sub-section and address this through landscape design outcomes and in the "Landscape Statement of Intent", as detailed in Section SC6.4.2 Development application guidelines.

(b) Public Open Space Management (POSM) Framework

A key objective of the Public open space management and associated levels of service is to ensure that the level of embellishment is consistent and sustainable with the available resources to maintain them.

Associated with the Public Open Space Hierarchy, council has developed a Public Open Space Management (POSM) Framework that specifies acceptable maintenance levels of service against different open space typologies. This POSM Framework and associated levels of service are also applied against the road hierarchy.

In order for council to properly assess future POSM requirements for each public open space development proposal, council may request the provision of a maintenance plan for maintenance activities not already detailed in the POSM Framework, as detailed in Section SC6.4.2 Development application guidelines. Where requested, this maintenance plan should seek to demonstrate alignment with the adopted POS Embellishment and POSM Frameworks.

Maintenance levels of service under the POSM Framework are defined by the public open space or road hierarchy classification and the frequency of maintenance services required. Associated with this, maintenance activities and frequencies are assigned, based on the public open space or road hierarchy classification and/or embellishments present.

A key objective of both the POS Embellishment and POSM Frameworks is to ensure that the level of embellishment is consistent and sustainable with the available resources to maintain them. As such, infrastructure must not be provided where the necessary maintenance required exceeds the allocated

maintenance level of service in order to ensure the public open space or items remain serviceable and safe for public use (e.g. dynamic fitness equipment that requires weekly safety inspections or electric barbeques that require daily cleaning to remain hygienic should not be installed in a park that has assigned fortnightly maintenance service). Further, the cost to establish, maintain and ultimately renew the infrastructure must be sustainable and cost effective for council and the community in the long-term.

In order for council to properly assess future POSM requirements for each public open space development proposal, council may request the provision of a maintenance plan, as detailed in Section SC6.4.2 Development application guidelines. Where requested, this maintenance plan should seek to demonstrate alignment with the adopted POS Embellishment and POSM Frameworks.

Editor's note—the POSM Framework is currently under review to align the maintenance frequency with the (POS) hierarchy review and further development. As such, detailed specifications relating to maintenance activities and frequency are not available at the present. Enquiries relating to this should be directed to Construction and Maintenance Operations.

(c) Irrigation Profile Level (IPL) Framework

As part of council's commitment to efficient, cost effective and responsible use of natural resources, council has developed an Irrigation Profile Level (IPL) Framework to categorise and define irrigation water usage within public open space.

The IPL Hierarchy identifies and defines a number of "profile levels" based on the level of irrigation applied, an indicative "functional application" based on open space typologies, and the performance indicators associated with each irrigation application rate. Refer to SC6.4.3.6 Attachment C for IPL Hierarchy.

Supporting this, the IPL Matrix identifies a number of criteria and "influences" used in the determination of an assigned IPL. Refer to SC6.4.3.6 Attachment D for the IPL Matrix.

Importantly, it must be recognised that the level of irrigation required is directly dependent upon the landscaping which it must support. As such, in the development of new public open space, the landscaping should be designed with consideration of the typical IPL classification for the public open space typology as well as the extent of landscaping and irrigation defined by the POS embellishment standards. Additional requirements are identified in SC6.4.3.6.34 Irrigation design and system requirements.

For existing public open space, the IPL classification must be based upon the required irrigation application rate necessary to support the health and longevity of the existing landscaping. Where a change to the IPL is proposed, this must include consideration of the open space typology, the intended use of the open space area and the impacts of reduced water application rate on existing plant specimens and include changes to the landscaping plantings where required.

Critically, an area of public open space may have more than one IPL (e.g. "high" IPL level around the activity node or within the minimum usable space, and then a "medium" or "low" profile for the balance of the open space). To achieve this in an efficient and effective manner, however, the associated landscaping and irrigation systems must be purpose-designed for this outcome (i.e. separate irrigation systems consistent with species selection and placement based on principles of hydro-zoning).

SC6.4.3.6.10 Recreation parks

Recreation parks includes the following:

(1) pocket parks: are small open space parklands that offer a limited range of recreational activities for local residents. Pocket parks are generally associated with specific urban design outcomes, e.g. to support small lot housing.

(2) local recreation parks: are moderately small open space parklands that offer local residents a communal open space to complement their own backyards. Local recreation parks are ideally located within 400m walking distance from residential properties and are generally accessed by non-motorised transport. These parks contain only basic infrastructure for recreational use, refer to the embellishment table for details.

(3) district recreation parks: are much bigger than local sized parks that can service several suburbs, or a whole community and or a community event. The parks provide for a variety of passive and active recreation and/or contain facilities to cater for a wider user group of all age and levels of ability. The parks are well known destinations for those people living within their catchment, enabling the park to become a significant social hub.

(4) regional recreation parks: are large open space parklands that offer a wide variety of both active and passive recreation opportunities to a broad section of the community.. The park area is capable of hosting large community events such as festivals, and unique functions. These parks have major embellishments features designed to attract visitation from a wider catchment area and encourage extended stay. It provides unique recreational experiences and is a major landmark and/or destination where people may spend (4+hours) in these parks.

(5) recreation corridors: are usually a linear open space that follows creeks, drainage channels, service corridors or green belts. Corridor parks traditionally have a dual functionality and may include opportunities for cycling, walking and other recreational activities. It can also provide an important ecological link for flora and fauna. Corridor parks are intended to provide a safe connection between two or more destination points.

Editor's note—currently, further definitions and intent statements are not developed for all individual recreation park typologies. Refer Part 4 Local government infrastructure plan of the Townsville City Plan for definitions, distribution and land areas relating to trunk recreation parks.

SC6.4.3.6.11 Sporting parks

Sporting parks includes the following:

(1) district sporting parks: are large sized open space parks that provide facilities that are suitable for the practicing and playing of structured or organised sports. These parks may not have the quality of playing surface or amenities of a regional sports park. The park generally contains a good level of embellishment provision. To service a wider user group the sporting areas are often lit, spectator facilities may include a club house, toilets, change rooms and off- street car parking. These parks may also include a limited range of informal recreation activities to cater for unstructured recreation.

(2) regional sporting parks: are large quality sports parklands that meet state regulations for the sport and can comfortably host either regional (or State competitions). Generally these sports parks cater to a large number of sporting organisation's and spectators who share the site. People may spend (4+hours) in these parks. The playing field may be lit to the required standard for the dedicated sport. Regional Sports parks also have a high level of player and spectator facilities, including clubhouse, canteen, toilets, change rooms, off-road car parking The park may also include a limited range of informal recreation activities for other park users such as playgrounds and BBQ areas.

(3) special use parks or facilities; are specialised recreational use and facility spaces where the nature of the activity precludes free, unrestricted access to members of the public, or where the land and facility result in a single use activity. These park spaces may be controlled by either Council or private organisation's (User Pays). Specialised use parks include (but are not limited to);Water parks/Privately Owned or Leased Swimming Pools, Equestrian, Archery/Bow hunting/Sport Shooting, Golf, Tennis, Lawn bowls, Model Planes and Motor Vehicle Sports.

Editor's note—Refer Part 4 Local government infrastructure plan of the Townsville City Plan for definitions, distribution and land areas relating to trunk sports parks.

SC6.4.3.6.12 Other public open space

Other public open space includes the following:

(1) amenity parks: are small landscaped areas with a strong focus on visual. Traditionally Amenity parks may include monuments, memorials or gateway treatments. The park area may also include opportunities for passive recreation such as seating areas. An example of an Amenity Park is Garbutt Park, Garbutt, which acts as an entrance statement welcoming visitors and residents to Townsville.

(2) civic parks and spaces: are relatively small areas generally associated with a high level of built infrastructure. While recreation use is minimal they provide landscape and amenity values for the general community. Civic parks provide an urban respite for social interaction and community gatherings. Often characterized by hard surface treatments associated with its setting and high activity use levels, these spaces may be used for social events such as community markets.

(3) natural and bushland areas: are set aside primarily for conservation purposes to protect and retain natural vegetation and habitat areas. Size may range from small to large areas that reflect the importance of the environmental value. These parks may also provide opportunities for outdoor recreation activities such as bushwalking, trail running, mountain biking, nature viewing and appreciation. Embellishment improvements are generally limited infrastructure associated with the above activities such as seating, lookouts and signage. Some of the park areas may also include cleared areas intended to be rehabilitated to improve habitat corridors.

(4) utility spaces: are areas that are often owned or maintained by council, for specific utility services such as electrical transmission, telecommunications, water and sewerage pump stations or other infrastructure purposes. These spaces may offer some dual functionality for recreation activities such as walking, cycling or civic amenity.

(5) unallocated open space: may be any reserve area of land and/or water reserve which has not been named or developed at present, but which has been deemed important enough to be set aside for future park development. The park area is usually substantially undeveloped with no built infrastructure and only minor improvements such as rural fencing.

(6) cemeteries: are an area under the control of council that is dedicated for the burial of the dead, or containing graves, tombs, funeral urns and interment of ashes.

Editor's note—currently definitions and intent statements are not developed for individual typologies within other public open space hierarchy categories.

SC6.4.3.6.13 Open space embellishments

(1) General requirements

A key objective of the POS Embellishment and POSM Framework is to ensure that the level of embellishment is consistent and sustainable.

As such, infrastructure must not be provided where the necessary maintenance required exceeds the allocated maintenance level of service. This is to ensure that the public open space or items remain serviceable and safe for public use (e.g. dynamic fitness equipment that requires weekly safety inspections or electric barbeques that require daily cleaning to remain hygienic should not be installed in a park that has assigned fortnightly maintenance service intervention). Further, the cost to establish, maintain and ultimately renew the infrastructure must be sustainable and cost effective for council and the community in the long-term.

(a) Open space embellishment levels should be consistent with the assigned public open space typology (refer Table SC6.4.3.6.1 public open space embellishment framework) and / or road hierarchy classification or the characteristics of the associated land use.

(b) Where private open space is associated with development, the private open space shall be considered on a case-by-case basis with consideration of the design points set out below.

(c) The quantity and amount of the embellishment level will be dependent on the available area of open space and the spatial requirements of the selected embellishment facility.

(d) The following key characteristics should be considered in the design process when selecting the level of embellishment:

(i) comply with any adopted master plan, environmental, heritage and character requirements;

(ii) consider the context, functionality and purpose for use (e.g. particular open space usage patterns for the site such as regular use for community events, or shared usage by multiple tenants in a large residential complex);

(iii) consider the setting, durability and aesthetic requirements for the intended area (e.g. specific materiality requirements for areas with a risk of vandalism, or more ornate detailing for intimate private courtyard space);

(iv) cater for the expected usage rates, demographic/s and their associated needs (e.g. reduced intervals between accessible bench seats along a pathway at a location with large senior user group);

(v) be located at appropriate locations or intervals, clustered near activity nodes and/or to

complement any distinguishing site features (e.g. seating situated to maximise a vista or allow surveillance of a play area by carers);

(vi) be climatically appropriate and consider localised conditions of the site (e.g. dynamic activity elements in coastal areas are not located in areas exposed to high onshore winds and salt spray);

(vii) ideally be located under natural or built shade to allow day long use through reduced exposure, glare and heat absorption, particularly on metal or dark coloured surfaces (e.g. metal playground slides to be shaded and/or swapped for plastic slides, or, communal gathering areas located under shelters in private unit complex);

(viii) complement natural materials or features and/or incorporate these where possible (e.g. grass mounding for seating; feature rock retaining walls consistent with local geology);

(ix) be vandal resistant;

(x) be installed on an appropriate surface material, on well drained ground and with an appropriate level of flood immunity (e.g. playgrounds not installed in an area surrounded by a retention basin); and

(xi) prioritise use of recycled, sustainable materials where practicable and available (e.g. decking to be constructed of recycled plastic and composite fibre supports).

(2) Public open space and streetscape embellishment standards

(a) Within public open space, embellishment selection must be in accordance with council's Public Open Space Embellishment Standards Framework, as detailed in Table SC6.4.3.6.1.

(b) For streetscapes, landscape treatments shall be provided per SC6.4.3.6.31 Streetscape design and landscape treatments.

(c) For public open space and streetscapes, embellishment standards must:

(i) be analogous to the Public Open Space Hierarchy, road hierarchy, or centre classification;

(ii) be consistent with any overarching design and embellishment strategy (e.g. adopted furniture suite against Public Open Space/Road Hierarchy);

Editor's note—other than landscape treatments as noted above, currently, detailed standards and specifications are not developed for other infrastructure items (e.g. shelters and seating) within streetscapes. Applications will therefore be assessed on a case-by-case basis and with consideration of the principles and standards outlined in this sub-section, and other sections of the Townsville City Plan. Refer to SC6.4.3.3 Footpath treatment policy and SC6.4.3.4 Outdoor dining design guidelines for requirements specific to these elements of a streetscape.

(iii) complement those facilities in nearby precincts or parks, ideally providing diversity in the facilities available to the community;

(iv) be consistent with any an existing style that is already established unless approved otherwise;

(v) only include high quality, fit for purpose, proprietary items for which replacement parts are readily available from an Australian distributor;

(vi) for district and regional level parks, custom suites or items may be permitted at particular sites, where the profile and location of the park warrants it. The decision will be made on a case by case basis at the discretion of council with consideration of the individual site characteristics and public open space classification

Editor's note—this decision will be made on a case-by-case basis, at the discretion of council and with consideration of the individual site characteristics and public open space classification

(vii) minimise the use of timber elements unless approved otherwise. Where timber is permitted for use, only hardwood timber or painted pine should be used and all furniture items should ideally be undercover, protected from direct exposure to the sunlight and other elements;

(viii) utilise high quality finishes that will reduced ongoing maintenance requirements and/or frequency (e.g. 2PAC epoxy paint in lieu of powder coating where items are not easily dissembled or repainted); and

(ix) for all foreshore locations and other locations subject to salt spray or prolonged wet conditions, embellishments must be constructed of marine grade materials, including 316L stainless steel fittings, to ensure improved asset longevity and lifecycle cost reduction.

Editor's note—the above are provide as guidelines to be considered in the course of public open space and streetscape development. Additional areas within this sub-section provide specifications for individual open space infrastructure types and for landscape treatments in streetscapes.

SC6.4.3.6.1 Public Open Space Embellishment Framework

		RECREATION PARKS					SPORTS PARKS			OTHER PUBLIC OPEN SPACE				
		POCKET	LOCAL	DISTRICT	REGIONAL	CORRIDOR	DISTRICT	REGIONAL	SPECIALISED	AMENITY	CIVIC SPACES	NATURAL /BUSHLAND	UTILITY	UNALLOCATED
CATEGORY	EMBELLISHMENT TYPE													
Activity elements	**Outdoor fitness equipment**			**Expected** (Max 6 Pieces)	**Expected** (Min 6 Pieces)	**Desirable** (Max 6 Pieces)			Embellishment standards not defined due to custom nature of specific sport activity and facility requirements - to be assessed on a case by case basis					
	Informal sports/courts (e.g. basketball half court; table tennis table)		**Desirable** (Max 1 informal sport facility)	**Expected** (Max 2 informal sports facilities)	**Expected** (Max 2 informal sports facilities)		**Desirable** (Max 2 informal sport facility)							
	Playground (all abilities)				**Desirable** (Max 1 play facility)									
	Playground (mixed ages)	**Desirable** (Max 1 Combination unit)	**Expected** (Max 1- 3 Pieces)	**Expected** (Min 3-5 Pieces)	**Expected** (Min 6-10 Pieces suitable for the catchment)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)								
	Skate facilities			**Desirable** (Max 1500 sqm, Suitable to meet the catchment zone, approved on a case by case basis	**Desirable** (Min 3000 sqm, Suitable to meet the catchment zone, approved on a case by case basis									
	Water-play				**Desirable** (Appropriate facility suitable to meet the needs of the catchment zone, approved on a case by case basis)									
Electrical	**3 phase power (events usage)**			**Desirable** (Max 1 unit)	**Expected** (Min 2 Units)		**Expected** (Max 1 Unit)	**Expected** (Min 2 Unit)			**Expected** (Min 1 Unit)			

	Activity node lighting		**Expected** (Max 1 Lighting node as required for the activity)	**Expected** (Min 2 Lighting nodes as required for the selected activity areas)	**Expected** (Multiple lighting nodes as required for selected activity areas)	**Desirable** (Min Lighting nodes as required for CEPTED along pathway links)	**Expected** (Min 2 Lighting nodes as required for the selected activity areas)	**Expected** (Multiple lighting nodes as required for selected activity areas)			**Expected** (Multiple lighting nodes as required for selected activity areas)				
	Pathway lighting (ex. designated bikeways/shared pathways)			**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Desirable** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)		**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Multiple lighting nodes as per ASNZ 1158.3.14_2005 - Lighting for roads and public spaces)			
	Sports field/court lighting						**Expected** (Multiple lighting nodes as per AS2560 Sporting Facilities Manual - Part 1 Sports Lighting)	**Expected** (Multiple lighting nodes as per AS2560 Sporting Facilities Manual - Part 1 Sports Lighting)							
Fencing	**Fencing (inc. bollards; post and rail; panels)**	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)		**Expected** (To adequately deter unauthorised vehicles from entering the Park Space)	**Essential** (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)	**Expected** Min RURAL FENCING TYPE (To adequately deter unauthorised vehicles from entering the Park Space)
	Maintenance access gate	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)		**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)	**Expected** (To provide adequate access for Maintenance requirements)
Furniture	**Bench seats**	**Desirable** (Max 1 Park bench seat)	**Expected** (Max 2 Park bench seat)	**Expected** (Min 4 Park bench seat)	**Expected** (Min 8 Park bench seat)	**Expected** (Min 2 park bench seats, or number as required spaced at approx. 400m intervals along pathway links)	**Expected** (Min 4 Park bench seat)	**Expected** (Min 8 Park bench seat)		**Expected** (Max 2 Park bench seat)	**Expected** (Min 8 Park bench seat)	**Expected** (Min 2 park bench seats, or number as required spaced at approx. 400m intervals along pathway links)		

	Barbeques (electric)			**Expected** (Max 2 Double Plate BBQ Units)	**Expected** (Min 4 Double Plate BBQ Units)									
	Bins	**Desirable** (Max 1 Bin unit)	**Expected** (Max 1 Bin unit)	**Expected** (Min 2 Bin units)	**Expected** (Min 4 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)	**Desirable** (Min 2bins, or number as required spaced at approx. 800m intervals along pathway links)	**Expected** (Min 2 Bin units)	**Expected** (Min 4 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)		**Desirable** (Max 1 Bin unit)	**Expected** (Min 2 Bins, or adequate number of Bins to meet anticipated demand - Including recycling bins)			
	End of trip facilities (e.g. bicycle racks)			**Expected** (Min 1 bike rack unit)	**Expected** (Max 2 bike rack units)		**Expected** (Min 1 bike rack unit)	**Expected** (Max 2 bike rack units)			**Expected** (Min 1 bike rack unit)			
	Picnic tables and seats	**Desirable** (Max 1 Picnic Table Set)	**Desirable** (Min 2 Picnic Table Sets)	**Expected** (Min 4 Picnic Table sets)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)	**Desirable** (Min 2 picnic table sets, or number as required spaced at approx. 800m intervals along pathway links)	**Expected** (Min 2 Picnic Table sets)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)		**Desirable** (Max 1 Picnic Table Set)	**Expected** (Min 6 Picnic Table sets, or number to meet anticipated demand)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)		
	Water bubbler/tap (inc. connection; drainage inlet; soakage well)	**Desirable** (Max 1 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 1 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Desirable** (Max 1 Drinking Fountain along pathway link- must be disability compliant and include dog drinking outlet as well)	**Expected** (Max 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)			**Expected** (Min 2 Drinking Fountain - must be disability compliant and include dog drinking outlet as well)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)		
Irrigation	**Irrigation**	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated. Provision of required irrigation to ensure all key activity high use areas are covered. To be considered on a case by case basis)	**Desirable** (May have natural areas that are not irrigated, provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (Provision of appropriate irrigation to be considered on a case by case basis, to ensure adequate coverage of key sporting and high activity use areas. designated playing fields to be irrigated at 100 % of field coverage)	**Expected** (Provision of required irrigation to be considered on a case by case basis, to ensure adequate coverage of key sporting and high activity use areas. designated playing fields to be irrigated at 100 % of field coverage)		**Desirable** (Provide adequate irrigation to cover key activity high use areas. To be considered on a case by case basis)	**Expected** (May have natural areas that are not irrigated. Provision of required irrigation to ensure all key activity high use areas are covered. To be considered on a case by case basis)			

Landscaping and surfacing	**Earthworks (e.g. grassed mounds)**	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 1 Mound, suitable mounding for play space relief and considered on a case by case basis)	**Desirable** (Min 2 Mound, suitable mounding for play space relief and considered on a case by case basis)		**Expected** (Min 2 Mounds, suitable mounding for Spectator viewing and considered on a case by case basis)	**Expected** (Min 2 Mounds, suitable mounding for Spectator viewing and considered on a case by case basis)			**Desirable** (Min 2 Mound, suitable mounding for play space relief and considered on a case by case basis)			
	Garden beds (excluding natural vegetation areas)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)		**Desirable** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)	**Expected** (Min 5% gardens cover. Extent and levels will be dependent on the park typology and considered on a case by case basis)			
	Shade trees	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for corridor parks shall be min 35% coverage along pathway linkage alignments)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 20% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 20% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)		**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Expected** (The desirable natural shade coverage outcome for recreational parks shall be min 35% coverage. With the shade coverage focused around park activity nodes, where this cannot be achieved supplementary man-made shade cover must be considered)	**Desirable** (The desirable natural shade coverage will consist of the predominant existing natural vegetation cover)	**Desirable** (Shade Trees should not impact on operation of services or facility structure)	

	Turf areas (Inc. events/activity lawns)	**Desirable** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 70% coverage of park area, including a 100% cover of the playing fields. The turf coverage shall be adequate to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 70% coverage of park area, including a 100% cover of the playing fields. The turf coverage shall be adequate to meet the intended usage and anticipated demand		**Desirable** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand	**Expected** (The desirable turf coverage outcome shall be min 60% coverage of park area, with adequate turf coverage to meet the intended usage and anticipated demand			
Signage	**Park name sign**	**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)		**Expected** (1 Park Name Sign near the predominant park entry access)	**Expected** (1 Park Name Sign near the predominant park entry access, for larger parks with multiple entry access entry points - additional park name signs shall be considered on a case by case basis)	**Expected** (1 Park Name Sign near the predominant park entry access)		
	Information signage (inc. regulatory, directional and interpretive signage)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)		**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Expected** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)
Sporting	**Indoor sport and recreation facility**						**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)						
	Outdoor spectator facilities						**Expected** (Min 20 Spectator Seat Capacity)	**Expected** (Min 100 Spectator Seat Capacity)						

	Motorised sports facilities						**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)	**Desirable** (Fit for Purpose, as required - will be considered on a case by case basis)							
	Sports courts/fields (formal)						**Expected** (Min number of formal courts or fields required to undertake the sport, will be considered on a case by case Basis)	**Expected** (Min number of formal courts or fields required to undertake the sport, will be considered on a case by case Basis)							
Structures and buildings	**Picnic shelters/gazebos**		**Desirable** (Max 1 Picnic Shelter or gazebo)	**Desirable** (Max 2 Picnic Shelter or gazebo)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)	**Desirable** (Max 1 Picnic Shelter or gazebo, generally kept to a minimum)	**Desirable** (Max 2 Picnic Shelter or gazebo)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)		**Desirable** (Max 1 Picnic Shelter or gazebo, generally kept to a minimum)	**Expected** (Min 2 Picnic Shelter or gazebo, or adequate number to meet anticipated demand)				
	Clubhouse/change rooms/canteens						**Desirable** (Adequate developable land of a min 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)	**Desirable** (Adequate developable land of a min 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)							

	Community buildings			**Desirable** (Within the available park space adequate total developable land to a max 200 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)	**Desirable** (Within the available park space adequate total developable land to a max 400 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)		**Desirable** (within the available park space an allowance for total developable land to a maximum 400 sq m. (includes clubhouse/change room 200 sq m) of a minimum 200 sq m. for approved clubs to develop their relevant facility requirements for their respective club)	**Desirable** (within the available park space an allowance for total developable land to a maximum 800 sq m. (includes clubhouse/change room 400 sq m) of a minimum 400 sq m. for approved clubs to develop their relevant facility requirements for their respective club)			**Desirable** (Within the available park space adequate total developable land to a max 400 sq m. (includes space for toilets etc.) to develop relevant facility requirements for the park space)			
	Commercial facilities				**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			**Desirable** (must fit within available Park space and not at the expense of available public open space, to be considered on a case by case basis)			
	Shade sails		**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Expected** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)		**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)	**Expected** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)			**Desirable** (Shall only be considered for use where there is not enough natural shade cover over prescribed park facilities, particularly playgrounds)			

	Toilet block			**Desirable** (Max 1 toilet facility, to be considered on a case by case basis)	**Expected** (Max 2 toilet facility, to be considered on a case by case basis)		**Desirable** (Max 1 toilet facility, to be considered on a case by case basis)	**Expected** (Max 2 toilet facility, to be considered on a case by case basis)			**Expected** (Max 2 toilet facility, to be considered on a case by case basis)			
Transport and access infrastructure	**Car parking (off-street)**			**Expected** (Minimum 20 car parking bays, , or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)	**Expected** (Minimum 30 car parking bays, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)		**Expected** (Minimum of 125 car parking bays – total on and off street. Minimum of 50% to be off-street parking bays. Parking may be angled or at 90 degree, including allowance for additional space for bus parking, turnaround and pull out zone)	**Expected** (Minimum of 300 car parking bays – total on and off street. Minimum of 50% to be off-street parking bays. Parking may be angled or at 90 degree, including allowance for additional space for bus parking, turnaround and pull out zone)			**Desirable** (Minimum 20 car parking bays. May be angled or 90 degrees, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis)			
	Car parking (on-street)	**Expected** (Minimum 5 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 15 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 20 car parking bays kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 50 car parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)	**Expected** (Minimum 10 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Maximum 75 parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)	**Expected** (Maximum 150 parking bays. May be parallel or indented at 90 degrees - including allowance for additional space for bus stop parking and pull out zones.)		**Desirable** (Minimum 15 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)	**Expected** (Minimum 20 car parking bays. May be angled or indented at 90 degree, or adequate number of car parking spaces to meet anticipated demand shall be considered on case by case basis. Including space for bus pull out zone where required)	**Desirable** (Minimum 5 car parking bays, kerbside external only. May be parallel or indented at 90 degrees)		

	Drainage and service connections	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)		**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (As required shall be considered on a case by case basis where there is a demonstrated need for such a facility)	
	Internal concrete pathways (min. 1.5m wide)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)		**Desirable** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)	**Expected** (Min length Pathways should provide connection from the park entrance access point to the key park activity elements)			
	Internal roads/vehicle access pathways			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Expected** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	
	Walking tracks (dirt)				**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the facility has been identified)							**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the facility has been identified)		

	Dog off leash park (fenced)			**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).	**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).	**Desirable** (Shall only be developed in accordance with Councils adopted Dog off-leash strategy. (Refer to SC6.4.3.6.24 Dog Off-leash facilities).								
	Fishing platform/pontoons/ boat ramps and Jetty's			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)								
Other Infrastructure	**Lookout platforms**			**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)	**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)							**Desirable** (Shall be considered on a case by case basis where there is a demonstrated need for such a facility)		
	Public art			**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)	**Expected** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)			**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)		**Desirable** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)	**Expected** (Will only be considered on a case by case basis, in accordance with the Public Art - policy and strategies)			
	Swimming pools						**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the service has been identified)	**Desirable** (Will only be considered on a case by case basis, where a demonstrated need for the service has been identified)						

	Water features				**Desirable** (To be kept to a minimum and considered on a case by case basis)						**Desirable** (To be kept to a minimum and considered on a case by case basis)			

Expected infrastructure – critical to the intended function of the open space classification.

Desirable infrastructure – not considered essential but may compliment the function of the park space and is dependent on location, need and adjacency to other infrastructure/services.

Indoor and aquatic sports facilities are not included in the Public Open Space Hierarchy, largely due to the enclosed, custom nature and high level of built form.

Editor's note—Table SC6.4.3.6.1 indicates items that are considered "essential" to the function of each open space typology and therefore should be provided with the development of that type of public open space. Importantly, the embellishment standard set for each typology is considered an "average" standard and therefore variation between locations with the same hierarchy classification may occur. However, whilst some locations may include less or additional infrastructure items, the overall level of embellishment cannot exceed the "average" to the point where the location would be delivering a standard equivalent to another typology. (e.g. a local park embellished to the standard of an district park). Items considered "desirable" and/or "conditional" are to be considered on a case-by-case basis, and provided as required, dependent on location, need, affordability and adjacency to other infrastructure/services. Where there is a co-location of open space typologies with the one open space area, embellishment infrastructure can be "shared" between the two functional areas.

SC6.4.3.6.14 Activity elements

(1) General requirements

(a) Activity elements may include, but are not limited to the following:

(i) outdoor fitness equipment;

(ii) play spaces and play equipment;

(iii) softfall surfacing;

(iv) skate and parkour elements and facilities; and

(v) informal sporting facilities.

(b) All activity elements must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for activity elements.

(2) Outdoor fitness equipment

(a) Outdoor fitness equipment may include a combination of:

(i) static fitness equipment such as step ups, hurdles and sit up benches; and

(ii) dynamic fitness equipment such as bench presses, leg presses and pull downs.

(b) Within public open space, outdoor fitness equipment shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

Editor's note—currently no further guidelines and standards are developed for the provision of outdoor fitness equipment across the public open space network. Inclusion of fitness equipment within public open space will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of outdoor fitness equipment, all development proposals will be assessed against the provisions within that plan.

(c) Fitness equipment selection

(i) All fitness equipment shall be designed, manufactured, installed, certified and maintained in accordance with all applicable Australian Standards, including:

(A) AS4685 – *Playground equipment – General safety requirements and test methods*;

(B) AS2555 – *Supervised adventure playground – Guide to establishment and administration*;

(C) AS4422 – *Playground Surfacing – Specification, requirements and test methods*; and

(D) AS4486.1 – *Playgrounds and playground equipment – Development, installation, inspection,*

maintenance and operation.

(ii) Equipment selection should take into account the existing demographics and cater for multiple age groups, subject to the population profile within the local area. Projected changes to the local demographic and/or aging of the original groups that will utilise the equipment should also be considered.

(iii) A diversity of exercise activities should be developed within the site.

(iv) Future inspection and maintenance requirements of the fitness equipment must be considered and the more onerous, dynamic equipment must be limited to district or regional level public open spaces only.

(v) Longevity of materials must be considered, particularly within the context of the local conditions (e.g. only include equipment of a high quality design and materials, particularly for moving parts and where intense usage is anticipated).

(d) Fitness equipment siting

(i) Fitness equipment should be located away from play spaces to reduce the temptation for children to play on the equipment.

(ii) Ideally, the equipment should be located along or in close proximity to a primary access path, with the fitness units to be offset from this for the comfort of users.

(iii) Individual units may be clustered together or spaced separately in a circuit along a pathway, dependent on the equipment, design and usage intent.

(iv) All fitness equipment is to have concrete slabs, all required shock pads, and wet-pour rubber surfacing in accordance with AS/NZS 4422 *Playground Surfacing – Specifications, requirements and test method*.

(3) Play spaces and play equipment

(a) Play spaces are to be provided in order to:

(i) provide a wide range of quality play opportunities that meet the needs of the local children and young people alike;

(ii) aid children's development by providing spaces and elements for physical coordination activities such as balancing, climbing, jumping, crawling and running;

(iii) assist in the development of social skills such as sharing and cooperation;

(iv) promote children's use of their imagination and development of problem solving skills; and

(v) provide a place for meeting and socialising amongst children, parents and other care givers.

(b) Play spaces shall include a combination of:

(i) active, equipment based play structures (e.g. swings);

(ii) active, non-structured play areas (e.g. kick-around areas or grass mounding);

(iii) imaginative and creative play areas (e.g. trees or natural "cubby" areas);

(iv) a parent or care-givers area (e.g. picnic settings or bench seats); and

(v) special features that cater for children and young people of all abilities (at select locations only).

(c) Within public open space, play spaces and play equipment shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

(d) Playground equipment selection

(i) All playground equipment shall designed, manufactured, installed, certified and maintained in accordance with all applicable Australian Standards, including:

(A) AS 4685 – *Playground equipment – General safety requirements and test methods, including AS 4685 parts 1- 6 and part 11*;

(B) AS 4486 – *Playgrounds and playground equipment – Development, installation, inspection, maintenance and operation*; and

(C) AS/NZS 4422 – *Playground surfacing –Specifications, requirements, and test method*.

(ii) Equipment selection should take into account the existing demographics and cater for multiple age groups, subject to the population profile within the local area and the likely park users. Projected changes to the local demographic and/or aging of the original groups that will utilise the equipment should also be considered.

(iii) Diversity of play experiences between sites within the local area should be provided where possible.

(iv) Future inspection and maintenance requirements of the play facilities must be considered and elaborate, more complicated equipment limited to locations with a higher maintenance level of service.

(v) Longevity of materials must be considered, particularly within the context of the local conditions (e.g. plastic coated chains are to be avoided due to accelerated deterioration in North Queensland sun).

(vi) Equipment selection and orientation should take into account the potential for vandalism. As such, equipment with significant amounts of hard, non-transparent panels should be avoided, except where this can be mediated through orientation and casual surveillance opportunities.

(e) Playground equipment siting

(i) Active and passive play areas should be integrated but physically separated to promote more cohesive use of the space and facilitate quiet areas for creative and imaginative play activities.

(ii) Play spaces, particularly toddler areas, should be sited within close proximity to the main activity node to maximise accessibility and casual surveillance from parents, carers and adjacent users.

(iii) Play spaces should ideally be located within close proximity to the main access path. Care should be taken, however, to not create a point of conflict by locating a busy activity area on a main thoroughfare of the open space, as per below.

(iv) Play spaces should be located away from potential safety hazards such as car parks or trafficable areas, watercourses or steep slopes.

(v) Play spaces should be located away from adjacent properties to limit potential nuisance from ongoing noise. A minimum buffer of 15 m from adjacent property boundaries should be applied.

(vi) Sun safety and protection opportunities including natural and built shade options should be addressed in accordance with SC6.4.3.6.19 Shelters and shading devices. Shading opportunities should consider sun orientation and ensure that shading of the equipment is maximised during the highest UV risk period of the day and over the highest need elements (e.g. metal slides).

(vii) Natural elements such as turf mounding, trees, shrubs and rocks should be safely integrated into the play space where possible.

(viii) Fencing of the play space is to be considered on a case-by-case basis and established as required, in accordance with SC6.4.3.6.16 Fencing.

(ix) At larger playgrounds of a district or regional level, consideration should be given to the location of public toilets within short walking distance of the play space.

Editor's note—public toilets should be installed at select locations only. Refer SC6.4.3.6.21(2) Public toilets for further details.

(x) Large, purpose built, "all-abilities" play areas are to be considered on a case by case basis and established as required.

(f) All playground equipment must be installed in accordance with the manufacturer's specifications. Certification of the equipment must also be provided.

(4) Softfall surfacing

(a) Softfall surfacing shall be provided in order to:

(i) create a safe, impact absorbing surface underneath activity elements; and

(ii) provide textual stimulation through different surfacing types (e.g. sand and rubber softfall).

(b) Softfall surfacing may include a combination of:

(i) wet-pour rubber softfall or approved rubber alternatives, including shock pads beneath;

(ii) astro turf, including shock pads beneath; and

(iii) certified softfall sand.

(c) Softfall surfacing shall be installed under all play spaces/equipment where a fall zone has been identified. Within public open space, the provision of equipment, and therefore softfall surfacing shall be at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1.

(d) Organic softfall surfacing such as woodchips is not considered an acceptable softfall outcome.

(e) Rubber softfall surfacing

(i) Rubber softfall must be installed in accordance with the equipment fall zone requirements, manufacturer's specifications and council approved standard drawings. Certification of the softfall installation must also be provided.

(ii) Shockpads shall be installed under all rubber softfall layers, as required by the applicable Australian Standards.

(iii) Rubber softfall colour selection shall minimise large areas of bright colours prone to fading in the sun. Rubber softfall mixes shall contain a minimum 70% EPDM rubber due to higher UV rating of this product.

(iv) Small, narrow and intricate designs (e.g. less than 300 mm in width) within the rubber softfall should be avoided due to ongoing deterioration of such designs.

(v) Rubber softfall shall be prioritised to areas requiring higher levels of accessibility or underneath high wear items.

Editor's note—currently, no standard drawings are formally adopted for rubber softfall surfacing.

(5) Informal sporting facilities
Informal sporting facilities may include but are not limited to:

(a) basketball half courts;

(b) outdoor table tennis tables; and

(c) handball courts or rebound walls.

Editor's note—currently no specific requirement relating to informal sporting facilities are developed.

(6) Skate facilities and parkour practice areas

Editor's note—currently no specific requirement relating to skate facilities and parkour practice areas are developed.

SC6.4.3.6.15 Electrical and lighting

(1) Lighting

(a) All lighting must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for lighting.

(b) Lighting requirements within public open space will be advised by council in accordance with the hierarchy classification of the public open space or pathways involved.

(c) Power supply options (mains or solar) will be considered on a case-by-case basis, subject to the nature of the proposal, the existing supply opportunities and the site context.

(d) All lighting works must be undertaken in accordance with SC6.4.3.20 Public lighting and utility services.

(e) Pathway lighting
Bicycle paths or pedestrian paths within public open space that require lighting shall be lit to the applicable pathway lighting category, as per AS 1158 Lighting for roads and public spaces and SC6.4.3.20.2(2)(c) Lighting for bicycle, pedestrian and shared paths.

(f) Activity node lighting
Pathways within public open space that require lighting shall be lit to the applicable pathway lighting category, as per AS 1158 Lighting for roads and public spaces and SC6.4.3.20.2 Public lighting (urban and rural).

Editor's note—currently, no further standards are set for lighting of activity nodes. Council will negotiate these requirements on a case-by case basis until formal standards are set.

(g) Sports field and court lighting in accordance with SC6.4.3.20.2(2)(e) Lighting for sports grounds and sports complexes .

Editor's note—currently, no further standards are set for lighting of sports fields and courts. Council will negotiate these requirements on a case-by case basis until formal standards are set. Guidance on the recommended levels of illumination for each sport can be found in external references such as the Western Australian Department of Sport and Recreation Sports Dimensions Guide for Playing Areas.

(2) Electrical
All electrical works must be undertaken in accordance with SC6.4.3.20 Public lighting and utility services, all applicable Australian Standards and legislative requirements.

SC6.4.3.6.16 Fencing

(1) General requirements

(a) Fencing may include, but is not limited to the following:

(i) fencing panels;

(ii) bollards;

(iii) post and rail systems;

(iv) rural type fencing; and

(v) other crash barriers.

(b) Fencing is to be provided in order to:

(i) provide a legible definition of the open space boundaries and limits;

(ii) provide enclosure of a space appropriate to its function (e.g. fenced playgrounds);

(iii) prevent encroachment into open space by adjacent private properties;

(iv) prevent unwanted vehicle access by the provision of barriers along the road frontage, including into drainage reserves, parks and other public open spaces; and

(v) restrict access to unsafe locations or private property.

(c) All fencing must be of a high standard, and designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for fencing.

(d) Fencing materials, design and location

(i) Fencing materials, design and location should not unreasonably hinder pedestrian circulation through open space, with sufficient pedestrian access points to be provided.

(ii) Where vehicle access prevention is required along pathways or bikeways, bicycle deflections rails are the preferred method and removable bollards should be avoided. Refer to SD-066 - Miscellaneous traffic details – bicycle path terminal treatments deflection rail and intersection at side street.

(iii) For public open space or streetscapes, proposals should seek to be consistent with any existing fencing style that is already established unless approved otherwise.

(iv) Fencing materials, design and location should be considered in the context, functionality and purpose for fencing use (e.g. post and rail installed where prevention of vehicle access, including motorbikes, is required).

(v) Public playground area and pool fencing must be in accordance with AS1926.1 *Swimming pool safety – safety barriers for swimming pools*.

(vi) Where appropriate, use of plants to screen or soften the fencing is recommended, except where this will conflict with CPTED requirements.

(e) Within public open space and streetscapes, fencing alignment and type shall include consideration of ongoing maintenance requirements and ensure:

(i) access for maintenance and other authorised vehicles shall be provided through a lockable gate or removable bollard, including provision of a kerb ramp or crossover at a safe location acceptable for council;

(ii) where provided in turf, a minimum 2 m wide clearance to other infrastructure (including trees) shall be maintained on either side of the fencing alignment to allow efficient mowing activities;

(iii) where bollards are provided in concrete, construction joints shall be provided to minimise damage to concrete slabs due to collisions, and allow ease of removal and replacement to damaged bollards; and

(iv) fencing is to be located within the surveyed boundary of the open space allotment; or

(v) where open space borders private property, fencing is to be located within the surveyed boundary of the private allotment.

SC6.4.3.6.17 Furniture

(1) General requirements

(a) Furniture may include, but is not limited to the following:

(i) barbeques (gas, electric and wood-fired);

(ii) benches, seats and picnic settings;

(iii) refuse bins;

(iv) bicycle parking facilities;

(v) water bubblers and taps; and

(vi) tree grates and guards.

(b) All furniture must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for furniture.

(2) Electrical and gas barbeques

(a) Within public open space, gas and electric barbeques are to only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1 Public Open Space Embellishment Framework.

Editor's note—Deviation from council's Public Open Space Embellishment Framework provisions for barbeques may only be considered where sufficient benefit to the wider community is demonstrated and supplementary conditions are satisfied. Proposed deviations must be discussed with council at preliminary approval stage and will only be approved where all community expectations have been considered; an extended maintenance period has been successfully negotiated and all other conditions are satisfied.

Editor's note—currently, no standard drawings are formally adopted for electrical and gas barbeques.

(b) Where permitted, gas and electric barbeques must be provided in accordance with council approved standard drawings.

(c) The following are the preferred specifications for outdoor gas and electric barbeques:

(i) cooktops to be all stainless steel construction, including high efficiency mono pressed stainless steel hotplate with laminated heat dispersion coating, high contact heating element and all stainless clamp plate;

(ii) timing, ignition and temperature control functions should feature on all hotplates to ensure optimum cooking temperature is constantly maintained and to maximise performance and efficiency. Visual and audible indication of operation and mode change should also be a key feature;

(iii) safety push button/stop systems are a mandatory requirement. These should ideally be located above the bench top, out of reach of children and fitted with a safety delay feature to ensure units cannot be inadvertently turned on;

(iv) hotplates are to be enclosed in a raised hob elevated and isolated above the bench top and with a minimum 100 mm protection zone. Benches should be designed without protrusions or ledges that may assist climbing;

(v) hotplates should be non-porous with no welds, creases or deep corners to trap food and bacteria. An automatic pre-heat mode should also feature and deliver minimum sterilising temperature;

(vi) enclosure frames are to consist of high strength, powder-coated aluminium extrusions. Cladding to be 18 mm compressed fibre cement backing panels with 0.55 mm stainless steel decorative fascia panels or approved similar. All doors to be stainless steel powder-coated or brushed stainless steel and fitted with a door lock matching council's preferred security key system;

(vii) barbeques are to be ideally located underneath a shelter, mounted on a concrete slab with minimum 450 mm clearance around the bench top on all sides;

(viii) units should be fitted with a fat collection tray and unobstructed access through fat tray access doors. Components should be designed to be easily unbolted and lifted out for maintenance and easy replacement;

(ix) electric components to be all fully sealed and power requirements are to be 240 volt A.C., 3.6 Kw, per plate or approved similar. All electrical works to be undertaken by a qualified electrician and in accordance with all relevant Australian Standards and legislation;

(x) gas barbeques may only be permitted by council where electricity power supply is restricted or

where connection to an electrical supply is cost prohibitive. Gas supply to be installed by a qualified plumber and in accordance with all relevant Australian Standards and legislation;

(xi) a water tap should be readily accessible to the barbeque cooking and eating area for ease of use during barbeque operation and cleaning; and

(xii) a minimum 2 year warranty must be provided with all barbeques installed within public open space.

(3) Wood fire barbeques and open fire areas

(a) Wood fire barbeques or open fire areas are NOT to be provided unless approved by council.

(b) "Natural settings" will be the only exception where wood fire barbeques or open fire areas may be permitted. Adequate environmental, fire and other safety measures must be included as part of any provision proposal to council.

(c) Where permitted, wood fire barbeques must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for wood fire barbeques and open fire areas.

(4) Benches, seats and picnic settings

(a) Where provided, benches, seats and picnic settings must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for benches, seats and picnic settings.

(b) All benches, seats and picnic settings are to be flange mounted on an appropriately sized concrete slab unless approved otherwise.

(c) Where within public open space or streetscapes, furniture should be consistent with any existing or adopted furniture suite for the public open space or streetscape, unless approved otherwise.

Editor's note—currently, no city-wide adopted furniture suite is developed. Some individual locations do, however, have formally adopted furniture suites and colour schemes. Others have informally established suites and colour schemes that have developed over the years. In both instances, new furniture selection should be consistent with these suites unless reasonable justification for deviating from the palette can be established.

(5) Refuse bins

(a) Where provided, refuse bins must be provided in accordance with council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for refuse bins.

(b) For district and regional level parks, civic spaces and amenity parks, acceptable bin provision includes 240 L rubbish and recycling wheelie bins, with single or dual bin enclosures, mounted on a concrete slab. Cigarette Butt bins may be attached where deemed appropriate.

(c) For local recreation parks and all other public open space, acceptable bin provision is restricted to 240 L rubbish and recycling wheelie bins, mounted on a concrete slab with a metal security bin stand unless approved otherwise.

Editor's note—refuse bin style and design for streetscapes will be considered on a case by case basis until further standards and design guidelines are developed.

(d) For all public open space and streetscapes where bin enclosures are provided, these must be fitted with a door lock matching council's preferred security key system.

(e) For all public open space, variations to size and quantity standards may be approved, as required to

support the associated waste collection requirements, particularly at locations of high usage or where sporting and community clubs are co-located.

(f) All bins and enclosures are to be appropriately screened and located to ensure ease of accessibility for use and waste collection, without compromising the amenity of the public open space or adjacent land uses.

(g) All bins and enclosures are of a design, construction and location that minimises any likely impacts, or the risk of hazards due to vandalism or fire.

(6) Bicycle parking facilities
Bicycle parking facilities are to be provided in accordance with AS 2890.3 *Parking facilities – Bicycle parking facilities*.

Editor's note—refer also SC6.4.4.7 Bicycle, pedestrian and shared path design

(7) Water fountains and taps

(a) For all public open space, ready access to a potable water source is to be provided as part of any open space development, including at activity nodes and at reasonable intervals along corridor parks or recreational pathways.

(b) All water fountains and taps should be located near existing services and water supply points wherever possible, focused around activity nodes or areas of high use.

(c) Dog bowls should be included as part of water fountain provision where necessary. Separate stand-alone units may be required where anticipated usage will be very high (e.g. in dog off-leash area).

(d) All water fountains should be installed on a concrete slab, above a drainage well and with adequate surface drainage inlets to prevent water pooling on adjacent surfaces.

(e) For all public open space, water fountains and taps should be designed, constructed and installed as per council specifications detailed in SC6.4.6.27 Irrigation. Each water fountain/tap is to have a water meter connected.

SC6.4.3.6.18 Signage

Signage may include, but is not limited to the following:

(1) park name signs;

(2) information signs;

(3) directional signs;

(4) regulatory signs; and

(5) entry statements (private developments and public statements).

Editor's note—currently no specific requirements relating to signage are developed. For signage within public open space, consideration should be given to the Public Open Space Embellishment Framework and council's corporate branding requirements, as detailed in council's Graphic Standards Manual (GSM). Signs within streetscapes should be as per requirements detailed in sub-section SC6.4.6.24 Signposting.

SC6.4.3.6.19 Shelters and shading devices

(1) General requirements

(a) Shelters and shading devices may include, but is not limited to the following:

(i) awnings;

(ii) picnic shelters or gazebos; and

(iii) shade sails.

(b) All shelters and shading devices must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for shelters and shading devices.

(2) Awnings

Editor's note—due to the place-specific, custom nature of awnings, no standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all applicable building and engineering requirements, Australian Standards and council's overarching design and management principles. Applicants should refer to SC6.4.3.4 Outdoor dining design for shading requirements applicable in this situation.

(3) Shade sails

(a) All shade sails are to be:

(i) designed, engineered, built and certified against Building Code of Australia, C2 wind rating requirements as per AS1170 *Structural design actions* and all other applicable standards;

(ii) located with consideration of shading requirements, sun orientation and natural shading opportunities on site. As such, provision must be considered on a case-by-case basis, and account for the existing versus desired extent and daily duration of shade cover (natural and built); and

(iii) provided in public car parking areas as a substitute to natural shading when there is insufficient available planting space or shade sails are deemed a more practicable and/or cost effective shading system.

Editor's note— Refer SC6.4.3.6.32 Car park plantings and shading for additional information

(b) All shade sails within public open space are to:

(i) be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in SC6.4.3.6.13 Open space embellishments, unless approved otherwise;

Editor's note—currently no further guidelines and standards are developed for the provision of shade sails across the public open space network. Inclusion of shade sails will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of shade sails, all development proposals will be assessed against the provisions within that plan.

(ii) be primarily provided over high use activity elements, where practicable and not cost prohibitive. Demand and need for shade sails is likely to be higher in greenfield sites or where there are minimal mature shade trees. In these instances, shade sail provision should be supplemented by ancillary shade tree plantings to ensure both natural and built shade are developed in the long term;

(iii) be located to minimise proximity to trees that may increase maintenance due to leaf drop or pose a risk to the sail structure from falling limbs during storm events;

(iv) have a 2.5 m minimum clearance between the highest accessible standing point of the shaded equipment/item and the lowest point of the shade sail. Access opportunities from adjacent structures should also be avoided, in order to reduce potential vandalism and damage to the structure or sail;

(v) within playground areas, all poles are to be located outside equipment fall zones and, where practicable, outside the softfall surfacing area provided this will not conflict with mowing activities or circulation;

(vi) be of premium quality shade fabric made of 100% monofilament yarns with a 10 year fabric warranty unless approved otherwise;

(vii) include hot-dipped galvanised and powder coated poles of a colour consistent with any existing colour palette or adjacent park infrastructure;

(viii) pole profile and diameter should inhibit climbing of the poles or anti climbing devices should be installed;

(ix) include marine grade fittings for all locations; and

(x) include quick release mechanisms on all sails for ease of removal during storm events and all necessary edge reinforcement and hardware to ensure longevity of the shade sail.

(4) Shelters and gazebos

(a) All shelter structures are to be designed, engineered, built and certified against Building Code of Australia, C2 wind rating requirements as per Australian Standard AS 1170.2 *Structural design actions – wind actions* and all other applicable standards.

(b) All shelter installations within public open space are to:

(i) be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1 Public Open Space Embellishment Framework;

(ii) have a minimum 300 mm clearance from the edge of the roofline to the edge of the slab to reduce erosion around the structure;

(iii) be design and installed without roof gutting systems unless specified otherwise;

(iv) have a frame constructed of oiled hardwood timber, painted pine or marine grade metal materials;

(v) include marine grade fittings for all locations; and

(vi) where painted, be of a colour consistent with any existing colour palette or accompanying furniture suite.

SC6.4.3.6.20 Outdoor sporting facilities

Outdoor sporting facilities may include, but is not limited to the following:

(1) sports fields and courts;

(2) outdoor spectator facilities;

(3) specialised sports facilities;

(4) motorised sports facilities;

(5) aquatic facilities; and

(6) equestrian facilities.

Editor's note—currently no further guidelines and standards are developed for the provision of outdoor sporting facilities across the public open space network. Inclusion of outdoor sporting facilities will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan for the provision of outdoor sporting facilities, all development proposals will be assessed against the provisions within that plan.

SC6.4.3.6.21 Structure and buildings

(1) General requirements

Structures and buildings may include, but are not limited to the following:

(a) public toilets;

(b) community facilities;

(c) commercial facilities;

(d) clubhouses, change rooms or canteens; and

(e) sheds and shipping containers.

Editor's note—currently no further guidelines and standards are developed for the provision of structures and buildings across the public open space network. Inclusion of structures and buildings will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan for the provision of outdoor sporting facilities, all development proposals will be assessed against the provisions within that plan.

(2) Public toilets

Editor's note—currently no further guidelines and standards are developed for the provision of public toilets across the public open space network. Inclusion of public toilets will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks and all other applicable sections of the Townsville City Plan and sub-sections of the Development manual planning scheme policy. Where council develops and adopts a strategic plan or design guidelines for the provision of public toilets, all development proposals will be assessed against the provisions within these documents.

SC6.4.3.6.22 Surface treatments

Surface treatments within all open space are to be:

(1) of an appropriate extent and material that will be durable under the local climatic and site conditions;

(2) of an appropriate extent and material that will mitigate the effects of large areas of impervious surfaces on run-off infiltration;

(3) fit for the intended purpose of the surface, its location, and the anticipated type and level of usage;

(4) shaded wherever possible and not prone to excessive heat retention, reflectivity and glare;

(5) not conducive to water pooling or slippery when wet;

(6) designed and located with consideration of the need for softening of hard surfaces with plantings; and

(7) be practical to maintain.

Editor's note—currently no further requirements relating to surface treatments are developed. Compliance with relevant sections of the Development manual planning scheme policy is required.

SC6.4.3.6.23 Transport and access infrastructure

(1) General requirements

(a) Transport and access infrastructure within open space is considered to include:

(i) car parking, both on and off street, associated with the open space or facilities;

(ii) internal roadways;

(iii) pedestrian paths, bicycle paths, shared paths;

(iv) public transport facilities;

(v) end of trip facilities;

(vi) walking tracks; and

(vii) boat ramps.

(b) All transport and access infrastructure within public open space must be designed, constructed and installed in accordance with:

(i) the provisions within the Townsville City Plan, planning scheme policies, sub-section SC6.4.4.7 Bicycle, pedestrian and shared path design and this sub-section of the Development manual planning scheme policy;

(ii) all applicable Australian Standards and legislation;

(iii) all applicable council local laws; and

(iv) council's approved standard drawings.

Editor's note—refer to SC6.4.3.6.31 Streetscape design and landscape treatments for requirements relating to areas of a designated road reserve.

(c) Bicycle, pedestrian and shared paths within public open space are to connect to activity areas within the open space and to the on-street verge pathway network. Where a verge pathway network does not exist, consideration may be given towards the future design and establishment of such a network in order to establish the best outcome for connectivity.

Editor's note—refer to SC6.4.4.7 Bicycle, pedestrian and shared path design for design guidelines for consideration of the type of paths to be provided through/within public open space. Consideration should be given to connectivity of bicycle paths and pedestrian path networks.

(d) All landscaping and irrigation associated with transport and access infrastructure is to be in accordance with the provisions of this sub-section, and sub-sections SC6.4.6.26 Landscaping and SC6.4.6.27 Irrigation.

Editor's note—with the exception of the below, currently no further guidelines and standards are developed for the provision of transport and access infrastructure specifically within open space. Proposals will be assessed against the policies and standards contained in the Townsville City Plan other sub-sections of and the Development manual planning scheme policy. Where proposals are within public open space, consideration of the Public Open Space Hierarchy and Embellishment Frameworks will be given. Refer clause SC6.4.3.6.9 Public open space.

(2) Walking tracks
Walking track provision is to:

(a) be provided in accordance with infrastructure design requirements, track markers and signage, in accordance with AS 2156 *Walking tracks*;

(b) be at select locations only, where construction of the walking track/s will not create any foreseeable adverse impacts including unsustainable maintenance requirements, public safety and liability concerns, habitat destruction, land slip or slope destabilisation; and

(c) be provided in accordance with any council adopted walking track strategy.

Editor's note—currently no further guidelines and standards are developed for the provision of walking tracks within public open space. Inclusion of walking tracks will be considered on a case-by-case basis and with consideration of the Public Open Space Hierarchy and Embellishment Frameworks. Where council develops and adopts a strategic plan for the provision of walking tracks, all development proposals will be assessed against the provisions within that plan.

(3) Boat ramps
Boat ramp provision is to:

(a) be permitted in limited circumstances only, at specific locations, and where all relevant considerations are reasonably satisfied; and

(b) include engagement with, and approval from all relevant authorities and asset owner/s.

Editor's note—due to the place-specific, custom nature of boat ramps, no standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable engineering, water safety and transport standards, legislation, and council's overarching design and management principles.

SC6.4.3.6.24 Dog off-leash facilities

Dog off-leash facilities are designated spaces under council's local law where within an open space dogs can recreate with their owners. Dog off-leash areas provide a safe and fun environment for owners and their dogs to enjoy parks and open spaces.

Dog off-leash facilities are to be built to a high standard that meets community expectations. Facilities where proposed Dog off-leash areas are proposed to be established shall have due regard for;

(1) Site selection

(a) within public open space, dog off-leash facilities shall only be provided at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1;

(b) an appropriate sized large dog off-leash fenced facility should range between 2000 to 4000 m^2;

(c) an appropriate sized small dog off-leash fenced facility should range between 1000s m^2 to 1500 m^2. It should be noted that small dog off-leash fenced facilities will not be installed as stand-alone facilities by themselves;

(d) dog off-leash facilities should have adequate drainage and should have reasonable flood immunity;

(e) dog off-leash facilities should have cross fall drainage of at least 2%. This will ensure that water will not pond within the dog off-leash area;

Editor's note—the surface cover all dog off-leash facilities will primarily consist of turf. In most instances open turfed areas above 2000 m^2 should be considered as a minimum for dog off-leash areas. Turf cover shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with a 25 mm depth of topsoil. The type of turf to be used will be selected from the SC.6.2.6.26 – Attachment A list of preferred plant species.

(f) the use of native groundcovers, shrubs and trees should be incorporated into the overall design of the dog off- leash areas. The usage of existing established trees can provide visual amenity to the park and will provide protection from the wind and sun;

(g) landscaping and plants add to the amenity of the park, but it is important to ensure that plants are non-toxic and non-irritating to dogs. Some plants may have seeds, stems, leaves, fruits or flowers that are irritating and/or toxic to dogs;

(h) all dog off-leash enclosures are required to be irrigated with pop up sprinklers; and

(i) all dog off-leash facilities must be of a high standard, being designed, constructed and installed in accordance with:

  (i) the provisions within the Townsville City Plan and this sub-section;

  (ii) manufacturer specifications;

  (iii) all applicable Australian Standards and legislation;

  (iv) all applicable council local laws; and

  (v) council's approved standard drawings.

Editor's note—Currently there are no approved standard drawings for dog off-leash areas.

(2) Siting of dog off-leash facilities

(a) dog off-leash facilities should be located away from play spaces to minimise the temptation for children to have unsupervised interaction with dogs;

(b) dog off-leash facilities should also be located away from other non-congruent recreation activities (e.g. barbeque areas and fitness equipment). As a general guide it is recommended that a spatial buffer of approximately 40 m is considered appropriate. However, other factors such a site gradient and vegetation coverage can be utilised to lessen the spatial buffer;

(c) dog off-leash areas should also be sited to minimise noise nuisance into residential areas. As a general guide it is recommended that a minimum spatial buffer of approximately 40 m is considered appropriate. However, other factors such a site gradient and vegetation coverage can be utilised to lessen the spatial buffer;

(d) a variety of open and shaded spaces should be created within a dog off-leash facility. There should be enough space to include active running areas as well as quieter environments where dogs can sniff, play and interact with their owners. As a guide it is recommended that a dog off-leash area have shade coverage (both natural and artificial) of approximately 35 per cent;

(e) effective dog off- leash areas disperse the dog and human traffic throughout the park, and spread the wear and tear on the underlying surface evenly across the facility;

(f) in all instances dog off-leash facilities should be supported by sufficient car parking spaces to

accommodate the amount of vehicle traffic likely to be generated by the particular use of the site. Refer to Table SC6.4.3.6.1 Public Open Space Embellishment Framework;

(g) to enhance site accessibility and convenience, locate dog off-leash areas in close proximity to the available car parking. Additionally, equitable access ramps and a connecting path from the car parking to the dog off-leash facility should also be installed; and

(h) The placement of Dog off-leash facilities and planting treatments, shall take into account the maintenance requirements for maintaining such a facility (e.g. allow minimum 2m between perimeter fence and facility item such as a seat).

(3) Design - entry way

(a) double-gated entry to prevent dog escapees is required at all access points. Consideration should be given to the installation of multiple access points, to minimise congestion.

(b) access points are high wear areas and appropriate sized concrete pads will be installed. These concrete pads should cover the entire entrance areas and extend out past the arc of the gate openings.

(c) gates should be fitted with self-closing child-proof locks to prevent dog escapees and unsupervised children from entering the facility.

(d) a separate entry for a maintenance gate (which should be 3-3.5m wide) will be installed within the perimeter fence line. This should be located away from all the other user access points.

(e) other physical structures to support amenity such as shelters, benches or drinking fountains should be located at a suitable distance away from the access points to discourage dogs and people from congregating.

(4) Design - fencing

(a) secure perimeter fencing will be installed that discourages canines from escaping under, over or through the fence;

(b) the fence alignment shall avoid acute angles that can result in entrapment issues for dogs and humans;

(c) fencing around all Dog Off-Leash Facilities will be approximately 1.2m – 1.5m in height; and

(d) fencing materials must provide good visibility so that park users can see activity inside and around the park. Standard powder coated fencing panels traditionally used in pool fencing should be utilised as fence panels.

Editor's note—Be aware that smaller dog breeds may be able to run through the gaps in the panels of traditional pool fencing.When designing small dog off-leash areas give consideration to the installation of alternatives or undertaking modifications to the fencing panels to ensure that the enclosure is fit for purpose.

(5) Design Amenities - Seating

(a) as a minimum, four bench seats should be installed within the large dog off-leash areas, and two bench seats within small-dog off-leash areas;

(b) seating should be placed in areas to maximise the benefit of any nearby shade;

(c) seating should be aligned and in close proximity to the fencing of the off-leash area. This ensures that the majority of the dog activity will occur in front of where the owner is sitting. A mowing strip of 2 m should be allowed between the fence and the seating. Finally seating should be located away from entry/exit gates to avoid congestion;

(d) the type of seating used within the dog off-leash will be consistent with any existing or adopted furniture suite within the nearby park open space;

(e) however, consideration should also be given to the space between the slat sizes utilised on the bench seat. Minimum gaps should be utilised to avoid dog paws entrapment points; and

(f) picnic tables should not be located inside dog off-leash areas as this encourages food to be brought into the facility.

(6) Design Amenities - Drink facilities

(a) as a minimum, two drink fountains should be installed within dog off-leash areas. These fountains should be accessible by dogs and people, but should be located away from the main entry gates to discourage

congregation in high traffic areas;

(b) dog water bowls should be fixed to the drink fountain and be hinged so that owners can tip water out of the bowl. Adequate drainage around the water bowl should be installed to ensure that water logging and muddy areas do no occur. All drinking fountains are required to be installed on a concrete slab, above a drainage well with adequate surface drainage inlets;

(c) drinking fountains should be aligned and in close proximity to the fencing of the off-leash area. This ensures that that drinking dogs are not impacting activity areas. A mowing strip of 2 m should be allowed between the fence and the drink fountains; and

(d) water fountains and taps should be designed, constructed and installed as per council's specification, Drink Fountain and Water Tap (SC.6.4.6.27 Irrigation).

(7) Design Amenities - Waste facilities

(a) as a minimum, two dog faeces bag dispensers should be installed within dog off-leash areas;

(b) dog faeces bag dispensers should have a locking device to prevent bags being pulled continuously and scattered in the park. Dog faeces bag dispensers should be located in close proximity to the access points (but should also not impede access). However, dog faeces bag dispensers should also be located in positions that ensure an ease of refill, which does not require council staff to enter the enclosure;

(c) two covered rubbish bins should be installed outside of the dog off leash area, in close proximity to the main gate access point (but should also not impede access).Bin position should also ensure easy collection: and

(d) generally, the acceptable bin provision will be a 240L rubbish wheelie bin, mounted on a concrete slab with a metal security bin stand. Variations to size and quantity standards may be approved, as required to support the associated waste collection requirements, particularly at locations of high usage.

(8) Design Amenities – Lighting

(a) most dog off-leash facilities do not require lighting. In many instances one security light may be installed to link the entrance of the dog off-leash area to the adjacent car parking will be sufficient;

(b) full lighting of dog off-leash facilities will be accepted where there is a demonstrated need and where the lighting will not have a negative impact on adjacent residential areas; and

(c) all lighting shall be carried out to the applicable lighting category, as per the Australian Standard AS11580 – Lighting for roads and public spaces.

(9) Design - Agility Equipment / Separate Small Dog Area / Specialised Play

(a) not all dog off-leash facilities require agility equipment or a dedicated small dog off-leash area. These facilities will only be supported where there is a demonstrated demand on a case-by-case basis;

(b) if agility equipment is considered appropriate it should be located away from access points and high running areas. Consultation with agility dog groups should be undertaken prior to assist in the design of appropriate agility facilities within dog off-leash areas;

(c) small dogs are considered to be dogs that weigh less than 8 kilograms or are less that 35cm in height when measured from the floor to the top of the dog's front shoulders;

(d) small dog off-leash areas will not contain agility equipment; and

(e) specialised canine recreation equipment will be considered on a case-by-case basis. Consideration of ongoing maintenance costs, asset replacement costs and any potential impacts on canine health will be the major considerations when determining the request to install specialised canine recreation equipment.

(10) Design - Signage

(a) council information signs on dog off-leash area rules are required to be installed in close proximity to all access points;

(b) council has standard information signs on dog off-leash and small dog off-leash areas for usage and behavioural requirements that shall be used at dog off-leash areas;

(c) park name signage should be installed in close proximity to the dog off-leash area so that people utilising the facility are able to readily recognise the name of the facility. Generally, dog off-leash areas will not have a separate specialised park name; and

(d) when dog off-leash facilities are not readily visible from the road frontage, directional signage from car parking facilities or areas of high visibility should be utilised.

Editor's note—For further information on the construction of dog off-leash facilities, refer to the detailed landscape specification standards as provided in SC6.4.6 Construction Standards, in particular SC6.4.6.26 Landscaping.

SC6.4.3.6.25 Drainage and service connections

Editor's note—currently no specific requirements relating to drainage within open space are developed. All drainage requirements should be determined in accordance with sub-section SC6.4.4.4 Stormwater drainage design along with the relevant construction specifications.

SC6.4.3.6.26 Landscape entry statements

(1) Landscape entry statements may be of the following types:

(a) sign/graphics on a wall or acoustic fence;

(b) a structure;

(c) public art; and

(d) landscaping plantings only.

(2) Landscape entry statements to public open space, residential or commercial estate developments are to meet the following requirements:

(a) landscape entry statements are to be suitably located to clearly identify the public open space, an individual neighbourhood or development, or area of distinctive character;

(b) landscape entry statements are to be of a high quality urban form that is easily maintained;

(c) landscape entry statements are to be of a scale appropriate for the hierarchy classification and surrounding landscape character;

Editor's note—refer to Table SC6.4.3.6.1 Public Open Space Embellishment Framework relating to entry statement and signage in public open space.

(d) where involving a wall entry statement, the wall is to be located within the private property on the property boundary, unless relating to public open space or designated park;

(e) any private properties containing wall/s or other landscape entry statements require a covenant protecting the wall or feature and outlining maintenance responsibilities, and a Property Note in council's rates system to ensure owners are aware of the existence of the wall or feature;

(f) other entry statements of an alternative nature or located within the road reserve will be considered on merit and must meet requirements for visibility and frangibility;

(g) landscape entry statements for residential or commercial estates are to be provided and maintained by the developer for the life of the development (i.e. off maintenance of the final stage); and

(h) landscape entry statements will not include water features.

(3) Landscape entry statements are be provided in accordance with the following hierarchy and requirements:

(a) "Suburb" level landscape entry statements:

(i) generally be located on public land and owned by council after completion of any applicable maintenance period; and

(ii) conform with corporate graphics standards;

Editor's note—refer to council's Graphics Standards Manual.

(b) Estate" level landscape entry statement:

(i) walls or acoustic fence located within private property; and

(ii) structures, public art or landscaping may be located on public land subject to operational works (landscaping) approval;

Editor's note—public art needs to be coordinated through the Manager Gallery Services in accordance with council's Public art policy.

(c) Neighbourhood/village" level landscape entry statement:

(i) generally a sign wall located on private property; and

(d) "Street" level landscape entry statement:

(i) generally not acceptable.

SC6.4.3.6.27 Lookout platforms and fishing pontoons

(1) Lookout platforms and fishing pontoons will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied.

(2) Where the proposed lookout platforms or fishing pontoons are associated with public open space, council owned land or will involve potential future council assets, infrastructure may only be permitted at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1. Approval from the relevant council asset owner/s will also be required.

(3) In order to properly assess any such proposals, council may request the provision of a maintenance plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

Editor's note—due to the place-specific, custom nature of lookout platforms and fishing pontoons, no further standard specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with necessary requirements defined by all applicable engineering and water safety standards, legislation, and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal.

SC6.4.3.6.28 Public art

(1) Public art is considered to be "a concept or work created by an artist/s in any medium, permanent, temporary or ephemeral, which enables stimulation of one or more of the senses and is situated in a place of public access".

(2) Public art will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied.

(3) All public art proposals must demonstrate alignment with any council adopted public art policy.

Editor's note—refer to council's Public art policy.

(4) Where the proposed public art is associated with public open space, streetscapes, council owned land, or will involve potential future council assets, the public art may only be permitted at approved locations and where the following overall requirements are also satisfied:

(a) the provision of the public art adds interest to the public open space or streetscape, reinforces the unique identity of Townsville, and contributes significantly to the sense of place;

(b) the public art is used as a medium to interpret the social and cultural values of the community, reflecting Townsville's diverse heritage and cultural identity, as well as the social context of the site;

(c) the public art responds to the environmental context of the site, and is integrated into the overall landscape or streetscape, being well-chosen and appropriately sited;

(d) the provision of public art within public open space is in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1, unless approved otherwise;

Editor's note—where a public art strategy has been formally approved by council for a precinct or development, this may take

precedence over the Public Open Space Embellishment Framework provisions.

(e) the provision of public art within streetscapes and at centres is aligned with the expected levels of embellishment and characteristics of the road or centre hierarchy classification;

(f) all public art should not create a public safety risk to the community or council maintenance staff;

(g) engagement and approval from the relevant council asset owner/s and other stakeholders is required;

(h) for all public art proposals, council may request the provision of a concept statement and details including, but not limited to the following:

  (i) concept images or models;

  (ii) detailed description of the artwork/theme/concept;

  (iii) materiality;

  (iv) scale;

  (v) structural detailing and footing designs;

  (vi) public safety considerations;

  (vii) ongoing maintenance requirements;

  (viii) project budget/costs; and

  (ix) previous works and references; and

(i) for all public art proposals, council may request the provision of a maintenance plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

Editor's note—due to the place-specific, custom nature of public art, no further specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with all necessary requirements defined by all applicable engineering and electrical standards, legislation, and council's overarching design and management principles.

SC6.4.3.6.29 Screening

Screening may include, but is not limited to the following:

(1) acoustic screening;

(2) vegetated visual screening; and

(3) architectural visual screening.

Editor's note—currently no specific requirements relating to acoustic and visual screening has been developed. Reference should be made to Department of Transport and Main Roads' *Road landscape manual*. Per SC6.4.2 Development application guidelines, council may ask for a description of any ongoing maintenance requirements to ensure that the stated noise attenuation performance of the measure does not deteriorate with time.

SC6.4.3.6.30 Soft landscaping

(1) General requirements

Soft landscaping may include, but is not limited to the following:

  (a) plant species selection;

  (b) earthworks and mounding;

  (c) garden beds;

  (d) shade trees; and

  (e) turf areas.

(2) Plant species selection

  (a) Preferred plant species

    (i) Plant species used are to be those recommended in the Preferred plant species list in SC6.4.3.6 Attachment A – Plant species schedules.

Editor's note—the Preferred plant species list found in SC6.4.3.6 Attachment A has been prepared as an inclusive list that takes into account council's requirements and those of relevant service providers, and is acceptable for use in most circumstances. The species list does not account for frangibility requirements relating to street tree plantings in streets or roads. This, along with all other relevant considerations associated with the site context must be considered in the development of the landscape plan and species selection. Refer to sub-section SC6.4.6.26 Landscaping for further detail relating to planting construction specifications.

(ii) Plant species are to be selected by a suitably qualified and experienced horticulturist, landscape architect or designer to suit each of the site's hydro zones, so that direct rainfall supplies all or most of their water needs.

(b) Undesirable plant species
Plant species are not to include undesirable species listed in the undesirable plant species list.

Editor's note—currently, no undesirable plant species list has been developed.

(c) Declared weed species
Plant species used are not to include prohibited species listed in any declared weeds list.

Editor's note—refer to the Department of Agriculture, Fishers and Forestry for a declared weed species list. Currently, no design guidelines relating to other soft landscaping elements are developed.

SC6.4.3.6.31 Streetscape plantings

(1) General requirements

(a) Landscape treatments may include, but is not limited to the following:

(i) street trees;

(ii) planted and/or mulched garden areas;

(iii) turf areas;

(iv) irrigation;

(v) artificial turf;

(vi) stencil-crete;

(vii) concrete (plain or coloured); and

(viii) other associated hard landscape treatments.

Editor's note—refer to the streetscape requirements under SC 6.4.3.3 Footpath treatment policy.

(b) All streetscapes must be of a high standard, being designed, constructed and planted in accordance with:

(i) the provisions within the Townsville City Plan, planning scheme policies and this sub-section of the Development manual planning scheme policy;

(ii) all applicable Australian Standards and legislation;

(iii) all applicable council local laws; and

(iv) all council approved standard drawings.

Editor's note—currently, no standard drawings are formally adopted for landscape treatments.

Editor's note—where streetscape outcomes are within roads managed by the Department of Transport and Main Roads, applicants should refer to the Department of Transport and Main Roads' *Landscape Design Manual* (2013). Requirements of the Department of Transport and Main Roads' Landscape Design Manual will take precedence in these instances. Engagement and

approval from other stakeholders/authorities may additionally be required as part of any development proposal.

(c) All streetscape outcomes should be underpinned by and contribute to the following strategic objectives:

(i) safety – streetscapes do not introduce risk to road users, must contribute positively to a safe road environment and be safe to maintain and construct;

(ii) functionality – proposed outcomes are fit-for purpose and comply with landscape and road planning and design principles, appropriate to the road hierarchy and function;

(iii) environment - ecological and sustainable design principles are incorporated to mitigate the environmental impacts of the road and maintain or improve the intrinsic value of the streetscape;

(iv) aesthetics – streetscapes provide high visual amenity and are contextually sensitive to the character of the surrounding built and natural environment;

(v) community – proposed outcomes are responsive to the needs and concerns of stakeholders and maintain or improve the quality of life and liveability of communities; and

(vi) economic – streetscapes represent value for money and provide cost effective design outcomes that seek to minimise costs over whole of life cycle.

Editor's note—whilst the above strategic objectives are relating specifically to streetscape outcomes, these objectives are aligned with the overarching sustainability principles outlined at the beginning of this sub-section and within Part 9.3.3 Landscape code. Alignment with both the above strategic objectives and the overarching sustainability principles are to be expressed in the proposed streetscape design outcomes and detailed in the "Landscape statement of intent" per SC6.4.2 Development application guidelines.

(2) Safety

(a) Streetscapes shall create a safe road environment by ensuring:

(i) a safe system approach to road safety is used, as detailed by Austroads;

(ii) safe and efficient pedestrian, cyclist and vehicle movement is facilitated through the integration of all infrastructure and landscape elements within the road corridor;

(iii) hazards, safety or security risks are not introduced;

(iv) safe sight distances are applied and maintained as per Austroads Part 3 and Part 4. At intersections, use of Minimum Gap Sight Distance, and at roundabouts, criteria 1 and 2, are mandatory;

(v) clear zones and frangibility requirements are met in accordance with clear zone criteria as per Austroads Part 6;

(vi) setbacks and other clearances are met;

(vii) signage and other road furniture is not obscured;

(viii) safety and traffic management is enhanced through the functional use of landscape plantings;

(ix) surface treatments are slip-resistant and non-reflective;

(x) effects of glare and shadowing are minimised;

(xi) CPTED principles are incorporated into all streetscape designs; and

(xii) a safe work environment for maintenance personnel is achieved and requirements for traffic control are minimised.

(b) Associated with the above, the following definitions apply.

(i) "Frangible" vegetation - is plants (including trees) with a stem or trunk diameter equal to or less than 100 mm in diameter at maturity, measured from 300 mm above the finished ground level. Shrubs and ground covers are considered frangible except for shrubs that exceed 3.5 m in height.

(ii) "Non-frangible" vegetation - is plants (including trees) with a stem or trunk diameter greater than 100 mm in diameter at maturity, measured from 300 mm above the finished ground level. This includes shrubs greater than 3.5 m in height and most trees.

(iii) Setback - is the distance measured from the outer edge of the specified component to the centre

of the vegetation trunk.

(iv) Clearance - is the distance measured from the edge of the specified component to the perimeter of the second component or vegetation.

(v) Canopy clearance – is the vertical distance measured between the finished ground level and the underside of the tree canopy.

Editor's note—the above definitions are based on Austroads' *Guide to Road Design*, Part 6B: Roadside Environment (2009) and Department of Transport and Main Roads' *Landscape Design Manual* (2013) – Appendix 4.

(3) Functional

Streetscape outcomes must be fit-for-purpose and shall:

(a) be supported by all other ancillary infrastructure requirements that are essential to the overall functionality and longevity of the streetscape, including but not limited to irrigation, subsoil drainage and root barrier; and

Editor's note—refer to sub-sections SC6.4.6.20 Subsoil, foundation and pavement drains, SC6.4.6.21 Subsurface drainage, SC6.4.4.1 Geometric road design, SC6.4.6.26 Landscaping and SC6.4.6.27 irrigation.

(b) demonstrate sound application of design theories including legibility, form, function, connectivity, way-finding, accessibility and mobility, robustness, place-making and imaging.

Editor's note—where proposed streetscape outcomes deviate from the outlined requirements of this sub-section, the merit for this deviation must be detailed. Notes documenting how all safety, functional and operational requirements are satisfied by the design exception must be included for further consideration. Any variances will be assessed on a case by case basis relative to the situation. Approval will not be granted where the design exception opposes safety requirements or increases safety risk. All plans are required to be signed off by a RPEQ registered engineer.

(4) Environment

Ecological and sustainable design principles shall be incorporated by:

(a) applying an appropriate planting approach such as: structured, naturalistic, and water sensitive planting; grass seeding; or turfing;

(b) integrating street trees in the streetscape that will create shade for all users (including pedestrians and cyclists) and ameliorate the urban heat island effect;

(c) providing a buffer between the road and surrounding land uses;

(d) integrating the streetscape within natural areas through planting approaches with a natural appearance and naturalistic, informal distribution;

(e) improving the health and resilience of the urban forest by establishing green corridors along streets or roads and providing habitat corridors within the urban matrix;

(f) incorporating functional landscape components such as the use of vegetation to screen headlight glare;

(g) using varied vegetation treatments to highlight progression or transition to a different speed environment;

(h) designating feature areas or nodal points by creating a marker or landmark element at interchanges, intersections, major structures and entry gateways;

(i) using vegetation and other components to maintain or frame views;

(j) establishing economical ways to treat large areas;

(k) assisting with integrated stormwater management by establishing vegetation that will reduce erosion and large expanses of impervious surface; and

(l) incorporating vegetation and other treatments in ways that minimise maintenance in high risk areas, require reduced maintenance interventions and become self-sustaining over time.

(5) Aesthetics

Streetscapes shall be contextually sensitive and provide high visual amenity by:

(a) establishing streetscape characters themes that address, retain, reflect and where possible enhance the local context of the project area (architectural themes, colours, visual heritage values etc.);

(b) creating balance in term of scale and mass between new streetscape components and the existing natural features and urban building forms;

(c) integrating natural elements that recognise and promote the value of the urban forest in all streetscapes;

(d) establishing innovative approaches to providing functional, high amenity outcomes whilst maintaining and enhancing the safety and operational function of the road;

(e) responding to changes in road conditions and promoting legibility under varied road conditions or different design speeds;

(f) presenting a visually cohesive and unified suite of treatments that are simple, refined and without unnecessary, non-functional embellishment;

(g) creating treatments that are visually recessive except where intended to be highly visible feature elements;

(h) maintaining an uncluttered road environment with limited visual intrusion that will minimise risk of road user distraction and conflict with official traffic signs and signals; and

(i) devising colouration and surface treatment solutions that shall mitigate the visual impact of dirt, staining and adhesion of other pollutants.

(6) Community

Proposed streetscaping shall be responsive to stakeholder needs and concerns by:

(a) identifying and addressing community values and associated interests, perceptions and preferences as part of transport and road landscape planning and design process;

(b) promoting participation and contribution by implementing effective community engagement processes;

(c) enhancing public amenity for all users through improvements to user comfort, way finding and walkability;

(d) promoting the health and well-being of the community by improving the useability of pedestrian networks through provision of shade or boulevard treatments;

(e) improving accessibility, connectivity and security within the streetscape;

(f) establishing streetscapes that are functional and facilitate equitable access to a variety of multi-modal transport systems;

(g) seeking design outcomes that create a sense of community and reinforce local character, identity, and cultural heritage; and

(h) improving experiences both for users traveling within the transport infrastructure corridor itself and the community beyond.

(7) Economic

Streetscapes will represent value for money and minimise costs over whole of life cycle by:

(a) implementing appropriate designs that provide balanced outcomes across all strategic objectives;

(b) creating iconic gateway entry statements, in strategic locations only, which emphasise the urban or regional identity and enhance tourism, business potential and associated economic benefits;

(c) promoting increased usage and visitation to business and services through the provision of user friendly vehicular, pedestrian, cyclist and public transport networks which incorporate a high level of amenity and deliver a high quality experience;

(d) ensuring the ongoing cost and level of service for operational requirements associated with the streetscape is appropriate for the hierarchy and profile of the road;

(e) minimising the overall cost of operational activities through responsive design that reduces high cost, high risk, high frequency and high intensity activities;

(f) creating designs that will evolve into a self-sustaining streetscape and have a progressive reduction in the number of maintenance interventions over the operational life of the corridor; and

(g) promoting innovation in the development of alternative treatment types that achieve a balance between the desired aesthetic and reduce maintenance outcomes.

(8) Streetscape treatment provision

(a) Requirements relating to all safety objectives such as clear zones, sight distances and frangibility will take precedence and determine the placement and control of landscaping elements within the streetscape.

(b) All hard and soft landscape treatment construction must be in accordance with the specifications set out in sub-sections SC6.4.6.26 Landscaping and SC6.4.6.27 Irrigation.

(c) Kerb types will be as per SC6.4.4.8 Standard drawings (Typical Road Cross Sections SD-001, SD-002, SD-003, SD-004, SD-005, SD-006, SD-010), and SC6.4.4.1 Geometric road design.

(d) Where a zero object height is necessary, only hard landscape areas must be established, subject to meeting all other requirements within this sub-section and other sub-sections of the Development manual planning scheme policy.

(e) A minimum 1.2 m width of hard surface treatment (which may be inclusive of road pavement, kerb, concrete, mountable aprons etc.) must be provided between soft landscaping and the edge of the traffic lane, unless approved otherwise.

(f) In areas >70 km/hr, an increase to 3 m in width of hard surface treatment may be required between soft landscaping and the edge of the traffic lane, subject to assessment of the associated risks of the road environment.

Editor's note—the above widths are based on standard clearances between traffic lanes and work sites, as detailed in *Manual Uniform Traffic Control Devices* (MUTCD), Queensland. These clearance requirements may be subject to reduction or increase dependent on the road speed environment being assessed and subject to council approval. The intention for all standard clearances is to ensure a safe work environment, reduced inconvenience to road users and reduced the reliance on traffic control and the associated costs.

(g) Installation of decorative walls, entry signs, rocks or other fixed objects in the medians or central island of roundabouts will only be approved in select locations and where:

(i) the median or roundabout is larger than 10 m in width/diameter;

(ii) vehicles are not likely to run off the road;

(iii) placement of the fixed objects will not distract drivers;

(iv) maintenance or repairs to the fixed objects will not put maintenance personnel at risk;

(v) all requirements (including frangibility, clear zones, sight triangles etc.) per Austroads are satisfied; and

(vi) green walls or vine trellises shall only be provided in limited circumstances and where all design, construction, safety and maintenance conditions are satisfied.

Editor's note—due to the custom nature of green walls, vertical gardens and façade greening, no design and construction standards are provided. Each site will be assessed on a case-by-case basis. Generally the majority of these type of planting features are to be within private property and should be under the maintenance regime of the owner. All engineering and hydraulic certification must be provided with any structure proposed.

(h) For medians, specific requirements apply being:
Streetscape treatments shall be provided in accordance with Table SC6.4.3.6.7 Treatment application based on median width and other requirements of this policy.

Table SC6.4.3.6.7 Treatment application based on median width

Treatment	Appropriateness of treatment application by median widths (including width of kerbs)				
	< 2.5 m	**2.5 m – 3.5 m**	**3.5 m – 6.0 m**	**6.0 m – 10.0m**	**> 10.0m**
Hard landscape (Stencil-crete, artificial turf, concrete or similar) [1] where the width of hard landscape treatments may exceed 6.0m, a combination of hard and soft landscape treatments should be applied to avoid large expanses of hardscape, subject to satisfaction of all safety requirements	Yes	Yes	Yes	Yes[1]	Yes[1]
Turf (Zoysia spp. or approved alternative) [2] may be approved in select locations only, minimum clearances may still apply subject to road speed environment. Unless approved otherwise, turf areas must be a minimum width of 2.0m to support an irrigation system in a safe and efficient manner and facilitate efficient operational maintenance. Turf areas greater than 6.0m in width should be combined with other hard and soft landscaping treatments	No	No[2]	Yes	Yes	Yes
Garden areas (Shrubs/ground covers below 3.5m in height) *Frangible* [3] may be approved in select locations only, minimum garden area width and clearances may still apply subject to road speed environment, subject to satisfaction of all safety requirements	No	Yes[3]	Yes	Yes	Yes
Small trees/ large shrubs (Mature canopy between 5.0 – 10.0m in height or large shrubs greater than 3.5m in height) *Frangible or* *Non – frangible*	No	No	Yes	Yes	Yes
Medium trees (Mature canopy between 10.0 – 15.0m in height) *Non – frangible*	No	No	No	Yes	Yes
Large tree (Mature canopy greater than 15.0m in height) *Non – frangible*	No	No	No	No	Yes
Palms *Frangible or* *Non – frangible* [4] select locations only, minimum setbacks may also apply subject to species selection and mitigation of risks associated with frond drop	No	No	No	Yes[4]	Yes[4]

Editor's note—appropriateness of treatment application is based on clearance and setback requirements in a 60 km/h speed environment. Council approval of design outcomes that deviate from the above may be granted at select locations, dependent on the road speed

environment being assessed and that all safety and operational requirements are satisfied. This includes requirements outlined in MUTCD (Queensland) relating to work sites, with the intention being to design streetscapes to minimise reliance on traffic control during regular, routine maintenance operations.

(i) For the roundabouts, specific requirements apply being:

(i) streetscape treatments shall be provided in accordance with Table SC6.4.3.6.8 and other requirements of this sub-section;

(ii) splitter or blister islands should not accommodate any soft landscaping unless approved otherwise (generally, islands must be an average width of 6 m or greater and all safety and operational requirements must firstly be satisfied); and

(iii) where garden areas and trees are provided, plant species in the central islands of roundabouts should only consist of ground covers, low growing shrubs and/or mulched areas with clean trunked trees unless approved otherwise.

Table SC6.4.3.6.8 Treatment application based on roundabout diameter

Treatment	Treatments application by roundabout diameter (including width of kerbs and mountable apron)			
	< 7.0 m	**7.0 m – 10.0 m**	**10.0 m – 14.0m**	**> 14.0m**
Hardscape (Stencil-crete, artificial turf, concrete or similar) [1] where the width of hardscape treatments may exceed 10.0 metres, a combination of hard and soft landscaping treatments must be applied to avoid large expanses of hardscape	Yes	Yes	Yes[1]	Yes[1]
Turf (Zoysia spp. or approved alternative) [2] may be approved in select locations only, minimum clearances may still apply subject to road speed environment. Unless approved otherwise, turf areas must be a minimum width of 2.0m to support an irrigation system in a safe and efficient manner and facilitate efficient operational maintenance. Turf areas greater than 6.0m in width should be combined with other hard and soft landscaping treatments	No	No	Yes[2]	Yes[2]
Garden areas (Shrubs/ground covers below 3.5m in height) *Frangible* [3] may be approved in select locations only, minimum garden area width and clearances may still apply subject to road speed environment	No[3]	Yes	Yes	Yes
Small trees/ large shrubs (Mature canopy between 5.0 – 10.0m in height or large shrubs greater than 3.5m in height) *Frangible or* *Non – frangible*	No	Yes	Yes	Yes
Medium trees (Mature canopy between 10.0 – 15.0m in height) *Non – frangible*	No	No	Yes	Yes
Large tree (Mature canopy greater than 15.0m in height) *Non – frangible*	No	No	No	Yes
Palms *Frangible or* *Non – frangible* [4] select locations only, minimum setbacks may also apply subject to species selection	No	No	Yes[4]	Yes[4]

(9) Hard landscape treatment requirements

(a) Hard landscape treatments must:

(i) comply with all requirements relating to:

(A) appropriate abrasion resistance in accordance with test methods stipulated in AS/NZS 4456.9 - *Masonry units and segmental pavers and flags - Methods of test - Determining abrasion resistance*; and

(B) appropriate slip resistance capability as required by AS/NZS 4586 - *Slip resistance classification of new pedestrian surface materials*; and

(ii) be colour-fast, UV resistant and non-reflective.

(b) Where the width of hard landscape treatments may exceed 6 m, it is desirable that a combination of hard and soft landscape treatments is used to avoid large expanses of hard surface. This excludes roundabouts below 10 m in diameter.

(10) Turf area requirements

(a) Turf areas shall be in accordance with all applicable council approved standard drawings for turf areas.

Editor's note—currently, no standard drawings are formally adopted for streetscape treatments.

(b) Turf areas may form part of clear zones, provided all other requirements are satisfied.

(c) Turf areas must be a minimum 1.5 m **clear** width to allow for mowing access unless approved otherwise (noting minimum 2 m **total** widths are desirable for irrigation purposes).

(d) Where the width of the medians exceed 6 m, it is desirable that turf areas are combined with other hard and soft landscape treatments to provide balance against the median width.

(e) Turf species must be low maintenance and Empire Zoysia or an approved equivalent species.

(11) Garden area requirements

(a) Garden areas (planted or mulched only) shall be in accordance with all applicable council approved standard drawings for garden areas.

Editor's note—currently, no standard drawings are formally adopted for garden areas.

(b) All garden areas must be a minimum width of:

(i) 1 m where combined with other soft and hard landscaping treatment; and

(ii) 1.5 m where provided as full width planting.

(c) Where garden areas are **within** the sight triangle, plantings should only consist of ground covers and low shrubs with a maximum mature height of 600 mm or less in order to preserve sight lines.

(d) Where garden areas are **outside** the sight triangle, plantings expected to exceed 600 mm in mature height may be provided where all clear zone and frangibility requirements are satisfied and plantings are provided:

(i) as screen planting or buffers along fence lines or acoustic barriers;

(ii) for functional reasons such as a visual barrier for headlight glare, a windbreak or a physical barrier to human movement; and

(iii) where screening or accent planting is desired.

(e) Approval of full width planting may be provided:

(i) for strategic locations only;

(ii) where the garden area will be a minimum width of 1.5 m; and

(iii) where garden areas will be located behind road safety barrier system; or

(iv) where the road speed and required clearances between the edge of the traffic lane and the garden area complies with MUTCD (Queensland) requirements for work sites (Short-term Low Impact - Built Areas or Static Work Areas) and will not require the use of traffic control.

Editor's note—approval for full width planting will only be for select locations, subject to the satisfaction of all safety and operational maintenance requirements. Approved locations will generally be associated with central median screening or buffering plantings, key entry gateways or high profile roads, and/or associated with centres or commercial precincts. Where the road speed is 40 km/h or less, full width plantings may be provided in medians between 2.5-3.5 m, subject to achieving the

minimum garden area width and council approval.

(f) Where full width plantings are approved, plants must setback (from back of kerb) at least half the mature plant diameter, in order to mitigate potential encroachment into the roadway, reduce obstructions that compromise safety and increased maintenance requirements.

(g) All species selection should have regard to aesthetic, suitability, functional and ecological selection criteria and include consideration of:

(i) appropriateness for the planting approach (e.g. structured or naturalistic);

(ii) mature spread dimension and required density, noting encroachment into road shoulder must be avoided;

(iii) mature height and compliance with sight triangle requirements, noting reliance on frequent maintenance to maintain sight lines must be avoided;

(iv) frangibility requirements;

(v) drought resistance/water requirements;

(vi) suitability for prevailing soil type;

(vii) lifespan, noting long-lived species are desired and annuals are not to be used unless approved otherwise;

(viii) salt tolerance;

(ix) pollution resistance;

(x) environmental and habitat value of particular species;

(xi) ongoing care and maintenance requirements; and

(xii) the intended purpose of the planting and the species' suitability for this, including uses such as:

(A) headlight screen planting;

(B) buffer screening;

(C) visual screening;

(D) visual guidance planting;

(E) user perceptions of speed;

(F) shade and sunlight control;

(G) windbreak;

(H) physical barrier;

(I) erosion control;

(J) safety; and

(K) noise attenuation.

(h) Garden areas (mulched only) shall:

(i) be provided where shrubs and groundcovers are not desired or cannot be planted without impacting sight lines; and

(ii) where tree planting is incorporated in the mulched garden area.

(12) Street tree requirements

(a) Street trees should be provided at the following rate:

(i) a minimum of one tree per standard building lot or spaced at approximately 20 m intervals; and

(ii) a maximum of four trees per standard building lot or spaced at approximately 7 m intervals.

(b) The above rates may be altered where:

(i) there is insufficient available space based on safety and setback requirements; or

(ii) existing street trees will be retained; and

(iii) subject to council approval of the reduced rate.

Editor's note—in locations where lot sizes are below the standard lot width, street tree provision rates will need to be assessed on a case by case basis. In these instances, a balance between provision rates, reduced setback requirements and appropriate mitigation measures to reduce potential damage to adjacent infrastructure must be sought.

(c) Street trees shall be planted in accordance with:

(i) all applicable council approved standard drawings for tree planting; and

Editor's note—currently, no standard drawings are formally adopted for landscape treatments.

(ii) all setback requirements, being:

(A) a minimum 5 m from an electricity pole or pillar box;

(B) a minimum 7 m from a street light pole;

(C) a minimum 2 m from side entry stormwater pits;

(D) a minimum 2.5 m from either side of a driveway;

(E) a minimum 1.05 m from back of kerb; and

(F) a minimum 0.5 m from a footpath.

Editor's note—the above requirements are based on cross sections outlined on SD-015 Verge Service Corridors and other longitudinal setbacks intended to mitigate risk of conflict between street trees and other infrastructure. Setbacks from all utility services should be confirmed with the relevant asset owner/service provider. For setbacks on the approach and departure sides of bus stops, refer to SC6.4.4.8 Standard drawings (SD-515 Standard bus stop urban location layout details Type 1 and 2). For setbacks from intersections, refer to Austroads minimum gap acceptance and sight distance criteria. For setbacks on the approach and departure sides of pedestrian crossings and other designated crossing points, refer to crossing sight distance (CSD) requirements in *Traffic and Road Use Management Manual – Pedestrian Cross Facility Guidelines* and *Prioritisation System User Guide*.

(d) In addition to the above, the following apply:

(i) When street trees are to be planted in medians or roundabouts, extended planting setbacks (from back of kerb or adjacent hard surface treatments) apply, being:

(A) for small trees or large shrubs (mature canopy between 5 – 10 m in height or large shrubs greater than 3.5 m in height), setback at a distance of 2 m or half the mature canopy diameter, whichever is greater;

(B) for medium trees (mature canopy between 10 – 15 m in height), setback at a distance of 4 m or half the mature canopy diameter, whichever is greater; and

(C) for large trees (mature canopy greater than 15 m in height), setback at a distance of 6 m or half the mature canopy diameter, whichever is greater.

(ii) Where setbacks cannot be achieved, appropriate mitigation measures such as root barrier must be included.

(iii) Where species proposed have a known invasive root system, increased setbacks are required and mitigation measures such as root barrier are to be provided as per arborist advice.

(iv) Street tress will not be planted in clear zones, except where:

(A) Tree species are considered frangible and the mature trunk diameter will not exceed 100 mm; or

(B) where non-frangible tree species will be located behind road safety barriers.

(v) When planted in the CBD, commercial zones, or where the planting area is completely surrounded by impervious surfaces, a minimum root development zone of 4 m^3 must be provided for each street tree. This may be achieved through the use of structural soils, root cell products, pervious pavements or a combination of these treatments.

(e) Street tree species selection should:

(i) be selected with consideration of suitability criteria, including:

(A) whether there is an existing dominant species in the street or suburb that contributes to the streetscape or suburb character;

(B) size of the available planting space as some tree species are better able to survive in restricted growing areas;

(C) location of the new tree, the species growing habit and branch structure;

(D) whether the new tree will be planted under power lines as only a limited number of species are suitable in this situation;

(E) tree species water requirements and drought resistance;

(F) suitability for prevailing soil type;

(G) pollution resistance;

(H) species with minimal fruit, leaf and limb drop;

(I) species with high shade potential;

(J) species with higher resilience to cyclone damage; and

(K) environmental and habitat value of particular species;

(ii) be appropriate for the available planting space, accounting for all setback, offset and clearance requirements (overhead, longitudinally and horizontally across the road cross section);

(iii) only consist of trees that will achieve canopy clearance heights applicable to the streetscape situations outlined in Table SC6.4.3.6.9 Canopy clearance heights and exhibit a 1.2 m clear trunk at the time of planting;

Table SC6.4.3.6.9 Canopy clearance heights

Streetscape situation	Minimum vertical clearance height (at maturity)
Standard pedestrian and car park environment	2.4m
Cyclist environment	2.7m
Main and arterial roads	5.4m
Other roads	4.6m
High clearance routes	5.9m
Very high clearance routes (with no alternative)	6.5m

Editor's note—above clearances are based on minimum vertical clearances detailed in Austroads *Guide to Road Design*, Part 3: Geometric Design.

(iv) in established areas, the street trees species are to be nominated by council;

(v) in new development areas, the street trees species are to be nominated by the developer and approved by council; and

(vi) include palms in select locations only where:

(A) palm species are self-cleaning; or

(B) sufficient area beneath the palms are provided to mitigate risks from falling palms fronds; and

(C) the plantings will not impose an unsustainable maintenance requirement.

(f) Selection of the street tree stock size for planting should consider:

(i) the planting location such as whether it is in a median, roundabout or on the footpath (e.g. more mature stock may be required in roundabout plantings where sight lines will be impeded by the foliage of a young tree);

(ii) the optimal size to achieve best establishment (e.g. smaller stock typically establish better, larger stock may be required to meet visibility requirements at time of planting); and

(iii) the size of the original tree where replacing a removed tree (e.g. in instances were a large,

significant tree is removed, a larger sized and/or increased quantity of replacement stock may be considered).

(13) Tree guards

(a) Tree guards may be used in order to temporarily, semi-permanently or permanently protect trees during establishment and ongoing growth.

(b) Trees guards should consist of proprietary available products and be installed as per manufacturer specifications.

(c) Where new trees are to be planted within known areas of high vandalism, more durable, vandal resistant, temporary tree guards may need to be selected and installed to reduce potential loss of new plantings during establishment.

(d) Where tree guards are to be provided semi-permanently or permanently and/or in conjunction with tree grates, tree guards are to be designed, constructed and installed as an integrated component of the tree grate system. In these instances, all requirements for tree grates detailed below should be considered, where applicable.

(14) Tree grates and surrounds

(a) Tree grates and tree surrounds are to be provided in accordance with the following;

(i) tree grates are to be designed, constructed and installed in accordance with AS 3996 – Access covers and grates;

(ii) tree grates and alternative tree surrounds are to be provided in order to increase the usable walking space, protect tree and root systems and provide a cost effective solution to reduce maintenance requirements;

(iii) installation of tree grates and tree surrounds is to be limited to high trafficable areas of streetscapes (as detailed in SC6.4.3.3 Footpath treatment policy), regional level parks and civic spaces, unless approved otherwise;

(iv) the tree grates or surrounds should be of an appropriate material, size and colour suitable for the location, tree type and available space. Tree grate or surround design must allow for the penetration of air and water to the soil, whilst minimising potential trip and slip hazards and rubbish trapping. Consideration should be given to the growing habit of the selected trees, trunk shape, "off centre" trunks and expected changes to trunk and root diameter, allowing for variation or future modification with tree growth;

(v) tree grates or surrounds must be installed flush with adjacent surfaces, with grate metal support frames and appropriate fixings to be installed at the time of construction, as required to meet the specified loading capacity;

(vi) tree plantings with grates or other surrounds must be supported by all other necessary elements including but not limited to, structural root cell, root barrier, drainage gravel, and perforated pipe;

(vii) permeable paving is considered to be a suitable tree surround option, particularly for installation around existing, mature trees;

(viii) where the sub-section SC6.4.3.3 Footpath treatment policy applies, permeable paving is considered to be an alternative option for tree grates. In these instances, the specified colours must be used, in accordance with the pavement treatment hierarchy as per SC6.4.3.3 Footpath treatment policy. Table SC6.4.3.6.2, Table SC6.4.3.6.3, Table SC6.4.3.6.4, Table SC6.4.3.6.5, Table SC6.4.3.6.6 identify the corresponding permeable paving colours against the Footpath treatment policy pavement hierarchy; or

(ix) where SC6.4.3.3 Footpath treatment policy does not apply, alternative colours may be proposed.

Table SC6.4.3.6.2 P1 - Central business district (CBD) - Central and P2 Central business district (CBD) - Fringe

P1 – Central Business District (CBD) – Central **P2 – Central Business District (CBD) – Fringe**	
Permeable Paving Tree Surrounds: P1 AND P2	
Colour: “Dove”	

Table SC6.4.3.6.3 P3 - Commercial and activity areas: Biscuit, P4 - Commercial and activity areas: Paperbark, P5c - The Strand North, and P5e - Gregory Street North

P3 – Commercial And Activity Areas: Biscuit **P4 – Commercial And Activity Areas: Paperbark** **P5c – The Strand North** **P5e – Gregory Street North**	
Permeable Paving Tree Surrounds: P3, P4, P5c AND P5e	
Colour: “Sunset”	

Table SC6.4.3.6.4 P5a - Palmer Street

P5 a – Palmer Street	
Permeable Paving Tree Surrounds: P5a	
Colour: “K-Hill Blue”	

Table SC6.4.3.6.5 - P5b - The Strand South and P6 - Industrial Areas

P5 b – The Strand south **P6 – industrial areas**	
PERMEABLE PAVING TREE SURROUNDS: P5b and P6	
COLOUR: “K-Hill Grey”	

Table SC6.4.3.6.6 P5c - Sir Leslie Thesis Drive

P5 c – Sir Leslie Thesis Drive	
Permeable Paving Tree Surrounds: P5c	
Colour: “Desert Rose”	

(15) Operational requirements

(a) Streetscape designs must seek to minimise the ongoing costs and operational maintenance requirements by:

(i) ensuring treatments are durable, weatherproof, UV resistant and of robust construction and finish to reduce repair or replacement frequency;

(ii) minimising the potential to create litter traps;

(iii) promoting resistance to damage, vandalism, unauthorised use and removal;

(iv) promoting easy cleaning and are fully accessible and responsive to maintenance activities including mechanical cleaning procedures;

(v) incorporating erosion and sediment control measures to reduce clearing out of drains;

(vi) minimising the need for herbicide applications and brush cutting around furniture such as guard rail posts or signs;

(vii) ensuring effective access for maintenance and to critical road infrastructure is integrated into the streetscape design to support easy, time efficient operations;

(viii) ensuring all turf areas are of the minimum specified width to facilitate safe and efficient operation of mowing vehicles and reduce the requirement for "on foot" maintenance;

(ix) complying with all clearance and setback requirements to ensure maintenance can be safely undertaken without a reliance on traffic control;

(x) considering the plant maintenance regimes needed to maintain all safety requirements. Ongoing pruning requirements and frequency to maintain all clearances (particularly within clear zones and sight triangle) should be minimised through appropriate planting and species selection. All costs associated with these maintenance regimes should be built into the whole of life design cost;

(xi) using planting design to progressively reduce the number of maintenance interventions required over time for planted areas. This should include reducing weed and vegetation management activities through improved plant layout and layering, densities and species selection that establish quickly to choke out competing weeds and require no pruning or shaping;

(xii) identifying any traffic control requirements associated with ongoing maintenance operations in early design stages. This should include any lane or road closures, detours, and the ongoing cost to implement any such requirements. All options to reduce identified traffic control requirements should be explored in order to reduce ongoing operational costs; and

(xiii) mitigating any potential for streetscape elements to cause significant damage to other road infrastructure such as driveways, kerb and channel, road pavement and utility services.

(b) In order to properly assess maintenance requirements associated with streetscape proposals, council may request the provision of a maintenance plan and approved traffic management plan as part of the development application, as per Section SC6.4.2 Development application guidelines.

SC6.4.3.6.32 Car parking plantings and shading

(1) Landscaping is to be provided to on-street and off-street car parking areas so as to improve the aesthetic and climatic properties associated with these sites. The prevailing climatic conditions in Townsville demand that shade is provided to car parking areas to improve the comfort and reduce the urban heat island effect from large areas of hard surface.

(2) Planting and shading options
Dependent on site and safety considerations, shading of car parks can be in the following manner:

(a) in single sided, angle or parallel bays – 1 tree per 3 car parks;

(b) in double sided – 1 tree per 6 car parks; and

(c) shade structures may be used in conjunction with low shrubs and low groundcovers internal to the parking area; and trees, low shrubs and ground covers on the periphery of the car park.

(3) Tree planting in car parks

(a) Trees planted within off-street car parking areas are provided with:

(i) a minimum surface planting area of 1.2 m^2, or are incorporated into continuous garden beds; and

(ii) planting pits for trees in car parks surrounded by hardstand are to provide a minimum of 4 m^3 for root zone development, at no greater depth than 1 m. The use of structural soils or root cell type products is highly recommended to achieve acceptable growth and form in shade trees.

(b) Trees planted within road reserve angle car parking areas are provided with garden bed areas between parking bays, which are to be kerbed and no less than 1.2 m wide internally.

(c) Trees must be planted in accordance with any approved standard drawings.

(d) Trees must be allowed to mature naturally and only pruned in accordance with AS4373.

Editor's note—currently, no standard drawings are formally adopted for tree planting. Refer also to SC.6.4.3.3 Footpath treatment policy.

(4) Landscape design and species selection

All car parking plantings must satisfy the following landscape design and species selection requirements:

(a) ground cover and shrubs should have a maximum height of 600 mm to preserve sight lines;

(b) tree canopies should achieve a minimum clearance above ground of 2.4 m above pedestrian and parking zones, or 4.6 m over vehicle movement zones;

(c) in public parking areas, trees are to be a species as nominated by council;

(d) in private parking areas, trees species are to be nominated by the developer and approved by council;

(e) trees and garden beds within car parking areas are protected by raised kerbs, wheel stops or bollards;

(f) all plantings in streetscapes and car parks are to comply with the specific design and construction requirements as detailed in sub-section SC6.4.6.26 Landscaping.

SC6.4.3.6.33 Green roofs, wall and vertical gardens

(1) Green roofs

Editor's note—due to the custom nature of green roofs, no design and construction standards are provided. Each site will be assessed on a case-by-case basis.

(2) Green walls, vertical gardens and façade greening

Editor's note—due to the custom nature of green walls, vertical gardens and façade greening, no design and construction standards are provided. Each site will be assessed on a case-by-case basis. Generally, planting features these types are to be within private property and should be under the maintenance regime of the owner. All engineering and hydraulic certification must be provided with any structure proposed.

SC6.4.3.6.34 Irrigation design and system requirements

(1) Introduction

Intent: Irrigation systems solely exist for the purpose of providing water to maintain the soil moisture content above the horticultural assets permanent wilting point and below the maximum field capacity. These conditions are required to maintain the health and growth of the horticultural assets.

(a) These guidelines, supported by SC6.4.6.27 Irrigation, set out the scope of work, workmanship standards and the responsibilities for the supply and installation of irrigation systems within private open space and public open space and streetscapes that will become a council asset on handover.

(b) In addition to this requirement council seeks to minimise water usage within all open space and reduce maintenance and operational costs associated with the council owned irrigation systems.

(c) Product and brand names for components in this sub-section and SC6.4.6.27 Irrigation are used to define a standard and quality acceptable to council, with particular emphasis on long term maintenance requirements. Components other than those specified may only be used if the components are of equal or better standard and quality of those specified and an authorised change has been approved by council.

(d) Where the developer/applicant has installed an unauthorized irrigation system not approved by Council, the developer/applicant will be required to remove such irrigation systems and rectify at their expense.

(e) Developer/applicants must aquaint themselves with Townsville's water restrictions of the time, and where required obtain written permission from Council to implement landscape treatments that require establishment water treatment. Such water treatment permissions shall be in line with Townsville's water restriction policy requirements for the establishment period.

(2) Irrigation design objectives:

(a) to ensure that irrigation systems are designed to the highest industry standards with the goal of maximising the efficient usage of water;

(b) to ensure that irrigation systems and components are installed in accordance with the relevant industry standards and tradesman like workmanship; and

(c) to ensure that the irrigation systems and components installed are of a quality and standard acceptable to council, with regard to the life of the system, the ongoing ease of maintenance and operational costs of the system and its components.

(3) General requirements

(a) All irrigation must be of a high standard, being designed, constructed and installed in accordance with:

(i) the provisions within the planning scheme, planning scheme policies and this sub section of the Development manual planning scheme policy;

(ii) manufacturer specifications;

(iii) all applicable Australian Standards and legislation;

(iv) all applicable council local laws; and

(v) council's approved standard drawings.

(b) All irrigation systems are to be:

(i) designed to achieve an even and efficient supply of water to the nominated Hydro-Zone areas;

(ii) designed with consideration of local conditions such as topography, prevailing winds, micro-climate, rainfall volumes and seasonal dry and wet periods;

(iii) constructed using quality materials and components;

(iv) automated to allow for efficient water usage;

(v) programmed to operate in accordance with any council water restrictions;

(vi) designed to operate efficiently and effectively based on the water supply pressure and flow volume available to the system;

(vii) The minimum industry accepted standard by TCC for turf sprinkler uniform cover is a Distribution Uniformity (DU) of 75% cover; and

(viii) The minimum industry accepted standard by TCC for sportsfield turf sprinkler uniform cover is a Distribution Uniformity (DU) of 100% cover for all of the sport playing surface with a 85% cover of the surrounding safety zone of the playing field surface.

(c) All irrigation in private open space that is to be:

(i) installed and operated by a **private entity**, is **not** required to comply with the specific design and construction standards, however such systems that are connected to the reticulated water network is required to comply with Townsville's water restrictions of the time.

(ii) installed and/or operated by council, is to be designed and constructed as per requirements detailed in this sub section and SC6.4.6.27 Irrigation.

(d) All irrigation systems in public open space and road landscaping are to:

(i) be designed by qualified professionals, being a certified irrigation agronomist or a certified irrigation designer;

(ii) constructed using quality materials and components to ensure a robust, reliable, and long asset life;

(iii) be designed to minimise life cycle costs through reduced operational and maintenance requirements;

(iv) be designed and apply volume that should not cause foreseeable damage to the road structure or surface; and

(v) be designed and constructed as per requirements detailed in this sub–section and SC6.4.6.27 Irrigation.

(e) All irrigation systems in streetscapes and car parking areas are to:

(i) in a "main street" or "special character" situation where council owns and operates an irrigation system or has agreed to accept irrigation assets, the irrigation is to be provided in accordance

with SC6.4.6.27 Irrigation, and will be subject to the acceptance of works procedure as per Section SC6.4.7 Acceptance of completed works; and

(ii) in all other locations where irrigated turf or plantings are required as a condition of development, the irrigation system is to be connected to the adjacent private development.

(f) Irrigation systems in public open space and streetscapes should be designed in conjunction with all landscape elements to ensure that:

(i) landscape design and plant selection ensures the required level of irrigation to maintain the function and longevity of landscape is analogous with the assigned irrigation profile, as detailed in SC6.4.3.6 Attachment C Irrigation Profile Level Hierarchy and SC6.4.3.6 Attachment D Irrigation Profile Level Matrix;

(ii) landscape design and plant selection facilitates hydro-zoning;

(iii) landscape features are designed to maximise water infiltration through use of appropriate landforms, soil types and mulches;

(iv) landscape features are designed and constructed to ensure ease of irrigation coverage in the short and long term; and

(v) landscape features are designed to contribute to an integrated water management system.

(4) Irrigation types requirements

(a) All turf areas shall be irrigated with pop-up sprinklers or subsurface drip irrigation with the following specific requirements:

(i) all turf areas in roundabouts and median strips that border roadways shall be irrigated by drip irrigation;

(ii) all turf areas within 5 m of a roadway and within 50 m of the centre of an intersection shall be drip irrigated; and

(iii) where a site specific risk analysis recommending either method has been provided and accepted by council.

(b) All garden areas shall to be irrigated with subsurface drip irrigation, except for areas containing plants or trees with vigorous root systems such as palms or lilies which shall be irrigated by pop-up sprinklers.

(5) Agronomic requirements

For all irrigation systems the approved hours of operation shall be between 10.00pm and 5.00am, the operation of such irrigation systems shall also comply with Townsville's water restrictions of the time.

(a) For pop-up sprinklers the total time taken to deliver 7 mm of equivalent precipitation when each station is operated individually and consecutively shall not exceed a 7 hour period for all stations on a given system. Variations to this requirement may apply for stations operated simultaneously.

(b) For drip irrigation the total time taken to deliver 7 mm of equivalent precipitation when each station is operated individually and consecutively shall not exceed a 7 hour period for all stations on a given system. Variations to this requirement may apply for stations operated simultaneously.

(c) The irrigation application rate shall not exceed the infiltration rate of the soil.

(d) The operation of irrigation systems must avoid operating in strong winds, excessive or poor irrigation mains pressure, poor irrigation design or lack of maintenance, which all contribute to system delivery inefficiency.

(e) All irrigation systems that are to become Council assets to maintain must be fully commissioned and operating efficiently in accordance with the approved irrigation design plans for a minimum of 3 months prior to acceptance "Off Maintenance".

(6) Environmental requirements

The system shall not have excessive runoff which causes erosion or pollution of surrounding native areas and/or storm water drains.

(7) Automation requirements

(a) The irrigation controller shall be chosen from the units outlined in Table SC6.4.3.6.10.

Table SC6.4.3.6.10 Controller Selection list

Controller Name	Power Type / Source	Valve Capacity
AC Irrinet M Slave 12 - 24	AC / 240V Mains	12 to 24
AC Irrinet M Slave 36 - 48	AC / 240V Mains	36 to 48
AC Irrinet M 12 - 24	AC / 240V Mains	12 to 24
AC Irrinet M 36 - 48	AC / 240V Mains	36 to 48
AC Irrinet ACE 24 - 48	AC / 240V Mains	24 to 48
XR 1 - 4	DC / 6V Solar	1 to 4

(b) A maximum of three stations may be operated simultaneously (by programming only) given the follow conditions:

(i) irrigation type and precipitation rate of the stations to be operated simultaneously shall be the same;

(ii) the soil type, vegetation and topography of the stations to be operated simultaneously shall be the same; and

(iii) all stations to be operated simultaneously shall be able to supply the manufacturer's recommended pressure.

(c) Only one valve per controller output is acceptable.

(8) Separation of irrigation zones

(a) Irrigation zones shall be classified in the following vegetation types:

(i) turf grass;

(ii) garden bed; and

(iii) native vegetation or revegetation plantings.

(b) A single irrigation valve shall water no more than one irrigation zone.

(9) Safety requirements

The system shall not have runoff onto roadways, footpaths or other pedestrian areas to such an extent that it may result in a hazard to traffic and/or pedestrians.

(10) Temporary irrigation design

Temporary irrigation is exempt from the technical design and installation conditions outlined in this document provided it meets all other legislated requirements.

(a) All temporary irrigation installed in the public realm must be removed and terminated in accordance with council specifications prior to the area being accepted "off maintenance". All terminations and disconnections of temporary irrigation must be inspected by a council officer prior to backfilling.

(11) Existing Council Irrigation Assets

(a) Council's Irrigation Operations Unit must be notified of any disruptions to council owned irrigation assets prior to works commencing on these assets;

(b) Works in areas containing existing council irrigation assets are required to have plans for the deconstruction and isolation of the existing irrigation to ensure the system is not unnecessarily damaged and account for the ongoing watering requirements of the soft landscaping serviced by that irrigation;

(c) All existing council irrigation affected by development works must be reinstated to standards current at the time of the works;

(d) Any extensions to existing mainline require the installation of an isolation valve;

(e) Council shall charge costs for water usage based on agreement with the developer. Options include the installation of a sub-metering device or use of Irrinet flow data.

(f) Upon activation of any additions to council owned irrigation, revised flow data must be provided to council's Irrigation Operations Unit.

Editor's note—For further information on the construction of all irrigation systems, refer to the detailed landscape specification standards as provided in SC6.4.6 Construction Standards – in particular SC6.4.6 26 Landscape Construction and SC6.4.6.27 Irrigation

SC6.4.3.6.35 Water features and water play areas

(1) Water features and water play areas will only be permitted in limited circumstances, at specific locations, and where all relevant considerations are reasonably satisfied, and will be considered on a case-by-case basis.

(2) Where the proposed water features and water play areas are associated with public open space, council owned land, or will involve potential future council assets, the infrastructure may only be permitted at approved locations and in accordance with council's Public Open Space Embellishment Framework, as detailed in Table SC6.4.3.6.1. Approval from the relevant council asset owner/s will also be required.

(3) In order to properly assess any such proposals, council may request the provision of a maintenance plan and a life-cycle costing as part of the development application, as per SC6.4.2 Development application guidelines.

(4) Where water features are proposed as a development entry statement, applications may only be approved where the water feature will be within private property and the developer will remain, for the life of the asset, solely responsible for all aspects relating to the water feature (including ongoing maintenance and water costs).

(5) All water features and water play areas must be designed and installed to comply with all relevant Australian Standards.

Editor's note—due to the place-specific, custom nature of water features and water play areas, no further specifications are currently developed. Proposals will be considered on a case-by-case basis in accordance with necessary requirements defined by all applicable engineering, electrical, drainage, swimming pool and water safety standards, legislation, local laws and council's overarching design and management principles. Engagement and approval from other stakeholders/authorities may additionally be required as part of any development proposal.

SC6.4.3.6 Attachment A: Preferred plant species list

CATEGORY	BOTANICAL NAME1	COMMON NAME	STREET TREES 3m wide desirable planting width (1m min)2	STREET TREES- 3-6 m desirable planting with (2m min)2	STREET TREES for ≥ 6m desirable palnting width (5m min)2	STREET TREES Suitable for planting under powerlines2	STREET TREES Suitable for avenue plantings2	TREES Suitable as features or specimen trees in parks & open space3	Suitable for COASTAL FOREHSORE AREAS	Suitable in and near NATURAL AREAS4	Suitable for Council PARKS AND OPEN SPACE (greater than 5m of space required for trees)3	Suitable for COMMERCIAL AND DOMESTIC PREMISES where space permits5
	Blank = does not fit criteria or	N.A.• = fits criteria.	TREES (BY LOCATION SUITABILITY)						ALL VEGETATION (BY 'SETTING' SUITABILITY)			
Large Trees over 10m (Native)												
	Acacia auriculiformis	Black Wattle		•	•			•		•	•	•
	Acacia crassicarpa	Beach Wattle							•	•	•	•
	Acacia mangium	Hickory Wattle						•		•	•	
	Acacia melanoxylon	Blackwood			•			•		•	•	•
	Adenanthera pavonina	Red Bead Tree		•	•			•		•	•	•
	Agathis robusta	Kauri Pine			•			•		•	•	•
	Aidia racemosa	Archer Cherry								•	•	•
	Albizia procera	Forest Siris			•					•	•	•
	Allocasuarina torulosa	Forest Oak						•		•	•	
	Alstonia actinophylla	Cape Milkwood						•		•	•	
	Alstonia scholaris	Milky Pine			•			•		•	•	
	Araucaria bidwillii	Bunya Pine			•			•		•	•	
	Araucaria cunninghamii	Hoop Pine			•		•	•		•	•	•

Bombax ceiba	Native Kapok Tree			•		•	•			•	
Brachychiton acerifolius	Flame Tree	•	•			•	•		•	•	•
Calophyllum inophyllum	Beauty Leaf			•			•	•	•	•	
Cananga odorata	Ylang Ylang Tree						•		•	•	
Canarium australasicum	Mango Bark		•	•			•	•	•	•	
Canarium australianum	Melville Island White Beech		•	•			•	•	•	•	•
Castanospermum australe	Black Bean			•			•		•	•	•
Casuarina cunninghamiana	River she-oak						•		•	•	
Corymbia citriodora (syn. Eucalyptus citriodora)	Lemon-scented Gum			•			•		•	•	
Corymbia clarksoniana (syn.Eucalyptus clarksoniana)	Clarkson's Bloodwood						•		•	•	
Corymbia erythrophloia (syn. Eucalyptus erythrophloia)	Red-barked Bloodwood						•		•		
Corymbia ptychocarpa (syn. Eucalyptus ptychocarpa)	Swamp Bloodwood						•			•	
Corymbia setosa (syn. Eucalyptus setosa)	Rough Leaf Bloodwood						•		•	•	
Corymbia tessellaris (syn. Eucalyptus tessellaris)	Moreton Bay Ash			•			•	•	•	•	•
Eleocarpus angusitfolius (syn E. grandis)	Blue Quandong			•			•	•	•	•	
Eucalyptus camaldulensis	River Red Gum						•			•	
Eucalyptus crebra	Narrow leafed Ironbark						•		•	•	
Eucalyptus drepanophylla	QLD Grey Ironbark						•		•	•	
Eucalyptus miniata	Darwin Woollybutt		•	•			•			•	•
Eucalyptus pellita	Red Mahogany		•	•			•		•	•	
Eucalyptus platyphylla	Poplar Gum						•		•	•	
Eucalyptus raveretiana	Black Ironbox						•		•	•	
Eucalyptus similis	Inland Yellow Jacket		•	•			•		•	•	
Eucalyptus tereticornis	Blue Gum						•		•	•	
Euroschinus falcatus	Ribbon Wood		•	•					•	•	
Ficus benjamina	Weeping Fig			•			•			•	
Ficus microcarpa var hillii	Hills Weeping Fig			•			•		•	•	
Ficus racemosa	Cluster Fig						•		•	•	
Flindersia brayleyana	Queensland Maple		•	•			•			•	
Ganophyllum falcatum	Scaly Bark Ash		•	•			•	•	•	•	
Gossia bidwillii (syn. Austromyrtus bidwillii)	Python Tree		•	•						•	•
Grevillea hilliana	White Silky Oak		•	•			•		•	•	
Lophostemon confertus	Brush box			•			•		•	•	
Lophostemon grandiflorus	Northern Swamp Mahogany		•	•			•		•	•	•
Melaleuca dealbata	Cloudy or Silver-leaved Paperbark		•	•			•		•	•	•
Melaleuca fluviatilis	Weeping Paperbark		•	•		•	•		•	•	
Melaleuca leucadendra (fine leaf form included)	Paperbark		•	•			•		•	•	•
Melaleuca quinquenervia	Broad leaved paperbark		•	•			•		•	•	•

	Nauclea orientalis	Leichhardt Tree			•			•		•	•	•
	Peltophorum pterocarpum (Nth Aust. Form)	Yellow Flame Tree			•			•			•	•
	Pittosporum ferrugineum	Rusty Pittosporum			•			•	•	•	•	•
	Pleiogynium timorense	Burdekin 87vPlum			•		•	•	•	•	•	•
	Rapanea variabillis	Muttonwood		•	•		•	•			•	•
	Syzygium forte	White Apple		•	•			•			•	•
	Syzygium fortes subsp. Potamophilum	Flaky Barked Satinash		•	•		•	•			•	•
	Syzygium francisii	Francis's Water Gum		•	•			•			•	
	Syzygium hemilamprum (Syn. Acmena hemilampra)	Broad-leaved Lillpilly	•	•				•		•	•	•
	Sygyzium luehmannii	Small leaved Lillypilly		•	•			•		•	•	•
	Syzygium tierneyanum	River Cherry			•			•		•	•	•
	Terminalia arenicola	Damson Plum			•			•		•	•	•
	Terminalia catappa	Sea Almond			•			•	•	•	•	
	Terminalia complanata	Cape York Terminalia			•			•			•	
	Terminalia melanocarpa	Sea Almond			•			•		•	•	
	Terminalia porphyrocarpa	Sea Almond		•	•			•		•	•	
	Terminalia sericocarpa = T. microcarpa	Damson Plum			•			•		•	•	
	Timonius timon	Tim Tam Tree		•	•			•		•	•	•
	Toona ciliata (syn. T. australis)	Red Cedar						•			•	
	Xanthostemon chrysanthus	Golden Penda	•	•	•			•		•	•	•
Large Trees over 10m (Exotic)												
	Caesalpinia ferrea	Leopard Tree		•	•			•			•	•
	Cassia javanica	Pink Cassia		•	•		•	•			•	
	Ficus benghalensis	Banyan Fig						•			•	
	Khaya senegalensis	African Mahogany						•			•	
	Mangifera indica	Mango		•	•			•			•	•
	Mesua ferrea	Ceylon Ironwood		•	•		•	•			•	•
	Pterocarpus indicus	Rosewood			•			•			•	
	Pterocarpus indicus 'Pendula'	Weeping Rosewood		•	•			•			•	•
	Handroanthus impetiginosus (syn.Tabebuia palmerii)	Pink Trumpet Tree		•	•			•			•	•
	Samanea saman (syn. Albizia saman)	Rain Tree						•			•	
	Swietenia mahoganii	Mahogany						•			•	•
	Tamarindus indica	Tamarind		•	•			•			•	•
	Tectona grandis	Teak						•			•	
Trees 5-10 m (Native)												
	Acacia flavescens	Yellow Wattle, Toothed Wattle							•	•	•	•
	Acmena smithii = Syzygium smithii	Lillypilly		•	•						•	•
	Alphitonia excelsa	Red Ash		•	•				•	•	•	•
	Antidesma bunius	Herbert River Cherry		•	•					•	•	•
	Arytera divaricata	Rose Tamarind	•	•	•		•			•	•	•
	Atalaya hemiglauca	Whitewood		•						•	•	•
	Atractocarpus fitzalanii (Syn. Randia fitzalanii)	Brown Gardenia		•						•	•	•
	Backhousia citriodora	Lemon Scented Myrtle			•					•	•	•
	Barringtonia acutangula	Freshwater Mangrove	•	•	•			•	•	•	•	•
	Barringtonia asiatica	Fish Killer Tree		•	•			•	•	•	•	•

Barringtonia calyptrata	Cassowary Pine	•	•	•		•	•	•	•	•	•
Barringtonia racemosa	Fish Poison Tree	•	•	•			•	•		•	•
Brachychiton australis	Broad-leaved Bottle Tree		•	•			•		•	•	•
Brachychiton discolor	White Kurrajong	•	•	•			•			•	•
Brachychiton rupestris	Bottle Tree		•	•		•	•			•	•
Buchanania arborescens	Little Gooseberry Tree					•	•			•	•
Buckinghamia celsissima (NQ Form)	Ivory Curl Tree	•	•	•		•	•		•	•	•
Bursaria spinosa	Prickly Box, Native Blackthorn		•	•	•			•	•	•	•
Carallia brachiata	Corkwood	•	•	•			•	•	•	•	•
Cassia brewsteri	Brewster's Cassia	•	•	•			•		•	•	•
Cassia queenslandica	Queensland Cassia	•	•	•			•			•	•
Cassia sp. (Paluma Range)	Paluma Range Cassia	•	•	•			•		•	•	•
Casuarina equisetifolia	Horsetail She-oak, Beach Casuarina			•				•	•	•	
Chionanthus ramiflorus	Native Olive	•	•	•					•	•	•
Cochlospermum gillivraei	Native Kapok							•	•	•	•
Cordia dichotoma	Glue Berry			•				•			
Cordia subcordata	Sea Trumpet	•	•	•			•	•		•	•
Corymbia peltata (syn. Eucalyptus peltata)	Rusty Jacket		•	•				•	•	•	•
Cupaniopsis anacardioides	Tuckeroo	•	•	•	•	•	•	•	•	•	•
Davidsonia pruriens	Davidson's Plum			•				•	•	•	•
Deplanchea tetraphylla	Golden Bouquet Tree		•	•			•		•	•	
Dillenia alata	Red Beech		•	•			•	•	•	•	•
Elaeocarpus eumundi	Eumundi Quandong	•	•	•			•		•	•	•
Eleocarpus reticulatus	Blueberry Ash		•	•			•			•	
Erythrina vespertilio	Bat Wing Coral Tree						•	•	•	•	
Eucalyptus phoenicea	Scarlet Gum		•	•						•	•
Eucalyptus pruinosa	Silver Box		•	•			•		•	•	•
Eucalyptus shirleyi	Shirley's Silver Leaved Ironbark			•					•	•	•
Ficus platypoda	Rock-cracker Fig			•					•	•	•
Geijera salicifolia	Scrub Wilga		•				•		•	•	•
Glochidion philippicum	Daintree Cheese Tree							•	•	•	•
Grevillea baileyana	Findlay's Silky Oak	•	•			•			•	•	•
Grevillea parallela	Beefwood								•	•	•
Grevillea pteridifolia	Golden Grevillea								•	•	•
Grevillea striata	Beefwood								•	•	•
Harpullia hillii	Tulipwood		•	•					•	•	•
Harpullia pendula (NQ Form)	Tulipwood/ Tulip Lancewood	•	•	•		•	•		•	•	•
Hibiscus tiliaceus	Cottonwood							•	•	•	•
Hymenosporum flavum	Native Frangipani	•	•	•					•	•	•
Lysiphyllum hookeri = Bauhinia hookeri	Native Bauhinia	•	•		•	•	•		•	•	•
Macaranga tanarius	Heart Leaf								•	•	•
Mallotus phillipensis	Red Kamala		•	•					•	•	•
Maniltoa browneoides	Handkerchief Tree		•	•			•			•	•
Maniltoa lenticellata	Silk Handkerchief Tree		•	•			•			•	•

	Melaleuca bracteata	Black Tea-tree	•	•		•	•			•	•	•
	Melaleuca linariifolia	Narrow-leaved Paperwork	•	•		•	•				•	•
	Melaleuca nervosa	Paperbark								•	•	•
	Melaleuca 'Revolution Green' & M. 'Revolution Gold'	Revolution Green & Revolution Gold	•			•						
	Melaleuca viminalis & cultivars (syn. Callistemon viminalis)	Bottlebrush	•	•		•				•	•	
	Melaleuca viridiflora	Broad-leaved Paperbark				•				•	•	•
	Melicope elleryana	Corkwood		•	•						•	•
	Melicope rubra (syn. Evodiella muelleri)	Little Evodia	•	•						•	•	•
	Micromelum minutum	Lime Berry								•	•	•
	Millettia pinnata (syn. Pongamia pinnata)	Pongamia or Indian Beech		•	•			•		•	•	•
	Mimusops elengi	Red Coondoo	•	•	•	•	•	•	•	•	•	•
	Mimusops elengi 'Street Elegance'	Variegated Mimusops	•	•	•		•				•	•
	Morinda citrifolia	Cheese Fruit							•	•	•	•
	Pararchidendron pruinosum	Snow Wood	•	•	•					•	•	•
	Petalostigma pubescens	Quinine Bush								•	•	•
	Pipturus argenteus	Native White Mulberry								•	•	•
	Planchonia careya	Cocky Apple							•	•	•	•
	Premna serratifolia	Creek Premna							•	•	•	•
	Scolopia braunii	Brown Birch	•	•	•	•	•	•		•	•	•
	Sterculia quadrifida	Peanut Tree	•	•	•		•			•	•	•
	Syzygium angophoroides	Yarrabah Satinash		•	•					•	•	•
	Syzygium australe & cultivars	Lillypilly	•	•						•	•	•
	Syzygium cormiflorum	Bumpy Satinash			•			•		•	•	•
	Syzygium johnsonii	Rose Satinash		•	•					•	•	•
	Syzygium oleosum	Blue Lillypilly		•	•					•	•	•
	Terminalia muelleri	Mueller's Damson			•			•		•	•	•
	Waterhousea floribunda = Syzygium floribundum	Weeping Lillypilly	•	•	•			•			•	•
	Waterhousea unipunctata = Syztgium unipunctatum	Roly Poly Satinash	•	•	•					•	•	•
	Vachellia bidwillii (syn. Acacia bidwillii)	Corkwood								•	•	•
Trees 5-10m (Exotic)												
	Cassia 'Rainbow Shower'	Rainbow Shower Cassia		•	•			•			•	•
	Delonix regia	Poinciana, Flamboyant Tree		•	•			•			•	•
	Fraxinus griffithii	Flowering Ash	•	•	•	•	•				•	•
	Kigelia pinnata	Sausage Tree						•			•	•
	Lagerstroemia speciosa	Queens Crepe Myrtle, Pride of India		•	•		•	•				
	Magnolia champaca (syn. Michelia champaca)	Michelia	•	•	•	•	•	•			•	•
	Plumeria obtusa and cultivars	Evergreen Frangipani	•	•	•	•	•	•			•	•
	Plumeria rubra and cultivars	Frangipani	•	•	•	•	•	•			•	•
	Polyalthia longifolia "Pendula'	Indian Mast Tree	•	•	•		•	•			•	•
	Schotia brachypetala	Drunken Parrot Tree	•	•	•		•	•			•	•

	Tabebuia aurea syn. T. argentea	Silver Trumpet Tree	•	•	•	•	•	•			•	
	Tabebuia heterophylla (syn. T. pallida [in part))	Pale Pink Trumpet Tree	•	•	•		•	•			•	•
	Tabebuia pallida	White Trumpet Tree	•	•	•		•	•			•	•
	Various tropical fruit, nut and spice trees	tropical fruit, nut and spice trees										•
Small Trees & Shrubs to 5m (Native)												
	Acacia leptostachya	Townsville Wattle								•	•	•
	Acacia jackesiana	Jackes Wattle								•	•	•
	Acacia podalyriifolia	Mt Morgan Wattle								•	•	•
	Acacia simsii	Sims Wattle								•	•	•
	Acmena smithii var. minor = Syzygium smithii	Lillypilly	•			•	•				•	•
	Acmena smithii 'Hot Flush'	Lillypilly - Hot Flush	•			•	•				•	•
	Antidesma parvifolium	Currant Bush								•	•	•
	Babingtonia spp. = Baeckea spp.	Baeckea									•	•
	Babingtonia virgata (Complex) syn. Baeckea virgata & cultivars	Twiggy Baeckea									•	•
	Banksia robur	Swamp Banskia								•	•	•
	Brachychiton bidwillii	Little Kurrajong	•	•		•	•				•	•
	Breynia oblongifolia (& 'Iron Range')	Coffee Bush (& Bronze Coffee Bush)								•	(•)	(•)
	Bursaria incana	Prickly Pine								•	•	•
	Bursaria tenuifolia	Native Mock Orange	•	•	•	•				•	•	•
	Clerodendrum floribundum	Lolly Bush	•			•		•	•	•	•	•
	Clerodendrum inerme	Scrambling Clerodendrum							•	•		
	Cleistanthus apodus	Weeping Cleistanthus	•	•	•						•	•
	Cleistanthus hylandii	Bernie's Cleistanthus		•		•	•				•	•
	Dodonaea lanceolata	Hop Bush								•	•	•
	Dodonaea viscosa	Sticky Hop Bush								•	•	•
	Gossia floribunda (syn. Austromyrtus floribunda)	Cape Ironwood	•			•					•	•
	Graptophyllum excelsum	Scarlet Fuchsia								•	•	
	Graptophyllum ilicifolium	Holly Leaved Fuchsia								•	•	
	Hibiscus divaricatus	Pink Native Hibiscus								•		•
	Hibiscus tiliaceus 'Rubra'	Bronze Cottonwood									•	•
	Jasminum simplicifolium subsp. australiense	Stiff Jasmine							•	•		•
	Larsenaikia ochreata	Native Gardenia								•	•	•
	Leptospermum madidum ssp. madidum syn. L. longifolium (in part)	Northern Weeping Tea Tree			•						•	•
	Leptospermum parvifolium syn. L. longifolium (in part)	Weeping Tea Tree		•	•						•	•
	Leptospermum petersonii	Lemon-scented Tea Tree									•	•
	Leptospermum polygalifolium syn. L. flavescens and cultivars	Yellow Tea Tree								•	•	•
	Leptospermum Cultivars	Tea Tree									•	•
	Leea indica	Bandicoot Berry								•	•	•

	Melaleuca linariifolia cultivars 'Purpurea', 'Claret Tops' and similar	Claret Tops									•	•
	Melaleuca sp. (Mount Stuart) (syn. Callistemon sp. (Mount Stuart))	Mount Stuart Bottlebrush								•	•	•
	Melaleuca thymifolia & cultivars	Thyme Honey Myrtle									•	•
	Melaleuca viminalis (Cultivars to 5m) (syn. Callistemon viminalis)	Bottlebrush	•	•	•	•	•			•	•	•
	Melastoma affine	Blue Tongue								•		•
	Melicope rubra	Little Evodia								•	•	•
	Murraya ovatifoliolata	Native Murraya	•			•				•	•	•
	Neofabrica myrtifolia	Yellow Tea Tree	•	•		•				•	•	•
	Phyllanthus cuscutiflorus & cultivars	Pink Phyllanthus	•	•		•		•			•	•
	Phyllanthus lamprophyllus	Phyllanthus								•	•	•
	Scaevola taccada	Cardwell Cabbage						•	•	•		•
	Sophora tomentosa	Silverbush						•	•	•		•
	Syzygium australe 'Aussie Southern'	Lillypilly	•	•		•	•				•	•
	Syzygium 'Elite'	Lillypilly	•	•		•	•				•	•
	Syzygium australe (Cultivars to 5m)	Lillypilly	•	•		•	•				•	•
	Thespesia populneoides	Beach Hibiscus						•	•			
	Xanthostemon 'Daintree Gem'	Varigated Penda	•	•	•	•	•	•			•	•
	Xanthostemon verticulatus	Cream Dancer									•	•
	Vitex trifolia	Native Lavender						•	•	•	•	•
Shrubs to 5m (Exotic)												
	Abelia spp.	Abelia									•	•
	Acalypha spp. and cultivars	Acalypha									•	•
	Barleria obtusa and cultivars	Purple Dazzler and Purple Gem									•	•
	Brunfelsia australis (syn. B. latifolia & B. bonodorata)	Yesterday, Today and Tomorrow									•	•
	Calliandra spp and cultivars	Pom pom Bush									•	•
	Codiaeum variegatum	Croton									•	•
	Duranta repens and cultivars	Duranta										•
	Eugenia uniflora	Surinam Cherry									•	•
	Euphorbia leucocephala	Snow Flake									•	•
	Euphorbia pulcherrima	Poinsettia									•	•
	Gardenia spp. and cultivars	Gardenia									•	•
	Graptophyllum pictum and cultivars	Caricature Plant									•	•
	Hibiscus spp and cultivars	Hibiscus									•	•
	Ixora spp. and cultivars	Ixora									•	•
	Mussaenda spp. & cultivars	Bangkok Rose									•	•
	Polyscias spp and cultivars	Ming Aralias									•	•
	Raphiolepis 'Apple Blossum' and similar	Indian Hawthorn									•	•
	Russelia equisetiformis and cultivars	Coral Plant									•	•
	Various tropical fruit, nut, spice, condiments and herbs	Tropical fruit, nut, spice,condiment & herbs										•

Palms, palm like and tropical foliage (Native)												
	Archontophoenix alexandrae	Alexandra Palm								•	•	•
	Archontophoenix cunninghamiana	Bangalow Palm									•	•
	Asplenium australasicum	Birds Nest Fern								•	•	•
	Asplenium nidus	Birds Nest Fern								•	•	•
	Alpinia caerulea	Native Ginger								•	•	•
	Alpinia modesta	Narrow-leaf Ginger								•	•	•
	Bowenia serrulata	Byfield Fern									•	•
	Bowenia spectabilis	Zamia Fern								•	•	•
	Carpentaria acuminata	Carpentaria Palm							•		•	•
	Cordyline cannifolia	Palm Lillies									•	•
	Curcuma australasica	Native Turmeric, Cape York Lily									•	•
	Cyathea cooperi	Tree Fern								•	•	•
	Cyathea rebeccae	Rebecca's Tree Fern								•	•	•
	Cycas media subsp. media	Australian Nut Palm								•	•	•
	Cycas spp	Cycad									•	•
	Lepidozamia hopei	Hopes Lepidozamia									•	•
	Lepidozamia peroffskyana	Peroffskys' Lepidozamia									•	•
	Licuala ramsayi	Australian Fan Palm								•	•	•
	Livistona australis	Cabbage Palm								•	•	•
	Livistona decora [syn. L. decipiens]	Weeping Cabbage Palm						•	•	•	•	•
	Livistona drudei	Fan Palm						•	•	•	•	•
	Livistona lanuginosa	Cape River Fan Palm						•		•	•	•
	Livistonia muelleri	Dwarf Fan Palm									•	•
	Macrozamia spp	Cycad									•	•
	Pandanus cookii [syn. P. whitei]	Screw Pine						•	•	•	•	•
	Pandanus spp	Pandanus							•		•	•
	Ptychosperma elegans	Solitare Palm								•	•	•
	Ptychosperma macarthurii	Macarthur Palm									•	•
	Wodyetia bifurcata	Foxtail Palm						•			•	•
	Xanthorrhoea johnsonii	Grass Tree								•	•	•
	Xanthorrhoea glauca	Grey Grass Tree									•	•
Palms, palm like and tropical foliage (Exotic)												
	Alpinia spp. and cultivars	Shell Ginger									•	•
	Alpinia galangal	Galangal									•	•
	Ananas comosus 'Variegatus'	Variegated Pineapple									•	•
	Beaucarnea recurvata	Ponytail Palm									•	•
	Bismarckia nobilis	Bismarckia Palm									•	•
	Calathea spp and cultivars	Calathea									•	•
	Chamaedorea spp	Bamboo Palms									•	•
	Codiaeum variegatum cultivars and forms	Garden Croton									•	•
	Cordyline fruticosa and cultivars	Ti-Plant									•	•
	Crinum spp. & cultivars	Crinum Lily									•	•
	Ctenanthe spp and cultivars										•	•
	Curcuma spp and cultivars	Ornamental Tumeric									•	•
	Cyathea spp and cultivars	Tree Ferns									•	•
	Cyrtostachys lakka	Lipstick Palm, Sealing Wax Palm						•			•	•
	Cycas revoluta	Cycad									•	•
	Dictyosperma album	Princess Palm						•	•		•	•
	Dypsis lutescens	Golden Cane Palm									•	•

	Dypsis spp	Palms									•	•
	Dracaena spp and cultivars	Dragon Tree						•			•	•
	Furcraea foetida and cultivars	Mauritius Hemp									•	•
	Heliconia spp and cultivars	Crab Flowers									•	•
	Hippeastrum spp and cultivars	Amaryllis									•	•
	Hyophorbe lagenicaulis	Bottle Palm									•	•
	Hyophorbe verschaffelti	Spindle Palm									•	•
	Licuala grandis	Ruffled Fan Palm									•	•
	Maranta spp and cultivars	Prayer Plants									•	•
	Neodypsis decaryii	Triangle Palm									•	•
	Pandanus spp	Screw Pines						•	•		•	•
	Philodendron spp and cultivars	Philodendron									•	•
	Phoenix roebelenii	Dwarf Date Palm									•	•
	Pitcairnia spp and cultivars	Stappy-leaved Bromeliads									•	•
	Pleomeles spp and cultivars	Lance Dracaena						•			•	•
	Pritchardia pacifica	Fijian Fan Palm							•		•	•
	Roystonea regia	Royal Palm									•	•
	Rhapsis excelsa and cultivars	Lady Palm									•	•
	Spathiphyllum spp and cultivars	Peace Lilly									•	•
	Strelitzia spp and cultivars	Bird of Paradise									•	•
	Veitchia merrelii	Christmas Palm									•	•
	Yucca spp. and cultivars	Yucca						•			•	•
	Verscaffeltia splendida	Stilt Palm									•	•
	Zamia furfuracea	Cardboard Plant							•		•	•
	Zamiaoculcas zamifolia	Zanzibar Gem or ZeeZee Plant									•	•
	Zingiber spp.	Ginger									•	•
Groundcover, border and tufted plants (Native)												
	Abelmoschus moschatus ssp.tuberosus	Native Rosella								•	•	•
	Acmena smithii 'Hedgemaster' , 'Allyn Magic','Mini Magic' and similar	Dwarf Acmena									•	•
	Bothriochloa bladhii subsp. bladhii	Local Native Grass								•	•	•
	Bothriochloa decipiens	Local Native Grass								•	•	•
	Bothriochloa ewartiana	Local Native Grass								•	•	•
	Bothriochloa spp. (other)	Native Grass									•	•
	Canavalia maritima	Beach Bean							•	•	•	•
	Casuarina glauca 'Cousin It'	'Cousin It'							•	•	•	•
	Crinum pedunculatum	Swamp Lily							•		•	•
	Crinum uniflorum	Small Swamp Lily							•		•	•
	Cajanus reticulatus	Rusty Rattlepod								•	•	•
	Canavalia rosea	Beach Bean							•	•		•
	Cymbopogon ambiguus	Australian Lemon-scented Grass								•	•	•
	Cymbopogon bombycinus	Silky Oil Grass								•	•	•
	Cymbopogon queenslandicus	Queenland Lemon-scented Grass							•	•		•
	Cymbopogon refractus	Barbed Wire Grass							•	•		
	Dianella atraxis	Flax Lily								•	•	•
	Dianella caerulea	Blue Flax Lily								•	•	•

	Dianella caerulea 'Little Jess'	Dwarf Flax Lily									•	•
	Eleocharis atropurpurea	Purple Spikerush								•	•	•
	Eleocharis dulcis	Water Chestnut								•	•	•
	Eleocharis geniculata	Spike Sedge								•	•	•
	Enchylaena tomentosa	Ruby Salt Bush							•	•	•	•
	Enneapogon polyphyllus	Leafy Nineawn							•	•	•	•
	Enteropogon unispiceus	Northern Kennedy Windmill Grass							•	•	•	•
	Enneapogon spp.	Bottle Washers or Pappus Grass							•	•	•	•
	Eustrephus latifolius	Wombat Berry							•	•	•	•
	Ficinia nodosa syn.Isolepis nodosa	Knobby Club-rush							•		•	•
	Haemodorum coccineum	Blood Lily								•		•
	Heteropogon contortus	Black Spear Grass								•		
	Juncus usitatus	Common Rush								•		
	Indigofera pratensis	Forest Indigo								•	•	•
	Ipomea pes-caprae	Beach Morning Glory or Goat's Foot							•	•	•	•
	Lomandra confertifolia	Little Lomandra								•	•	•
	Lomandra hystrix	Slender Mat Rush								•	•	•
	Lomandra longifolia	Mat Rush								•	•	•
	Melaleuca 'Little John' syn. Callistemon 'Little John' & similar cultivars	Little John Bottlebrush									•	•
	Phyla nodiflora	Phyla or Frog Fruit								•	•	•
	Proiphys amboinensis	Cardwell Lily								•	•	•
	Schoenoplectus validus	Lake Club-rush								•		
	Spathoglottis plicata	Ground Orchid									•	•
	Spinifex sericeus	Silky Spinifex							•	•	•	•
	Syzygium australe 'Tiny Trev' and similar ciltivars	Dwarf Lillypilly									•	•
	Themeda triandra	Kangaroo Grass								•		
	Thuarea involuta	Beach Grass							•	•	•	•
	Vigna marina	Beach Pea							•	•	•	•
	Vitex rotundifolia (syn. V. ovata)	Beach Vitex							•	•	•	•
	Viola hederaceae	Native Violet									•	•
	Xanthostemon 'Little Goldie' and similar cultivars	Little Goldie Penda									•	•
Groundcover, border and tufted plants (Exotic)												
	Aglaonema spp and cultivars	Aglaonema									•	•
	Arachis pintoi	Peanut Pinto									•	•
	Austromyrtus 'Copper Tops' and similar cultivars	Dwarf Midyim									•	•
	Cuphea hyssopifolia	Mad Hatter									•	•
	Dianella 'Silver Streak' & 'Silver'	Stripped Dianella									•	•
	Dietes bicolour	Butterfly Iris									•	•
	Dietes grandiflora	Wild Iris									•	•
	Evolvulus pilosus 'Blue Sapphire'	Blue Sapphire									•	•
	Gardenia florida 'Radicans'	Gardenia									•	•
	Gazania spp and cultivars	Treasure Flowers									•	•
	Hemigraphis spp	Red Ivy									•	•
	Hippeastrum spp and cultivars	Hippeastrum									•	•

	Hymenocallis littoralis	Spider/Seaside Lily									•	•
	Hymenocallis 'Thai Spider'	Varigated Spider Lily									•	•
	Hymenocallis speciosa	Green-tinged Spider Lily									•	•
	Impatiens 'New Guinea' spp and cultivars	Impatiens										•
	Liriope spp. and cultivars	Liriope									•	•
	Ipompea batatas 'Rust Red' & ' Bright Ideas Lime'	Ipompoea									•	•
	Murraya paniculata 'Min-A-Min' and similar cultivars	Dwarf Mock Orange									•	•
	Ophiopogon spp and cultivars	Mondo Grass									•	•
	Pandanus pygmaeus 'Aurea Nana'	Pygmy Pandanus									•	•
	Phyllanthus multiflorus	Fountain Plant									•	•
	Rhoeo 'Hawaiian Dwarf'	Dwarf Rhoeo/Moses in the cradle									•	•
	Trachlospermum jasminoides 'Tricolor'	Creeping Star-Jasmine									•	•
	Tulbaghia violecea	Society Chives									•	•
	Zephyranthes candida	Autumn Crocus or Rain Lily									•	•
	Zephyranthes grandiflora	Rose Pink Rain Lily									•	•
	Zoysia tenuifolia	No Mow Grass									•	•
	Vegetables (various)											•
Vines and scrambling plants (Native)												
	Aristolochia acuminata (syn. A. tagala)	Native Dutchman's Pipe								•	•	•
	Cissus antartica	Kangaroo Vine								•	•	•
	Jasminium didymum	Coastal Jasmine							•	•	•	•
	Jasminium simplicifolium	Simple-leaved Jasmin								•	•	•
	Pandorea jasminoides	Bower of Beauty									•	•
	Pandorea pandorana	Wonga Vine								•	•	•
	Tecomanthe hillii	Fraser Island Creeper									•	•
	Tecomanthe spp and Cultivars										•	•
Vines and scrambling plants (Exotic)												
	Dipladenia spp and cultivars	Dipladenia									•	•
	Mandevilla spp and cultivars	Mandevilla									•	•
	Mucuna bennettii	Scarlet Jade Vine									•	•
	Petrea volubilis	Purple Weath									•	•
	Pyrostegia venusta	Orange Trumpet Vine									•	•
	Strongylodon macrobotrys	Jade Vine									•	•
	Trachelospermum jasminoides	Star Jasmin									•	•
	Thunbergia mysorensis	Lady Slipper Vine									•	•
	Various climbing & scrambling fruit, vegetables and condiments											•
Lawn grasses												
	Axonopus affinis	South Johnson Buffalo									•	•
	Axonopus compressus	Broad-leaf Carpet Grass or Nthn Buffalo Grass							•		•	•
	Cynodon dactylon	Couch							•		•	•
	Digitaria didactyla	Blue Couch									•	•
	Stenotaphrum secundatum 'Sir Walter'	Sir Walter Soft Buffalo							•		•	•

	Zoysia 'Empire' and similar	Zoysia Turf									•	•
	Zoysia mutrella	Manila Grass									•	•

Click here to view PDF of SC6.4.3.6 Attachment A: Preferred plant species list

Note—

1. Nomenclature generally based on Census of the Queensland Flora 2013, edited by Peter D. Bostock and Ailsa E. Holland found on the Queensland Government data website = indicates where plant name differs from Australian Plant Name Index at http://www.anbg.gov.au/cgi-bin/apclist
   Synonyms included where superseded name is still in common use in trade.
2. Refer streetscape design and treatments section for location and setback requirements. Case by case assessment of species suitability will be required dependent on location (verge, central median etc.)
3. Refer public open space section for requirements in these locations.
4. Species with a natural distribution within North Kennedy Pastoral District. Distribution checked against Census of the Queensland Flora 2010.
5. Refer to development codes for offset distances from property boundaries.

SC6.4.3.6 Attachment B: Adopted Master plans

Thuringowa Riverway Master Plan
Stage 1: Pioneer Park and Loam Island
February 2003

Riverway Sustainable Development Policy
City of Thuringowa Planning Scheme Policy 2003

SC6.4.3.6 Attachment C: Irrigation Profile Level (IPL) Hierarchy definition

The TCC Irrigation Profile Level (IPL) Hierarchy includes the following types: High, Medium, Low, Non.

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

High	• Provides irrigation to Townsville City Councils landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets,
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• Formal gardens irrigated to (IPL) levels High and Medium only.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Promote**:
		  • **Vigorous plant growth,**
		  • **Best plant health,**
		  • **Best presentation.**
		
		Visual Indicators - **turf**:
		  • **Lush thick turf,**
		  • **Rich even green appearance.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 28 - 38mm/week.**
		  • **Garden 18 – 28mm/week.**	

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Medium	• Provides irrigation to Townsville City Councils landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets,
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• Formal gardens irrigated to (IPL) levels High and Medium only.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Promote**:
		  • **Good plant growth,**
		  • **Good plant health,**
		  • **Good presentation.**
		
		• Visual Indicators - **turf**:
		  • **Mostly medium thickness turf,**
		  • **Mostly green appearance, with some patches of green/brown.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 18 - 28mm/week,**
		  • **Garden 15 – 25mm/week.**	

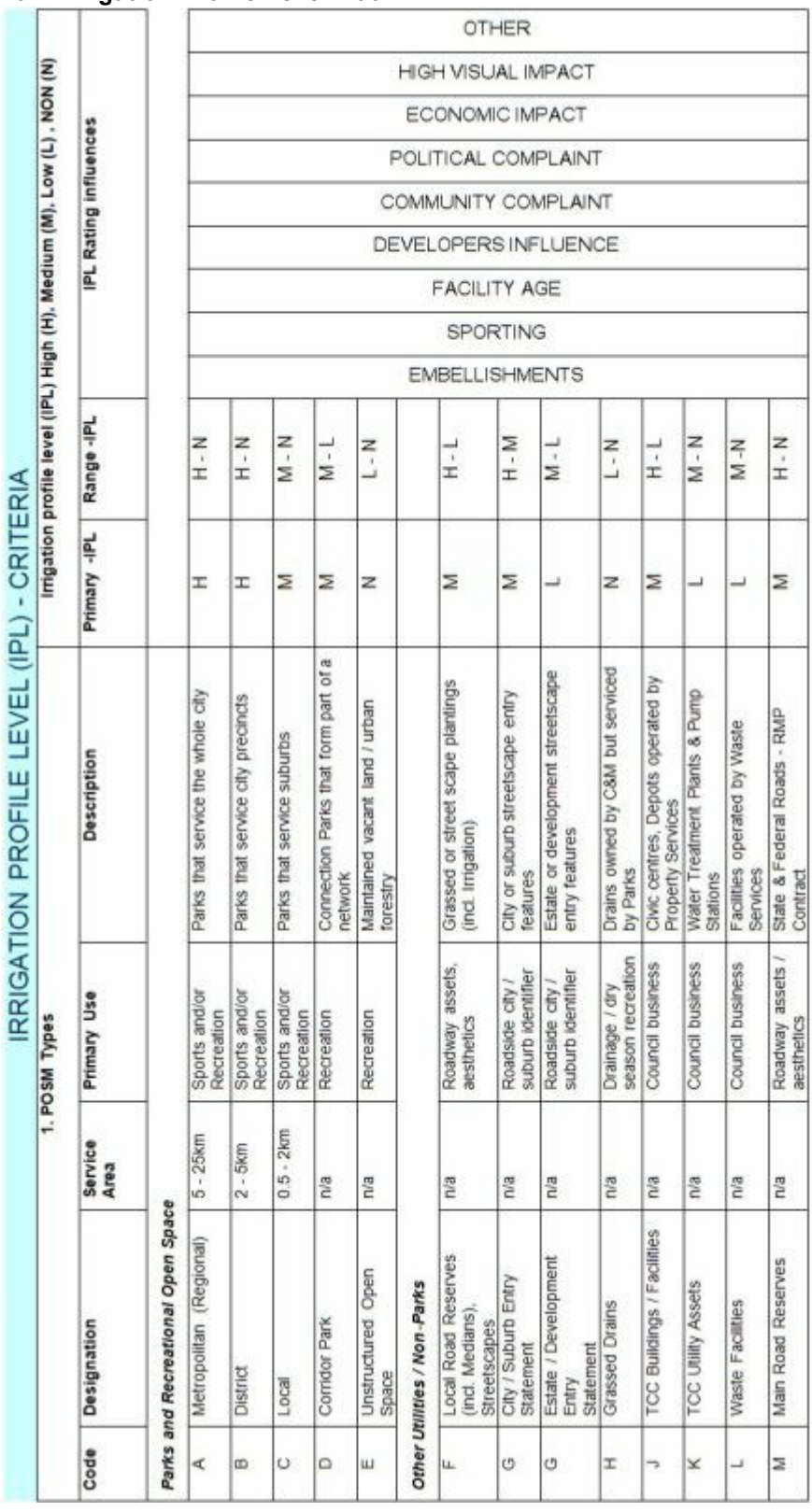
IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Low	• Provides irrigation to Townsville City Council's landscaped areas including:
	  • Public open spaces,
	  • Facilities and utility assets
	  • Local road reserves and street scaping
	
	• Provides irrigation to State Government main road - road reserves.
	
	• **Formal gardens irrigated to (IPL) levels High and Medium only**.
		• Provide irrigation in a uniform application to supply landscaping plants with soil moisture to **Sustain**:
		  • **Minimal plant growth,**
		  • **Minimal plant health,**
		  • **Minimal plant presentation.**
		
		• **Significant seasonal influences on landscaping**.
		
		• Visual Indicators – **turf**:
		  • **Thin coverage of turf,**
		  • **Mostly brown with green tinge appearance, some patches of brown.**
		
		• Yearly application range (assumed clay to clay loam soil types and subject to site conditions)
		  • **Turf 12 - 20mm/week.**	

IPL	Function Description	Performance Requirements	Typical Image of Turf Area

Non	• Areas where no irrigation is required:
	  • Natural areas
	  • Naturally landscaped areas such as native plantings,
	  • Open grass areas such as drainage swales,
	  • Other areas deemed not requiring irrigation.
		• Areas depend solely on rain and naturally occurring moisture. **Seasonal plant growth, health and presentation**.	

SC6.4.3.6 Attachment D: Irrigation Profile Level Matrix



IRRIGATION PROFILE LEVEL (IPL) - CRITERIA

1. POSM Types					Irrigation profile level (IPL) High (H), Medium (M), Low (L) , NON (N)		IPL Rating influences									
Code	Designation	Service Area	Primary Use	Description	Primary -IPL	Range -IPL	EMBELLISHMENTS	SPORTING	FACILITY AGE	DEVELOPERS INFLUENCE	COMMUNITY COMPLAINT	POLITICAL COMPLAINT	ECONOMIC IMPACT	HIGH VISUAL IMPACT	OTHER
Parks and Recreational Open Space															
A	Metropolitan (Regional)	5 - 25km	Sports and/or Recreation	Parks that service the whole city	H	H - N									
B	District	2 - 5km	Sports and/or Recreation	Parks that service city precincts	H	H - N									
C	Local	0.5 - 2km	Sports and/or Recreation	Parks that service suburbs	M	M - N									
D	Corridor Park	n/a	Recreation	Connection Parks that form part of a network	M	M - L									
E	Unstructured Open Space	n/a	Recreation	Maintained vacant land / urban forestry	N	L - N									
Other Utilities / Non -Parks															
F	Local Road Reserves (incl. Medians), Streetscapes	n/a	Roadway assets, aesthetics	Grassed or street scape plantings (incl. Irrigation)	M	H - L									
G	City / Suburb Entry Statement	n/a	Roadside city / suburb identifier	City or suburb streetscape entry features	M	H - M									
G	Estate / Development Entry Statement	n/a	Roadside city / suburb identifier	Estate or development streetscape entry features	L	M - L									
H	Grassed Drains	n/a	Drainage / dry season recreation	Drains owned by C&M but serviced by Parks	N	L - N									
J	TCC Buildings / Facilities	n/a	Council business	Civic centres, Depots operated by Property Services	M	H - L									
K	TCC Utility Assets	n/a	Council business	Water Treatment Plants & Pump Stations	L	M - N									
L	Waste Facilities	n/a	Council business	Facilities operated by Waste Services	L	M -N									
M	Main Road Reserves	n/a	Roadway assets / aesthetics	State & Federal Roads - RMP Contract	M	H - N									

Click here to view PDF of SC6.4.3.6 Attachment D: Irrigation Profile Level Matrix

SC6.4.3.7 Steep land development design guidelines

SC6.4.3.7.1 Introduction

(1) Background

(a) Development on steep land requires additional considerations for design, in particular, geotechnical considerations, as well as safety, servicing, environmental and economic considerations for the provision of development and associated infrastructure services.

(b) The stability of land which is steep, erosion prone, prone to slip and other geotechnical problems can be adversely affected by the following actions or development:

(i) earthworks (filling and excavation);

(ii) vegetation clearing;

(iii) construction of buildings and other structures (retaining walls);

(iv) construction of roads and driveways;

(v) on-site disposal of waste water; and

(vi) changes to the existing flow of surface or groundwater.

Inappropriate development on land subject to landslide hazard can result in significant risk to people and property on the subject site, on surrounding land and land down slope of the site. To ensure that these matters are appropriately considered when making decisions, geotechnical investigations are required and appropriate design solutions implemented. In some circumstances development may be avoided.

(c) This sub-section provides guidelines and advice for undertaking development on steep lands and the application of suitable design practices and design considerations.

Editor's note—this policy sub-section should also be read in conjunction with the AGS (2007e), *The Australian GeoGuides for slope management and maintenance*, Australian Geomechanics Society, *Australian Geomechanics*, Vol 42, No 1 and the planning scheme policy sub-section SC6.4.3.18 Geotechnical investigations.

(d) Wherever practical to do so, best practice techniques for construction and development techniques are expected to be demonstrated.

(e) In a broad sense, development should seek to achieve the following objectives:

(i) avoid unstable or hazardous sites and protect lives and property from hazardous conditions such as rock falls, excess stormwater run-off, erosion etc.;

(ii) minimise infrastructure maintenance requirements and costs to the community and residents;

(iii) provide practical and safe access for residents, visitors and service providers;

(iv) complement the scenic hillside character of the surrounding area by integrating unique or special natural features such as landforms, rock outcroppings, existing trees and vegetation, water features, hilltops and ridgelines and avoid further expansion onto scenic features, particularly ridgelines;

(v) minimise the footprint of development during and after construction;

(vi) protect wildlife habitat, corridors and environmentally sensitive areas; and

(vii) be compatible with existing adjacent development.

The creation of good amenity, when viewing the development from streetscapes and surrounding areas, should be a key consideration in all designs to avoid development on steep slopes that is visually dominant.

SC6.4.3.7.2 Development on steep land

As a general and overall consideration, the design of development on steep land should consider the following.

(1) Safety

(a) Major considerations in relation to safety are:

(i) landslide risk; and

(ii) debris flow.

(b) The location and/or form of development and infrastructure should not increase the extent or severity of any landslide hazard or present any unacceptable risk to life, property, the community, or the environment. Risks may arise internally or externally to the site, or affect the subject site or adjacent sites.

(c) Safety of the development should be addressed though appropriate investigations and design.

Editor's note—the preparation of a site specific geotechnical investigation is to be undertaken in accordance with SC6.4.3.18 Geotechnical investigations.

(d) The findings, recommendations and specific works of the geotechnical investigation report must be implemented and complied with to ensure that the risk level for the development will be no more than "low" in accordance with SC6.4.3.18 Geotechnical investigations. If the engineer's assessment report finds that the site will be "low risk" after development without the need for specific works to achieve this, certification need not be required.

Editor's note—risk level "low" in accordance with "Landslide Risk Management", Australian Geomechanics Volume 42 No 1 March 2007.

(e) Any recommendations contained in the geotechnical investigation report must be adopted in the final approved design.

(2) Servicing

(a) Development should provide for the safe and efficient servicing of the site by appropriate infrastructure and minimise ongoing costs to the final user and community. Specific designs for earthworks, roads, drainage, water and sewerage, water quality treatment, and site access may need to be demonstrated at an earlier stage than comparable developments on flatter land.

(b) Stormwater, in particular, should be controlled and conveyed in a manner that mitigates potential problems and emulates the area's natural water cycle, rather than shifting increased flows and issues downstream. Post development flows must not exceed pre-development flows. Particular attention should be paid to designing practical and robust inter-allotment drainage systems. Groundwater flows should also be a key consideration in relation to drainage systems and the potential for landslide risk.

(c) Any public infrastructure developed should not result in unsustainable increases in infrastructure operation and maintenance costs relative to the number of rateable units created (e.g. high level water systems, high maintenance drainage systems). Retaining walls in road or drainage reserves are discouraged and will only be accepted in exceptional circumstances where there is demonstrated benefit for the protection of public infrastructure. All retaining structures must be certified by an RPEQ and constructed of material that ensures public safety and minimised maintenance costs for the design life and should be designed to achieve good streetscape amenity.

(d) Road geometry should be designed in accordance with SC6.4.4.1 Geometric road design and Austroads with particular attention to grades, property accesses, design speeds and sight distances to ensure the safety of all road users. Where variations are sought to council's standards strong justification must be given to support the application. Long distances of steep roads or sharp curves without adequate sight distances or turning paths will not be approved. Road aesthetics are valued as a significant contributor to the character and quality of development and should be a key consideration.

(e) Access to all properties must be safe and functional. The design of the accesses must be shown in the overall development design to ensure the safety, practicality and impact on the public and private

domains. Lot levels should reflect the requirement of accesses to meet minimum grade requirements and allow for additional near level on-site parking for visitors, service vehicles and other parking needs. Access designs should be in accordance with the SC6.4.3.17 Driveways. Where lot accesses may be problematic to construct later, they should be constructed with the roads.

(f) Pedestrian, cyclist and public transport infrastructure design should also be considered at the overall development design as these means of movement are often restricted on steep lands. Alternate facilities to standard road routes and footpaths (e.g. pedestrian connections stairs) may require special design considerations due to grade and safety needs. Residential streets are designed to create low speed environments and to facilitate and encourage pedestrian and cyclist use.

(3) Sustainability

(a) Hillside development can add its own positive character to the particular region however it can also have negative effects on the natural and built environment. Development should seek to enhance positive site characteristics and should enhance the natural qualities of hillsides (e.g. skylines, vistas, landscape form, vegetation, rock outcrops and other topographic features) whilst negative effects (e.g. scarring and a lack of respect for natural terrain and aesthetics) should be contained and avoided. Scenic natural features should be incorporated into the subdivision design as natural open space or through the use of larger allotments that can contain the features.

(b) The layout of a development should be sympathetic to the area's natural terrain and hazardous conditions. It should endeavour to maintain sensitive natural areas and protect and preserve the scenic characteristics of hillsides. Where possible the clustering of development should be used to restrict the impact on the natural state, improve the financial efficiency of the development and assist in creating a variety of the housing forms.

(c) The effect of slope on built form should be identified in the initial stages of the development's design and appropriate types of construction should be encouraged through suitable lot sizes, site and access works, building envelopes, and covenants. This will help ensure the development can be built as proposed and reduce the likelihood of conflict or compromise at a later date.

(d) The extent of earthworks (cut and fill) is a major consideration in the design of developments on steep slopes, not just for reasons of site stability but in terms of cost and efficient use of land as well as visual impact. Constructed slopes should be stable and capable of re-vegetation and effective maintenance. They should also not be so high as to be obtrusive to the streetscape or scenic quality of the development. Heights between the streets and site levels should not be so great as to provide a disconnect between housing and the street or prove impractical for regular movement. Long stretches of high cuts or fill adjacent to road edges will not be approved. Site grading and retaining walls respect existing terrain; that is, large cuts/fills are not used to create “build-able lots” or flat yards. Final lot grades should wherever practical mimic the natural slope.

(e) Where disturbance from future site development is likely to be problematic then earthworks to individual sites should occur at the subdivision stage. For subdivision, this may include providing level building pads to accommodate a future dwellings, associated filling and the construction of private retaining walls. This may occur where there are large cuts and fills, repeated or close accesses, or where future blasting may be required.

(f) Retaining walls should be minimised and should not be of heights that detract from the amenity and human scale of the development. Generally, walls should not exceed one metre in height adjacent to roadways on property boundaries. High walls should be articulated, be constructed with appealing materials or finishes (complementing natural materials where possible), and have sufficient landscaping to screen the wall and should be set back from the road boundary to permit landscape treatment. Where possible a series of smaller stepped walls should be utilised and designed to permit landscaping of the terraces. Retaining walls can be used to reduce slope disturbance, rather than modify natural terrain – lot sizes should increase as the natural slope increases. Constructed slopes can be placed behind buildings if needed, however, consideration should be given to the principle of reduced earthworks in the first instance.

(4) Economic

(a) The volume of cut and fill over the development should be minimised and a cut and fill balance over the

site as a whole should be achieved where possible.

(b) It is expected that with any new public infrastructure the cost of ongoing maintenance should generally be no more for steep sites than for flat sites on a per lot basis. Where there may be a special requirement for non-standard or higher maintenance infrastructure it is expected that a full life cycle cost comparison would be provided (e.g. high level pumps or reservoirs, drainage structures, access to landscaped areas, etc.).

SC6.4.3.7.3 Development applications advice

Particular steep land issues that must be addressed at various application stages are indicated below.

(1) Council encourages applicants to discuss development proposals with council during initial design phases.

(2) It is important that the design reflect all the recommendations of the geotechnical report and that sufficient design detail is provided to demonstrate that the proposed road and lot layouts will work in practice and result in infrastructure and built form outcomes that comply with these guidelines. In particular, there should be enough certainty provided to be sure that the layout will not require significant change due to technical design constraints, i.e. it should not be left to the operational works stage to prove the development will work. Sufficient drawings and design data (including multiple sites and building sections) should be provided to determine this.

(3) The technical design of all earthworks and infrastructure should reflect the recommendations of the geotechnical report and all relevant design guidelines and standards. Where the initial MCU/ROL geotechnical report outlined further detailed investigation prior to design as necessary then this must be carried out. The operational works design should be certified by a geotechnical engineer as complying with the recommendations of the geotechnical report.

SC6.4.3.8 Stormwater management plans for development

SC6.4.3.8.1 Introduction

The development of effective site based stormwater management plans is imperative to the understanding of stormwater quality and quantity during the land development phase to minimise the risk of causing environmental harm to receiving waters, damage to council infrastructure, and unnecessary financial burdens to council and the community.

Where a development is required to demonstrate how proposed stormwater management is protecting water quality and quantity, an applicant will be requested to undertake and prepare a conceptual site based stormwater management plan (CSBMP) or a site based stormwater management plan (SBMP) which addresses the likely impacts of the proposed development and suggests measures to avoid or mitigate against unacceptable risk and other impacts.

(1) Objectives

(a) Ensure that land-use activities potentially discharging contaminated run-off or wastes to waterways during land development, construction and operation phases are sited and managed to minimise such discharges and to protect the quality and quantity of water entering natural and constructed waterways, natural and constructed wetlands, as well as groundwater resources.

(b) To assist planning and decision making on development that may result in stormwater erosion of disturbed soil and sediment transport to land and waters, potentially having an impact on receiving waters environmental values under the *Environmental Protection (Water) Policy 2009* (the EPP Water).

The environmental values established under the EPP Water need to be protected, in part, by:

(i) providing natural water infiltration and flows;

(ii) using water sensitive urban design (WSUD) principles and effective erosion and sediment control; and

(iii) using best practice urban stormwater quality and quantity management.

(2) Terminology

In addition to the definitions presented in Part 1.3.1 of the Townsville City Plan, the following terminology is referenced in support of this policy sub-section.

Site based stormwater management	land development controls identified by a site assessment report. Examples of land development controls include: • erosion source control; • sediment traps; • wetlands for nutrient control; • stabilised temporary drainage lines; • riparian management; and • site rehabilitation.
Wetland	area of permanent or periodic/intermittent inundation, whether natural or artificial, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which a low tide does not exceed 6 m. AS/NZS 1547:2000 Onsite domestic waste water management.

(3) References and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.3.9 Water sensitive urban design guidelines

SC6.4.4.4 Stormwater drainage design

SC6.4.6.1 Water sensitive urban design construction and establishment guidelines

(b) Queensland guidelines
Queensland Government (1999) *Strategy for the conservation and Management of Queensland Wetlands*
Queensland Government (2010) *Urban Stormwater Quality Planning Guidelines*
SEQ Healthy Waterways Partnership, *Construction and Establishment Guidelines*: Swales, Bioretention Systems and Wetlands

(c) Other guidelines
Water by Design, *Construction and establishment guidelines*; Swales, Bioretention Systems and Wetlands
International Erosion Control Association (2008), *Best practice erosion and sediment control*.
Water by Design, *MUSIC modelling guidelines*, June 2012 (as amended)

Note—where local guidelines exist and these include modifications to the Queensland or other guidelines based on local knowledge or investigation, these shall take precedence over Queensland or other guidelines.

SC6.4.3.8.2 Planning and concept design guidelines

(1) Pre-lodgement development guidelines

(a) Prior to the lodgement of a development application it is recommended that the applicant meet with council to confirm acceptable stormwater management practices (for example, wetland, sediment basin and bioretention system designs) and discuss how stormwater treatment may influence overall development design.

(b) In order to make pre-lodgement more beneficial, it is recommended that applicants undertake a preliminary site assessment and provide a range of baseline information to council to assist and inform the pre-lodgement discussions.

(c) This baseline information ideally will include accurate survey plans which demonstrate information on pre-development site conditions including:

(d)

topography	a suitable ground survey of the site is required to allow an assessment of existing grades and flow pathways;
drainage characteristics	drainage infrastructure and flowpaths upstream, within, and downstream of the development must be surveyed for size, location and level;
proposed discharge points and invert levels	define likely flow paths and the level of the receiving drainage system or waterway. Critically, levels must be collected for inverts of drainage systems that will accept treated water from the stormwater treatment systems. If water is ponding in these drainage systems, the water level must also be surveyed;
wetlands	if the site contains wetlands identified through council wetland mapping (refer to Part 8 Overlays and SC2.5 Overlay maps), they should be identified on preliminary plans;
soils	a soil evaluation undertaken in accordance with AS/NZS 1547:2000. Clause 4.1.3 will assist in selecting and locating treatment devices. The soil evaluation should identify soil types, hydraulic conductivity, presence of potential acid sulphate, sodic or saline soils, presence of rock, and general groundwater details; and
site disturbance	an indication of the current extent of disturbance across the site during the previous 12 months.

(e) This baseline information is critical to facilitate designs which suitably respond to site constraints and opportunities. Consideration of constraints and opportunities early in the design process minimises redesigns and expedites the assessment process. The recommended approach allows the information request stage to then be used to clarify minor issues in the report (should this practically be required).

(2) General guidelines

(a) It is recommended that the above information is included with the lodgement of an application to manage stormwater quality and quantity. This will ensure that stormwater treatment matters are suitably addressed prior to a decision notice being issued and do not contribute to extended assessment timeframes.

(b) The design and location of stormwater treatment measures has the potential to greatly influence a

number of things, including lot configuration and as a result, needs to be resolved prior to the presentation to council for approval of any site development plans. Designers should be aware that the design of stormwater treatment measures will not only influence site design due to the footprint but also potentially due to their specific drainage requirements. Ensuring that treatment systems can freely drain becomes an increasingly important issue on sites with flat topography and must be resolved on every site prior to plan approval.

(c) A conceptual site based stormwater quality management plan (CSBMP) should be submitted for material change of use (MCU) and reconfiguring a lot (ROL) applications to demonstrate that there are feasible measures available to adequately manage the impacts of development as they are understood and relevant to those stages and to the degree required to protect the environmental values. See Table SC6.4.3.8.1 for a checklist of items to be included in a CSBMP.

(d) Table SC6.4.3.8.1 has been provided as a check list to outline the minimum standards for creation and preparation of a SBMP. Further, SC6.4.3.8.5and SC6.4.3.8.6 provide additional information to that provided in Table SC6.4.3.8.1 and should be read in conjunction when preparing a SBMP.

(e) This also informs the developer of the economic consequences of impact management at the outset of the development process. As site constraints increase, the cost-effectiveness of best practice control measures decrease. Where the conceptual plan cannot substantiate that best practice control measures are feasible and still achieve the environmental performance objectives, the proposed nature, layout and intensity of development should be reconsidered, for example—by fitting the development more to the terrain, rather than fitting the terrain to the development, to reduce the need for clearing and earthworks.

(f) The designer is to consider the site characteristics, constraints and opportunities relating to stormwater management at the initial planning phases of the development. This is to ensure that sufficient area is allocated within the development site for appropriate stormwater management infrastructure during land development, construction and operational stages.

SC6.4.3.8.3 Development Applications

(1) Development applications may require a CSBMP or site based stormwater management plan (SBMP) to be submitted with the development application to council for all developments requiring assessment against the Part 9.4.2 Healthy waters code. This will assist in assessing the impact of the development on the site.

(2) SC6.4.3.8.5 SBMP document information outlines the overall framework required for SBMPs.
The following information should also be considered:

(a) the overall potential impacts of both the construction and permanent phases, and the feasibility and cost-effectiveness of control measures on each site (given, for example, site constraints, and nature and scale of the development) need to be considered first when a change in land use is proposed, and subsequently as the development unfolds; and

(b) potentially serious land capability constraints affecting the cost-effectiveness and hence the feasibility of a development include:

flood prone areas	sediment basins are often located at the low point of a development and they may not be stable or able to be properly installed or operated if subject to flooding;
acid sulphate soils	larger treatment devices such as sediment basins, wetlands and bioretention systems are often located in low lying areas that are susceptible to the disturbance of acid sulphate soils;
steep terrain	high erosion risk, difficulty in preventing erosion, and in installing a stable and adequately sized sediment basin; and
flat terrain with high groundwater levels	difficulty in collecting and directing surface flows, coupled with difficulty of installing a sediment basin in the presence of high groundwater, which is sometimes geochemically contaminated.

Editor's note—this will include a brief description of erosion and sediment control (ESC) for these two stages of the development approval process.

(4) Operational works guidelines

(a) Operational works applications may require the submission of a preliminary erosion and sediment control plan (ESCP) as supportive information which complies with council requirements as a minimum technical standard.

(b) The preliminary ESCP will be confirmed on site during the pre-start meeting. At this stage, council can check the appropriateness of the preliminary design on site to ensure that the contractor(s) will implement what is on the design plan and will not be responsible in making any changes to suit the site condition during the construction phase.

(c) The preliminary ESCP should take into consideration change to surface levels that are reflected in the bulk earthworks plan(s) of the siteworks plan(s) accepted as part of the operational works approval. The primary ESCP submitted as part of the CSBMP may later be followed by a series of secondary ESCPs for the various stages of the project.

(d) Subsequent installation, operation, maintenance and monitoring of structural controls and their works programming and coordination requires ongoing adaptive management, and this must be carried out in compliance with the general environmental duty under the Environmental Protection Act, that is, taking all reasonable and practicable measures to protect the environmental values of receiving waters from environmental harm. Refer to information in Table SC6.4.3.8.1. Operational works applications should be accompanied by a series of detailed stormwater management drawings. The plans (ESCP) should include notes on the drawings which require contractors to follow the preferred construction and establishment methodology outlined in an approved SBMP and in accordance with the *SEQ Healthy Waterways Partnership Construction and Establishment Guidelines*: Swales, Bioretention Systems and Wetlands.

(e) Drawings should be in accordance with SC6.4.2 Development application guidelines.

(f) The extent of unnecessary soil disturbance, including disturbances outside the designated work area, must be minimised at all times.

(g) Land clearing must be limited to the current stage of works unless otherwise approved in writing possible standard condition by the assessment manager.

(h) It is recommended that land clearing is undertaken, as a minimum, necessary to provide either of the following:

(i) up to 8 weeks of site activity during those months when the expected rainfall erosivity is less than 100, 6 weeks if between 100 and 285, 4 weeks if between 285 and 1500, and 2 weeks if greater than 1500; or

(ii) up to 8 weeks of site activity during those months when the actual or average rainfall is less than 45 mm, 6 weeks if between 45 and 100 mm, 4 weeks if between 100 and 225 mm, and 2 weeks if greater than 22 mm; or

(iii) utilising local sediment export data to assess the risks of land exposure during different months of the year.

Editor's note—minimise works during the "wet season" months of 1 December to 31 March. The month of December is also critical to allow establishment of 70% groundcover prior to the expected high rainfall in the months of January and February.

These impacts need to be considered separately from the post-development or permanent settlement phase as the issues and impact assessment methodology are different.

(i) The critical impact factors are site erosion hazard (including the timing of development with respect to wet seasons) and the duration and areal extent of exposed soil until final site stabilisation after the end of major house-building activities.

Editor's note—definitions of site erosion hazard and major house-building activities to come.

(j) Avoiding exposure of disturbed areas during peak rainfall periods will significantly reduce the potential for erosion and stream hydro-modification to occur. While it is generally recommended that larger sites are

cleared and developed in manageable smaller stages, this may sometimes conflict with the need to quickly complete and stabilise a large development prior to the wet season.

Editor's note—minimise works during the "wet season" months of 01 December to 31 March. The month of December is also critical to allow establishment of 70% groundcover prior to the expected high rainfall in the months of January and February.

(k) Where larger sites are not staged, however, there should be a progressive revegetation (or other effective stabilisation measure) program implemented following commencement of clearing (not at the end) so that no part of the site is left exposed and unstable for extended periods in the high rainfall coastal regions. Refer to SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction.

Editor's note—even temporary grass vegetation or synthetic covers can reduce erosion levels to less than 1 per cent of the level expected if the site is left with soils exposed.

(5) Water quality objectives

(a) Environmental values (EVs) and water quality objectives (WQOs) need to be identified to ensure that the quality of affected receiving waters are maintained or enhanced. WQOs includes all measurable water quality goals that have been derived to protect corresponding environmental values.

(b) The EPP (Water) establishes the EVs in receiving waters.

(c) The associated WQOs form the basis for defining the required water quality of urban stormwater entering and mixing in local waterways.

(d) There are three ways to estimate the level of stormwater quality improvement necessary for a site to ensure WQOs are taken into account to help protect council infrastructure and the EVs for waterways.

For the site scale these are:

(i) monitoring – actual stormwater quality can be compared with receiving water quality to establish the level of treatment necessary to protect EVs, where sufficient monitoring data are available from the same development type in similar landscape conditions;

(ii) modelling – stormwater quality and its potential impact on receiving waters can be mathematically modelled to determine treatment requirements (design objectives). Some monitoring data are usually required to validate such models. e.g. SC6.4.3.8.6 MUSIC modelling; and

(iii) best management practices – best available data on the performance efficacy of current best practice treatment technologies can be used to establish minimum standards of performance (typically expressed as minimum average annual pollutant load reductions, or minimum average percentage reductions in pollutant loads, e.g. measures in SC6.4.3.9 Water sensitive urban design guidelines).

(e) In rapidly urbanising catchments, the wet-weather impacts of the construction phase of the land development phase need to be considered as well as the post-development (or permanent settlement phase), as the issues and impact assessment methodology are different. Critical impact factors include soil erosion hazard of the landscapes being developed, and increased rainfall run-off coefficients which occur when land is cleared and topsoil removed.

(f) The preferred method for determining the required level of treatment is described in SC6.4.3.9 Water sensitive urban design guidelines.

(g) Modelling provides an ability to predict likely changes in water quality associated with proposed urban developments. Such water quality models can be used to establish performance outcomes for stormwater systems. These are limited by the availability of local water quality data and the understanding of the biological and physical processes that influence water quality and the receiving water environment. There are often significant limits on the confidence with which predictions can be made using water quality models at the site scale. Despite the uncertainty of modelling, adopting predictive modelling techniques to quantify estimates of stormwater pollutant concentrations and loads from urban land surfaces and the pollutant removal efficacy of current best practice stormwater treatment infrastructure is an accepted method for establishing best practice stormwater management "treatment

train" design for regions where limited or no monitoring data exists.

(6) Stormwater quality risk classification
Developments are classified as either having a “low risk” or a “high risk”.

Note—a development (or development proposal) may be classified as “high risk” if it falls within one of the following categories:

(a) any development (or development proposal) within or adjoining areas of identified ecological status as indicated on council planning scheme maps; or

(b) material change of use for urban purposes that involves:

(i) greater than 2,500m2 of land; or

(ii) 6 or more additional dwellings; or

(c) reconfiguring a lot for urban purposes that:

(i) would result in 6 or more residential allotments or that provides for 6 or more dwellings; or

(ii) involves greater than 2,500m2 of land and results in an increased number of lots; or

(iii) is associated with operational work disturbing greater than 2,500m2 of land; or

(d) operational work for urban purposes that involves:

(i) disturbing greater than 2,500m2 of land.

“Low risk” is a development (or development proposal) that is not “high risk”.

Small, “low risk” developments in Townsville do not have to identify EVs and WQOs for receiving waters. Proposals for these developments need to demonstrate achievement of best management practices for the type of pollutants that are likely to be generated.

(a) Developments in Townsville considered as “high risk” in relation to impacts on stormwater quality require the identification of EVs and WQOs for receiving waters within and/or downstream of the development. Proposals for these developments need to demonstrate that stormwater draining from the site will not threaten the relevant environmental values and their corresponding water quality objectives, in affected receiving waters through the use of appropriate SBMPs.

(7) Water sensitive urban design considerations.

Note—refer to information in Table SC6.4.3.8.1.

(a) WSUD approaches to water management during development and its construction aim to minimise impacts on the natural water cycle, avoid or minimise off-site pollutant discharge, limit changes to the volume, rate, duration and frequency of stormwater discharge, and protect council infrastructure and the EVs of receiving waters.

(b) WSUD applied to the construction phase of land development is primarily concerned with surface drainage and erosion and sediment control.

(c) WSUD at the construction stage needs to take account of the final layout of permanent stormwater controls that will be constructed.

(d) Temporary erosion and sediment controls need to be incorporated into SBMPs to protect permanent stormwater controls such as wetlands, swales, and bio-retention systems proposed to be constructed.

(e) Poor erosion and sediment control planning and implementation can severely compromise the success of biological assets utilised as part of operational stormwater quality controls and increase weed infestations, decrease drainage and filtering capacities, smother landscaping and greatly reduce system reset times.

(f) WSUD principles must be incorporated into construction phase, planning and design.

(8) Detailed design

(a) A SBMP shall be submitted to council as part of the detailed engineering design documentation following

approval of the concepts from council.

(b) The documents are to be site specific and not a generalisation of erosion and sediment control or stormwater quality. The documents may also form part of the contract specifications for a contractor to comply with during construction.

(c) Where available, examples of proposed developments detailing locations of water quality structures, sediment and erosion control methodology may be obtained from council and used as a guide when preparing SBMPs.

(9) Construction

(a) No site works shall commence prior to council's approval of the detailed design documents.

(b) All works are to be undertaken in accordance with the development conditions, accepted drawings, the approved SBMP, local laws and environmental regulations.

(c) Implementation of the approved works during construction must be supervised by the nominated professional.

(d) The developer (or representative) shall constantly monitor, review and modify soil and water management practices to correct any deficiencies.

(e) Random audits may be performed by council throughout the construction phase of the project to review compliance with approved documentation.

Editor's note—where inconsistencies are noted, written advice will be sent to the developer (or representative) requiring appropriate action within 24 hours.

(f) A key reference document, *Best Practice Erosion and Sediment Control*, should be consulted for information on the main concepts for reducing pollution from construction sites.

(g) Construction activity can be divided into two phases—the land development stage and the building construction stage.

Editor's note—both of these phases are known to result in serious stormwater pollution unless appropriately managed.

(i) Land development stage
Land development involves making undeveloped vacant land suitable for urban uses through vegetation clearing, land forming and provision of services such as roads, drainage, water supply, sewers, electricity, gas and other services.

Land development usually involves major earthworks resulting in significant potential for contamination of stormwater by eroding soils.

(ii) Building stage
Building construction can result in significant soil disturbance as well as the contamination of stormwater with building wastes. Pollutants can include litter, rubble, concrete-mixer waste, paints, plaster, brick sand, cleaning products and imported soils, etc. It should be noted that conventional allotment sediment control practices for a building site are largely ineffective at turbidity control. Therefore, for greenfield developments, subdivision-scale controls may be needed.

(iii) Effective source control measures employed during construction can greatly minimise the impact of both phases of construction activity on stormwater quality. SBMPs (these may sometimes be referred to as erosion and sediment control plans or include such provisions) are an effective means of planning and implementing measures to minimise the generation of pollutants from construction activities.

(10) Maintenance plan requirements

(a) Maintenance plans are to be provided for stormwater quality improvement devices (SQIDs) that are to be handed over to council.

(b) SC6.4.3.9 Water sensitive urban design guidelines should be consulted when preparing a maintenance plan.

(c) The responsibilities for maintenance of SQIDs are to be detailed in the SBMP.

(d) The maintenance plans are to be written for use by council's maintenance and asset personnel.

Editor's note—examples of SQIDs that require maintenance plans include trash racks, constructed wetlands and ponds.

Note—trash racks, Gross Pollutants Traps and similar are not preferred.

(e) The maintenance plans are to include as a minimum:

(i) design details;

(ii) manufacturer and supplier contact details (where relevant);

(iii) inspection frequency;

(iv) maintenance frequency;

(v) data collection requirements;

(vi) clean-out procedures that address, at a minimum, public safety, maintenance techniques, wet waste disposal, equipment requirements, environmental management considerations and occupational health and safety and disposal requirements; and

(vii) permeability testing requirements and guidelines for the filter media.

(f) An on-site hand-over meeting and completion of handover documentation must occur between the developer (or representative), responsible maintenance personnel and appropriate representatives from council.

(g) In the event that the SQID is not complying with approved conditions, council is under no obligation to accept responsibility of the asset.

SC6.4.3.8.4 Lodgement of site based stormwater management plans

(1) A site based stormwater management plan (SBMP) identifies stormwater management strategies and actions to broadly address:

(a) water quality;

(b) water quantity;

(c) waterway corridor issues; and

(d) The contents of the SBMP are dependent on the stage of development (concept or detailed design) and the level of risk for the proposed development ("low" or "high").

(2) The SBMP should contain sufficient detail to determine whether the stormwater controls are acceptable to address water quality, water quantity and waterway corridor issues. All SBMP should consider if a development is staged, including the anticipated timeframes for the staged works.

(3) Where an SBMPs is required, it should be prepared in accordance with this sub-section and Table SC6.4.3.8.1 as a minimum standard.

(4) Tables SC6.4.3.8.1, SC6.4.3.8.2 and SC6.4.3.8.3 Checklist for preparation of a site based stormwater management plan has been provided as a detailed check list to outline the minimum standards for creation and preparation of an SBMP that has been requested by council, to be submitted as part of an application or as part of a development condition.

SC6.4.3.8.1 Rapid risk assessment for conceptual site based management plans

Rapid risk assessment for cSBMP	Value
Land size:	
≤5,000m²	0
>5,000m² ≤10,000m²	1
>10,000m²	2
Estimated impervious area of site (road, roofs, parking, etc)	
≤25% of developable area	0
>25% ≤75% of developable area	1
>75% of developable area	2
Lot distance from areas identified within Natural assets environmental importance overlay map OM-08 as of 'very high environmental importance'	
>100m from the proposed development	0
Within 100m of the proposed development	1
Within 50m of the proposed development	2
Within the proposed development	3
Total value – 3 scores combined	
Conceptual site based management plan required at MCU and ROL stages for scores >6	

Table SC6.4.3.8.2 Checklist for preparation of a site based stormwater management plan

Site Based Management Plan Requirements
Introduction and Site Characteristics - Both Operational and Construction Phases
Description and location of the proposed development including existing and proposed land uses
Identification and description of any waterways or wetlands on or adjacent to the site including relevant background water quality data
Related studies and or plans such as catchment management plans, waterway management plans, stormwater management plans
Description of site flora and fauna including any areas of ecological significance
Summary of hydrologic and hydraulic information
Map indicating the proposed size and location for all major stormwater treatment devices such as sediment basins, constructed wetlands and bioretention systems
Parkland contributions (if required)
Completed site risk assessment
Summary of the SBMP study team
Construction Phase Elements (ESCP)
General Plan Requirements
Plan sign off including contact details for the nominated 'Suitably Qualified Person' and 'Responsible Person'
A summary statement describing the scope and intent of the work to be performed
Proposed limits of disturbance during construction activities including fencing, non-disturbance areas, retained groundcover and vegetation
Description of the proposed works including commencement and duration
Description of site preparation and initial land clearing strategies, including ESC controls to be installed prior to disturbance
Map indicating any areas of high erosion risk and/or critical environmental values
Map indicating the existing and proposed topography and drainage (including clearly depicted overland flows)
Descriptions of stabilised construction access points
Plan indicating the locations of the site office, car park(s), sediment stockpiles and associated drainage and sediment controls
Soils
General soil description as identified from published soil maps used in the soil investigation for the site
If required by State Planning Policy 2/02 - an acid sulphate soil investigation
Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the 'Cation Exchange Capacity' values
Description of the proposed remedial actions required to treat problem soils: steep slopes, saline soils, dispersive soils, extremely acidic or alkaline soils and acid sulphate soils

Drainage, Erosion and Sediment Control Measures
Map indicating how off site water is diverted around or through the site and how stormwater is diverted away from site entry and exit points
Plan/s submitted for each stage of works that utilise standard ESC symbols and clearly indicate the proposed controls and control locations
Design and construction details for any specified ESC measures, including calculation sheets for the sizing and layout of sediment basins
Specification of the flocculent type, methodology and application rate for any and each sediment basin proposed
Description of how any soil stockpiles are to be protected
Hydraulic analysis demonstrating flow velocities and capacities on site
Implementation schedule providing specific timeframes and sequences for works to be carried out
Specifications of stabilising measures for surfaces exposed for more than 14 days
Technical notes demonstrating best practice site management including dust, chemical, oil, fuel, litter and debris control
Site Revegetation, Rehabilitation, Maintenance and Monitoring
Capital cost of proposed strategy
Description of revegetation, hydroseeding, hydromulching or mulching methods
Site maintenance plan indicating performance standards for ESC structures, establishment of ground cover and monitoring frequencies
An Inspection Test Plan (ITP) for monitoring site performance is provided clearly indicating witness points, hold points and end points
Nominated Total Suspended Solid (TSS) concentration targets for water leaving site
Weekly site inspection checklist for ESC controls in place
Completion of the Townsville City Council Erosion and Sediment Control Plan Checklist
Nomination of 'Responsible Person' accountable for maintenance of structural controls
Total Suspended Solids monitoring program identifying methodology and locations for water quality monitoring
Operational Phase Elements (WSUD)
General Plan Requirements
Plan sign off and contact details for the nominated 'Suitably Qualified Person' and 'Responsible Person'
Clear indication of proposed works including expected commencement and duration
Map indicating the existing and proposed topography and drainage (including clearly depicted flowpaths for various AEP’s)
General soil description as identified from published soil maps used in the soil investigation for the site
Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the Cation Exchange Capacities values
Proposed remedial actions required to treat problem soils: steep slopes, saline soils, dispersive soils, extremely acidic or alkaline soils and acid sulphate soils
Electronic copy of MUSIC (or similar pollution reduction modelling program) outputs for the proposed works
Description of any existing stormwater infrastructure
Stormwater Quantity (Hydrology and Hydraulics)
Description of proposed methodology
Details of model analysis
Comparison of existing and proposed hydrology and hydraulics eg. catchments, flows and flood levels for various AEP’s
Selection and assessment of controls
Description of proposed mitigation measures
Designs drawings for proposed controls
Stormwater Quality (Pollution Reduction)
Identification of environmental values, pollutions of concern and water quality objectives
Description of proposed methodology
Details of model analysis
Selection and assessment of controls
Description of proposed mitigation measures
Design drawings for proposed controls

Water quality monitoring program identifying methodology and locations for water quality monitoring
Maintenance and Asset Handover
Capital cost of proposed strategy
Map and details of maintenance access points and dewatering areas
Annual maintenance strategy including asset access, maintenance and resetting methodologies
Details of asset reset times and life cycle costings including ongoing maintenance costs
Nomination of 'Responsible Person' accountable for maintenance of structural controls
Description and timing for asset handover to council

SC6.4.3.8.3 Checklist preparation of a conceptual site based stormwater management plan

Site Based Management Plan Requirements

Introduction and Site Characteristics Both Operational and Construction Phases

Description and location of the proposed development including existing and proposed land uses

Identification and description of any waterways or wetlands on or adjacent to the site including relevant background water quality data

Description of site flora and fauna including any areas of ecological significance

Map indicating the proposed size and location for all major stormwater treatment devices such as sediment basins, constructed wetlands and bioretention systems

Parkland contributions (if required)

Completed site risk assessment

Construction Phase Elements (ESCP)

General Plan Requirements

Description of the proposed works including commencement and duration

Map indicating the existing and proposed topography and drainage (including clearly depicted overland flows)

Soils

General soil description as identified from published soil maps used in the soil investigation for the site

Testing and description of local soil types, identifying the limitations of both topsoils and subsoils determined through soil testing and in particular the 'Cation Exchange Capacity' values

Drainage, Erosion and Sediment Control Measures

Site Revegetation, Rehabilitation, Maintenance and Monitoring

Nominated Total Suspended Solid (TSS) concentration targets for water leaving site

Operational Phase Elements (WSUD)

General Plan Requirements

Clear indication of proposed works including expected commencement and duration

Map indicating the existing and proposed topography and drainage (including clearly depicted flowpaths for various AEP’s)

Description of any existing stormwater infrastructure

Stormwater Quality (Pollution Reduction)

Description of proposed mitigation measures

SC6.4.3.8.5 SBMP document information

The SBMP should outline information relevant to the authorship of the SBMP (ideally provided in tabular form), including document title, reference number, document ownership (including names of personnel that have issued and checked the SBMP) and name of client (and client representative, if appropriate).

The lodgement of development information should be accompanied by information including topographic, drainage, vegetation and soils details as well as the proposed development plan in addition to the following items (1) to (12) and clause SC6.4.3.8.6.

(1) Executive summary

A concise summary of the study methodology and findings should be presented along with a table outlining how the proposed methodology and findings and response to any previous information requests from council.

(2) Table of contents

The table of contents should include a table of the body of the report, a table of appendixes and a table of figures and diagrams.

(3) Introduction

The introduction should include a general description of the proposed development/ works, existing site, scope of the SBMP and the following information:

(a) submission date;

(b) developer's name;

(c) consultant's name;

(d) current and proposed land use of development site;

(e) description of site location (including street directory reference); and

(f) reference to associated documents.

(4) Locality plan

The report should include a locality plan which shows the site location in relation to major topographic features and landmarks such as waterways and major infrastructure such as roads as well as applying the principles of good mapping and drafting.

(5) Site characteristics

(a) An accurate site plan, including survey, should be presented at a smaller scale than the locality plan to show appropriate development site details; and

(b) The plan should include the baseline information used to determine the layout including existing topography catchment/drainage information and vegetation.

(c) If the development is to be constructed in stages these should also be shown on the site plan.

(d) Depending on the extent of information available and scale, it may be more appropriate to present a range of plans which show the different site characteristics. These plans can be presented in the appendixes but for ease of assessment the report should not simply refer to separate reports.

(e) Supporting text should include detailed description of the site characteristics and discussion of how proposed clearing/earthworks will influence existing drainage.

(f) A description of the opportunities and constraints (for example, steep topography preventing the application of devices like swales) should also be discussed.

(6) Proposed land uses

As well as presenting information in plan format, land uses should also be presented in tabular form as follows:

Table SC6.4.3.8.4 Proposed land-uses in tabular format

Land type	Area (ha)	Assumed impervious area
Open space/parkland		
Low density residential		
Medium density residential		
High density residential		
Industrial		
Commercial		
Other		
Total/Overall		

(7) Location conditions

The rainfall and soil category will influence treatment location, design and construction and should also be presented.

(8) Design objectives

The report is to identify the stormwater quality management objectives for both the construction phase and post-construction phase (operational-construction phase) of the proposed development.

(9) Strategy description and plan

(a) The proposed treatment strategy should be presented in plan format (with scale bar) showing sub-catchment boundaries (including any untreated areas) and flow paths.

(b) Other aspects critical in explaining the proposed strategy include:

(i) treatment area locations and indicative footprints including allowance for all relevant design;

(ii) requirements, for example, batters, maintenance access and fore bays;

(iii) description of how run-off will be conveyed to treatment systems; and

(iv) confirmation that treatment system can drain (that is, outlet can freely drain).

(c) Sub-catchments should also be presented in tabular form as follows:

Table SC6.4.3.8.5 Sub-catchment in tabular format

Sub-catchment code	Sub-catchment land use category	Treatment ID	Sub-catchment area (ha (% imp))
A			
B			
Total			

The designer should ensure that sub-catchment names (for example, sub-catchment A) and sub-catchment areas noted on the plan also match those presented in the table. Similarly the designer should ensure that the areas match the sub-catchment names and areas modelled. Confirmation that these cross checks have occurred should be noted in the report.

(10) Modelling approach
Reporting the modelling approach should be undertaken in accordance with council's music modelling requirements.

(11) Treatment plans and sections

(a) The tables should be supported by a full layout plan and sections (longitudinal and cross sections) for each stormwater treatment measure showing integration with the existing or proposed drainage system, benching levels (and, if appropriate, standing water, extended detention and peak water levels), bunding and other conceptual features such as, but not limited to, maintenance access, monitoring access (if proposed) and safety precautions (for example, fencing and/ or dense vegetation restricting public access).

(b) For sites with multiple small treatment devices, a full layout plan and a section drawing of a selected representative sample of devices must be provided.

(c) Layout plans should consider the integration of the stormwater treatment measures into the surrounding topography.

(d) These designs must be prepared as preliminary design drawings suitable for the subsequent preparation of detailed civil design drawings for construction.

(e) The design of treatment devices should be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(12) Professional preparation of site based stormwater management plans

(a) It is a requirement that all site based stormwater management plans are prepared by suitably qualified and experienced professionals.

(b) A suitably qualified and experienced professional is defined as a person with the following attributes:

(i) Site Based Stormwater Management Plans (SBMP): relevant tertiary qualifications or equivalent, including being a registered professional Engineer of Queensland (RPEQ).

SC6.4.3.8.6 MUSIC modelling requirements

(1) MUSIC modelling is the standard accepted for modelling for stormwater management for development in Townsville.

(2) The modelling, reporting and assessment methodology presented in the MUSIC Modelling Guidelines is to be applied using local data.

(3) Rainfall, evaporation and pollutant data are to be used from the following sources to ensure that parameter values within the Townsville Local Government Area are regionally relevant to the Townsville environment.

(a) Data for rainfall is to be based on Townsville records for a significant period of time (10 – 20 years) with a range of significant wet and dry periods.

(b) Parameter values for pollutant loads are to be sourced from SC6.4.3.9 Water sensitive urban design guidelines.

(4) Reporting is to specifically outline all parameters used (for example, meteorological data, time step, percentage effective impervious areas, base and stormflow concentration parameters, pollutant reduction efficiencies, treatment node dimensions), either in the body of the report or as an appendix.

(5) The report should record the version of urban stormwater model used.

(6) A digital file containing all relevant modelling files must be provided with the report to enable checking of all modelling calculations by Townsville City Council. The files should include a 'readme' text file, containing a description of the contents and details of any naming conventions used for model files. The checking will also ensure integrity of data to ensure that no parameters have been altered.

(7) Models provided should include:

(a) pre-development condition;

(b) developed site without any stormwater treatment measures; and

(c) developed site with proposed stormwater treatment strategy.

(8) The design of treatment devices should be in accordance with the SC6.4.3.9 Water sensitive urban design guidelines.

(9) Parameters used in the modelling will therefore need to be checked for consistency during design as well as assessment.

(10) A description of the selected stormwater management options should be presented.

(11) This section should include modelling results and dimensions of stormwater treatment measures.

SC6.4.3.8.7 Erosion and sediment control plans

(1) Erosion and sediment control plans (ESCPs) shall contain the following.

(a) Adequate local site data, including soil data, must be obtained to allow the preparation of an appropriate ESCP, and allow the selection, design and specification of required Erosion and sediment control (ESC) measures.

(b) Prior to development of the ESCP, the site must be assessed from a hydrological, hydro-geological, hydraulic, vegetation, soils and geological perspective to determine relevant site constraints that may affect the focus or detail of the plan.

(c) The plan(s) must include all aspects of proposed site disturbance, temporary drainage works, erosion and sediment control measures, installation sequence, and site rehabilitation for the duration of the project, including (where appropriate) the nominated maintenance period.

(d) Generally, an ESCP must address the following issues:

(i) identify the likely need for the construction of sediment basins on the site;

(ii) identify that adequate space has been made available for the construction and operation of major sediment traps and essential flow diversion systems;

(iii) demonstrate that there is a feasible means of constructing the project while still protecting key environmental values;

(iv) identify problem soil areas including, dispersive soils, acid sulfate soils, areas of potential mass movement; and

(v) identify key environmental features on the site such as protected vegetation.

(e) The level of detail supplied in the ESCP must be commensurate with the complexity of the proposal and the assessed environmental risk.

(f) Where appropriate, ESCPs (including supporting documentation) should include, but not be limited to:

(i) north point and plan scale;

(ii) site and easement boundaries and adjoining roadways;

(iii) construction access points;

(iv) site office, car park and location of material stockpiles;

(v) limits of disturbance;

(vi) retained vegetation including protected trees;

(vii) general soil information and location of problematic soils;

(viii) groundwater, and flood-affected areas (50% AEP);

(ix) location of critical environmental values (where appropriate);

(x) existing site contours (unless the provision of these contours adversely impacts the clarity of the ESCP);

(xi) final site contours including locations of cut and fill;

(xii) construction drainage plans for each stage of earthworks, including land contours for that stage of construction, sub-catchment boundaries and location of watercourses;

(xiii) existing and final overland flow drainage paths;

(xiv) location of vegetated buffer strips;

(xv) stabilised entry/exit point (rumble pad);

(xvi) location of soil and sand stockpiles;

(xvii) location of all proposed temporary drainage control measures;

(xviii) location of all proposed erosion control measures (alternatively, use notes to describe locations);

(xix) installation sequence and maintenance requirements;

(xx) permanent site stabilisation measures;

(xxi) a statement of who is responsible for establishing and maintaining all erosion and sediment control measures;

(xxii) general layout and staging of proposed works;

(xxiii) location of all drainage, erosion and sediment control measures;

(xxiv) full design and construction details (such as, cross-sections, minimum channel grades, channel linings) for all drainage and sediment control devices, including diversion channels and sediment basins;

(xxv) site revegetation requirements (if not contained on a separate plan submitted to the assessing authority);

(xxvi) site monitoring and maintenance program, including the location of proposed water quality monitoring stations (if required);

(xxvii) technical notes relating to:

(A) site preparation and land clearing;

(B) extent, timing and application of erosion control measures;

(C) temporary ESC measures installed at end of working day;

(D) temporary ESC measure in case of impending storms, or emergency situations;

(E) installation sequence for ESC measures;

(F) site revegetation and rehabilitation requirements;

(G) application rates (or at least the minimum application rates) for mulching and revegetation measures;

(H) legend of standard symbols used within the plans; and

(I) sediment basin operation and flocculent dosing.

(xxviii) calculation sheets for the sizing of ESC measures;

(xxix) completed ESCP checklist; and

(xxx) any other relevant information council may require to properly assess the ESCP.

(g) If the timing of the proposed construction activities are not known during development of the ESCP, and if rainfall erosivity varies significantly throughout the year, then the erosion control specifications placed on the ESCP must specify appropriate erosion control measures for each level of rainfall erosivity. Refer to SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction.

(h) The timing of works and the installation of control measures has a major influence on the management of stormwater. As such, the installation sequence must be considered generally as outlined below.

(i) establish a single stabilised entry/exit point (rumble pad);

(ii) install sediment fence(s) along the low side of the site;

(iii) divert up-slope water around or through the work site and appropriately stabilise any drainage channels;

(iv) clear only those areas necessary for building or construction work to occur;

(v) stockpile topsoil within the sediment-control zone;

(vi) stabilise exposed earth banks e.g. vegetation, erosion control blankets;

(vii) install on-site waste receptacles e.g. mini-skips, bins, reo cages. These should be covered to prevent waste being moved by wind;

(viii) commence building activities;

(ix) install roof downpipes as soon as practicable after the roof is laid;

(x) maintain all control measures in good working order; and

(xi) revegetate or otherwise stabilise the site.

(i) An ESCP is required to be approved by council prior to the commencement of any work or activity, including land clearing (except as allowed under for the purposes of ground survey, geotechnical investigation, or other recognised essential purposes), provided the work is:

(i) consistent with state and council vegetation protection and/or preservation requirements and/or policies; and

(ii) undertaken so that the ground surface is not disturbed and at least 150mm stubble remains on the surface (where such a stubble exists prior to clearing); or

(iii) to provide site access via the minimum practicable number of site access corridors.

(j) Erosion and sediment control management plans (ESCMP) shall be scaled drawings (no larger than 1:1000) with detailed specifications/diagrams which can be readily understood and applied on site by supervisory staff.

(k) All drawings/plans shall be prepared in accordance with SC6.4.2 Development application guidelines and good drafting principles.

(2) Professional ESCP sign-off

(a) The ESCP must clearly state that no land-disturbing activities on the site shall occur until all perimeter ESC measures, sediment basins, and associated temporary drainage controls, have been constructed in accordance with best practice erosion and sediment control.

(b) It is a requirement that all ESCPs are signed by suitably qualified and experienced professional. A suitably qualified and experienced professional is defined as a person with the following attributes:

(i) design phase (ESCP) - relevant tertiary qualification or satisfies at least one of the following 3 criteria:

(A) Statement of Attainment from a Townsville City Council 5 or 6 Day Course (Erosion and Sediment Control Planning for North Queensland); or

(B) Certified Professional in Erosion and Sediment Control (CPESC); or

(C) holds a qualification which is equivalent to either of the above and is accepted by council.

(ii) construction phase (ESCP): relevant tertiary qualifications or satisfies at least one of the following criteria:

(A) holds a Statement of Attainment from a Townsville City Council 2 Day Course (Erosion and Sediment Control for Site Supervisors); or

(B) holds a qualification which is equivalent to the above and is accepted by council; or

(iii) operational phase (WSUD):

(A) relevant tertiary qualifications or a Statement of Attainment from a Townsville City Council 2 day course (Water sensitive urban design for Site Supervisors).

(B) holds a qualification which is accepted by council.

Editor's note—Statement of Attainment from a Townsville City Council 2 Day Course (Water sensitive urban design for Site Supervisors) is a course currently being developed by TCC.

(c) When signing-off on an ESCP, the signatory is deemed to be making the following statements:

(i) the ESCP satisfies the intent and design/performance standards established by all relevant local, state and federal policies relating to erosion and sediment control;

(ii) the ESCP has been reviewed and approved by personnel suitably trained and experienced (to a degree appropriate for the given type and size of the land disturbance) in each of the following categories: construction, soil science, hydrology/hydraulics, and site revegetation/rehabilitation;

(iii) the ESCP is both reasonable and practicable; and

(iv) the ESCP contains sufficient information to allow the appropriate implementation of the plans.

(d) ESCPs that incorporate a sediment basin with a constructed earth embankment with a height greater than 1m, must be signed-off by a geotechnical specialist.

(e) The approved ESCP must be available on-site for inspection by council officers while work activities are occurring.

(3) Should the development be commenced and not completed within 12 months of approval of the ESCP, a revised ESCP must be prepared, with further revisions thereafter at half-yearly intervals. For master planned developments this requirement applies for the ESCPs for each stage.

(4) Additional erosion and sediment control measures are implemented, and a revised ESCP is submitted for approval (within five business days of any such amendments) in the event that:

(a) there is a high probability that serious or material environmental harm may occur as a result of sediment leaving the site; or

(b) the implemented works fail to achieve the local government ESC standard/code, or state environmental protection requirements; or

(c) site conditions significantly change; or

(d) site inspections indicate that the implemented works are failing to achieve the "objective" of the ESCP.

(5) In circumstances where it is considered necessary to prepare an amended ESCP, and the preparation of the amended ESCP is not imminent, then all necessary new or modified erosion and sediment control measures

must be implemented in accordance with current best practice:

(a) in circumstances where there is significant risk of environmental harm, then upon receipt of the amended ESCP, all works must be implemented in accordance with the revised plan;

(b) otherwise, only upon approval of the amended ESCP by the assessing authority shall works be implemented in accordance with the amended plan; and

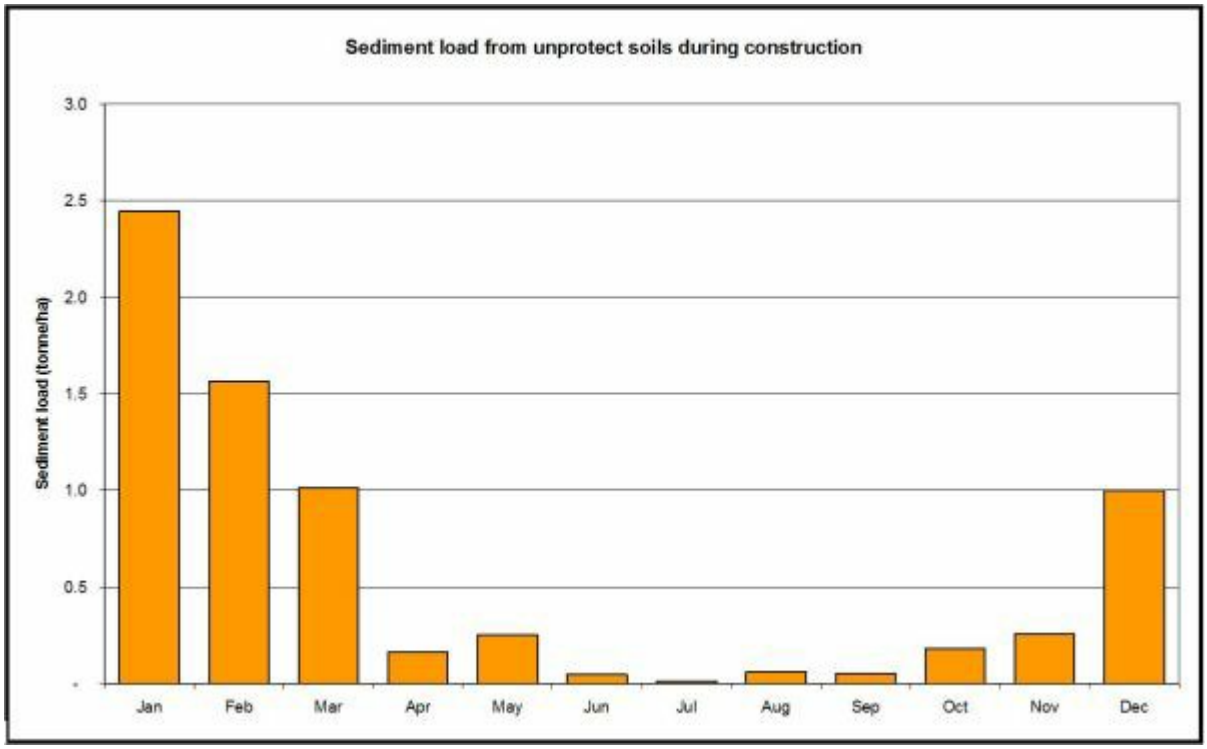
(c) a copy of the amended ESCP must be forwarded to council within 5 business days of any such amendments.

(6) The design standard of erosion and sediment control must be commensurate with the degree of environmental risk associated to the proposed works.

(7) All erosion and sediment control measures, including temporary drainage control measures, must be designed in accordance with the design standards in SC6.4.4.4 Stormwater drainage design.

(8) The ESCP must incorporate “hold points” (where appropriate) detailing critical performance indicators of the various elements of the ESCP. The development must not be allowed to proceed without adherence to designated hold points at specified times.

SC6.4.3.8 Attachment A: Background information - Sediment load from unprotected soils during construction



Month	Sediment (Tonnes/hectare)	% yearly load			
Jan	2.40	32.9			Very high risk
Feb	1.60	21.9			
Mar	1.00	13.7			
Apr	0.20	2.7			Low to moderate risk
May	0.30	4.1			
Jun	0.10	1.4			
Jul	0.00	0			
Aug	0.10	1.4			
Sep	0.10	1.4			
Oct	0.20	2.7			
Nov	0.30	4.1			
Dec	1.00	13.7			
	7.30	100			

Source: Extrapolated from *Black Ross Water Quality Improvement Plan.*

SC6.4.3.9 Water sensitive urban design guidelines

SC6.4.3.9.1 Introduction

(1) Water By Design's *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland*, Version 1, 2006 (or as amended), are adopted, with the following exclusions:

(a) Chapter 1 Introduction

(b) Chapter 6 Constructed Stormwater Wetlands.

Note—Chapter 3 Bioretention Swales, Chapter 5 Bioretention Basins, and Appendix A Plant Selection for WSUD Systems, which formed part of the original version of the Technical Design Guidelines, have been superseded by Healthy Waters' *Bioretention Technical Design Guidelines (Version 1, October 2012)*. The *Bioretention Technical Design Guidelines* are **not** being adopted.

(2) The following sections – Introducing water sensitive urban design, Bioretention swales, Bioretention basins, Constructed stormwater wetlands, and Appendix A Plant selection for water sensitive urban design systems - have been developed specifically for the coastal dry tropic conditions found in the Townsville area, and replace those equivalent sections in the *Water Sensitive Urban Design Technical Design Guidelines for South East Queensland* (and the superseded parts that form the *Bioretention Technical Design Guidelines*).

(3) References to chapters and sections in this sub-section refer to the chapters and sections in the *Water Sensitive Urban Design Guidelines for South East Queensland*.

SC6.4.3.9.2 Introducing water sensitive urban design

(1) Water sensitive urban design (WSUD) is an internationally recognised concept that offers an alternative to traditional development practices. WSUD is a holistic approach to the planning and design of urban development that aims to minimise negative impacts on the natural water cycle and protect the health of aquatic ecosystems. It promotes the integration of stormwater, water supply and sewage management at the development scale.

The key principles of WSUD are to:

(a) protect existing natural features and ecological processes;

(b) maintain the natural hydrologic behaviour of catchments;

(c) protect water quality of surface and ground waters;

(d) minimise demand on the reticulated water supply system;

(e) minimise sewage discharges to the natural environment; and

(f) integrate water into the landscape to enhance visual, social, cultural and ecological values.

These guidelines are not intended to limit innovation in design or construction of WSUD elements by restricting alternative approaches to those presented here. Alternative designs should be considered where potential improvements in performance, constructability or maintenance requirements can be demonstrated. However, the design procedures and recommendations given in these guidelines are based on contemporary best practice, incorporating lessons from local experience, and are regarded as appropriate for the coastal dry tropics region.

(2) Design objectives for stormwater management
The adopted design objectives for the coastal dry tropics in mean annual pollutant load leaving a development site, compared to traditional urban design where stormwater is not treated:

(a) >= 80% reduction in total suspended solids load

(b) >= 65% reduction in total phosphorus load

(c) >= 40% reduction on total nitrogen load

(d) >= 90% reduction in gross pollutant load.

Editor's note—this sub-section contains illustrations and photographs of stormwater treatment devices. These are intended as examples only and should not be regarded as acceptable solutions. Unless specifically indicated, all drawings are not to scale.

(3) Selection of appropriate stormwater management measures

(a) Not all of the stormwater management measures presented in this sub-section are suitable for any given site. Appropriate measures should be selected by matching device characteristics to target pollutants and the physical constraints of the site.

(b) These guidelines are not intended to provide detailed advice on selection of stormwater treatment devices. However, the following tables provide an indication of:

(i) the scale at which various treatment measures are typically applied (Table SC6.4.3.9.1);

Table SC6.4.3.9.1 Scale of WSUD application in urban catchments

WSUD Measure	Allotment Scale	Street Scale	Precinct or Regional Scale
Swales and buffer strips		✓	
Bioretention Swales		✓	✓
Sedimentation basins			✓
Bioretention basins	✓	✓	✓
Constructed wetlands		✓	✓
Infiltration measures	✓	✓	
Sand filters	✓	✓	
Aquifer storage and recovery			✓

(ii) the effectiveness of these treatment measures in removing pollutants, attenuating peak flow rates and reducing runoff volume (Table SC6.4.3.9.2); and

Table SC6.4.3.9.2 Effectiveness of WSUD measures for runoff quality and quantity management

WSUD Measure Water	Quality Treatment			Peak Flow Attenuation*	Reduction in Runoff Volume*
	TSS	TP	TN		
Swales and buffer strips	H	M	L	L	L
Bioretention Swales	H	H	H	M	L
Sedimentation basins	H	M	L	M	L
Bioretention basins	H	H	H	M	L
Constructed wetlands	H	H	H	H	L
Infiltration measures**	-	-	-	H	H
Sand filters	H	M	L	L	L
Aquifer storage and recovery**	-	-	-	H	H

H – High; M – Medium; L – Low * Frequent events only ** Water quality treatment is not a primary function of these devices

(iii) site conditions that may affect the suitability of different treatment measures (Table SC6.4.3.9.3).

Table SC6.4.3.9.3 Site constraints for WSUD measures

WSUD Measure	Steep site (>5%)	Shallow bedrock	Acid Sulfate Soils	Low permeability soil (eg. Clay)	High permeability soil (eg. sand)	High water table	High sediment input	Land availability
Swales and buffer strips	C	D	D	✓	✓	D	D	D
Bioretention Swales	C	C	C	✓	✓	C	D	D
Sedimentation basins	C	✓	✓	✓	✓	D	✓	D
Bioretention basins	D	D	D	✓	✓	C	C	D
Constructed wetlands	C	D	C	✓	D	D	D	D
Infiltration measures	C	C	C	C	✓	C	C	D
Sand filters	D	✓	✓	✓	✓	D	C	✓
Aquifer storage and recovery	C	C	C	C	✓	C	C	D

C – Constraint may preclude use; D – Constraint may be overcome through appropriate design; ✓ – Generally not a constraint

(4) Safety and risk management

(a) WSUD aims to protect the environmental assets of a site and enhance liveability through greater integration of built and natural features. This approach may introduce some risks to the urban environment that are greater than or different to those encountered in traditional land development practice. The more obvious of these risks relate to the presence of open water bodies and the introduction of street-scape elements that may alter lines of sight or other aspects of traffic safety.

(b) Whilst this sub-section makes occasional comment on various aspects of safety, they are not intended to provide comprehensive advice on appropriate risk management strategies. Designers are responsible for providing an appropriate level of public safety in their designs and for ensuring that risk management procedures, in accordance with relevant standards and guidelines, are followed. Further information on risk management for water-related urban infrastructure is provided in the *Queensland Urban Drainage Manual*.

SC6.4.3.9.3 Bioretention swales

(1) Bioretention swales act to disconnect impervious areas from downstream waterways and provide protection to natural receiving waterways from frequent storm events by reducing flow velocities compared with piped systems. The bioretention component is typically located at the downstream end of the overlying swale “cell” (i.e. immediately upstream of the swale overflow pit(s) as shown in Figure SC6.4.3.9.1.

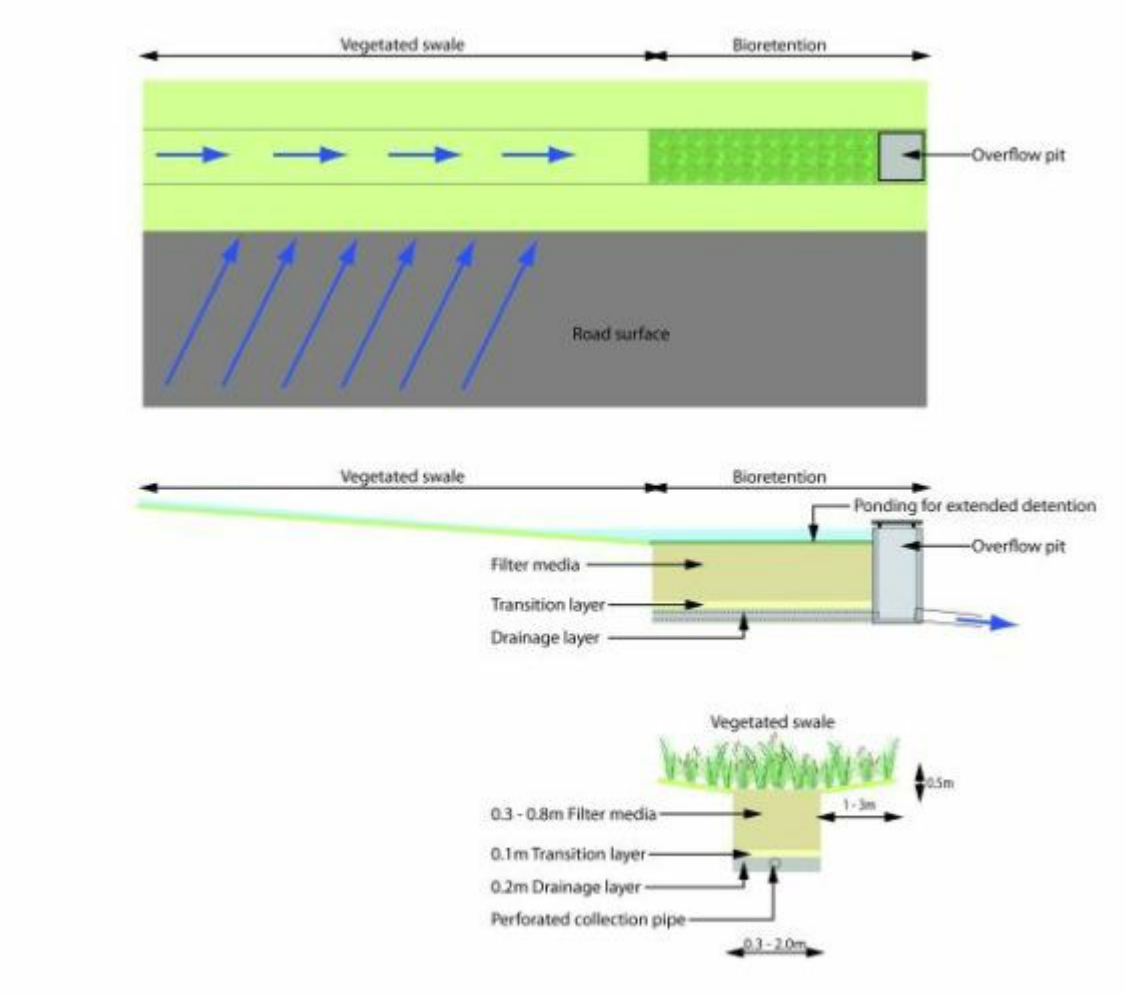


Figure SC6.4.3.9.1 Bioretention swale conceptual layout

The choice of bioretention location within the overlying swale will depend on a number of factors, including area available for the bioretention filter media and the maximum batter slopes for the overlying swale. Typically, when used as a continuous trench along the full length of a swale, the desirable maximum longitudinal grade of the swale is 4%. For other applications, the desirable grade of the bioretention zone is either horizontal or as close as possible to encourage uniform distribution of stormwater flows over the full surface area of bioretention filter media and allowing temporary storage of flows for treatment before bypass occurs.

(2) Design considerations for bioretention swales

(a) This section outlines some of the key design considerations for bioretention swales that the detailed designer should be familiar with before applying the design procedure presented later in this chapter. Standard design considerations for the swale component of bioretention swales are discussed in detail in Chapter 2 (Swales) and are not reproduced here. However, other swale design considerations that relate specifically to the interactions between the swale and bioretention components are presented in the following sections together with design considerations relating specifically to the bioretention component.

(i) Landscape design

Bioretention swales may be located within parkland areas, easements, car parks or along roadway corridors within footpaths (i.e. road verges) or centre medians. Landscape design of bioretention swales along the road edge can assist in defining the boundary of road or street corridors as well as providing landscape character and amenity. It is therefore important that the landscape design of bioretention swales addresses stormwater quality objectives whilst also being sensitive to these other important landscape functions. It is also necessary to adequately address potential aesthetics issues such as weeds and sustaining perennial plants during the dry season.

(i) Hydraulic design

A key hydraulic design consideration for bioretention swales is the delivery of stormwater runoff from the swale onto the surface of a bioretention filter media. Flow must not scour the bioretention surface and needs to be uniformly distributed over the full surface area of the filter media. In steeper areas, check dams may be required along the swale to reduce flow velocities discharged onto the bioretention filter media.

It is important to ensure that velocities in the bioretention swale from both minor (2-10 year ARI) and major (50-100 year ARI) runoff events are kept sufficiently low (preferably below 0.5 m/s and not more than 2.0 m/s for major flood) to avoid scouring. This can be achieved by ensuring the slope and hydraulic roughness of the overlying swale reduce flow velocities by creating shallow temporary ponding (i.e. extended detention) over the surface of the bioretention filter media via the use of a check dam and raised field inlet pits. This may also increase the overall volume of stormwater runoff that can be treated by the bioretention filter media.

(iii) Ex-filtration to in-situ soils

Bioretention swales can be designed to either preclude or promote ex-filtration of treated stormwater to the surrounding in-situ soils depending on the overall stormwater management objectives established for the given project.

Where the concept design specifically aims to preclude ex-filtration of treated stormwater runoff it is necessary to consider if the bioretention swale needs to be provided with an impermeable liner. The amount of water lost from bioretention trenches to surrounding in-situ soils is largely dependent on the characteristics of the local soils and the saturated hydraulic conductivity of the bioretention filter media (see SC6.4.3.9.3(2)(a)(iii)).

If the selected saturated hydraulic conductivity of the bioretention filter media is less than 10 times that of the native surrounding soils, it may be necessary to provide an impermeable liner. Flexible membranes or a concrete casting are commonly used to prevent excessive ex-filtration. This is particularly applicable for surrounding soils that are very sensitive to any ex-filtration (e.g. sodic soils and reactive clays in close proximity to significant structures such as roads).

The greatest pathway of ex-filtration is through the base of a bioretention trench, as gravity and the difference in hydraulic conductivity between the filter media and the surrounding native soil would typically act to minimise ex-filtration through the walls of the trench. If lining is required, it is likely that only the base and the sides of the drainage layer (refer to SC6.4.3.9.3(2)(a)(iii)) will need to be lined.

Where ex-filtration of treated stormwater to the surrounding in-situ soils is promoted by the bioretention swale concept design, it is necessary to ensure the saturated hydraulic conductivity of the in-situ soils is at least equivalent to that of the bioretention filter media, thus ensuring no impedance of the desired rate of flow through the bioretention filter media. Depending on the saturated hydraulic conductivity of the in-situ soils it may be necessary to provide an impermeable liner to the sides of the bioretention filter media to prevent horizontal ex-filtration and subsequent short-circuiting of the treatment provided by the filter media. Bioretention trenches promoting ex-filtration do not require perforated under-drains at the base of the filter media or a drainage layer.

A subsurface pipe is often used to prevent water intrusion into a road sub-base. This practice is to continue as a precautionary measure to collect any water seepage from bioretention swales located along roadways.

(iv) Vegetation types

Bioretention swales can use a variety of vegetation types including turf (swale component only), sedges and tufted grasses. Vegetation is required to cover the whole width of the swale and bioretention filter media surface, be capable of withstanding design flows and be of sufficient density to prevent preferred flow paths and scour of deposited sediments.

Grassed (turf) bioretention swales can be used in residential areas where a continuous bioretention

trench approach is used. The preferred vegetation for the bioretention component of bioretention swales is therefore sedges and tufted grasses (with potential occasional tree plantings) that do not require mowing.

The denser and taller the vegetation planted in the bioretention filter media, the better the treatment provided, especially during extended detention. Taller vegetation has better interaction with temporarily stored stormwater during ponding, which results in enhanced sedimentation of suspended sediments and associated pollutants. The vegetation that grows in the bioretention filter media also acts to continuously break up the surface of the media through plant root growth and wind induced agitation, which prevents surface clogging. Vegetation also provides a substrate for biofilm growth in the upper layer of the filter media which facilitates biological transformation of pollutants (particularly nitrogen).

To maintain aesthetics in highly visible areas supplemental irrigation may be required to sustain vegetation. The incorporation of saturated zones beneath the bioretention filter media can help to sustain soil moisture and is beneficial for nitrogen removal from stormwater. The ability to sustain dense perennial vegetation is important for long term weed management.

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides more specific guidance on the selection of appropriate vegetation for bioretention swales.

(v) Bioretention filter media

Selection of an appropriate bioretention filter media is a key design step involving consideration of three inter-related factors:

(A) saturated hydraulic conductivity required to optimise the treatment performance of the bioretention component given site constraints on available filter media area;

(B) depth of extended detention provided above the filter media; and

(C) suitability as a growing media to support vegetation growth (i.e. retaining sufficient soil moisture and organic content).

The area available for bioretention swales in an urban layout is often constrained by factors such as the available area within the footpaths of standard road reserves. Selecting bioretention filter media for bioretention swale applications in the coastal dry tropics will often require careful consideration of saturated hydraulic conductivity and extended detention depth to ensure the desired minimum volume of stormwater runoff receives treatment. This must also be balanced with the requirement to also ensure the saturated hydraulic conductivity does not become too high such that it can no longer sustain healthy vegetation growth. The maximum saturated hydraulic conductivity should not exceed 500 mm/hr (and preferably be between 50 - 200 mm/hr) in order to sustain vegetation growth.

The concept design stage will have established the optimal combination of filter media saturated hydraulic conductivity and extended detention depth using a continuous simulation modelling approach (such as MUSIC). Any adjustment of either of these two design parameters during the detailed design stage will require the continuous simulation modelling to be re-run to assess the impact on the overall treatment performance of the bioretention system.

As shown in Figure SC6.4.3.9.2 below, bioretention media can consist of three or four layers. In addition to the filter media required for stormwater treatment, a saturated zone can also be added to enhance nitrogen removal and to provide a source of water for vegetation over the dry season. A drainage layer is also required to convey treated water from the base of the filter media or saturated zone into the perforated under-drains. The drainage layer surrounds the perforated under-drains and can be either coarse sand (1 mm) or fine gravel (2-5 mm). If fine gravel is used, a transition layer of sand must also be installed to prevent migration of the filter or saturated zone media into the drainage layer and subsequently into the perforated under-drains.

(vi) Saturated zone

The saturated zone design involves a relatively simple modification to a conventional bioretention system. An additional layer located below the filter media is designed to retain stormwater providing a saturated zone at the base of the bioretention system. A saturated zone can be formed by using a riser pipe with the outlet level higher than the drainage layer or by incorporating a weir within the outlet pit. The saturated zone holds water and therefore provides a source of water to maintain soil moisture for plant uptake during dry periods.

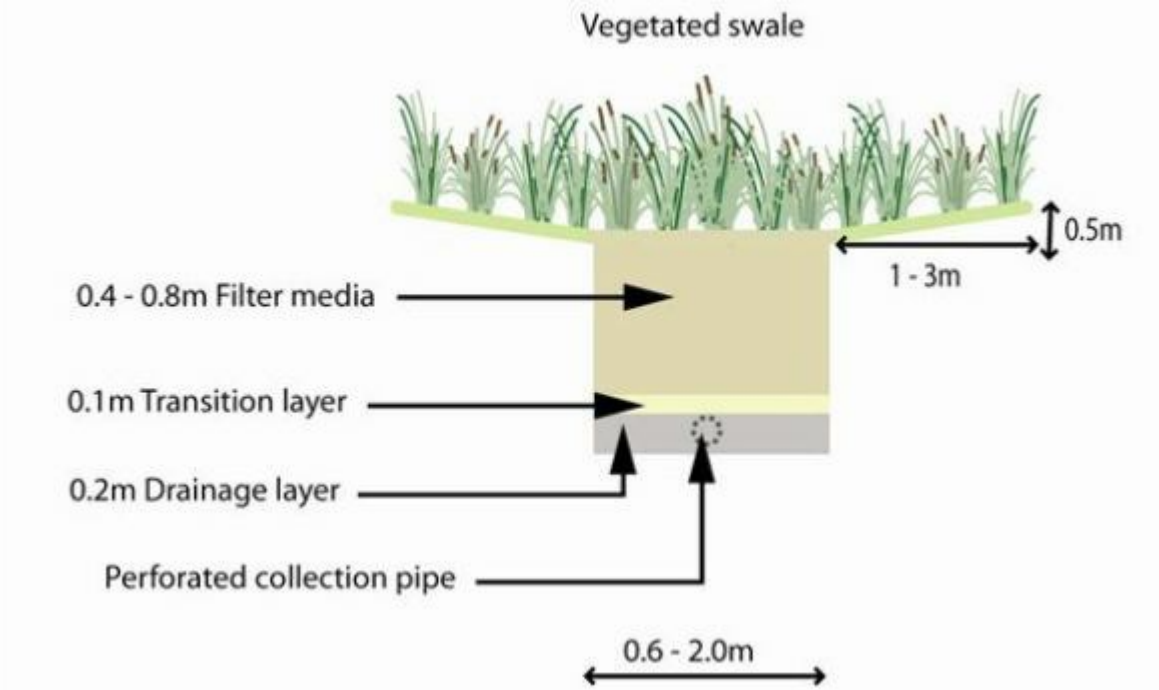


Figure SC6.4.3.9.2 Typical section of a bioretention swale

(vii) Traffic controls

Another design consideration is keeping traffic and building material deliveries off swales, particularly during the building phase of a development.

A staged construction and establishment method (SC6.4.3.9.3(5) Construction and establishment - bioretention swales) affords protection to the sub-surface elements of a bioretention swale from heavily sediment laden runoff during the subdivision construction and allotment building phases. However, to prevent vehicles driving on bioretention swales and inadvertent placement of building materials, it is necessary to consider appropriate traffic control solutions as part of the system design. These can include temporary fencing of the swale during the subdivision construction and allotment building phases with signage erected to alert builders and contractors of the purpose and function of the swales. Kerb and channel should be used at all corners, intersections, cul-de-sac heads and at traffic calming devices to ensure correct driving path is taken. For all of these applications, the kerb and channel is to extend 5 m beyond tangent points.

(viii) Roof water discharge

Roof runoff can contain a range of stormwater pollutants including nitrogen washed from the atmosphere during rainfall events. Roof water should be discharged onto the surface of the swale for subsequent conveyance and treatment by the swale (and downstream treatment measures) before being discharged to receiving aquatic environments. Depending on the depth of the roof water drainage system and the finished levels of the bioretention swale, this may require the use of a small surcharge pit located within the invert of the swale to allow the roof water to surcharge to the swale. Any residual water left in the surcharge pit can be discharged to the underlying subsoil drainage by providing perforations in the base and sides of the surcharge pit. If a surcharge pit is used then an inspection chamber along the roof water drainage line is to be provided within the property boundary. Surcharge pits are discussed further in SC6.4.3.9.3(3)(d)(ii) Concentrated inflow.

(ix) Services

Bioretention swales located within footpaths (i.e. road verges) must consider the standard location for services within the verge and ensure access for maintenance of services. Typically it is acceptable to have water and sewer services located beneath the batters of the swale with any sewers located beneath bioretention swales to be fully welded polyethylene pipes with rodding points.

(3) Bioretention swale design process

(a) Step 1: Confirm treatment performance of concept design

This design process assumes a conceptual design has been undertaken. Before commencing detailed design, the designer should first undertake a preliminary check to confirm the bioretention swale treatment area from the concept design is adequate to deliver the required level of stormwater quality improvement. This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in an appropriate quantitative modelling program. This modelling must be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows for the swale component

(i) Design flows

Two design flows are required for the design of a swale:

(A) minor flood flow (2 year ARI) to allow minor floods to be safely conveyed. For commercial and industrial areas the design flow requirement for minor flows is a 5 year ARI event.

(B) major flood flow (100 year ARI) to check flow velocities, velocity depth criteria, conveyance within road reserve, and freeboard to adjoining property.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. As the typical catchment area should be relatively small (<50 ha) the Rational Method design procedure is considered to be a suitable method for estimating design peak flows.

(c) Step 3: Dimension the swale component with consideration to site constraints

Factors to consider are:

(i) allowable width given the proposed road reserve and/ or urban layout;

(ii) how flows are delivered into a swale (e.g. cover requirements for pipes or kerb details);

(iii) vegetation height;

(iv) longitudinal slope;

(v) maximum side slopes and base width;

(vi) provision of crossings (elevated or at grade); and

(vii) requirements of QUDM and Townsville City Plan.

Depending on which of the above factors are fixed, the other variables can be adjusted to derive the optimal swale dimensions for the given site conditions. The following sections outline some considerations in relation to dimensioning a swale.

(i) Swale width and side slopes

Where the swale width is not constrained by an urban layout (e.g. when located within a large parkland area) then the width of the swale can be selected based on consideration of landscape objectives, maximum side slopes for ease of maintenance and public safety, hydraulic capacity required to convey the desired design flow, and treatment performance requirements. The maximum swale width needs to be identified early in the design process as it dictates the remaining steps in the swale design process. Selection of appropriate sideslopes for swales in parks, easements or median strips is heavily dependent on site constraints, and swale side slopes are typically between 1 in 10 and 1 in 4.

For swales located adjacent to roads, the types of driveway crossing used will typically dictate batter slopes. Where there are no driveway crossings, the maximum swale side slopes will be established for ease of maintenance and public safety considerations. Generally “at-grade”

crossings, are preferred which require the swale to have 1:9 side slopes with a nominal 0.5 m flat base to provide sufficient transitions to allow for traffic movement across the crossing. Flatter swale side slopes can be adopted but this will reduce the depth of the swale and its conveyance capacity. Where “elevated” crossings are used, swale side slopes would typically be between 1 in 6 and 1 in 4. “Elevated” crossings will require provision for drainage under the crossings with a culvert or similar.

(ii) Maximum length of a swale

The maximum length of a swale located within parkland areas and easements is calculated as the distance along the swale to the point where the flow in the swale from the contributing catchment (for the specific design flood frequency) exceeds the bank full capacity of the swale. For example, if the swale is to convey the minor flood flow (1-5 year ARI) without overflowing, then the maximum swale length would be determined as the distance along the swale to the point where the 1-5 year ARI flow from the contributing catchment is equivalent to the bank full flow capacity of the swale (bank full flow capacity is determined using Manning’s equation as discussed in SC6.4.3.9.3(3)(c) (iii) Swale capacity).

(iii) Swale capacity – Manning’s Equation and selection of Manning’s *n*

To calculate the flow capacity of a swale, use Manning’s equation. This allows the flow rate and flood levels to be determined for variations in swale dimensions, vegetation type and longitudinal grade.

$$Q = \frac{A \cdot R^{2/3} \cdot S^{1/2}}{n}$$

Where A = cross section area of swale (m^2)
R = hydraulic radius (m)
S = channel slope (m/m)
N = roughness factor (Manning’s *n*)

Figure SC6.4.3.9.3 shows a plot of Manning’s *n* versus flow depth for a grass swale with longitudinal grade of 5 %. It is reasonable to expect the shape of the Manning’s n relation with flow depth to be consistent with other swale configurations, with the vegetation height at the boundary between low flows and intermediate flows (Figure SC6.4.3.9.3) on the top axis of the diagram. The bottom axis of the plot has been modified from Barling and Moore (1993) to express flow depth as a percentage of vegetation height.

Further discussion on selecting an appropriate Manning’s n for a swale is provided in Appendix E of the MUSIC User Guide (CRCCH 2005).

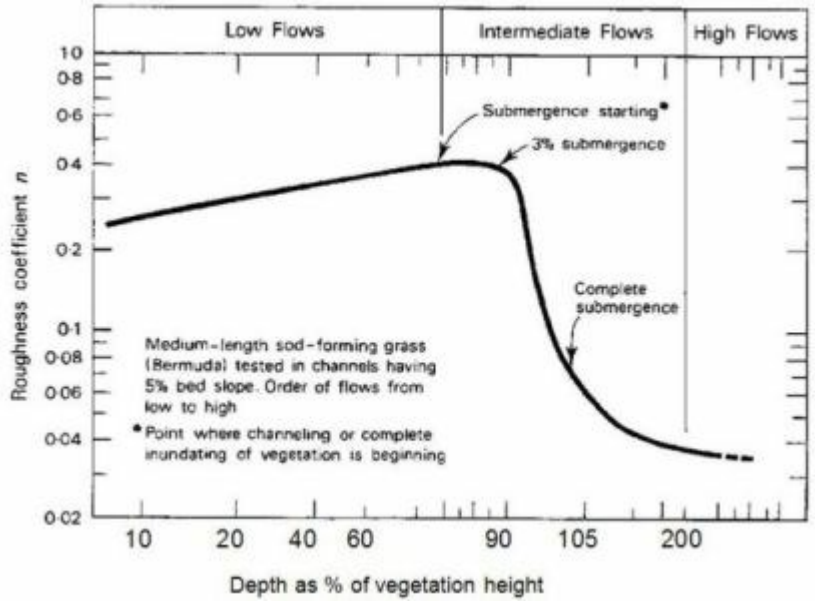


Figure SC6.4.3.9.3 Impact of flow depth on hydraulic roughness (adapted from Barling and Moore (1993))

(d) Step 4: Design inflow systems to swale and bioretention components

Inflows to bioretention swales can be via distributed runoff (e.g. from flush kerbs on a road) or point outlets such as pipe outfalls. Combinations of these inflow pathways can also be used.

(i) Distributed inflow

An advantage of flows entering a bioretention swale system in a distributed manner (i.e. entering perpendicular to the direction of the swale) is that flow depths are kept as shallow sheet flow, which maximises contact with the swale and bioretention vegetation, particularly on the batter receiving the distributed inflows. This swale and bioretention batter is often referred to as a buffer (see Figure SC6.4.3.9.4). The requirement of the buffer is to ensure there is dense vegetation growth, flow depths are shallow (below the vegetation height) and erosion is avoided. The buffer provides good pre-treatment (i.e. significant coarse sediment removal) prior to flows being conveyed along the swale.

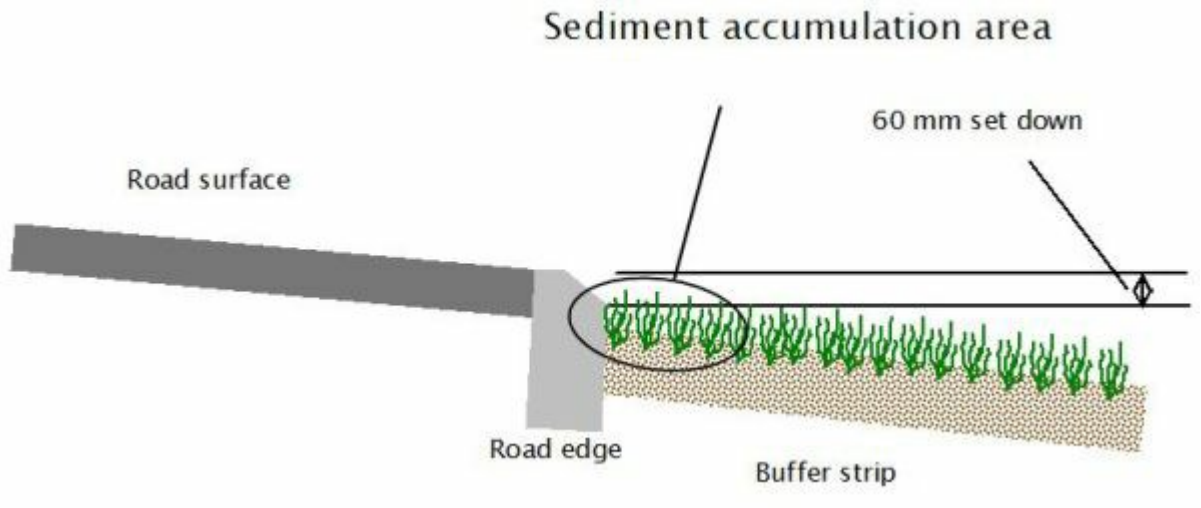


Figure SC6.4.3.9.4 Flush kerb with 60 mm setdown to allow sediment to flow into vegetated area

Distributed inflows can be achieved either by having a flush kerb or by using kerbs with regular breaks in them to allow for even flows across the buffer surface (Figure SC6.4.3.9.5).

Figure SC6.4.3.9.5 Kerb arrangements with breaks and flush kerbs to distribute inflows on to bioretention swales and prevent vehicle access

Key design parameters of buffer systems are:

(A) providing distributed flows into a buffer (potentially spreading stormwater flows to achieve this);

(B) avoiding rilling or channelised flows;

(C) maintaining flow heights lower than vegetation heights (this may require flow spreaders, or check dams); and

(D) minimising the slope of buffer, best if slopes can be kept below 5%.

Maintenance of buffers is required to remove accumulated sediment and debris therefore access is important. It is important to ensure coarse sediments accumulate off the road surface at the start

of the buffer. Figure SC6.4.3.9.6 shows sediment accumulating on a street surface where the vegetation is the same level as the road. To avoid this accumulation, a tapered flush kerb must be used that sets the top of the vegetation 60 mm which requires the top of the ground surface (before turf is placed) to be approximately 100 mm below the road surface. This allows sediments to accumulate off any trafficable surface.

Figure SC6.4.3.9.6 Flush kerb without setdown, showing sediment accumulation on road

(ii) Concentrated inflow

Concentrated inflows to a bioretention swale can be in the form of a concentrated overland flow or a discharge from a piped drainage system (e.g. allotment drainage line). For all concentrated inflows, energy dissipation at the inflow location is required to minimise any erosion potential. This can usually be achieved with rock benching and/ or dense vegetation.

The most common constraint on pipe systems discharging to bioretention swales is bringing the pipe flows to the surface of a swale. In situations where the swale geometry does not allow the pipe to achieve “free” discharge to the surface of the swale, a “surcharge” pit may be used but should be avoided where possible.

Surcharge pit systems are most frequently used when allotment runoff is required to cross a road into a swale on the opposite side of the road or for allotment runoff discharging into shallow profile swales. Where allotment runoff needs to cross under a road to discharge to a swale, it is preferable to combine the runoff from more than one allotment to reduce the number of crossings required under the road pavement. Figure SC6.4.3.9.7 illustrates a typical surcharge pit discharging into a swale.

Another important form of concentrated inflow in a bioretention swale is the discharge from the swale component into the bioretention component, particularly where the bioretention component is located at the downstream end of the overlying swale and receives flows concentrated within the swale. Depending on the grade, its top width and batter slopes, the resultant flow velocities at the transition from the swale to the bioretention filter media may require the use of energy dissipation to prevent scour of the filter media (if flow velocities > 0.5 m/sec). For most cases, this can be achieved by placing several large rocks in the flow path to reduce velocities and spread flows. Energy dissipaters located within footpaths must be designed to ensure pedestrian safety.

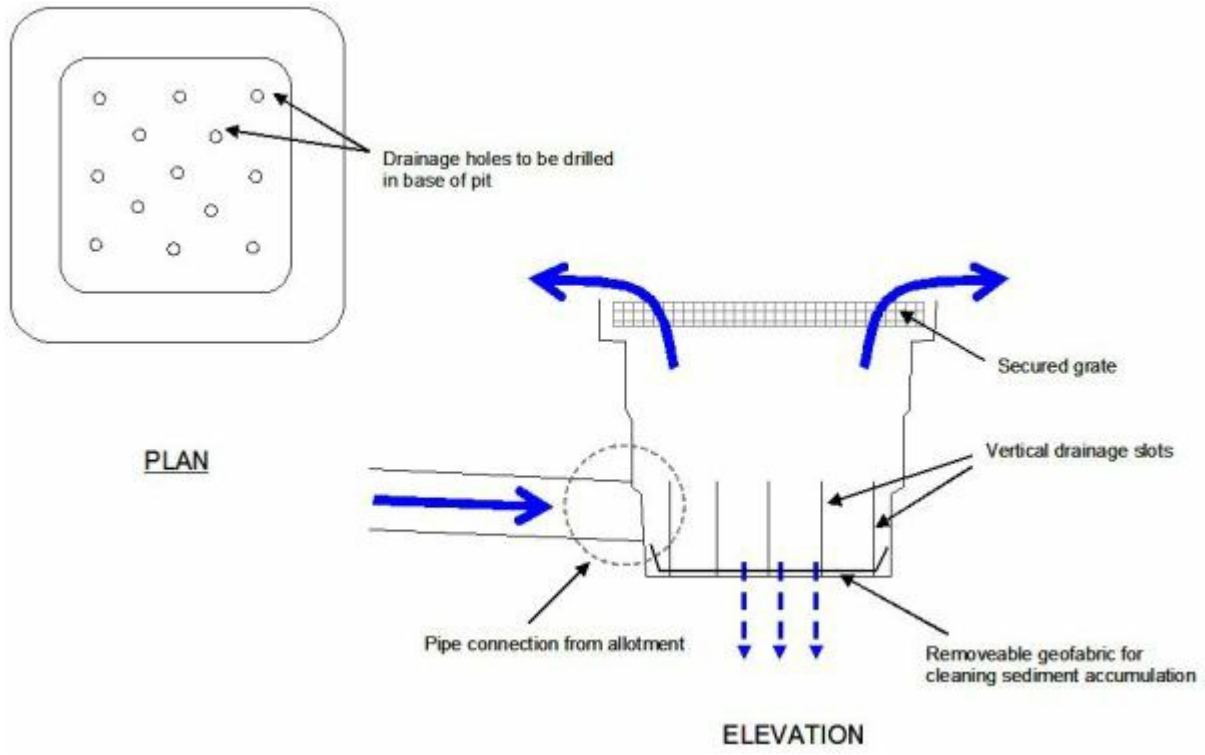


Figure SC6.4.3.9.7 Example of surcharge pit for discharging allotment runoff into a swale

(e) Step 5: Design bioretention component

(i) Select filter media saturated hydraulic conductivity and extended detention

Where design Steps 2 and 3 (SC6.4.3.9.3(3)(b) and SC6.4.3.9.3(3)(c)) reveal that the swale geometry derived during the concept design stage does not comply with the relevant local road drainage design standards and/or the standards established in QUDM for minor flood and major flood flows on adjoining road pavements and minimum freeboard requirements to adjoining properties, it is necessary to revise the swale geometry. As such, an alternative dimension for the surface area of the bioretention component may result and this may require further quantitative modelling to determine the “new” optimal combination of filter media saturated hydraulic conductivity and extended detention depth to maximise the water quality treatment function of the bioretention component.

(ii) Specify the bioretention filter media characteristics

Three to four types of media can be required in the bioretention component of bioretention swales (refer Figure SC6.4.3.9.2).

Filter media

The filter media layer provides the majority of the pollutant treatment function, through fine filtration and also by supporting vegetation. The vegetation enhances filtration, keeps the filter media porous, provides substrate for biofilm formation and provides some uptake of nutrients and other stormwater pollutants. As a minimum, the filter media is required to have sufficient depth to support vegetation. Typical depths are between 600-1000 mm with a minimum depth of 300 mm accepted in depth constrained situations. It is important to note that if deep rooted plants such as trees are to be planted in bioretention swales, the filter media must have a minimum depth of 800 mm to avoid roots interfering with the perforated under-drain system.

The saturated hydraulic conductivity of the filter media is established by optimising the treatment performance of the bioretention system given site constraints of the particular site (using a continuous simulation model). Saturated hydraulic conductivity should remain between 50-200 mm/hr (saturated hydraulic conductivity of greater than 500 mm/hr would not be accepted by most councils). Once the saturated hydraulic conductivity of the filter media has been determined for a particular bioretention swale, the following process can then be applied to derive a suitable filter media soil to match the design saturated hydraulic conductivity:

(A) identify available sources of a suitable base soil (i.e. topsoil) capable of supporting vegetation growth such as a sandy loam or sandy clay loam. In-situ topsoil should be considered first before importing a suitable base soil. Any base soil found to contain high levels of salt (see last bullet point), extremely low levels of organic carbon (< 5%), or other extremes considered retardant to plant growth and denitrification should be rejected. The base soil must also be structurally sound and not prone to structural collapse as this can result in a significant reduction in saturated hydraulic conductivity. The risk of structural collapse can be reduced by ensuring the soil has a well graded particle size distribution with a combined clay and silt fraction of < 12%;

(B) using laboratory analysis, determine the saturated hydraulic conductivity of the base soil using standard testing procedures (AS 4419-2003 Appendix H Soil Permeability). A minimum of five samples of the base soil should be tested. Any occurrence of structural collapse during laboratory testing must be noted and an alternative base soil sourced;

(C) the required content of sand or clay (by weight) to be mixed to the base soil will need to be established in the laboratory by incrementally increasing the content of sand or clay until the desired saturated hydraulic conductivity is achieved. The sand or clay content (by weight) that achieves the desired saturated hydraulic conductivity should then be adopted on-site. A minimum of five samples of the selected base soil and sand (or clay) content mix must be tested in the laboratory to ensure saturated hydraulic conductivity is consistent across all samples. If the average saturated hydraulic conductivity of the final filter media mix is within ± 20% of the design saturated hydraulic conductivity then the filter media can be adopted and installed in the bioretention system. Otherwise, further amendment of the filter media must occur through the addition of sand (or clay) and retested until the design saturated hydraulic conductivity is achieved;

(D) the base soil must have sufficient organic content to establish vegetation on the surface of the bioretention system. If the proportion of base soil in the final mix is less than 50%, it may be necessary to add organic material. This should not result in more than 10% organic content (measured in accordance with AS 1289.4.1.1-1997) and should not alter the saturated hydraulic conductivity of the final filter media mix;

(E) the pH of the final filter media is to be amended (if required) to between 6 and 7. If the filter media mix is being prepared off-site, this amendment should be undertaken before delivery to the site; and

(F) the salt content of the final filter media (as measured by EC1:5) must be less than 0.63dS/m for low clay content soils like sandy loam. (EC1:5 is the electrical conductivity of a 1:5 soil/ water suspension).

Transition layer (if required)

The purpose of the transition layer is to prevent the filter media from migrating down into the drainage layer (or saturated layer). It also acts as a buffer between the permanently saturated zone and the filter media. This buffer is necessary to ensure the filter media is not saturated for prolonged periods during rainfall events due to increases in water levels in the saturated zone. To achieve this, the transition layer depth must be greater than the head created by flows over the saturated zone outlet weir.

It is required if the particle size difference between the filter media and the drainage layer (or saturated layer) is more than one order of magnitude. If a transition layer is required then the material must be a clean, well-graded sand/coarse sand material containing little or no fines.

The transition layer is recommended to be 100 mm thick and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A recent particle size distribution for the transition layer sand will need to be obtained to ensure that it meets the required grading/"bridging" criteria outlined below. The "bridging" criteria is based on the engineering principles that rely on the largest 15% of the filter media particles "bridging" with the smallest 15% of the sand particles. This results in smaller voids, which prevent the migration of the filter media particles into the sand particles. The following equation is taken from the United

States Golf Association's recommendations for golf course construction:

Bridging Factor: **D15 (transitional layer sand) ≤ 8 x D85 (filter media)**

The addition of a transition layer increases the overall depth of the bioretention system and may be an important consideration for some sites where total depth of the bioretention system may be constrained. In such cases, the use of a sand drainage layer and/ or perforated pipes with smaller slot sizes may need to be considered (SC6.4.3.9.4(2)(e) Step 5: Design under-drain and undertake capacity checks (if required)).

Saturated layer (if required)

The saturated layer should be about 400 mm deep (but may deeper depending on the specific application) and composed of clean (i.e. free from fines) medium-coarse washed sand, gravel or small rock (50 mm diameter maximum) together with a long term carbon source. Hardwood wood chips, 5 mm to 40 mm in size, are recommended as the carbon source because they breakdown slowly to provide a long term carbon source yet have a decomposition rate that should not limit the denitrification process.

The total mass of carbon/electron donor that is required for denitrification must be calculated based on the expected stormwater influent TN mass over the desired life span of the system (e.g. 25 years). The calculation is based on the stoichiometry of the denitrification reaction (shown below).

Denitrification reaction:

$NO_3^- + 1.25\ (CH_2O) + H^+\ (10^7 M) \rightarrow 0.5N_2\ (g) + 1.75H_2O + 1.25CO_2\ (g)$

Based on a 400 mm deep saturated zone and the modelled annual TN runoff mass (for Townsville) for a bioretention system that is 2% of the contributing 1ha catchment, the saturated zone media would have the following composition:

- 76.7 m^3 washed coarse sand, gravel or small rock; and
- 3.3 m^3 hardwood wood chips, well graded 5 mm-40 mm.

This is equivalent to an organic carbon content of approximately 4-5% by volume. If the saturated zone depth changed, or the bioretention system to catchment area ratio changed, the hardwood proportion would need to be recalculated using the denitrification stoichiometry.

Calculating Carbon Source for Saturated Zone with safety factor (x2)	
Catchment Area	1 ha
Treatment Area Required	2%
Bioretention Surface Area	200 m^2
Saturated Zone Depth	400 mm
Total volume of Saturated Zone	80 m^3
TN load 1 year	12.5 kg/yr
TN load 25 years	312.5 kg/25yrs
Stoichiometry:	
N:C ratio = 1:1.25 (mol), which equates to 14:15(g) [Mw: N = 14g/mol, C = 12g/mol]	
Average total carbon content of hardwood woodchips is 50%, therefore	
N:C (woodchip) = 14:30 (g)	
N:C (woodchip) = 1:2.1	
Woodchips (312.5 x 2.1)	656 kg/carbon
Safety Factor (x 2)	1313kg/carbon
Density of wood chips	400 kg/m^3 (approx.)
Hardwood Wood Chips	**3.3 m^3**
Clean Coarse Sand	**76.7 m^3**

The saturated media must have a hydraulic conductivity of >1000 mm/hr (the ASTM F1815-06 test method is to be used to measure hydraulic conductivity).

The saturated zone should be lightly compacted (e.g. with one pass of a smooth drum lawn roller) during installation to stabilise the structure. Under no circumstances should heavy compaction or multiple-passes be made.

Drainage layer (if required)

The drainage layer is used to convey treated flows from the base of the filter media layer (or saturated zone) into the perforated under-drainage system. The composition of the drainage layer is to be considered in conjunction with the selection and design of the perforated under-drainage system (refer to SC6.4.3.9.3(e)(iii)) as the slot sizes in the perforated pipes may determine the minimum drainage layer particle size to avoid washout of the drainage layer into the perforated pipe system. Coarser material (e.g. fine gravel) is to be used for the drainage layer if the slot sizes in the perforated pipes are too large for use of a sand based drainage layer. Otherwise, sand is the preferred drainage layer media as it is likely to avoid having to provide a transition layer between the filter media and the drainage layer (if there is no saturated zone). The drainage layer is to be a minimum of 200 mm thick.

Bridging Factor:

D15 (drainage gravel/sand) ≤ 8 x D85 (filter media/saturated zone/transition layer)

Ensure drainage media is washed prior to placement in bioretention system to remove any fines.

(iii) Under-drain design and capacity checks

The maximum spacing of the perforated pipes in wide bioretention trenches is 1.5 m (centre to centre) so that the distance water needs to travel (horizontally) through the drainage layer does not hinder drainage of the filtration media.

By installing parallel pipes, the capacity of the perforated pipe under-drain system can be increased. The recommended maximum size for the perforated pipes 100 mm to minimise the required thickness of the drainage layer. Either flexible perforated pipe (e.g. ag pipe) or slotted

PVC pipes can be used, however care needs to be taken to ensure that the slots in the pipes are not so large that sediment would freely flow into the pipes from the drainage layer. This is also a consideration when specifying the drainage layer media.

To ensure the slotted pipes are of adequate size, several checks are required:

- ensure perforations are adequate to pass the maximum infiltration rate;
- ensure the pipe itself has capacity to convey the design flow/ infiltration rate; and
- ensure that the material in the drainage layer will not be washed into the perforated pipes (consider a transition layer).

The maximum infiltration rate represents the maximum rate of flow through the bioretention filter media and is calculated by applying Darcy's equation (Equation 3.2) as follows:

$$Q_{max} = K_{sat} \cdot L \cdot W_{base} \cdot \frac{h_{max} + d}{d}$$

Where Q_{max} = maximum infiltration rate (m^3/s)
K_{sat} = hydraulic conductivity of the soil filter (m/s)
W_{base} = base width of the ponded cross section above the soil filter (m)
L = length of the bioretention zone (m)
h_{max} = depth of pondage above the soil filter (m)
d = depth of filter media (m)

The capacity of the perforated under-drains need to be greater than the maximum infiltration rate to ensure the filter media drains freely and the pipe(s) do not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system rather than the perforated under-drainage system).

To ensure the perforated under-drainage system has sufficient capacity to collect and convey the maximum infiltration rate, it is necessary to determine the capacity for flows to enter the under-drainage system via perforations in the pipes. To do this, orifice flow can be assumed and the sharp edged orifice equation can be used. Firstly, the number and size of perforations needs to be determined (typically from manufacturer's specifications) and used to estimate the flow rate into the pipes using the maximum driving head (being the depth of the filtration media if no extended detention is provided or if extended detention is provided in the design then to the top of extended detention). It is conservative but reasonable to use a blockage factor to account for partial blockage of the perforations by the drainage layer media. A 50% blockage of the perforation is recommended.

$$Q_{perf} = B \cdot C_d \cdot A\sqrt{2 \cdot g \cdot h}$$

Where Q_{perf} = flow through perforations (m^3/s)
B = blockage factor (0.5)
C_d = orifice discharge coefficient (assume 0.61 for sharp edge orifice)
A = total area of the orifice (m^2)
g = gravity (9.79 m/s^2)
h = head above the perforated pipe (m)

If the capacity of the drainage system is unable to collect the maximum infiltration rate then additional under- drains will be required.

After confirming the capacity of the under-drainage system to collect the maximum infiltration rate is it then necessary to confirm the conveyance capacity of the underdrainage system is sufficient to convey the collected runoff. To do this, Manning's equation (Equation 3.1) can be used (which assumes pipe full flow (in place of channel flow) but not under pressure). The Manning's roughness used will be dependent on the type of pipe used. When a saturated zone is incorporated into the design, the underdrainage pipes are laid flat however the conveyance capacity can be calculated using the Manning's equation with an assumed friction slope of 0.5%.

The under-drains should be extended vertically to the surface of the bioretention system to allow inspection and maintenance when required. The vertical section of the under-drain should be unperforated and capped to avoid short circuiting of flows directly to the drain.

In bioretention systems with a saturated zone, the capacity of the weir or up-turned pipe (maintaining the water level within the saturated zone) must also be checked to ensure it does not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system). A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) to convey the maximum flow/filtration rate. The maximum depth of flow over the weir is to be 100 mm. This is important to limit increase in the saturated zone depth and avoid prolonged saturation of the filter media.

(iv) Check requirement for impermeable lining

The saturated hydraulic conductivity of the natural soil profile surrounding the bioretention system should be tested together with depth to groundwater, chemical composition and proximity to structures and other infrastructure. This is to establish if an impermeable liner is required at the base (only for systems designed to preclude ex-filtration to in-situ soils) and/or sides of the bioretention system (refer also to discussion in SC6.4.3.9.3(2)(a)(iii) Ex-filtration to in-situ soils). If the saturated hydraulic conductivity of the filter media in the bioretention system is more than one order of magnitude (10 times) greater than that of the surrounding in-situ soil profile, no impermeable lining is required.

(f) Step 6: Verify design

(i) Vegetation scour velocity check

Potential scour velocities are checked by applying Manning's equation (Equation 3.1) to the bioretention swale design to ensure the following criteria are met:

(A) less than 0.5 m/s for minor flood (2-10 year ARI) discharge; and

(B) less than 2.0 m/s for major flood (50-100 year ARI) discharge.

(ii) Velocity and depth check – safety

As bioretention swales are generally accessible by the public, it is important to check that depth x velocity within the bioretention swale, at any crossings and adjacent pedestrian and bicycle pathways, satisfies the following public safety criteria:

(A) depth x velocity < 0.6 m^2/s for low risk locations and 0.4 m^2/s for high risk locations as defined in QUDM; and

(B) maximum depth of flow over crossing = 0.3 m.

(iii) Confirm treatment performance

If the previous two checks are satisfactory then the bioretention swale design is satisfactory from a conveyance function perspective and it is now necessary to confirm the treatment performance of the bioretention swale by reference to the performance information presented in SC6.4.3.9.3(3)(a)).

(g) Step 7: Size overflow pit (field inlet pits)

In a bioretention swale system, an overflow pit can be provided flush with the invert of the swale and/ or bioretention system filter media (i.e. when no extended detention is provided in the design) or it can be provided with the pit crest raised above the level of the bioretention filter media to establish the design extended detention depth (if extended detention is provided for in the design).

Grated pits are typically used and the allowable head for discharges into the pits is the difference in level between the pit crest and the maximum permissible water level to satisfy the local council's minimum freeboard requirements. Depending on the location of the bioretention swale, the design flow to be used to size the overflow pit could be the maximum capacity of the swale, the minor flood flow (2-5 year ARI) or the major flood flow (50 year ARI). There should be a minimum of 100 mm head over the overflow pit crest to facilitate discharge of the design flow into the overflow pit.

To size an overflow pit, two checks should be made to test for either drowned or free flowing conditions. A broad crested weir equation can be used to determine the length of weir required (assuming free overflowing conditions) and an orifice equation used to estimate the area between openings required in the grate cover (assuming drowned outlet conditions). The larger of the two pit configurations should be adopted (as per Section 7.05 QUDM). In addition, a blockage factor is to be used, that assumes the grate is 50% blocked.

For free overfall conditions (weir equation):

$$Q_{weir} = B \cdot C_w \cdot L \cdot h^{3/2}$$

Where	Q_{weir}	=	Flow into pit (weir) under free overfall conditions (m^3/s)
	B	=	Blockage factor (= 0.5)
	C_w	=	Weir coefficient (= 1.66)
	L	=	Length of weir (perimeter of pit) (m)
	h	=	Flow depth above the weir (pit) (m)

Once the length of weir is calculated, a standard sized pit can be selected with a perimeter at least the same length of the required weir length.

For drowned outlet conditions (orifice equation):

$$Q_{orifice} = B \cdot C_d \cdot A\sqrt{2 \cdot g \cdot h}$$

Where B, g and h have the same meaning as in Equation 3.4

$Q_{orifice}$	=	flow rate into pit under drowned conditions (m^3/s)
C_d	=	discharge coefficient (drowned conditions = 0.6)
A	=	area of orifice (perforations in inlet grate) (m^2)

When designing grated field inlet pits, reference is also to be made to the procedure described in QUDM Section 7.05.4 (DNRW, IPWEA and BCC, 1998).

When a saturated zone is included in the design of a bioretention system, additional components must be incorporated into the outlet design. A saturated zone can be formed at the base of a bioretention system by using a riser pipe with the outlet level set at the top of the desired saturation depth (i.e. top of the saturated zone) or by incorporating a weir/overflow structure within the outlet pit (see Figure SC6.4.3.9.22). The saturated zone would hold water rather than draining freely, and would therefore provide a source of water to the plants during dry periods.

(h) Step 8: Make allowances to preclude traffic on swales

Refer to SC6.4.3.9.3(a)(vii) for discussion on traffic control options.

(i) Step 9: Specify plant species and planting densities

Refer to SC6.4.3.9.3(4) Landscape design notes - bioretention swales and SC6.4.3.6 Landscape policy for advice on selecting suitable plant species for bioretention swales in the coastal dry tropics. Consultation with landscape architects is recommended when selecting vegetation to ensure the treatment system compliments the landscape design of the area.

(j) Step 10: Consider maintenance requirements

Consider how maintenance is to be performed on the bioretention swale (e.g. how and where is access available, where is litter likely to collect etc.). A specific maintenance plan and schedule should be developed for the bioretention swale in accordance with SC6.4.3.9.3(6) Maintenance requirements - bioretention swales.

(k) Design calculation summary

The following design calculation table (Table SC6.4.3.9.4) can be used to summarise the design data and calculation results from the design process.

Click here to view **Table SC6.4.3.9.4 Bioretention swales design calculation summary**

(l) Typical design parameters

Table SC6.4.3.9.5 shows typical values for a number of key bioretention swale design parameters.

Table SC6.4.3.9.5 Typical design parameters for bioretention swales

Design Parameter	Typical Values
Swale longitudinal slope	1% to 4%
Swale side slope for trafficability (with “at grade” crossover)	Maximum 1 in 9
Swale side slope (with elevated driveway crossover)	1 in 4 to 1 in 10
Manning’s *n* (with flow depth lower than vegetation height)	0.15 to 0.3
Manning’s *n* (with flow depth greater than vegetation height)	0.03 to 0.05
Maximum velocity for scour in minor event (e.g. 2-10yr ARI)	0.5 m/s
Maximum velocity for 50-100yr ARI	2.0 m/s
Perforated pipe size	100 mm (maximum)
Drainage layer average material diameter (typically fine gravel or coarse sand)	1-5 mm diameter
Transition layer average material diameter typically sand to coarse sand	0.7 – 1.0 mm diameter

(4) Landscape design notes - bioretention swales

Bioretention swales are a combined solution that involves integrating a swale with the filtration function of a bioretention basin/trench. These can involve an extended detention treatment and some biological uptake through the planted bioretention component. The landscaping for both the swale and bioretention parts are essentially similar to the treatments for the stand alone components however consideration of the interface landscape between the vegetated swale and bioretention is important.

(a) Objectives

Landscape design for bioretention swales has four key objectives:

(i) ensure surface treatments and planting designs address stormwater quality objectives by incorporating appropriate plant species for stormwater treatment (biologically active root zone) whilst enhancing the overall natural landscape. This includes requirements for maintaining dense perennial vegetation throughout the dry season to maintain aesthetics and to minimise weed growth;

(ii) integrated planning and design of bioretention swales within the built and landscape environments;

(iii) incorporating crime prevention through environmental design (CPTED) principles and road, driveway and footpath visibility safety standards; and

(iv) create landscape amenity opportunities that enhance community and environmental needs, such as visual aesthetics, shade, screening, view framing, and way finding.

(b) Streetscape bioretention systems

When using bioretention swales in road reserves it is important to understand how the swale landscape can be used to define the visual road space. Creative landscape treatments may be possible given that the bioretention swale element will typically be a minimum of 4 m in width. Design responses may range from informal “natural” planting layouts to regimented avenues of trees along each external and internal edge of the bioretention swale element. Bioretention swales can be incorporated into a typical streetscape landscape using either a central splitter median or using one side of the road reserve.

Bioretention swale surface treatments are generally a vegetated swale that integrates into a densely planted bioretention component. The use of turf for the bioretention parts of the system is discouraged as mowing and public use of these areas will compact the upper filter media and limit the amount of filtration.

Vegetated bioretention swales can provide a relatively maintenance free finish if the planting and invert treatment are designed well. Key considerations when detailing are density and types of plantings, locations of trees and shrubs, type of garden (mowing) edges to turf areas that allows unimpeded movement of stormwater flow and overall alignment of swale invert within the streetscape.

(i) Centre median

Generally, the central median swale will provide a greater landscaped amenity, allowing planting and shade trees to enhance the streetscape more effectively, whilst verges remain constraint free. This swale configuration is however confined to roads requiring larger corridors for increased traffic.

This can be seen in Figure SC6.4.3.9.8 and Figure SC6.4.3.9.9.

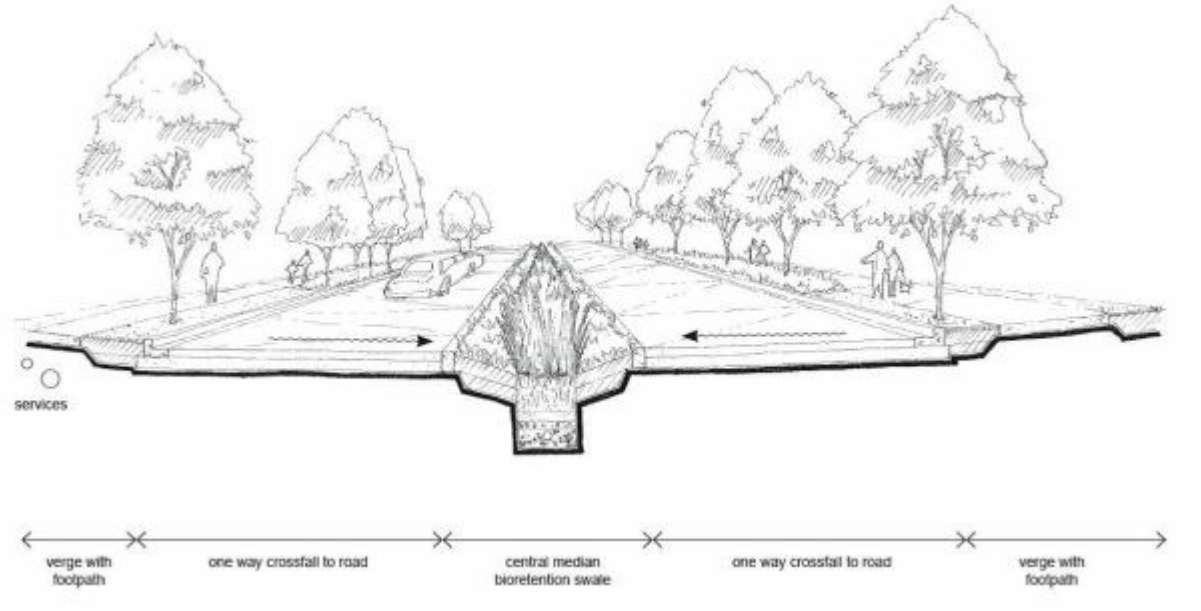


Figure SC6.4.3.9.8 Bioretention swale in centre median

Figure SC6.4.3.9.9 Median strip bioretention applications

(ii) Side of road

In smaller minor roads, one side of the road can have a swale landscape to capture stormwater runoff from road pavements and house lots. To enhance the visual road space, creative landscape treatments to driveway cross-overs, general planting and invert treatments should be used. It is important in this swale arrangement that services and footpaths that are standard for road verges have been planned and located to avoid clashes of function. This can be seen in Figure SC6.4.3.9.10.

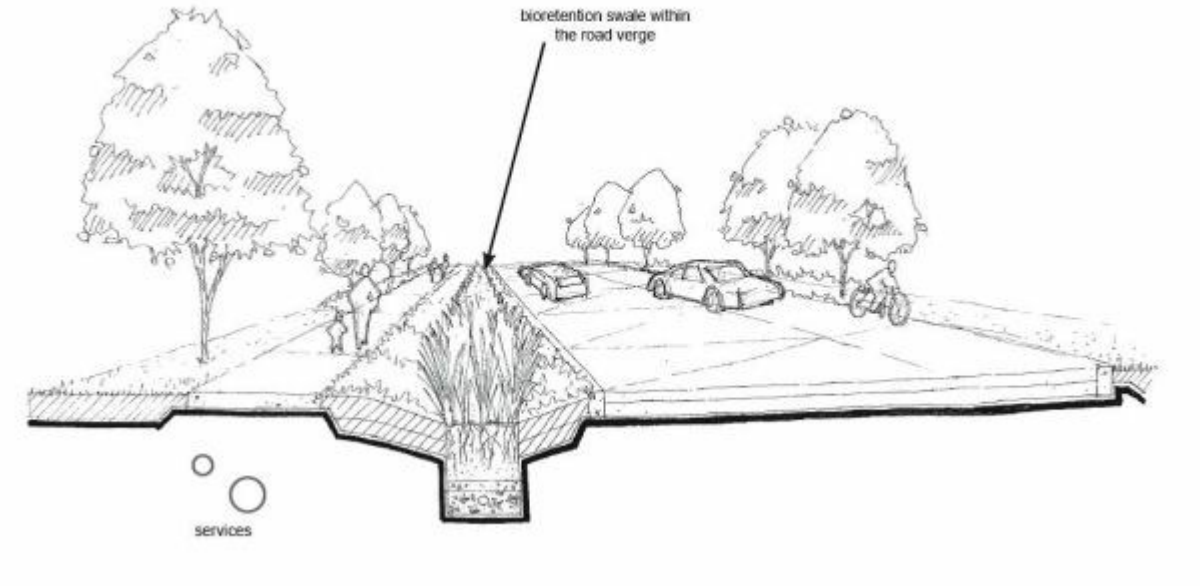


Figure SC6.4.3.9.10 Bioretention swale within road verge

(c) Civic and urban spaces

With increasing population growth in the coastal dry tropics, gentrification of urban areas is required to create more robust spaces that meet current environmental and social needs. Often constrained by existing infrastructure, landscape treatments of swales can have a dual role of providing functional stormwater quality objectives whilst creating landscapes that enhance the communities' perception of water sensitive design.

By creating hard useable edges to swales and using complimentary planting strategies, civic spaces can provide an aesthetic landscape that meets recreational uses and promotes water sensitive design to the community. Refer to Figure SC6.4.3.9.11 for an illustrative example.

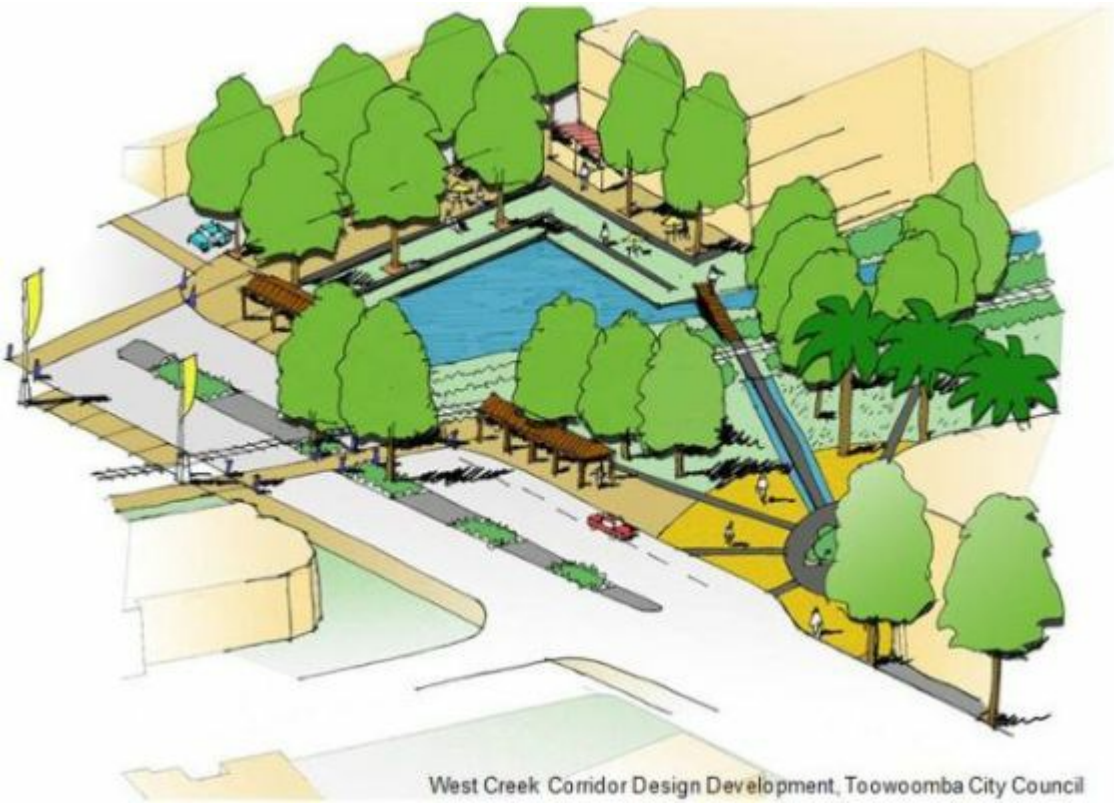


Figure SC6.4.3.9.11 Swale treatment in civic space

(d) Appropriate plant species

Planting for bioretention swale elements may consist of up to four vegetation types:

(i) groundcovers for stormwater treatment and erosion protection (required element);

(ii) shrubbery for screening, glare reduction, character, and other values;

(iii) street trees for shading, character and other landscape values; and

(iv) existing vegetation.

It is important to note that deep rooted plants such as trees are to be planted towards the top of the swale bank rather than near the bioretention trench, to avoid roots interfering with the underdrain system.

Where the landscape design includes canopy layers, more shade tolerant species should be selected for the groundcover layer. Trees and shrubbery should be managed so that the groundcover layer is not out-competed. If this does occur, replacement planting and possible thinning of the upper vegetation layers may be required.

(v) Groundcovers, shrubs and street trees

Refer to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for guidance on selecting suitable plant (including turf) species and cultivars that meet the functional requirements of bioretention swales to deliver the desired stormwater quality objectives.

(vi) Existing vegetation

Existing vegetation, such as remnant native trees, within the bioretention swale alignment may be nominated for retention. In this case, the swale will need to be diverted or piped to avoid the vegetation's critical root zone (equivalent to 0.5 m beyond the vegetation's drip line).

(e) Safety issues

Bioretention swales within streetscapes and parks need to be generally consistent with public safety requirements for new developments. These include reasonable batter profiles for edges, providing adequate barriers to median swales for vehicle/pedestrian safety and safe vertical heights from driveways to intersecting swale inverts.

(i) Crime prevention through environmental design (CPTED)

Landscape design of bioretention swales need to accommodate the standard principles of informal surveillance, exclusion of places of concealment and open visible areas. Regular clear sightlines should be provided between the roadway and footpaths/ property. Where planting may create places of concealment or hinder informal surveillance, groundcovers and shrubs should not generally exceed 1 m in height.

(ii) Traffic sightlines

The standard rules of sightline geometry apply – planting designs should allow for visibility at pedestrian crossings, intersections, rest areas, medians, driveways and roundabouts. Refer to the *Road Landscape Manual* (DMR 1997) for further guidance.

(5) Construction and establishment - bioretention swales

This section provides general advice for the construction and establishment of bioretention swales and key issues to be considered to ensure their successful establishment and operation.

(a) Staged construction and establishment method

(i) Construction and establishment challenges

There exist a number of challenges that must be appropriately considered to ensure successful construction and establishment of bioretention swales. These challenges are best described in the context of the typical phases in the development of a greenfield or infill development, namely the subdivision construction phase and the building phase (see Figure SC6.4.3.9.13).

(A) Subdivision construction - the risks to successful construction and establishment of the WSUD systems during this phase of work have generally related to the following:

- construction activities which can generate large sediment loads in runoff which can smother vegetation and clog bioretention filter media; and

- construction traffic and other works can result in damage to the bioretention swales. Importantly, all works undertaken during Subdivision Construction are normally “controlled” through the principle contractor and site manager. This means the risks described above can be readily managed through appropriate guidance and supervision.

(B) Building phase - the allotment building phase (see Figure SC6.4.3.9.12) represents the greatest risk to the successful establishment of bioretention swales.

Figure SC6.4.3.9.12 Example of building phase

(ii) Staged construction and establishment method

To overcome the challenges associated within delivering bioretention swales a staged construction and establishment method should be adopted (see Figure SC6.4.3.9.13).

(A) Stage 1: Functional installation - construction of the functional elements of the bioretention system at the end of subdivision construction (i.e. during landscape works) and the installation of temporary protective measures.

(B) Stage 2: Sediment and erosion control – during the building phase the temporary protective measures preserve the functional infrastructure of the bioretention swales against damage whilst also providing a temporary erosion and sediment control facility throughout the building phase to protect downstream aquatic ecosystems.

(C) Stage 3: Operational establishment - at the completion of the building phase, the temporary measures protecting the functional elements of the bioretention swales can be removed along with all accumulated sediment and the system planted in accordance with the design planting schedule.

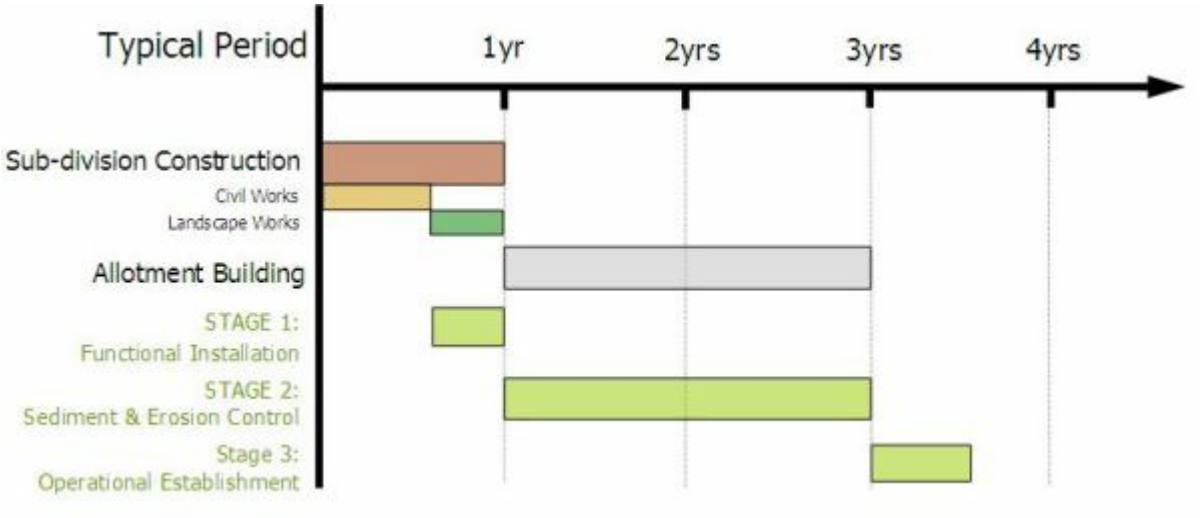


Figure SC6.4.3.9.13 Staged construction and establishment method

(iii) Functional installation

Functional installation of bioretention swales (see Figure SC6.4.3.9.14) occurs at the end of subdivision construction as part of landscape works and involves:

(A) bulking out and trimming;

(B) installation of the outlet structures;

(C) placement of liner and installation of drainage layer (i.e. under-drains and drainage layer);

(D) placement of filter media;

(E) placement of a temporary protective layer - covering the surface of filtration media with geofabric and placement of 25 mm topsoil and turf over geofabric. This temporary geofabric and turf layer will protect the bioretention system during construction (subdivision and building phases) ensuring sediment/litter laden waters do not enter the filter media causing clogging; and

(F) place silt fences around the boundary of the bioretention swale to exclude silt and restrict access.

Figure SC6.4.3.9.14 Bioretention swale functional installation

(iv) Sediment and erosion control

The temporary protective layers are left in place through the allotment building phase to ensure sediment laden waters do not clog the filtration media and allotment building traffic does not enter the bioretention swale (see Figure SC6.4.3.9.15). Importantly the configuration of the bioretention swale and the turf vegetation allow the system to function effectively as a shallow sedimentation

basin reducing the load of coarse sediment discharging to the receiving environment. Using this approach, WSUD systems can operate effectively to protect downstream ecosystems immediately after construction.

Figure SC6.4.3.9.15 Bioretention swale sediment and erosion control

(v) Operational establishment

At the completion of the allotment building phase the temporary measures are removed with all accumulated sediment and the bioretention swale re-profiled and planted in accordance with the proposed landscape design. Establishment of the vegetation to design condition can require more than two growing seasons, depending on the vegetation types, during which regular watering and removal of weeds will be required.

(b) Sourcing bioretention vegetation

The minimum recommended lead time for ordering is 3-6 months. This usually allows enough time for plants to be grown to the required size. The following pot sizes are recommended as the minimum:

(i) viro tubes 50 mm wide x 85 mm deep;

(ii) 50 mm tubes 50 mm wide x 75 mm deep; and

(iii) native tubes 50 mm wide x 125 mm deep.

(c) Vegetation establishment

The following weed control measures and watering schedule are recommended to ensure successful plant establishment. Regular general maintenance as outlined in SC6.4.3.9.3(6) Maintenance requirements - bioretention swales will also be required.

(i) Weed control

Conventional surface mulching of bioretention swales with organic material like tanbark, should not be undertaken. Most organic mulch floats and runoff typically causes this material to be washed away with the risk of blockage of drains occurring. Weed management will need to be done manually until such time that the design vegetation is established with sufficient density to effectively prevent weed propagation.

(ii) Watering

Regular watering of bioretention swale vegetation is essential for successful establishment and healthy growth and weed reduction. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. The following watering program is generally adequate but should be adjusted (increased) to suit the site conditions:

(A) Week 1-2 3 visits/ week;

(B) Week 3-6 2 visits/ week; and

(C) Week 7-12 1 visit/ week.

After this initial three month period, temporary, supplementary irrigation will be required in bioretention swales without submerged zones and may be required in bioretention swales with submerged zones (particularly during the 2 year plant establishment period). Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

(6) Maintenance requirements - bioretention swales

Bioretention swales have a flood conveyance role that needs to be maintained to ensure adequate flood protection for local properties. Vegetation plays a key role in maintaining the porosity of the soil media of the bioretention system and a strong healthy growth of vegetation is critical to its performance.

(a) Typical maintenance of bioretention swale elements will involve:

(i) routine inspection of the swale profile to identify any areas of obvious increased sediment deposition, scouring of the swale invert from storm flows, rill erosion of the swale batters from lateral inflows, damage to the swale profile from vehicles and clogging of the bioretention trench (evident by a “boggy” swale invert);

(ii) routine inspection of inlet points (if the swale does not have distributed inflows), surcharge pits and field inlet pits to identify any areas of scour, litter build up and blockages;

(iii) removal of sediment where it is impeding the conveyance of the swale and/ or smothering the swale vegetation, and if necessary, reprofiling of the swale and revegetating to original design specification;

(iv) repairing any damage to the swale profile resulting from scour, rill erosion or vehicle damage;

(v) tilling of the bioretention trench surface if there is evidence of clogging;

(vi) clearing of blockages to inlet or outlets;

(vii) regular watering/ irrigation of vegetation until plants are established and actively growing (see SC6.4.3.9.3(5)(c) Vegetation establishment);

(viii) mowing of turf or slashing of vegetation (if required) to preserve the optimal design height for the vegetation;

(ix) removal and management of invasive weeds;

(x) removal of plants that have died and replacement with plants of equivalent size and species as detailed in the plant schedule;

(xi) pruning to remove dead or diseased vegetation material and to stimulate new growth;

(xii) litter and debris removal; and

(xiii) vegetation pest monitoring and control.

(b) Additional maintenance required if a saturated zone is included in the design:

(i) check weir/up-turned pipe is clear of debris; and

(ii) check water level in the saturated zone is at the design level.

(c) Resetting (i.e. complete reconstruction) of bioretention elements will be required if the available flow area of the overlying swale is reduced by 25% (due to accumulation of sediment) or if the bioretention trench fails to drain adequately after tilling of the surface. Inspections are also recommended following large storm events to check for scour.

(d) All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure. Maintenance personnel and asset managers will use this plan to ensure the bioretention swales continue to function as designed. The maintenance plans and forms must address the following:

(i) inspection frequency;

(ii) maintenance frequency;

(iii) data collection/ storage requirements (i.e. during inspections);

(iv) detailed cleanout procedures (main element of the plans) including:

(A) equipment needs;

(B) maintenance techniques;

(C) occupational health and safety;

(D) public safety;

(E) environmental management considerations;

(F) disposal requirements (of material removed);

(G) access issues;

(H) stakeholder notification requirements; and

(I) data collection requirements (if any); and

(v) design details.
An example operation and maintenance inspection form is included in the checking tools provided in SC6.4.3.9.3(7).

(7) Checking tools - bioretention swales

A number of checking aids have been developed for designers and council development assessment officers. In addition, advice on construction techniques and lessons learnt from building bioretention swale systems are provided.

(a) Design assessment

The checklist at Table SC6.4.3.9.6 presents the key design features to be reviewed when assessing design of a bioretention swale. These considerations include configuration, safety, maintenance and operational issues that need to be addressed during the design phase. Where an item results in an “N” when reviewing the design, referral is to be made back to the design procedure to determine the impact of the omission or error.

In addition to the checklist, a proposed design is to have all necessary permits for its installations. Council development assessment officers need to ensure that all relevant permits are in place. These can include permits to clear vegetation, to dredge, create a waterbody, divert flows or disturb fish or platypus habitat.

Click here to view Table SC6.4.3.9.6 Bioretention swale design assessment checklist

(b) Construction (during and post)

The checklist at Table SC6.4.3.9.7 presents the key items to be reviewed when inspecting the bioretention swale during and at the completion of construction. The checklist is to be used by construction site supervisors and compliance inspectors to ensure all the elements of the bioretention system have been constructed in accordance with the design. If an item receives an “N” in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view Table SC6.4.3.9.7 Bioretention swale construction inspection checklist

(c) Operation and maintenance inspection

The form at Table SC6.4.3.9.8 is to be used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time.

Click here to view Table SC6.4.3.9.8 Bioretention swale maintenance checklist

(d) Asset transfer (following defects period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater

treatment device. A proposed design is to clearly identify the ultimate asset owner and who is responsible for its maintenance. Local authorities will use the asset transfer checklist at Table SC6.4.3.9.9 when the asset is to be transferred to the local authority.

Click here to view Table SC6.4.3.9.9 Bioretention swale asset transfer checklist

(8) Engineering drawings - bioretention swales

The relevant local authority should be consulted to source standard drawings applicable to bioretention swales. These drawings may provide example dimensions for a number of different road reserve configurations. Standard drawings are not intended to be prescriptive drawings which must be adhered to, rather they are intended to provide detailed examples of swales which can be incorporated into commonly used urban subdivision layouts. Designers are encouraged to develop alternative bioretention swale designs to suit site specific conditions.

In the absence of locally specific guidelines, Brisbane City Council (BCC) standard drawings applicable to swales and bioretention systems are UMS 151-158. These may also be used as reference standards for swale design. BCC Standard drawings are available online.

(9) References - bioretention swales

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SC6.4.3.9.4 Bioretention basins

(1) Bioretention basins are vegetated areas where runoff is filtered through a filter media layer (e.g. sandy loam) as it percolates downwards. It is then collected via perforated under-drains and flows to downstream waterways or to storages for reuse. Bioretention basins often use temporary ponding above the filter media surface to increase the volume of runoff treated through the filter media. They treat stormwater in the same way as bioretention swales; however, "above design" flows are conveyed through overflow pits or bypass paths rather than over the filter media. This has the advantage of protecting the filter media surface from high velocities that can dislodge collected pollutants or scour vegetation.

Bioretention basins are generally not intended to be "infiltration" systems that discharge from the filter media to surrounding in-situ soils. Rather, the typical design intent is to recover stormwater at the base of the filter media in perforated under-drains and discharge to receiving waterways or to storages for potential reuse.

Figure SC6.4.3.9.16 shows examples of a basin integrated into a local streetscape and into a car park. Figure SC6.4.3.9.16 also illustrates the key elements of bioretention basins, namely surface vegetation, extended detention, filter media, drainage layer and overflow pit.

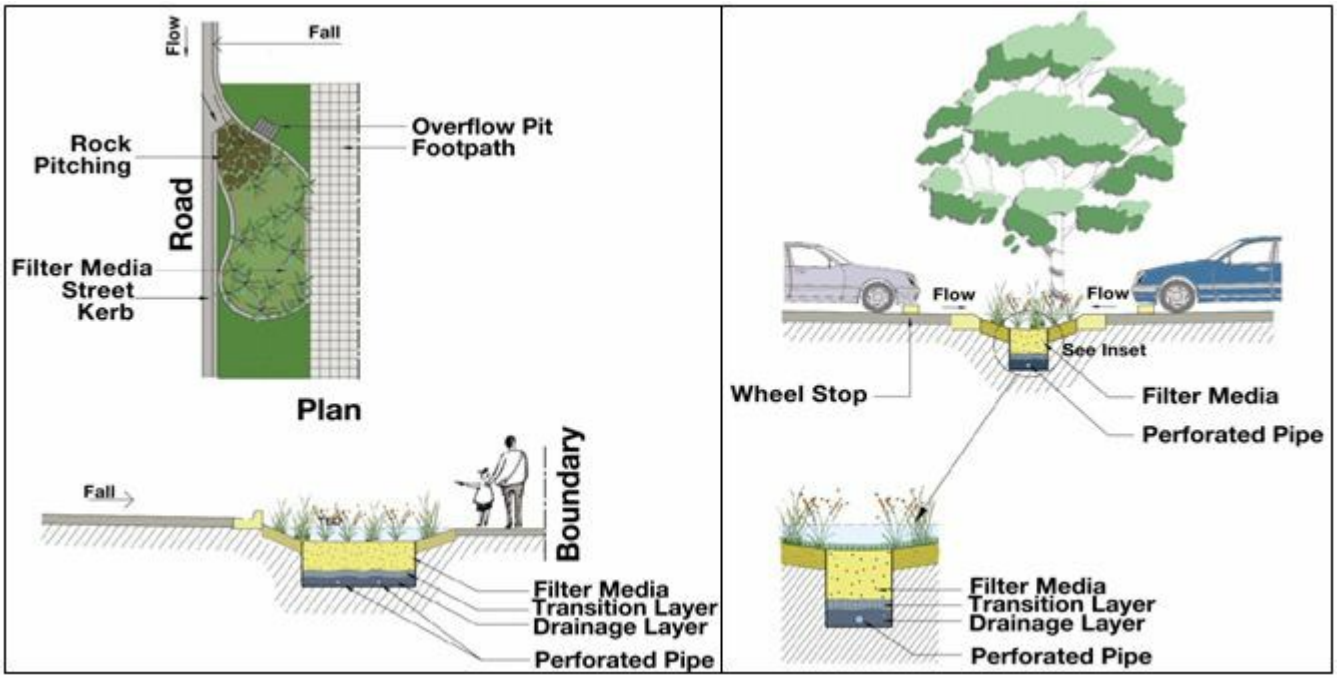


Figure SC6.4.3.9.16 Bioretention basin integrated into a local streetscape (left) and a car park (right).

(2) Design considerations – bioretention basins

This section outlines some of the key design considerations for bioretention basins that the detailed designer should be familiar with before applying the design procedure presented later in this chapter.

Rain patterns in the dry tropics mean that bioretention systems will receive large volumes of consistent rainfall during the wet season and are likely to remain dry for extended periods during the dry season. Therefore, bioretention basin design will need to be adapted to incorporate the following elements:

- controls to ensure the bioretention basin is not compromised by sediment smothering;
- a saturated zone beneath the filter media to increase soil moisture and help sustain vegetation during dry periods; or
- supplemental temporary irrigation to sustain vegetation and maintain aesthetics in highly visible areas (e.g. bioretention pods within road verges).

(a) Landscape design

Bioretention basins are predominantly located within public areas, such as open space or within streets, which provide a primary setting for people to experience their local community and environment. It is therefore necessary for bioretention basins to be given an appropriate level of landscape design consideration to compliment the surrounding landscape character and to adequately address potential aesthetics issues such as weeds and sustaining perennial plants during the dry season. The landscape design of bioretention basins must address stormwater quality objectives whilst also being sensitive to other important landscape objectives such as road visibility, public safety and community character and habitat. To achieve this, the design process requires close collaboration between landscape architects, urban designers, ecologists and WSUD engineers (see example at Figure SC6.4.3.9.17).

Figure SC6.4.3.9.17 Bioretention basin within roundabout at Kalynda Chase Development, Bohle Plains

(b) Hydraulic design

The correct hydraulic design of bioretention basins is essential to ensure effective stormwater treatment performance, minimise damage by storm flows, and to protect the hydraulic integrity and function of associated minor and major drainage systems. The following aspects are of key importance:

(i) the finished surface of the bioretention filter media must be horizontal (i.e. flat) to ensure even flow dispersion across the filter media surface (i.e. full engagement of the filter media by stormwater flows) and to prevent concentration of stormwater flows within depressions and ruts resulting in potential scour and damage to the filter media;

(ii) temporary ponding (i.e. extended detention) of up to 0.3 m depth over the surface of the bioretention filter media created through the use of raised field inlet pits (overflow pits) can assist in managing flow velocities over the surface of the filter media as well as increase the overall volume of stormwater runoff that can be treated by the bioretention filter media;

(iii) where possible, the overflow pit or bypass channel should be located near the inflow zone (refer to Figure SC6.4.3.9.16 (left)) to prevent high flows passing over the surface of the filter media. If this is not possible, then velocities during the minor (2-10 year ARI) and major (50-100 year ARI) floods should be maintained sufficiently low (preferably below values of 0.5 m/s and not more than 1.5 m/s for major flood) to avoid scouring of the filter media and vegetation;

(iv) where the field inlets in a bioretention system is required to convey the minor storm flow (i.e. is part of the minor drainage system), the inlet must be designed to avoid blockage, flow conveyance and public safety issues; and

(v) for streetscape applications, the design of the inflow to the bioretention basin must ensure the kerb and channel flow requirements are preserved as specified in the Queensland Urban Drainage Manual (QUDM) (DNRW, IPWEA and BCC 1998).

(c) Ex-filtration to in-situ soils

Bioretention basins can be designed to either preclude or promote ex-filtration of treated stormwater to the surrounding in-situ soils depending on the overall stormwater management objectives established for the given project. When considering ex-filtration to surrounding soils, the designer must consider site

terrain, hydraulic conductivity of the in-situ soil, groundwater and building setback. Where the concept design specifically aims to preclude ex-filtration of treated stormwater runoff it is necessary to consider if the bioretention basin needs to be provided with an impermeable liner. If the selected saturated hydraulic conductivity of the bioretention filter media is less than 10 times that of the native surrounding soils, it may be necessary to provide an impermeable liner. Flexible membranes or a concrete casting are commonly used to prevent excessive ex-filtration. This is particularly applicable for surrounding soils that are very sensitive to any ex-filtration (e.g. shallow groundwater or close proximity to significant structures).

Bioretention systems constructed in sodic soils without an impermeable lining are not at risk of exporting salt from in-situ soil into local streams or groundwater. Even after six months of intensive flushing under controlled, laboratory conditions, bioretention systems (constructed in sodic soils) did not leach salt from the surrounding soils (Deletic and Mudd, 2006).

The greatest pathway of ex-filtration is through the base of a bioretention basin, as gravity and the difference in hydraulic conductivity between the filter media and the surrounding native soil would typically act to minimise ex-filtration through the walls of the trench. If lining is required, it is likely that only the base and the sides of the drainage layer will need to be lined.

(d) Vegetation types

Vegetation is required to cover the whole bioretention filter media surface, be capable of withstanding minor and major design flows, and be of sufficient density to prevent preferred flow paths, scour and re-suspension of deposited sediments. Additionally, vegetation that grows in the bioretention filter media functions to continuously break up the surface of the filter media through root growth and wind induced agitation, which prevents surface clogging. The vegetation also provides a substrate for biofilm growth within the upper layer of the filter media, which facilitates biological transformation of pollutants (particularly nitrogen).

Ground cover vegetation (e.g. sedges and tufted grasses) is an essential component of bioretention basin function. Generally, the greater the density and height of vegetation planted in bioretention filter media, the better the treatment provided especially when extended detention is provided for in the design. Contact between stormwater and vegetation results in enhanced sedimentation of suspended sediments and adsorption of associated pollutants.

Plant species selected for bioretention systems must be able to tolerate free draining sandy soils and be capable of withstanding long dry periods as well as periods of inundation. To maintain aesthetics in highly visible areas (e.g. bioretention pods within road verges) temporary supplemental irrigation may be required to sustain vegetation. The incorporation of saturated zones beneath the filter media can help to sustain soil moisture and is beneficial for nitrogen removal from stormwater. The ability to sustain dense perennial vegetation is important for long term weed management.

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides more specific guidance on the selection of appropriate vegetation for bioretention basins. It should be noted that turf is not considered to be suitable vegetation for bioretention basins. The stem and root structure of turf is not suitably robust and rapid growing to ensure the surface of the bioretention filter media is continuously broken up to prevent clogging.

(e) Bioretention filter media

Selection of an appropriate bioretention filter media is a key design step that involves consideration of the following four inter-related factors:

(i) saturated hydraulic conductivity required to optimise the treatment performance of the bioretention basin given site constraints and available filter media area;

(ii) depth of extended detention provided above the filter media;

(iii) surface area of the filter media; and

(iv) suitability as a growing media to support vegetation (i.e. retains sufficient soil moisture and organic content).

The concept design stage will have established the optimal combination of filter media saturated

hydraulic conductivity and extended detention depth using a continuous simulation modelling approach (i.e. MUSIC). Any adjustment of either of these two design parameters during the detailed design stage will require the continuous simulation modelling to be re-run to assess the impact on the overall treatment performance of the bioretention basin.

As shown in Figure SC6.4.3.9.18 below, bioretention media can consist of three or four layers. In addition to the filter media required for stormwater treatment, a saturated zone can also be added to enhance nitrogen removal and to provide a source of water for vegetation over the dry season. A drainage layer is also required to convey treated water from the base of the filter media or saturated zone into the perforated under-drains. The drainage layer surrounds the perforated under-drains and can be either coarse sand (1 mm) or fine gravel (2-5 mm). If fine gravel is used, a transition layer of sand must also be installed to prevent migration of the filter or saturated zone media into the drainage layer and subsequently into the perforated under-drains.

(f) Saturated zone

The incorporation of a saturated zone into bioretention design has evolved from research demonstrating improved nitrate removal through denitrification processes (Kim et al. 2003 and Zinger et al. 2007b).

The saturated zone design involves a relatively simple modification to a conventional bioretention system. An additional layer located below the filter media is designed to retain stormwater providing a saturated zone at the base of the bioretention system. A saturated zone can be formed by using a riser pipe with the outlet level higher than the drainage layer or by incorporating a weir within the outlet pit (see Figure SC6.4.3.9.18 below). The saturated zone holds water and therefore provides a source of water to maintain soil moisture for plant uptake during dry periods.

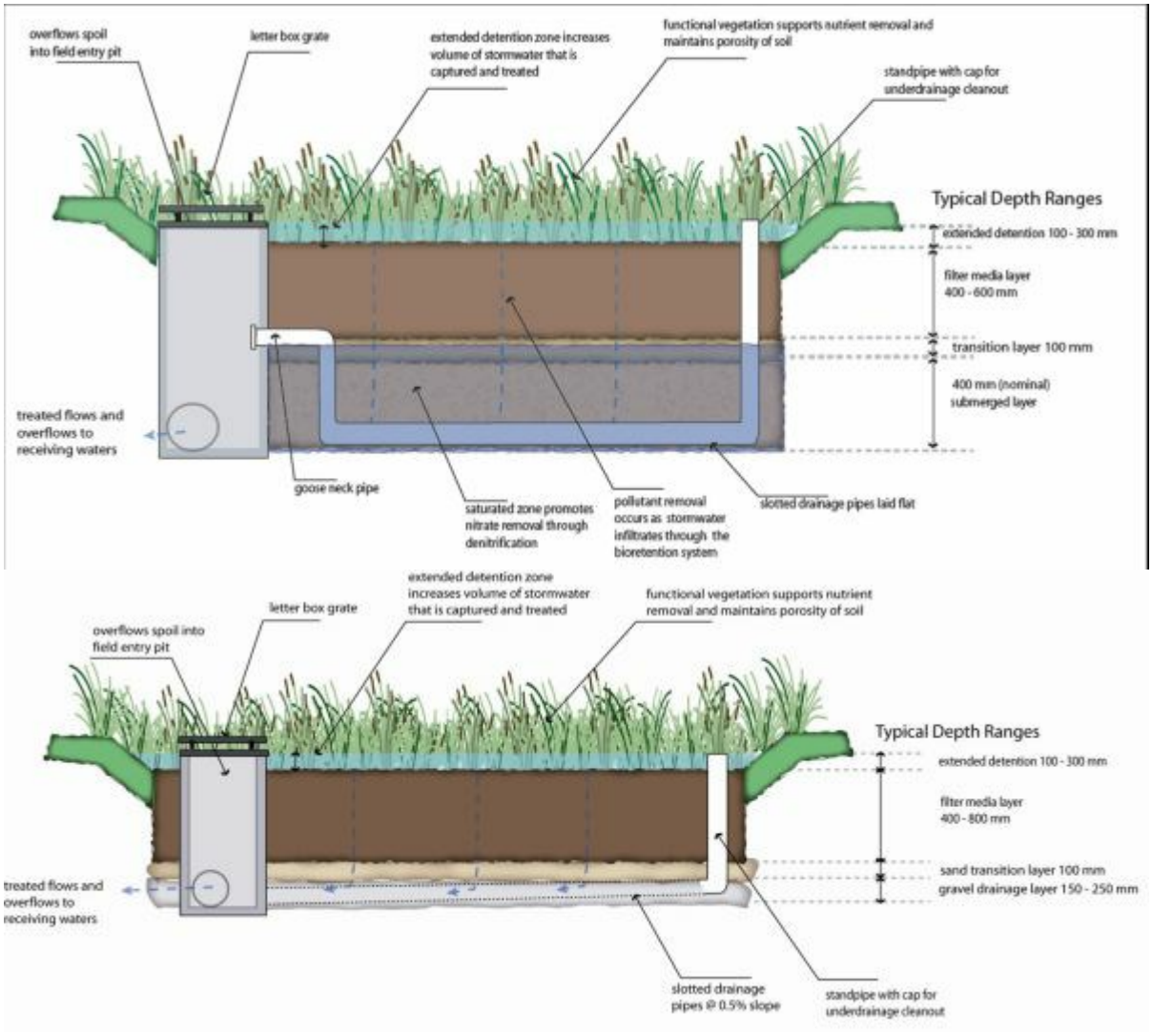


Figure SC6.4.3.9.18 Cross section of bioretention basins (top- with a saturated zone; below- without a saturated zone)

(g) Traffic controls

Another design consideration is keeping traffic and building material deliveries off bioretention basins (particularly during the construction phase of a development). If bioretention basins are driven over or used for parking, the filter media will become compacted and the vegetation damaged.

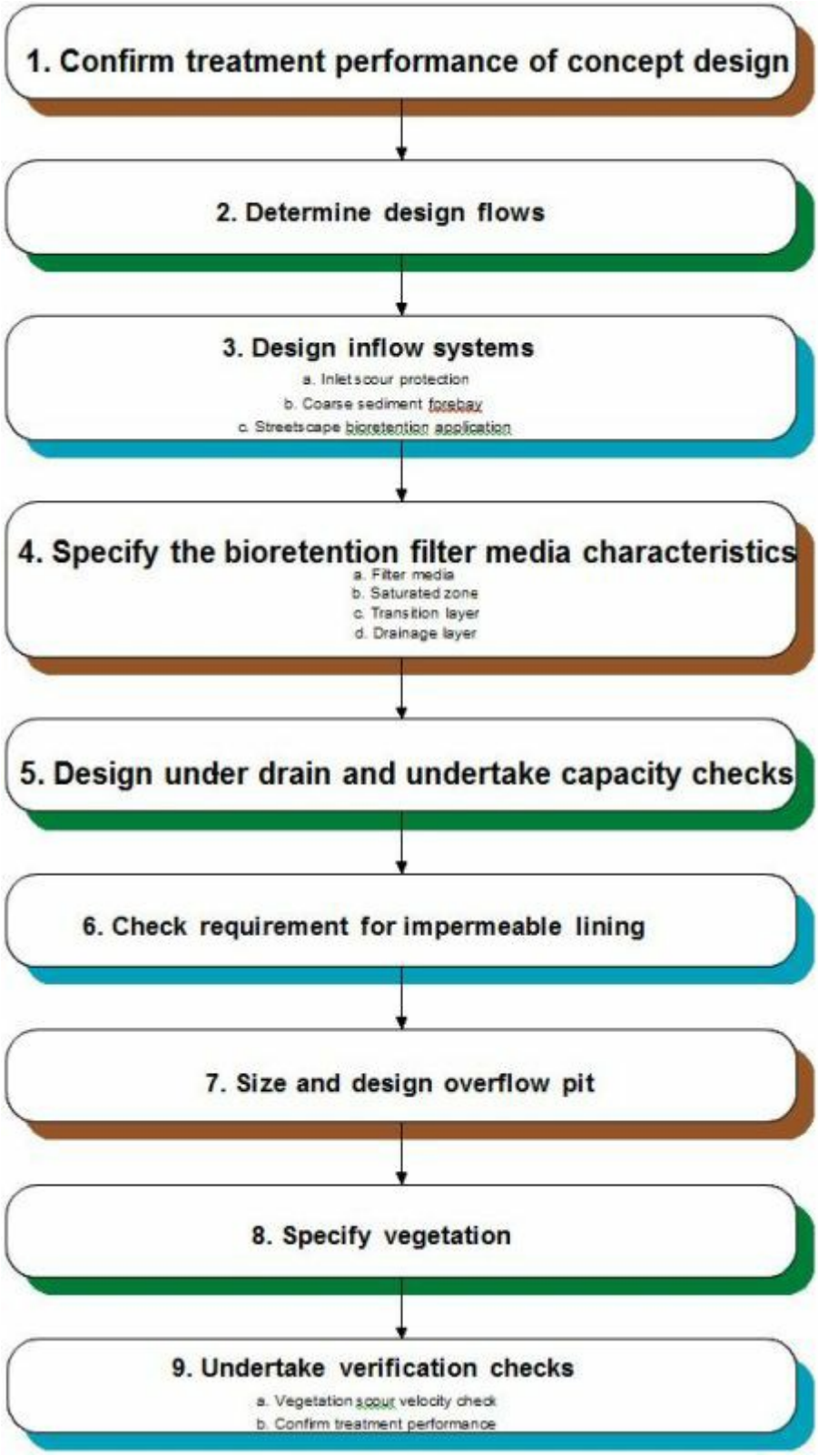
Streetscape bioretention systems must be designed to satisfy local authority requirements with respect to traffic calming devices within particular street or road reserve widths. Where bioretention is incorporated into traffic calming or control devices, or directly adjacent to mountable kerbs, consideration should be given to protection of the area immediately behind the kerb where vehicles are likely to mount the kerb.

(h) Services

Bioretention basins or cells located within road verges or within footpaths must consider the standard location for services within the verge and ensure access for maintenance of services without regular disruption or damage to the bioretention system.

(3) Design process – bioretention basins

The following sections detail the design steps required for bioretention basins. Key design steps are:



(a) Step 1: Check treatment performance of concept design

Before commencing detailed design, the designer should first undertake a preliminary check to confirm the bioretention basin treatment area (i.e. the surface area of the filter media) from the concept design is adequate to deliver the required level of stormwater quality improvement. This design process assumes a conceptual design has been undertaken.

This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in an appropriate quantitative modelling program. Where possible, this modelling should be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows

(i) Design flows

The hydraulic design of the bioretention basin should be based on the following design flows:

(A) minor flood flow (2 year ARI) to allow minor floods to be safely conveyed. For commercial and industrial areas the design flow requirement for minor flows is a 5 year ARI event; and

(B) major flood flow (100 year ARI) to check flow velocities, velocity depth criteria, conveyance within road reserve, and freeboard to adjoining property.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. If the typical catchment areas are relatively small, the Rational Method design procedure is considered to be a suitable method for estimating design flows. However, if the bioretention system is to form part of a retention basin or if the catchment area to the bioretention system is large, then a full flood routing computation method needs to be used to estimate design flows.

(c) Step 3: Design inflow systems

(i) The design of the inflow systems to bioretention basins needs to consider a number of functions:

(A) scour protection – In most bioretention applications stormwater flows will enter the bioretention basin as concentrated flow (piped, channel or open channel) and as such is it important to slow and spread flows using appropriate scour (rock) protection;

(B) coarse sediment forebay – Where stormwater runoff from the catchment is delivered directly to the bioretention basin without any coarse sediment management (through vegetated swale or buffer treatment) a coarse sediment forebay is to be included in the design. The forebay is to remove coarse sediment (1 mm +) from stormwater to minimise the risk of vegetation in the bioretention basin being smothered;

(C) constant low base flows have to be taken into account and dealt with as they can blind the filter material and promote weed growth within permanently saturated areas; and

(D) street hydraulics (streetscape applications only) – In streetscape applications, where stormwater is delivered directly from the kerb and channel to the bioretention basin, it is important to ensure the location and width of the kerb opening is designed such that flows enter the bioretention basin without adversely affecting trafficability of the road (QUDM, Table 7.04.1).

(ii) Each of these functions and the appropriate design responses are described in the following sections.

(iii) Inlet scour protection

Erosion protection should be provided for concentrated inflows to a bioretention basin. Typically, flows will enter the bioretention basin from either a surface flow system (i.e. roadside kerb, open channel) or a piped drainage system. Rock beaching is a simple method for dissipating the energy of concentrated inflow, as depicted in Figure SC6.4.3.9.19 (with the “D” representing the pipe diameter dimension). The rocks can form part of the landscape design of the bioretention component.

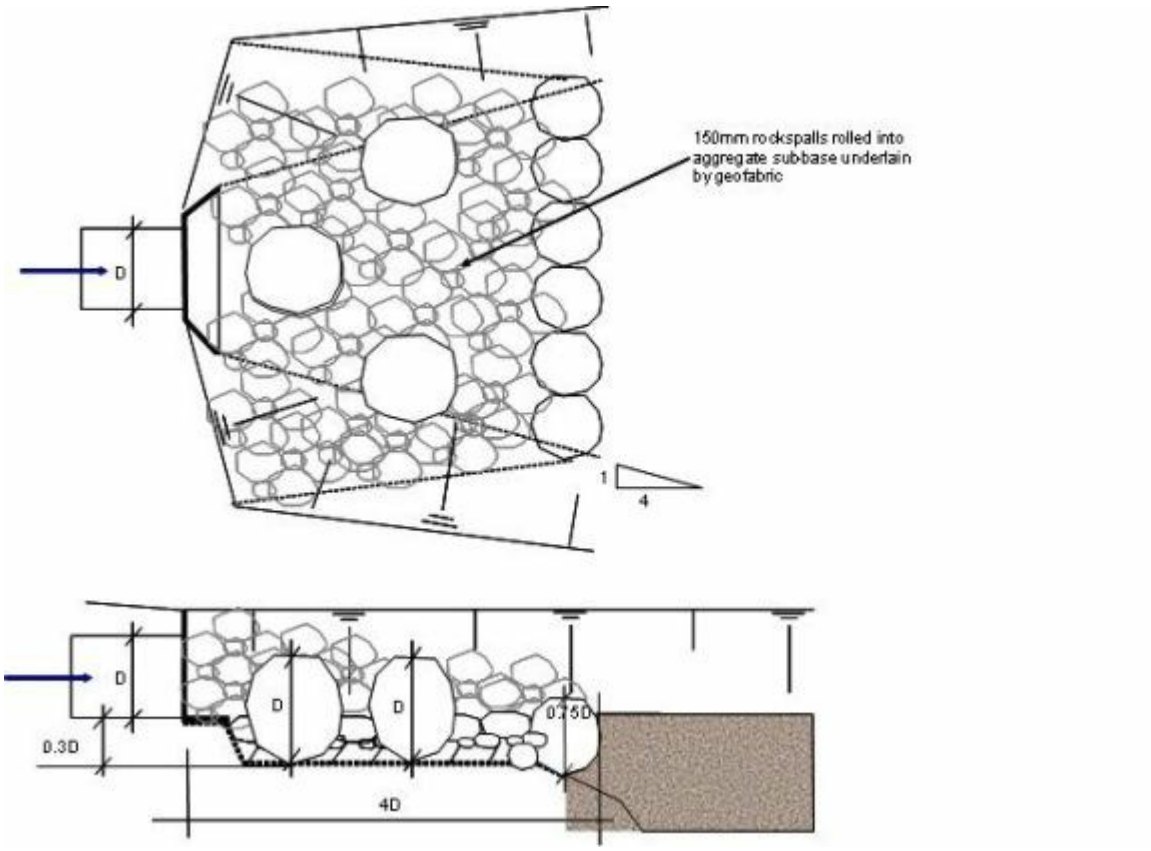


Figure SC6.4.3.9.19 Typical inlet scour protection detail for bioretention basins receiving piped flows

(iv) Coarse sediment control

Where stormwater runoff from the catchment is delivered directly to the bioretention basin without pre-treatment (through vegetated swale or buffer treatment), coarse sediment may accumulate near the basin inflow. This sediment may smother vegetation and reduce infiltration to the filter media. To mitigate these effects, either a sedimentation basin (see Chapter 4) is to be located upstream or the bioretention basin inflow system is to incorporate a coarse sediment forebay. The forebay should be designed to:

(A) remove particles that are 1 mm or greater in diameter from the 3 month ARI storm event; and

(B) provide appropriate storage for coarse sediment to ensure desilting is required no more than once per year.

The size of the sediment forebay is established using the following equation:

$$V_s = A_c \cdot R \cdot L_o \cdot F_c$$

Where
- V_s = volume of forebay sediment storage required (m^3)
- A_c = contributing catchment area (ha)
- R = capture efficiency (assume 80%)
- L_o = sediment loading rate (m^3/ha/year)
- F_c = desired cleanout frequency (years)

A catchment loading rate (L_o) of 1.6 m^3/ha/year for developed catchments can be used to estimate the sediment loads entering the basin. The area of the forebay is established by dividing the volume by the depth. The depth of the forebay should not be greater than 0.3 m below the surface of the filter media.

$$A_s = \frac{V_s}{D_s}$$

Where D = depth of sediment forebay (max 0.3 m below filter media surface).
The sediment forebay area should be checked to ensure it captures the 1 mm and greater particles using the following expression (modified version of Fair and Geyer (1954).

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A}\right]^{-n}$$

Where:

R	=	fraction of target sediment removed (80%)
v_s	=	settling velocity of target sediment (100 mm/s or 0.1 m/s for 1 mm particle)
Q/A	=	applied flow rate divided by forebay surface area ($m^3/s/m^2$)
n	=	turbulence or short-circuiting parameter (adopt 0.5)

The coarse sediment forebays will contain large rocks for energy dissipation and be underlain by filter material to promote drainage following storm events.

(v) Kerb opening configuration (streetscape applications)

In streetscape applications where stormwater is delivered directly from a kerb and channel to a bioretention basin, the following design issues must be considered:

(A) the location of the kerb opening must be designed to ensure flows in the channel do not exceed the maximum allowance widths as defined by QUDM Table 7.04.1 (DNRW, IPWEA & BCC 1998); and

(B) the width of the kerb opening is designed to allow the design flow to enter the bioretention basin.

Channel flow width at kerb opening

The width of channel flow at the kerb opening during a minor storm event (2 10 year ARI) needs to be checked to ensure it does not exceed the maximum allowable channel flow widths defined by QUDM Table 7.04.1 (DNRW, IPWEA & BCC 1998) and the local authority requirements. This check can be undertaken by applying Manning's equation or Izzard's equation and ensuring the flow depth does not exceed either the crest of the road or the top of kerb (whichever is lowest).

Design kerb opening width (where kerb and channel is used)

To determine the width of the opening in the kerb to allow flows to enter the bioretention basin, Manning's equation or Izzard's equation (QUDM Section 7.04.2) can be used with the kerb, channel and road profile to estimate the flow depth in the kerb and channel at the entry point. Once the flow depth for the minor storm (e.g. 2-10 year ARI) is known, this can then be used to calculate the required width of the opening in the kerb by applying a broad crested weir equation. The opening width is estimated by applying the flow depth in the channel (as h) and solving for L (opening width).

$$Q = C_w \cdot L \cdot h^{3/2}$$

Where

Q	=	flow (m^3/s)
Cw	=	weir coefficient (= 1.66)
L	=	length of opening (m)
h	=	depth of flow (m)

This method ensures the kerb opening does not result in an increase in the upstream channel flow depth, which in turn ensures the bioretention basin does not impact on the trafficability of the adjoining road pavement as required by the QUDM. To ensure the kerb opening width is adequate, additional width factors may be required to account for slope of the kerb and channel, and the angle at which flow meets the kerb opening. This will depend on the location and position of the bioretention system in relation to the kerb and channel. Design of the inflow system within the kerb and channel will need to consider maximising flow into the bioretention system. The kerb opening

can be made more effective by lowering the kerb opening below the channel, increasing the cross fall at the kerb opening or by providing deflectors at the kerb opening.

(d) Step 4: Specify the bioretention filter media characteristics

Up to four types of media are required in bioretention basins (refer Figure SC6.4.3.9.18 Cross section of bioretention basins (top—with a saturated zone; below—without a saturated zone)).

(i) Filter media

As a minimum, the filter media is required to have sufficient depth to support vegetation, typically between 400-600 mm (or as specified in the engineering design). It is important to note that if deep rooted plants such as trees are to be planted in bioretention basins, the filter media must have a minimum depth of 800 mm to avoid roots interfering with the perforated under-drain system.

In general, the media should be a loamy sand with an appropriately high permeability under compaction and should be free of rubbish, deleterious material, weed seeds, toxicants, and should not be hydrophobic. The filter media should contain some organic matter for increased water holding capacity but be low in nutrient content. To ensure a proposed soil is suitable as filter media, a testing regime is required. The *Guidelines for Soil Filter Media in Bioretention Systems*: Version 2.01 (FAWB, March 2008) (refer to http://www.monash.edu.au/fawb/products/index.html) provides best practice guidance on filter media selection and testing. It is recommended that soils used for bioretention filter media fulfil the requirements outlined in the FAWB Guideline. In summary, these requirements include:

(A) organic carbon levels < 5%;

(B) pH between 5.5 and 7.5;

(C) electrical conductivity < 1.2 dS/m;

(D) saturated hydraulic conductivity between 100-500 mm/hr. The saturated hydraulic conductivity of the filter media is established by optimising the treatment performance of the bioretention system given site constraints of the particular site (using a continuous simulation model such as MUSIC); and

(E) the filter media must also be structurally sound and not prone to structural collapse as this can result in a significant reduction in saturated hydraulic conductivity. The risk of structural collapse can be reduced by ensuring the soil has a well graded particle size distribution with a combined clay and silt fraction of < 3%.

(ii) Transition layer (if required)

The purpose of the transition layer is to prevent the filter media from migrating down into the drainage layer (or the saturated zone). It also acts as a buffer between the permanently saturated zone (if required) and the filter media. This buffer is necessary to ensure the filter media is not saturated for prolonged periods during rainfall events due to increases in water levels in the saturated zone. To achieve this, the transition layer depth must be greater than the head created by flows over the saturated zone outlet weir.

It is required if the particle size difference between the filter media and the drainage layer (or the saturated zone) is more than one order of magnitude. If a transition layer is required then the material must be a clean, well-graded sand/coarse sand material containing little or no fines.

The transition layer is recommended to be 100 mm thick and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A recent particle size distribution for the transition layer sand will need to be obtained to ensure that it meets the required grading/"bridging" criteria outlined below. The "bridging" criteria is based on the engineering principles that rely on the largest 15% of the filter media particles (or saturated zone particles) "bridging" with the smallest 15% of the sand particles. This results in smaller voids, which prevent the migration of the filter media particles into the sand particles. The following equation is taken from the United States Golf Association's recommendations for golf course construction:

Bridging Factor: **D15 (transitional layer sand) ≤ 8 x D85 (filter media)**

The addition of a transition layer increases the overall depth of the bioretention system and may be an important consideration for some sites where total depth of the bioretention system may be constrained. In such cases, the use of a sand drainage layer and/ or perforated pipes with smaller slot sizes may need to be considered.

(iii) Saturated layer (if required)

The saturated layer should be about 400 mm deep (but may deeper depending on the specific application) and composed of clean (i.e. free from fines) medium-coarse washed sand, gravel or small rock (50 mm diameter maximum) together with a long term carbon source. Hardwood wood chips, 5 mm to 40 mm in size, are recommended as the carbon source because they breakdown slowly to provide a long term carbon source yet have a decomposition rate that should not limit the denitrification process.

The total mass of carbon/electron donor that is required for denitrification must be calculated based on the expected stormwater influent TN mass over the desired life span of the system (e.g. 25 years). The calculation is based on the stoichiometry of the denitrification reaction (shown below).

Denitrification reaction:

$NO_3^- + 1.25\ (CH_2O) + H^+\ (10^{-7}\ M) \rightarrow 0.5N_2\ (g) + 1.75H_2O + 1.25CO_2\ (g)$

Based on a 400 mm deep saturated zone and the modelled annual TN runoff mass (for Townsville) for a bioretention system that is 2% of the contributing 1 ha catchment, the saturated zone media would have the following composition:

(A) 76.7 m^3 washed coarse sand, gravel or small rock; and

(B) 3.3 m^3 hardwood wood chips, well graded 5 mm-40 mm.

This is equivalent to an organic carbon content of approximately 4-5% by volume. If the saturated zone depth changed, or the bioretention system to catchment area ratio changed, the hardwood proportion would need to be recalculated using the denitrification stoichiometry.

Calculating carbon source for saturated zone with safety factor (x2)	
Catchment Area	1 ha
Treatment Area Required	2%
Bioretention Surface Area	200 m^2
Saturated Zone Depth	400 mm
Total volume of Saturated Zone	80 m^3
TN load 1 year	12.5 kg/yr
TN load 25 years	312.5 kg/25 yrs
Stoichiometry:	
N:C ratio = 1:1.25 (mol), which equates to 14:15 (g) [Mw: N = 14g/mol, C = 12g/mol]	
Average total carbon content of hardwood woodchips is 50%, therefore	
N:C (woodchip) = 14:30 (g)	
N:C (woodchip) = 1:2.1	
Woodchips (312.5 x 2.1)	656kg/carbon
Safety Factor (x 2)	1313kg/carbon
Density of wood chips	400kg/m^3 (approx.)
Hardwood Wood Chips	**3.3 m^3**
Clean Coarse Sand	**76.7 m^3**

The saturated media must have a hydraulic conductivity of >1000mm/hr (the ASTM F1815-06 test method is to be used to measure hydraulic conductivity).

The saturated zone should be lightly compacted (e.g. with one pass of a smooth drum lawn roller) during installation to stabilise the structure. Under no circumstances should heavy compaction or multiple-passes be made.

(iv) Drainage layer (if required)

The drainage layer is used to convey treated flows from the base of the filter media layer (or the saturated zone) into the perforated under-drainage system. The composition of the drainage layer is to be considered in conjunction with the selection and design of the perforated under-drainage pipes as the slot sizes in the perforated pipes may determine the minimum drainage layer particle size to avoid washout of the drainage layer into the perforated pipe system. Coarser material (e.g. fine gravel aggregate) is to be used for the drainage layer if the slot sizes in the perforated pipes are too large for use of a sand based drainage layer. The drainage layer is to provide a minimum of 50 mm cover above the perforated under-drainage pipes and have a minimum saturated hydraulic conductivity of 1000 mm/hr.

A particle size distribution for the gravel will need to be obtained to ensure that it meets the "bridging" criteria outlined below:

Bridging Factor:
D15 (drainage gravel/sand) ≤ 8 x D85 (filter media/saturated zone/transition layer)

Ensure drainage media is washed prior to placement in bioretention system to remove any fines.

(e) Step 5: Design under-drain and undertake capacity checks (if required)

The maximum spacing of the perforated under-drains in bioretention basins located in streetscape zones and small public zones (i.e. bioretention < 100 m^2) is 1.5 m (centre to centre). This ensures that the distance water needs to travel horizontally toward the perforated pipes through the drainage layer does not hinder drainage of the filter media. The maximum spacing of the perforated pipes in bioretention basins located in local parks and large open space areas (i.e. bioretention > 100 m^2) can be increased to 2.5 – 3 m.

In bioretention systems without saturated zones, perforated pipes are to grade at a minimum of 0.5% towards the overflow pit to ensure effective drainage. In bioretention systems with saturated zones, perforated pipes should be laid flat (i.e. at 0% grade) to avoid preferential flow paths forming vertically through the filter media closer to the outlet.

Perforated pipes should not use a geofabric wrapping, as this is a potential location for blockage and would require a complete resetting of the bioretention system. Where perforated pipes are supplied with geofabric wrapping, it is to be removed before installation.

Installing parallel pipes is a means to increase the capacity of the perforated pipe system. 100 mm diameter is recommended as the maximum size for the perforated pipes to minimise the thickness of the drainage layer. Either slotted PVC pipes or flexible perforated pipes (e.g. Ag pipe) can be used; however, care needs to be taken when selecting the type of pipe to consider the following:

(i) ensure the slots in the pipes are not so large that sediment will freely flow into the pipes from the drainage layer. This is also a consideration when specifying drainage layer media; and

(ii) minimise the potential for tree roots to enter the pipes in search of water. Generally, this is only a concern when the filter media has a low water holding capacity, or trees are planted in filter media whose depth is too shallow. In general, trees are not recommended if the filter media depth is less than 800 mm. Flexible "ribbed" pipes are more likely, than PVC pipes, to retain "beads" of moisture due to the small corrugations on the inside of the pipe. Therefore, a smooth surface perforated/slotted pipe system is recommended for use in bioretention basins exhibiting any of these characteristics.

(iii) To ensure slotted pipes are of adequate size, several checks are required:

(A) ensure the perforations are adequate to pass the maximum filtration rate;

(B) ensure the pipe itself has sufficient capacity; and

(C) ensure that the material in the drainage layer will not be washed into the perforated pipes (consider a transition layer).

The maximum filtration rate represents the maximum rate of flow through the bioretention filter media and is calculated by applying Darcy's equation as follows:

$$V_s = A_c \cdot R \cdot L_o \cdot F_c$$

Where V_s = volume of forebay sediment storage required (m^3)

A_c = contributing catchment area (ha)

R = capture efficiency (assume 80%)

L_o = sediment loading rate (m^3/ha/year)

F_c = desired cleanout frequency (years)

To ensure the perforated under-drainage system has sufficient capacity to collect and convey the maximum filtration rate, it is necessary to determine the capacity for flows to enter the under-drainage system via the perforations in the pipes. To do this, orifice flow can be assumed and the sharp edged orifice equation used. It is conservative, but reasonable to use a blockage factor to account for partial blockage of the perforations by the drainage layer media. A 50% blockage of the perforations should be used.

The flow capacity of the perforations is thus:

$$A_s = \frac{V_s}{D_s}$$

If the capacity of the drainage system is unable to collect the maximum filtration rate additional under-drains will be required.

The Manning's roughness used will be dependent on the type of pipe used (refer to QUDM Table 7.16.3 (DNRW, IPWEA & BCC 1998)). When a saturated zone is incorporated into the design, the underdrainage pipes are laid flat however the conveyance capacity can be calculated using the Manning's equation with an assumed friction slope of 0.5%.

Under-drains should be extended vertically to the surface of the bioretention system to allow inspection and maintenance when required. The vertical section of the under-drain should be unperforated and capped to avoid short-circuiting of flows directly to the drain. Reference is made to the drawings following the worked example (Section SC6.4.3.9.4(3)(i) Step 9: Undertake verification checks) for further guidance.

In bioretention basins with a saturated zone, the capacity of the weir or up-turned pipe (maintaining the water level within the saturated zone) must also be checked to ensure it does not become the hydraulic "control" in the bioretention system (i.e. to ensure the filter media sets the travel time for flows percolating through the bioretention system). A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) to convey the maximum flow/filtration rate. The maximum depth of flow over the weir is to be 100 mm. This is important to limit increase in the saturated zone depth and avoid prolonged saturation of the filter media.

(f) Step 6: Check requirement for impermeable lining

The saturated hydraulic conductivity of the natural soil profile surrounding the bioretention system should be tested together with depth to groundwater, chemical composition and proximity to structures and other infrastructure. This is to establish if an impermeable liner is required at the base (only for systems designed to preclude ex-filtration to in-situ soils) and/or sides of the bioretention basin (refer also to discussion in SC6.4.3.9.4(2)(c) Ex-filtration to in-situ soils). If the saturated hydraulic conductivity of the filter media in the bioretention system is more than one order of magnitude (10 times) greater than that of the surrounding in-situ soil profile, no impermeable lining is required.

(g) Step 7: Size overflow pit

There should be a minimum of 50 mm head over the overflow pit crest to facilitate discharge of the design flow into the overflow pit.

In streetscape bioretention applications, a level of conservatism is built into the design of grated overflow pits by placing their inverts at least 50 mm below the invert of the street channel (and therefore setting the maximum ponding depth). The head over the overflow pit crest is the sum of the 50 mm and the maximum ponding in the street channel under the minor storm (see SC6.4.3.9.4(3)(c)(v) Kerb opening configuration). To size an overflow pit, two checks must be made to test for either drowned or free flowing conditions. A broad crested weir equation can be used to determine the length of weir required (assuming free flowing conditions) and an orifice equation used to estimate the area between openings required in the grate cover (assuming drowned outlet conditions). The larger of the two pit configurations should be adopted (as per Section 7.05 QUDM (DNRW, IPWEA & BCC 1998)). In addition, a blockage factor that assumes the grate is 50% blocked is to be used.

For free overfall conditions (weir equation):

$$R = 1 - \left[1 + \frac{1}{n} \cdot \frac{v_s}{Q/A}\right]^{-n}$$

Where:

R	=	fraction of target sediment removed (80%)
v_s	=	settling velocity of target sediment (100 mm/s or 0.1 m/s for 1 mm particle)
Q/A	=	applied flow rate divided by forebay surface area ($m^3/s/m^2$)
n	=	turbulence or short-circuiting parameter (adopt 0.5)

Once the length of weir is calculated, a standard sized pit can be selected with a perimeter at least the same length of the required weir length.

For drowned outlet conditions (orifice equation):

$$Q = C_w \cdot L \cdot h^{3/2}$$

Where

Q	=	flow (m^3/s)
Cw	=	weir coefficient (= 1.66)
L	=	length of opening (m)
h	=	depth of flow (m)

When designing grated field inlet pits, reference is also to be made to the procedure described in QUDM Section 7.05.4.

In terms of the actual grate, letter box or dome type grates must be used in bioretention basins.

When a saturated zone is included in the design of a bioretention system, additional components must be incorporated into the outlet design. A saturated zone can be formed at the base of a bioretention system by using a riser pipe with the outlet level set at the top of the desired saturation depth (i.e. top of the saturated zone) or by incorporating a weir/overflow structure within the outlet pit (see Figure SC6.4.3.9.18). The saturated zone would hold water rather than draining freely, and would therefore provide a source of water to the plants during dry periods.

(h) Step 8: Specify vegetation

Refer to SC6.4.3.9.4(4) Landscape design notes and SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for advice on selecting vegetation for bioretention basins in the coastal dry tropics.

Editor's note—applicants will also need to address 9.4.3 Landscape Code and sub-section SC6.4.3.6 Landscape policy.

(i) Step 9: Undertake verification checks

Once the detailed design is complete, a final check should be undertaken to confirm that vegetation will be protected from scour during flood events and that the final design will achieve the required treatment performance.

(i) Vegetation scour velocity check

Velocities should be kept below:

(A) 0.5 m/s for minor flood (2-5 year ARI) discharges; and

(B) 2.0 m/s for major flood (50 year ARI) discharges.

If the inlet to the bioretention basin "controls" the maximum inflow to the basin then it is appropriate to use this maximum inflow to check velocities. In this case, velocities should be maintained below 0.5 m/s.

(ii) Confirm treatment performance

If, during the course of undertaking detailed design of the bioretention basin, the basic design parameters established by the conceptual design phase have changed (e.g. area, filter media depth, etc.) then the designer should verify that the current design meets the required water quality improvement performance. This can be done by re-modelling expected treatment performance determined in the conceptual design based on the revised configuration of the system.

(j) Design calculation summary

A calculation summary sheet for the key design elements of a bioretention basin is provided in Table SC6.4.3.9.10.

Click here to obtain a copy of **Table SC6.4.3.9.10**

(4) Landscape design notes – bioretention basins

(a) Objectives

Landscape design for bioretention basins has four key objectives:

(i) addressing stormwater quality objectives by incorporating appropriate groundcover plant species for sediment removal, erosion protection, stormwater treatment (biologically active root zone) and preventing filter media blockages;

(ii) ensuring that the overall landscape design for the bioretention basin integrates with its surrounding environment. This includes requirements for maintaining dense perennial vegetation throughout the dry season to maintain aesthetics and to minimise weed growth;

(iii) incorporating crime prevention through environmental design (CPTED) principles and traffic visibility safety standards for roadside systems. This objective also needs to incorporate public safety; and

(iv) providing other landscape values such as shade, amenity, character, buffers, glare reduction, place making and habitat.

For further guidance refer to the *South East Queensland WSUD Conceptual Design Guidelines* (Healthy Waterways Partnership, 2008)

(b) Bioretention basin vegetation

Planting for bioretention basin elements may consist of up to three vegetation types:

(i) groundcovers for stormwater treatment and erosion protection;

(ii) shrubbery for screening, glare reduction and character; and

(iii) trees for shading, character, breaking up filter material and other landscape values.

The plant species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics tolerate free draining sandy soils and are capable of withstanding long dry periods as well as periods of inundation. However, because the dry periods in the coastal dry tropics can be severe, bioretention systems must have supplemental temporary irrigation or include a saturated zone. These measures ensure dense perennial vegetation can be sustained to maintain aesthetics, stormwater treatment capacity and to minimise weed growth.

(c) Parkland bioretention basins

Once the general location has been determined, it will be necessary to investigate how the elements of the bioretention system will be arranged within the open space including:

(i) opportunities and constraints presented by various siting options;

(ii) if the device is to be visually prominent (perhaps for educational value) or merged with the surrounding parkland space using a consistent planting layout in the basin, embankment and parkland; and

(iii) a formal or informal style dependent on the setting and surrounding open space and urban design.

(d) Safety issues

The standard principles of informal surveillance, exclusion of places of concealment and open visible areas apply to the landscape design of bioretention basins. Regular clear sightlines should be provided between the roadway and footpaths/ property. Safety measures in accordance with the requirements of the relevant local authority should also be installed around structural components of bioretention basins where safety hazards exist.

(i) Crime prevention through environmental design (CPTED)

Where planting may create places of concealment or hinder informal surveillance, groundcovers and shrubs should not generally exceed 1 m in height.

(ii) Traffic sightlines

The standard rules of sightline geometry apply. Planting designs should allow for visibility at pedestrian crossings, intersections, rest areas, medians and roundabouts.

(5) Construction and establishment – bioretention basins

This section provides general advice for the construction and establishment of bioretention basins and key issues to be considered to ensure their successful establishment and operation (see Figure SC6.4.3.9.20).

Figure SC6.4.3.9.20 Bioretention basin functional installation

(a) Staged construction and establishment method

(i) Sediment and erosion control

Many soils within the coastal dry tropics region are dispersive, highlighting the critical importance of appropriate sediment and erosion control. All development and land disturbance activities must employ best practice sediment and erosion control practices to minimise the impact on receiving environments (refer to the Development manual planning scheme policy SC6.4.3.8 Stormwater management plans for development).

In relation to bioretention systems, temporary protective layers must be installed and left in place throughout the allotment building phase to ensure sediment laden waters do not clog the filtration media and allotment building traffic does not enter the bioretention system (see Figure SC6.4.3.9.21). Importantly the configuration of the bioretention basin and the turf vegetation allow the system to function effectively as a shallow sedimentation basin reducing the load of sediment discharging to the receiving environment. Using this approach, WSUD systems can operate effectively to protect downstream ecosystems immediately after construction.

Figure SC6.4.3.9.21 Bioretention basin sediment and erosion control

(ii) Operational establishment

At the completion of the allotment building phase the temporary measures (i.e. geofabric and turf) are removed with all accumulated sediment and the bioretention system re-profiled and planted in accordance with the proposed landscape design. Establishment of the vegetation to design condition can require more than two growing seasons, depending on the vegetation types, during which regular watering and removal of weeds will be required.

(iii) Quality control during construction

The primary responsibility for supervision of the construction of WSUD elements lies with the site superintendent. Key milestones requiring inspection and sign off by either the superintendent or

the design team are detailed in the suggested construction sequence below.

Meetings between the design team and contractors should also take place at the commencement of each phase of works, i.e.:

- prior to commencement of civil works;
- prior to commencement of landscape works; and
- at the completion of works.

Regular site inspections by a member of the design team are also recommended to ensure the bioretention basins are constructed as per the design intent and to provide ongoing construction and establishment advice to the contractors.

The suggested construction sequence for the bioretention basins are as follows:

(A) survey bioretention basin location;

(B) undertake bulking out, including construction of bunds surrounding basin. Construct outflow headwall(s) and install section(s) of stormwater reinforced concrete pipes (RCP) that runs underneath bund. Terminate pipe at interface of bund and bioretention basin;

(C) excavate surrounding landform to design subsoil level (achieving surrounding level at this stage reduces the need for earthworks adjacent to the basins after they have been constructed);

(D) install overflow pit(s) and ensure pit crest(s) is at design level. The pit crest(s) will then be used as a datum from which other levels within the basin will be measured. The pit requires holes for pipe connections and these should be drilled at this stage;

(E) detailed excavation, trimming and profiling of sides and base of basin, ensuring base has minimum 0.5% grade (0% slope when saturated zones are included in the designs) towards pit. Ensure base of basins are free from debris. As constructed survey is required at this time and should include the base and bunds of the system and all hard structures (i.e. overflow pit, overflow weir and pipe connection punch-out holes);

(F) install silt fences around basin to prevent sediment entering system and to keep construction vehicles off the basin;

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING

(G) line basin with geofabric, ensuring geofabric extends beyond top of bioretention basin side walls, up to the sediment control fence. This ensures that exposed earth on the bunds won't wash into basins during construction;

(H) install remaining RCP stormwater pipe connecting overflow pit(s) to existing RCP stormwater pipe installed as part of Step 2;

(I) install slotted PVC under-drainage pipes and PVC collector pipes in specified layout. Ensure all pipes are laid at min 0.5% slope (0% slope when saturated zones are included in the designs) with no localized depressions verified using level or string line. Arrange slots so that they are not directly on top of the pipe (to minimise fine particles blocking the slots). Seal junctions and connections (i.e. slotted PVC pipes to PVC collector pipes; slotted PVC pipes/PVC collector pipes to overflow pits) using sealant to prevent sand/gravel/soil passing into drainage network. Connect clean out points ensuring top of clean out points will ultimately sit 200 mm below overflow pit crest;

SUPERINTENDENT INSPECTION AND SIGN OFF REQUIRED BEFORE PROCEEDING

(J) install drainage, transition and saturated zones as required and as detailed in the design drawings;

(K) place prescribed bioretention filter media to design surface level of bioretention basin. Spread material using excavator bucket, hand tools, or a small "pozitrack" bobcat. Do not drive over filter media with any vehicle other than a "pozitrack" bobcat and only if agreed to by civil superintendent. In order to remove air pockets within the filter media, apply light and even compaction by making a single pass with a "pozitrack" bobcat (or similar). If required, apply additional filter media to ensure final surface level is correct. Use a spreader bar to flatten the surface of the filter media. Ultimately, the surface of the filter media must be level

(horizontal) and free from local depressions and set at 300 mm below pit crest;

(L) construct coarse sediment forebay utilising large, flat rocks to form base of forebay and interface between forebay and bioretention area;

(M) install temporary protective covering over bioretention surface. This involves covering the surface of filtration media with geofabric and placement of 50 mm topsoil and turf over the geofabric. This geofabric/turf layer is a temporary measure to protect the filter media from being clogged with construction sediment while allotment building is being undertaken. Once a majority of the allotment building is complete and the construction sediment load is minimal, this protective layer will be removed, and the system will be planted out with the vegetation as per designs;

(N) place landscaping topsoil on top of geofabric covering the bunds and around basin as per designs;

(O) flush under-drainage pipes to remove any initial ingress of material; and

(P) undertake as constructed survey of the basin surface and surrounding bunds, picking up at least one spot level per 100m² on the basin surface and at least one spot level every 10m along the top of the bunds.

FINAL SUPERINTENDENT INSPECTION AND SIGN OFF

(b) Construction tolerances

It is important to emphasise the significance of tolerances in the construction of bioretention basins (e.g. profiling of trench base and surface grades). Ensuring the surface of the bioretention filter media is free from localised depressions is particularly important to achieve even distribution of stormwater flows across the surface. In bioretention systems without saturated zones, the base of the trench should be sloped towards the outlet pit (min 0.5% longitudinal grade) to enable the perforated sub-surface drainage pipes to drain freely. Generally an earthworks tolerance of plus or minus 50 mm is considered acceptable.

(c) Sourcing bioretention vegetation

Notifying nurseries early for contract growing is essential to ensure the specified species are available in the required numbers and of adequate maturity in time for bioretention basin planting. When this is not done and the planting specification is compromised, poor vegetation establishment and increased initial maintenance costs may occur. The species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are generally available commercially from local native plant nurseries. Availability is, however, dependent upon many factors including demand, season and seed availability. To ensure planting specification can be accommodated, the minimum recommended lead time for ordering is 3-6 months. This usually allows enough time for plants to be grown to the required size. The following pot sizes are recommended as the minimum:

(i) viro tubes - 50 mm wide x 85 mm deep;

(ii) 50 mm tubes - 50 mm wide x 75 mm deep; and

(iii) native tubes - 50 mm wide x 125 mm deep.

(d) Vegetation establishment

The following weed control measures and watering schedule are recommended to ensure successful plant establishment. Regular general maintenance as outlined in SC6.4.3.9.4(5) will also be required.

(i) Weed control

Conventional surface mulching of bioretention basins with organic material like tanbark, should not be undertaken. Most organic mulch floats and runoff typically causes this material to be washed away with a risk of blocking drains. Adopting high planting densities (e.g. 8-10 plants per square metre) and if necessary, applying a suitable biodegradable erosion control matting to the basin batters will help to combat weed invasion and reduce labour intensive maintenance requirements for weed removal. A heavy application of seedless hydro-mulch or hydro-mulch seeded with a sterile annual grass (e.g. Sterile Rye Grass) to create an anchored mulch can also provide short term erosion and weed control prior to planting with nursery stock. No matting or hydro-mulch is to be applied to the surface of the bioretention basin following the construction phase (i.e. in its final design form, vegetated as per planting schedule), as this will hinder filtration of stormwater through

the filter media.

(ii) Watering

Regular watering of bioretention basin vegetation is essential for successful establishment and healthy growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. The following watering program is generally adequate but should be adjusted (increased) to suit the site conditions:

(A) week 1-2 3 visits/ week;

(B) week 3-6 2 visits/ week; and

(C) week 7-12 1 visit/ week.

After this initial 3 month period, supplementary irrigation will be required in bioretention basins without submerged zones and may be required in bioretention basins with saturated zones (particularly during the 2 year plant establishment period (see Figure SC6.4.3.9.22)). Watering requirements to sustain healthy vegetation should be determined during ongoing maintenance site visits.

Figure SC6.4.3.9.22 Plant establishment period in bioretention basin

(6) Maintenance requirements – bioretention basins

Vegetation plays a key role in maintaining the porosity of the filter media of a bioretention basin and a strong healthy growth of vegetation is critical to its performance. Therefore the most intensive period of maintenance is during the plant establishment period (first 2 years) when weed removal and replanting may be required.

Inflow systems and overflow pits require careful monitoring, as these can be prone to scour and litter build up. Debris can block inlets or outlets and can be unsightly, particularly in high visibility areas. Inspection and removal of debris should be done regularly, and debris should be removed whenever it is observed on a site. Where sediment forebays are adopted, regular inspection of the forebay is required (3 monthly) with removal of accumulated sediment undertaken as required.

For larger bioretention basins, a maintenance access track for maintenance vehicles (e.g. 4WD ute) should be provided to the full perimeter of the system for maintenance efficiency and ease.

(7) Checking tools – bioretention basins

A number of checking aids have been developed for designers and council development assessment officers. In addition, SC6.4.3.9.4(5) Construction and establishment - bioretention basins provides general advice for the construction and establishment of bioretention basins and key issues to be considered to ensure their successful establishment and operation based on observations from construction projects around Australia.

(a) Design assessment

The checklist at Table SC6.4.3.9.11 presents the key design features that are to be reviewed when assessing the design of a bioretention basin. These considerations include configuration, safety, maintenance and operational issues that need to be addressed during the design phase. If an item receives an “N” when reviewing the design, referral is made back to the design procedure to determine the impact of the omission or error. A copy of the completed design calculation summary from Table SC6.4.3.9.10 should be provided as part of the application to assist in the design assessment. In addition to the checklist, a proposed design is to have all necessary permits for its installation. Council development assessment officers will require all relevant permits to be in place prior to accepting a design.

Click here to view **Table SC6.4.3.9.11 Bioretention basin design assessment checklist**

(b) Construction (during and post)

The checklist at Table SC6.4.3.9.12 presents the key items to be reviewed when inspecting the bioretention basin during and at the completion of construction. The checklist is to be used by Construction Site Supervisors and local authority Compliance Inspectors to ensure all the elements of the bioretention basin have been constructed in accordance with the design. If an item receives an “N” in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view **Table SC6.4.3.9.12 Bioretention basin construction inspection checklist**

(c) Operation and maintenance inspection

The example form at Table SC6.4.3.9.13 should be developed and used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time. Inspections should occur every 1 - 6 months depending on the size and complexity of the system. More detailed site specific maintenance schedules should be developed for major bioretention basins and include a brief overview of the operation of the system and key aspects to be checked during each inspection.

Click here to view **Table SC6.4.3.9.13 Bioretention basin maintenance checklist**

(d) Asset transfer (following on maintenance period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater treatment device. A proposed design should clearly identify the asset owner and who is responsible for its maintenance. The proposed owner should be responsible for performing the asset transfer checklist. For details on asset transfer to specific to each council, contact the relevant local authority. Table SC6.4.3.9.14 provides an indicative asset transfer checklist.

Click here to view **Table SC6.4.3.9.14 Bioretention basin asset transfer checklist**

(8) Example engineering drawings – bioretention basins

Where council has standard drawings appropriate to a bioretention basin application, these should be used to guide the design and construction of a bioretention basin. In the absence of local standards, Brisbane City Council have developed a set of Standard Drawings (UMS 155, 156 and 337) that can be readily applied to bioretention basin applications in the coastal dry tropics. These drawings relate specifically to inlet pits and sub-surface drains for bioretention swales but may be used to guide design for bioretention basins.

Editor’s note—these are not intended to be prescriptive drawings which must be adhered too; rather they are intended to provide detailed examples of bioretention system configurations.

(9) References and additional information – bioretention basins

BCC 2000a (with revisions 2004), *Subdivision and Development Guidelines*.

BCC 2000b, *Brisbane City Plan 2000*, BCC, Brisbane.

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SC6.4.3.9.5 Constructed stormwater wetlands

Editor's note—due to the different climatic conditions, the design of constructed wetlands in the coastal dry topics differs from the design of wetlands in south east Queensland and southern states. The following design considerations and criteria outlined below are specific to the coastal dry topics and are intended to address key requirements such as maintaining perennial wetland vegetation during the dry season; managing the potential for weed ingress and providing natural means of managing mosquito populations.

(1) Constructed wetland systems are densely vegetated water bodies that use enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater. Water levels rise during rainfall

events and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. In addition to treating stormwater, constructed wetlands can also provide habitat, passive recreation and improved landscape amenity.

Constructed wetlands in the coastal dry tropics will generally consist of an inlet zone (sedimentation basin to remove coarse sediments, deep pools, a deep marsh macrophyte zone (i.e. a heavily vegetated area to remove fine particulates and uptake soluble pollutants) and a high flow bypass channel (to protect the macrophyte zone from scour and vegetation damage). Figure SC6.4.3.9.23 Schematic layout of a constructed wetland system and Figure SC6.4.3.9.24 Wet and dry season conditions in a constructed freshwater wetland show the key elements of constructed stormwater wetland systems.

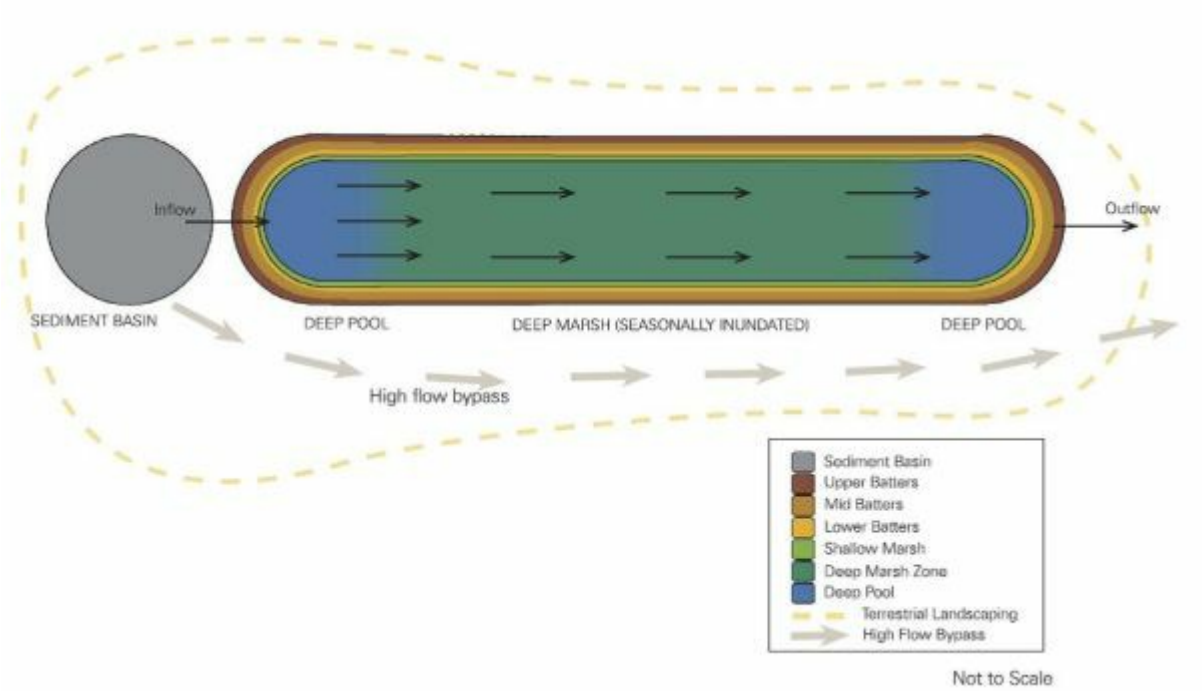


Figure SC6.4.3.9.23 Schematic layout of a constructed wetland system

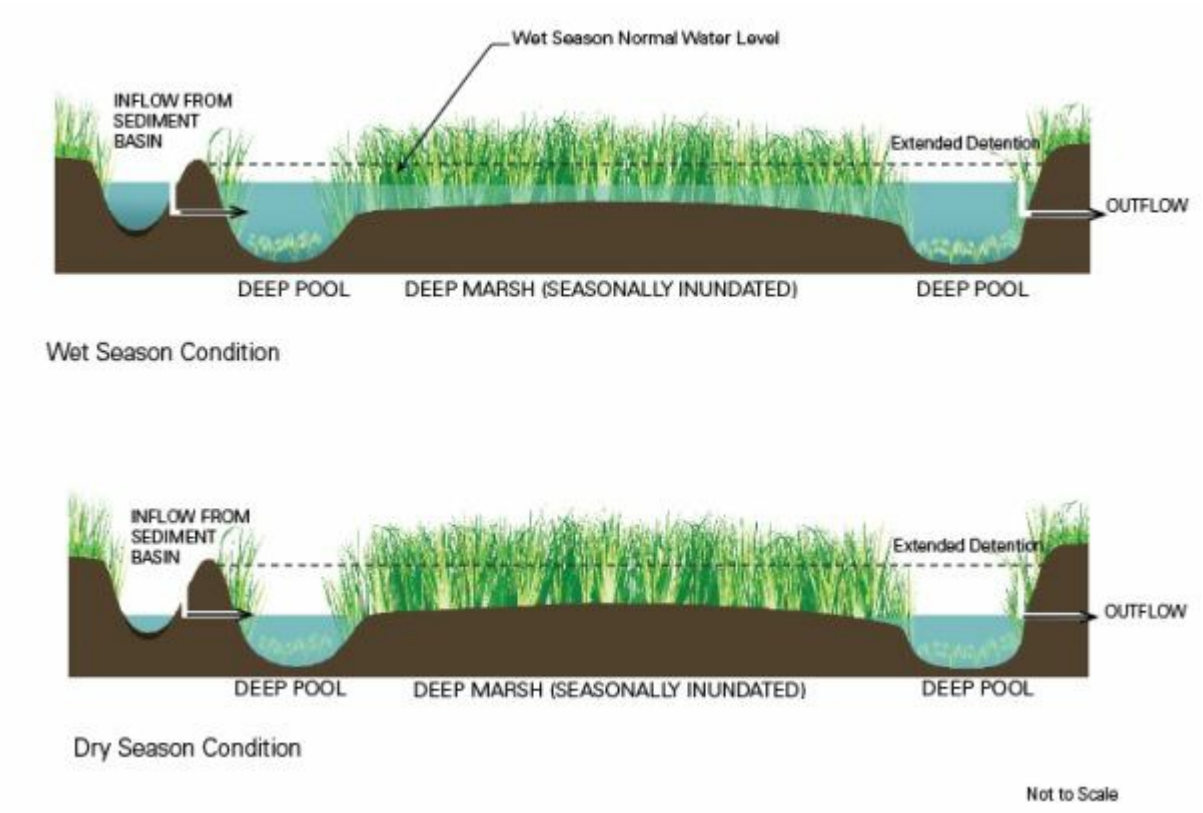


Figure SC6.4.3.9.24 Wet and dry season conditions in a constructed freshwater wetland

Constructed wetlands treat stormwater by capturing runoff and slowly passing it horizontally through a densely vegetated macrophyte zone. Soluble and colloidal (fine particles held in suspension) pollutants are mostly removed by sorption (absorption – "into" and adsorption – "onto") to biofilms on stems of wetland plants (Figure SC6.4.3.9.25). For this reason, dense vegetation is important for effective treatment and vegetation with a large stem surface area provides greatest treatment (i.e. plants with many small diameter stems are able to support more biofilms than plants with fewer, thicker stems). Emergent macrophytes are also important for:

(a) transferring oxygen to the sediments (oxygen pumps) thereby facilitating the processing and/or immobilising of pollutants captured and held within wetland sediments;

(b) aiding in the treatment of nutrient and heavy metal concentrations, either through direct uptake, or through providing a surface for biofilms and epiphytes that assist with the removal of pollutants;

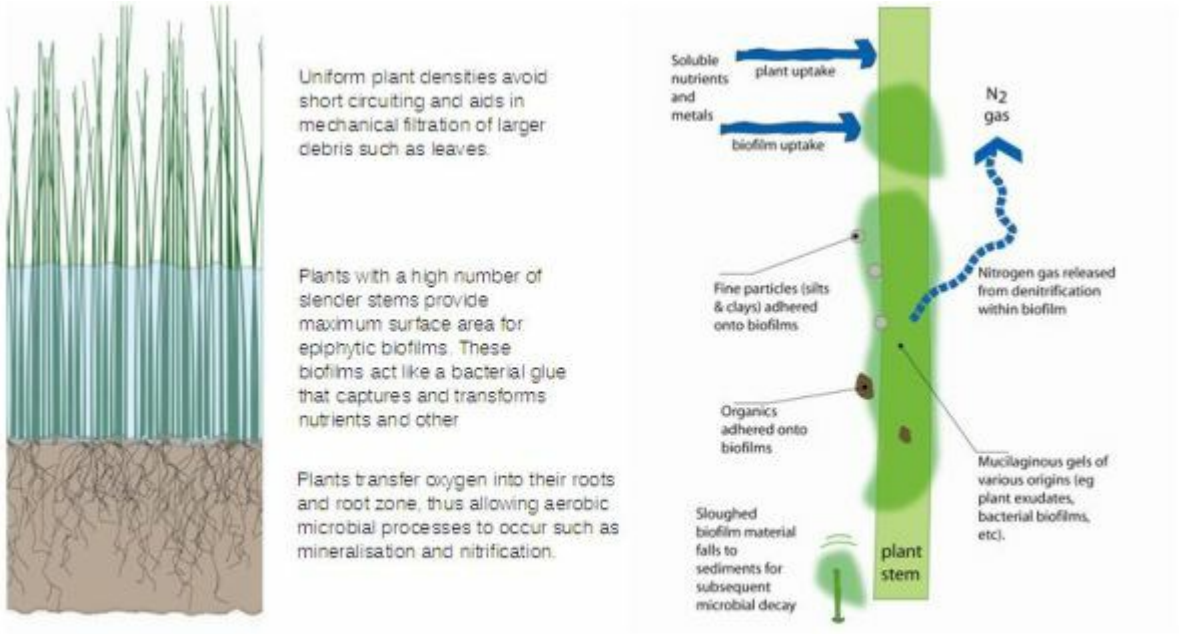
(c) influencing sediment deposition and physically filtering sediment particles from the water column;

(d) influencing hydrology and hydraulics by promoting even flow distribution through the wetland;

(e) providing shade, decreasing light availability for algal synthesis;

(f) decreasing erosion by reducing wave action and flow velocities while binding soil particles with their root systems; and

(g) providing a basis for wetland food chains and supplying shelter for mosquito predators such as macroinvertebrates and fish.



(Figure and associated text from the *Healthy Waterways WSUD Technical Design Training Notes for South East Queensland* - Version 1 June 2007)

Figure SC6.4.3.9.25 Dense emergent macrophytes and biofilms on the plant stems play an important role in nutrient removal in constructed stormwater wetlands

Source—Figure and associated text from the *Healthy Waterways WSUD Technical Design Training Notes for South East Queensland* - Version 1 June 2007.

(2) Design considerations - constructed wetlands

Due to the different climatic conditions, the design of constructed wetlands in the coastal dry topics differs from the design of wetlands in south-east Queensland and southern states. The following design considerations and criteria outlined below are specific to the coastal dry topics and are intended to address key requirements such as maintaining perennial wetland vegetation during the dry season; managing the potential for weed ingress and providing natural means of managing mosquito populations. Constructed wetlands in the form detailed below have not yet been constructed in the Townsville region. Therefore it is recommended that demonstration projects adopting the design guidelines detailed below are constructed and revisions/updates of this clause

made, where deemed appropriate, to reflect practical learnings and understanding of the performance and sustainability of constructed stormwater treatment wetlands in the coastal dry tropics.

Community acceptance of constructed wetlands will be driven by their aesthetics and landscape amenity value. Poorly designed and/or maintained wetlands are unlikely to gain community support; therefore, it is essential to address potential issues such as pests and weeds starting at conceptual design and continuing through implementation and long-term maintenance.

The operation of constructed wetlands involves the interaction between stormwater runoff, vegetation and hydraulic structures and the successful implementation of constructed wetlands requires appropriate integration into the landscape design. In this regard, the following sections provide an overview of the key design issues that must be considered when conceptualising and designing constructed wetlands.

(a) Landscape design

Constructed wetlands are often located within accessible open space areas and can become interesting community features. Landscape design aims to ensure that macrophyte planting fulfils the intended stormwater treatment function as well as integrating with their surrounds. Opportunities to enhance public amenity and safety with viewing areas, pathway links, picnic nodes and other elements should be exploited. Community education through signage and public art can also be explored. It is important that the landscape of constructed wetlands addresses stormwater quality objectives whilst being sensitive to these other important landscape aims.

Terrestrial landscaping provides a visual buffer and framework for the wetland system within the community and native habitat. Native trees can encourage recreational elements such as walking and bird watching. These recreational elements, as well as education in the form of descriptive panels and signs, can increase acceptance of these systems within the community.

Figure SC6.4.3.9.26 Boardwalk and public viewing area on the edge of a landscaped wetland

(b) Invasive weed control

To protect landscape amenity and the stormwater treatment efficiency of the wetland it is important to maintain, throughout the year, the design vegetation communities to avoid excessive colonisation of the wetland by weeds. Weed infestation is a major problem in the dry tropics, particularly within ephemeral waterways and stormwater treatment facilities. The wetland design presented in this chapter is based on an ephemeral wetland (i.e. it will dry periodically) and therefore, the design and management of the wetland to manage weed infestation takes on high importance. Management of weeds is achieved as follows:

(i) designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities;

(ii) planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season; and

(iii) during the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

(c) Detention time and hydrologic effectiveness

Detention time is the time taken for each "parcel" of water entering the wetland to travel through the macrophyte zone assuming "plug" flow conditions. In highly constrained sites, simulations using quantitative computer models, such as the Model for Urban Stormwater Improvement Conceptualisation (MUSIC, CRCCH 2005), are often required to optimise the relationship between wetland detention time1 and wetland hydrologic effectiveness to maximise treatment performance. Hydrologic effectiveness is a measure of the mean annual volume of stormwater runoff captured and treated within the wetland and is expressed as a percentage of the mean. It is recommended that a notional detention time should preferably be around 48 hours to remove nutrients effectively from urban stormwater. Optimal hydrologic effectiveness in the coastal dry tropics Region is a balance between minimising overflows in the wet season and sustaining vegetation in the dry season (i.e. sizing the wetland to treat the majority of stormwater runoff while not being too large as to result in water level drawdown and drying in excess of 60–70 days in the dry season). Further discussion on hydrologic effectiveness and sizing of wetlands in the coastal dry tropics is provided in the following sections of this clause.

Editor's note—it should be noted that detention time is rarely a constant and the term notional detention time is used throughout this chapter to provide a point of reference in modelling and determining the design criteria for riser outlet structures.

(d) Hydrodynamic design

Poor wetland hydrodynamics is often identified as a major contributor to wetland operational and management problems. A summary of desired hydrodynamic characteristics and design considerations is presented in Table SC6.4.3.9.15.

Table SC6.4.3.9.15 Desired wetland hydrodynamic characteristics and associated design considerations

Hydrodynamic Characteristics	Design Considerations	Remarks
Uniform Distribution of flow velocity	Wetland shape, inlet and outlet placement and bathymetrical design of wetland to eliminate short-circuit flow paths and poorly mixed zones.	Poor flow pattern within a wetland will lead to zones of stagnant pools which promote litter, oil and scum accumulation as well as potentially supporting mosquito breeding. Short circuit flow paths of high velocities will lead to the wetland being ineffective in water quality improvement.

Inundation depth, wetness gradient, base flow and hydrologic regime	Selection of wetland size and design of outlet control to ensure compatibility with the hydrology and size of the catchment draining into the wetland. Bathymetry layout and outlet control design to compliment the botanical design and the hydrology of the wetland.	Wetland area and outlet design is critical to achieve the WSUD Objectives (e.g. target pollutant load reduction) as well as ensuring the size is adequate to sustain wetland vegetation (i.e. not too large as to result in excessive water level drawdown and drying in excess of 60 days in the dry season). Inadequate attention to the inundation depth, wetness gradient of the wetland and the frequency of inundation at various depth ranges would lead to sparse vegetation cover and/or dominance of certain plant species (especially weed species over time). This results in a deviation from the intended botanical layout of the wetland and reduced stormwater treatment performance.
Uniform vertical velocity profile	Selection of plant species and location of inlet and outlet structures to promote uniform vertical velocity profile.	Preliminary research findings have indicated that certain plant species have a tendency to promote stratification of flow conditions within a wetland leading to ineffective water pollution control and increasing the potential for algal blooms.
Scour protection	Design of inlet structures and erosion protection of banks.	Owing to the highly dynamic nature of stormwater inflows, measures are to be taken to “protect” the wetland from erosion during periods of high inflow rates.

(e) Inlet zone design considerations

The inlet zone of a constructed stormwater wetland is designed as a sedimentation basin and has two key functional roles. The primary role is to remove coarse to medium sized sediment (i.e. 125 µm or larger) prior to flows entering the macrophyte zone. This ensures the vegetation in the macrophyte zone is not smothered by coarse sediment and allows the macrophyte zone to target finer particulates, nutrients and other pollutants.

The second role of the inlet zone is the control and regulation of flows entering the macrophyte zone and bypass of flows during “above design flow” conditions. The outlet structures from the inlet zone (i.e. sedimentation basin) are designed such that flows up to the “design flow” (typically the 1 year ARI) enter the macrophyte zone whereas “above design flows” are bypassed around the macrophyte zone. In providing this function, the sedimentation basin protects the vegetation in the macrophyte zone against scour during high flows (see Figure SC6.4.3.9.27).

When the available space for a constructed wetland is constrained, it is important to ensure that the size of the inlet zone (i.e. sedimentation basin) is not reduced. This ensures the larger sediments are effectively trapped and prevented from smothering the macrophyte zone. When the site constrains the size of the constructed wetland it is the macrophyte zone of the wetland that should be reduced accordingly.

Large wetland systems usually require a gross pollutant trap (GPT) as part of the inlet zone to protect the wetland from litter and debris. The decision of whether a GPT is required or not, depends on the presence of upstream GPT measures and catchment size. The relevant local authority should be

consulted to determine if a GPT is required.

Figure SC6.4.3.9.27 Inlet zone bypassing major design flows around wetland.

(f) Macrophyte zone design considerations

The layout of the macrophyte zone needs to be configured such that system hydraulic efficiency is optimised and healthy vegetation sustained. Design considerations include:

(i) the preferred extended detention depth is 0.5 m. Deeper extended detention depths, up to a maximum of 0.75 m, may be acceptable where the wetland has a high hydrologic effectiveness and where the botanic design uses plant species tolerant to greater depths of inundation;

(ii) the longitudinal bathymetry of the macrophyte zone should grade (min 0.5% grade) smoothly from 0.7 m in depth (based on design normal water level) up to a central crest 0.5 m in depth and then back down to a maximum of 0.7 m in depth. This ensures that isolated pools of water are not created within the macrophyte zone during the dry season when the normal water level slowly draws down due to evapotranspiration;

(iii) the macrophyte zone is to have a flat cross sectional bathymetry only grading up at the edge batters. This facilitates the even distribution of flows to avoid short circuiting, creates a uniform hydraulic conveyance and maximises stormwater contact with macrophyte stems and biofilms;

(iv) the bathymetry of the macrophyte zone should be designed so that the macrophyte zone is connected to deeper open water pools (located at the inlet and outlet of the macrophyte zone) to allow mosquito predators to seek refuge in the deeper open water zones during periods of extended dry weather;

(v) the deep open water pools should be 2 m in depth to ensure that a permanent pool of water is sustained throughout the dry season. This ensures habitat is retained for fish, macroinvertebrates (mosquito predators) and submerged macrophytes;

(vi) the surface area of deep refuge pools (excluding the sediment basin) within the wetland should be between 20% and 30% of the total macrophyte area;

(vii) the constructed wetland is required to retain water permanently and therefore the base must be of suitable material to retain water (e.g. clay). If in-situ soils are unsuitable for water retention, a clay liner (e.g. compacted 300 mm thick) must be used to ensure there will be permanent water for vegetation and habitat;

(viii) particular attention should be given to the placement of the inlet and outlet structures, the length to width ratio of the macrophyte zone and flow control features to promote a high hydraulic efficiency within the macrophyte zone;

(ix) dense littoral vegetation around the perimeter of the wetland is required to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season. During extended dry periods (e.g. in excess of 60 days) wetland macrophytes may also require irrigation to sustain dense foliage and prevent habitat opportunities for weed species;

(x) provision to drain the macrophyte zone for water level management during the plant establishment phase should also be considered; and

(xi) the macrophyte zone outlet structure needs to be designed to provide a notional detention time (usually48 hours) for a wide range of flow depths. The outlet structure should also include measures to exclude debris to prevent clogging.

(g) Wetlands constructed within retention (or detention) basins

In many urban applications, wetlands can be constructed in the base of retention basins, thus reducing the land required for stormwater treatment. In these situations, wetland systems will occasionally become inundated to greater depths than the extended detention depth; however, the inundation duration is usually relatively short (hours) and is unlikely to affect the wetland vegetation provided there is a safe pathway to drain the wetland following flood events which avoids scour of the wetland vegetation and banks.

When designing a wetland within a retention basin, the outlet control structure of the retention basin (typically culverts) should be placed at the end of the wetland bypass channel. This ensures flood flows "backwater" across the wetland thus protecting the macrophyte vegetation from scour by high velocity flows.

(h) Vegetation types

Vegetation planted in the macrophyte zone has an important functional role in treating stormwater flows, as well as adding aesthetic value. A dense cover of perennial emergent macrophytes is essential for both stormwater treatment function and for the control of weeds. It is necessary for the macrophytes to permanently occupy the wetland habitat to limit weed colonisation opportunities. Dense perennial littoral vegetation is also important to avoid the ingress of weed species into the wetland macrophyte zone. Dense planting of the littoral zone will inhibit public access to the macrophyte zone, minimising potential damage to wetland plants and reducing the safety risks posed by water bodies.

The reader is referred to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for a list of suggested plant species suitable for constructed wetland systems in the coastal dry tropics. The planting densities recommended in the list should ensure that 70 - 80% cover is achieved within two growing seasons (2 years). The distribution of the species within the wetland will relate to their structure, function, relationship and compatibility with other species. The plant species in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are listed in accordance with the wetland zone/water depth in which they should be planted. The wetland zones are: deep marsh, shallow marsh (wetland edge), lower littoral and upper littoral.

(i) Designing to avoid mosquitoes

To reduce the risk of high numbers of mosquitoes, there are a number of design features that can be considered. Not all of these will be feasible in any one situation, but they include:

(i) providing access for mosquito predators, such as fish and predatory insects, to all parts of the water body (avoid stagnant isolated areas of water);

(ii) providing a deep permanent pool (for long dry periods or for when water levels are artificially lowered) so that mosquito predators can seek refuge and maintain a presence in the wetland;

(iii) where possible, incorporating a steep slope into the water, preferably greater than 300 or 3:1 horizontal to vertical. Note that steep edges may be unacceptable for public safety reasons, and a slope of up to 8:1 horizontal to vertical is generally used;

(iv) wave action from wind over open water will discourage mosquito egg laying and disrupt the ability of larvae to breathe;

(v) providing a bathymetry such that water draws down evenly so isolated pools are avoided;

(vi) providing sufficient gross pollutant control at the inlet such that human derived litter does not accumulate and provide breeding habitat;

(vii) providing ready access for field operators to monitor and treat mosquito larvae if required;

(viii) ensuring maintenance procedures do not result in wheel rut and other localised depressions that create isolated pools when water levels fall; and

(ix) ensuring overflow channels don't have depressions that will hold water after a storm event.

(j) Designing for maintenance access

Access to all areas of a constructed wetland is required for maintenance. In particular inlet zones and

gross pollutant traps require a track suitable for heavy machinery for removal of debris and desilting as well as an area for dewatering removed sediments. If sediment removal requires earthmoving equipment to enter the basin, then a stable ramp suitable for heavy plant will be required into the base of the inlet zone (maximum slope 1:10).

To aid maintenance, it is recommended that the inlet zone is constructed with a hard (i.e. rock) bottom. This is important if maintenance is performed by driving into the basin. It also serves an important role by allowing excavator operators to detect when they have reached the base of the inlet zone during desilting operations.

Macrophyte zones require access to the areas for weeding and replanting as well as regular inspections. Commonly, these access tracks can be incorporated with walking paths around a wetland system. Maintenance access to constructed wetland needs to be considered when determining the layout of a wetland system.

(3) Technical note: saline/brackish constructed wetlands

Urban communities in the dry tropics are often located near large estuarine river systems. In some locations it may be useful to have an optional estuarine stormwater treatment system. While estuarine systems are typically lower nutrient environments than freshwater stormwater treatment systems, a modified salt marsh community would still have considerable nutrient processing capability and could potentially provide a stormwater treatment capacity in some locations. This is a new concept that has not yet been tested and therefore should only be considered if other design solutions are not possible or practical.

If an estuarine stormwater treatment system was to be trialled/ constructed as a demonstration project, it is recommended that the model would need to consider the following list of features/design elements:

(a) drain a large stormwater runoff event over several tidal cycles;

(b) during a runoff event, extended detention depth should not exceed 0.5 m, but preferably be lower;

(c) the wetland should consist of a series of cells that would progressively fill and spill during a runoff event;

(d) the initial cell would be a sedimentation pond;

(e) surrounding the sedimentation pond and throughout the subsequent cells would support salt marsh communities (ranging from herbaceous to woody);

(f) a dry weather drainage system would allow complete drainage over a single tide cycle;

(g) the wetland would be drained by a series of runnels that would be capable of completely draining the system on a low tide sequence, thus managing potential mosquito breeding habitat;

(h) high tides (exceeding mean high tide) would be allowed to penetrate the entire system;

(i) a salinity gradient would be maintained through the system for most seasons;

(j) a series of berms and chokes would be included to ensure cells progressively fill and spill and that a salinity gradient is created and maintained;

(k) in high tidal range environments particular care will be needed in the design of the hydraulic connection between the perched salt marsh treatment system and the larger and deeper estuarine drainage channels (these environments are highly susceptible to erosion particularly after catchment development); and

(l) an important element in a estuarine system will be the wetting and drying sequence in that this will heighten the capacity to process nitrogen pollutants which are critical pollutants to near shore marine ecosystems.

The illustrations on the following page (Figure SC6.4.3.9.28 Possible design features of saline/brackish constructed wetlands), demonstrate how a saline/brackish wetland may be configured to achieve the above design criteria.

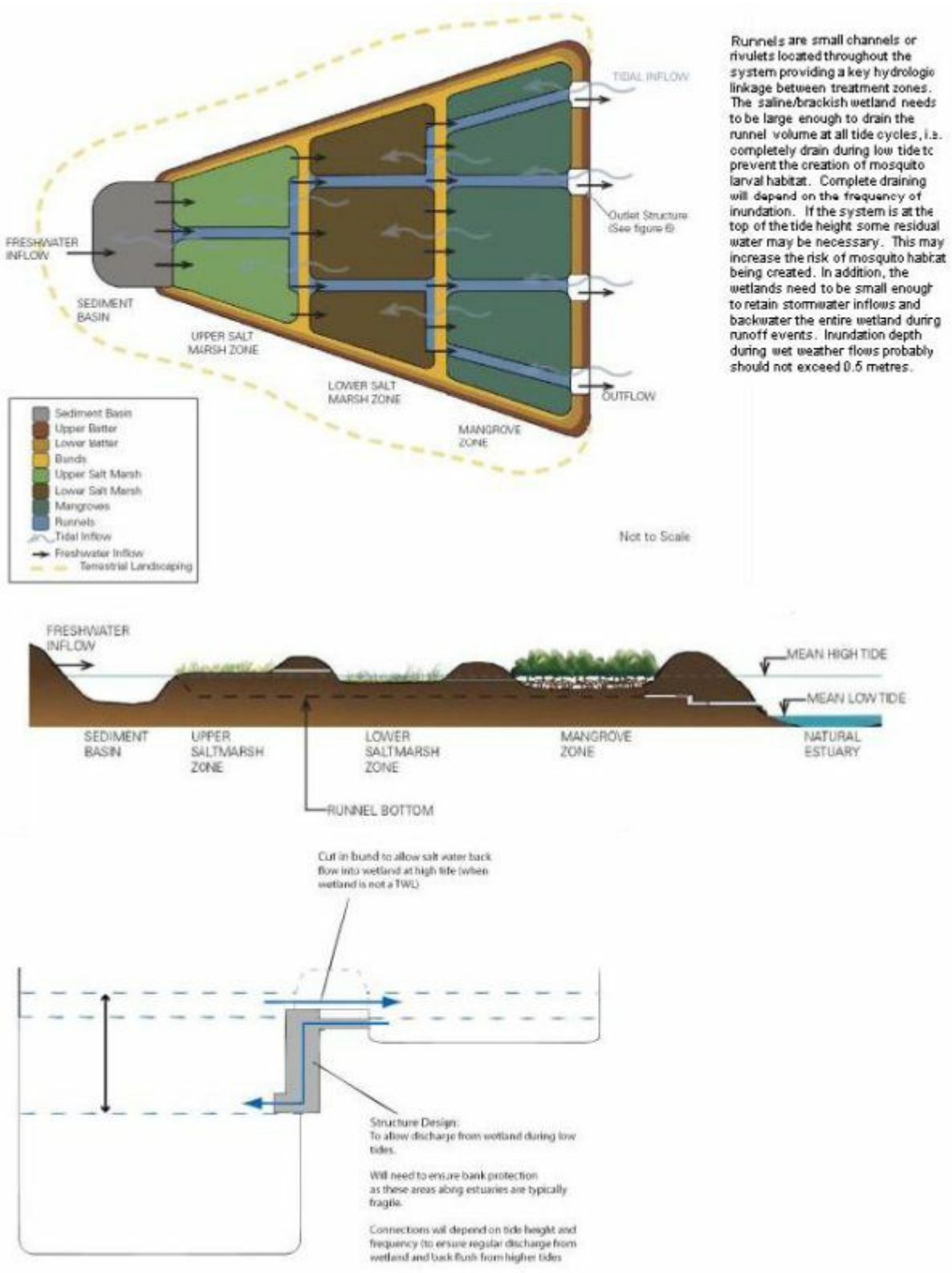
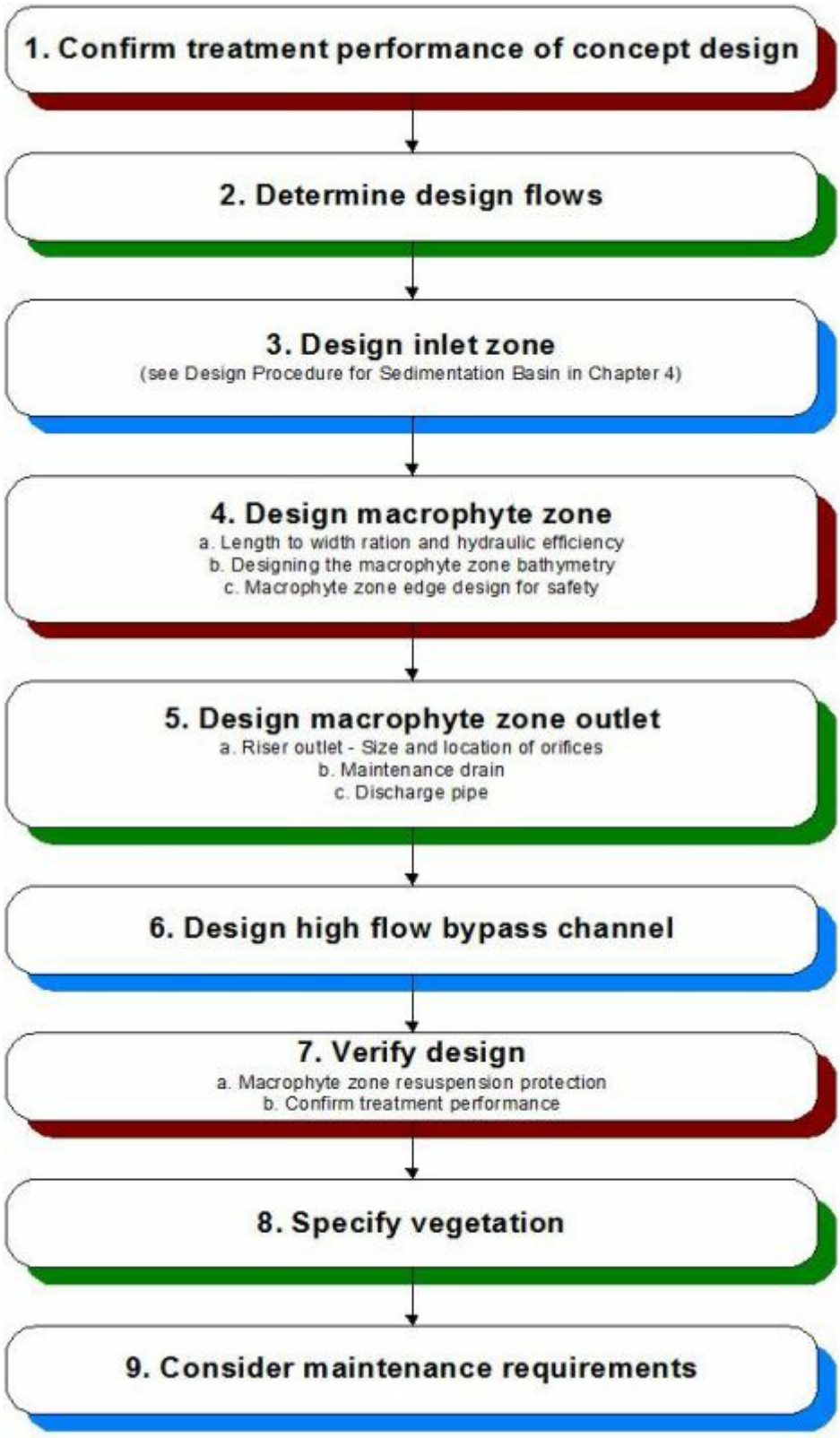


Figure SC6.4.3.9.28 Possible design features of saline/brackish constructed wetlands

(4) Wetland design process

The key design steps following the site planning and concept development stages are:



(a) Step 1: Confirm treatment performance of concept design

Before commencing detailed design, the designer should first undertake a preliminary check to confirm the constructed wetland area (i.e. the macrophyte zone surface area) from the concept design is adequate to deliver the required level of stormwater quality improvement. This assessment should be undertaken by a WSUD specialist and can be achieved by modelling expected treatment performance in

an appropriate quantitative modelling program. Where possible, this modelling should be based on local rainfall data, the proposed configuration of the system, and based on local stormwater treatment performance data.

(b) Step 2: Determine design flows

(i) Design discharges

To configure the inlet zone and high flow bypass elements of a constructed wetland the following design flows apply:

(A) design operation flow (1 year ARI) for sizing the inlet zone (i.e. sedimentation basin) and the "control" outlet structure (i.e. overflow pit and pipe connection) discharging to macrophyte zone; and

(B) above design flow for design of the high flow bypass around the macrophyte zone. The discharge capacity for the bypass system may vary depending on the particular situation but will typically correspond to one of the following:

- minor design flow (2 year ARI) – for situations where only the minor drainage system is directed to the inlet zone; and
- major flood flow (100 year ARI) – for situations where both the minor and major drainage system discharge into the inlet zone.

(ii) Design flow estimation

A range of hydrologic methods can be applied to estimate design flows. If the typical catchment areas are relatively small, the Rational Method design procedure is considered to be a suitable method for estimating design flows. However, if the constructed wetland is to form part of a retention basin (refer to SC6.4.3.9.5(2)(g) Wetlands constructed within retention (or detention) basins) or if the catchment area to the wetland is large (> 50 ha), then a full flood routing computation method needs to be used to estimate design flows.

(c) Step 3: Design inlet zone

As outlined in SC6.4.3.9.5(2)(e) Inlet zone design considerations, the inlet zone (see example in Figure SC6.4.3.9.29 Inlet zone of a constructed wetland in Brisbane) of a constructed stormwater wetland is designed as a sedimentation basin and serves two functions: (1) pretreatment of inflow to remove coarse to medium sized sediment; and (2) the hydrologic control of inflows into the macrophyte zone and bypass of floods during "above design" operating conditions. As depicted in Figure SC6.4.3.9.30 Example of inlet zone connection to macrophyte, the inlet zone consists of the following elements:

(i) sedimentation basin "pool" to capture coarse to medium sediment (125µm or larger).

(ii) inlet zone connection to the macrophyte zone (or "control" structure as defined in normally consisting of an overflow pit within the inlet zone connected to one or more pipes through the embankment separating the inlet zone and the macrophyte zone.

(iii) high flow bypass weir (or "spillway" outlet structure to deliver "above design" flood flows to the high flow bypass channel.

Figure SC6.4.3.9.29 Inlet zone of a constructed wetland in Brisbane

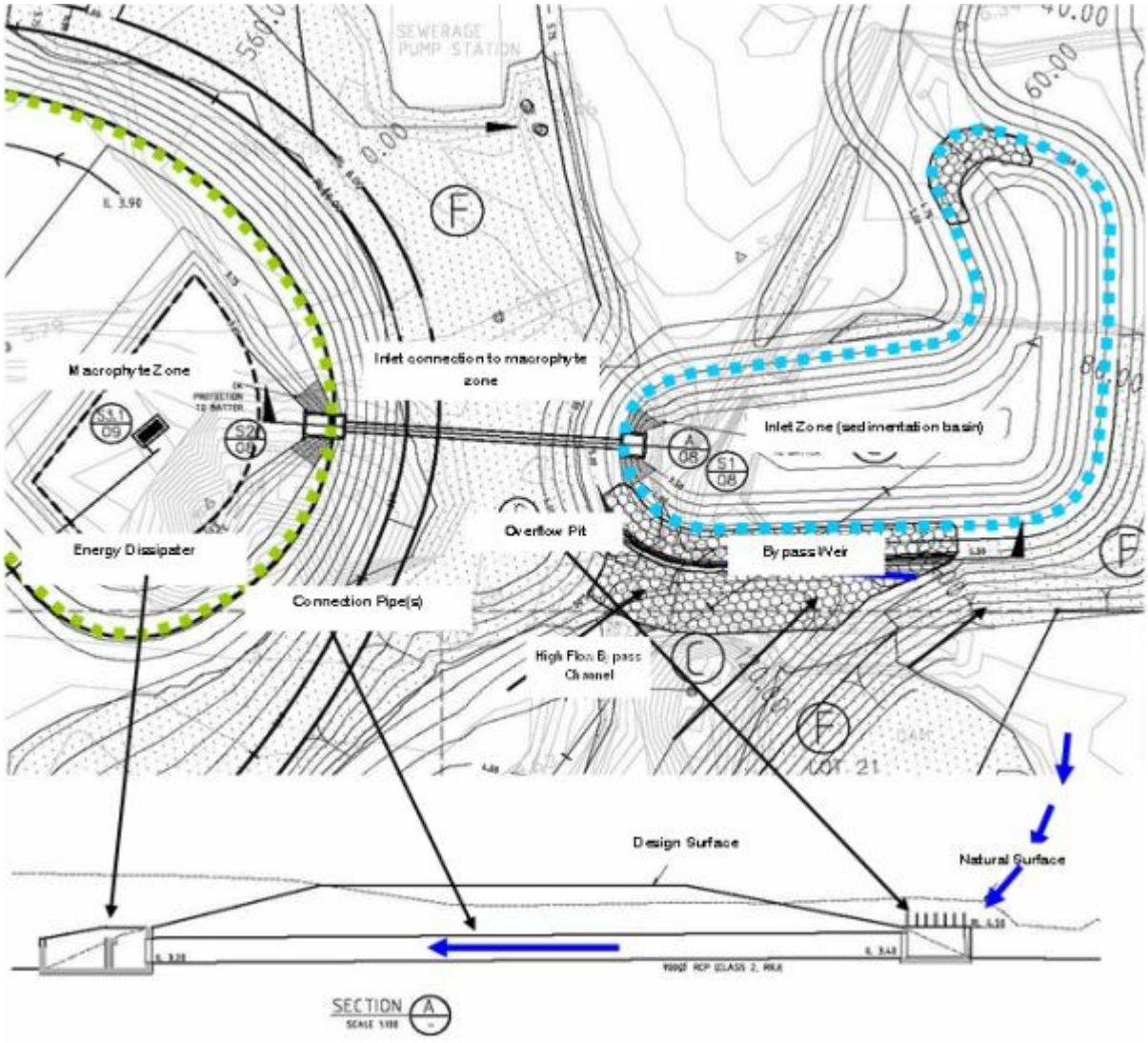


Figure SC6.4.3.9.30 Example of inlet zone connection to macrophyte zone

(iv) For more information and design guidance for each of the inlet zone elements listed above, the reader is referred to Chapter 4 Sedimentation Basins. When applying the design procedure outlined in Chapter 4, the following should be used as a guide:

(A) the inlet zone typically must comprise a deep open water body that operates essentially as a sedimentation basin designed to capture coarse to medium sized sediment (i.e. 125 µm or larger);

(B) it may be necessary for a GPT to be installed such that litter and large debris can be captured at the interface between the incoming waterway (or pipe) and the open water of the inlet zone;

(C) the crest of the overflow pit must be set at the normal water level of the inlet zone (which is typically set 0.3 m above the normal water level of the macrophyte zone);

(D) the pipe that connects the sedimentation basin to the macrophyte zone needs to have sufficient capacity to convey a 1 year ARI flow, assuming the macrophyte zone is at the normal water level and without resulting in any flow over the high flow bypass weir;

(E) the obvert of the connection pipe can be set below the normal water level of the wetland to conceal the pipe (below the normal water level) during the dry season;

(F) an energy dissipater is usually required at the end of the pipes to reduce velocities and distribute flows into the macrophyte zone;

(G) the inlet zone is to have a structural base (e.g. rock) to define the base when desilting and provide support for maintenance plant/ machinery when entering the basin for maintenance; and

(H) the high flow bypass weir ("spillway" outlet) is to be set at the same level as the top of extended detention in the macrophyte zone.

(d) Step 4: Designing the macrophyte zone

(i) Length to width ratio and hydraulic efficiency

To optimise wetland performance, it is important to avoid short circuit flow paths and poorly mixed regions within the macrophyte zone. One way to minimise this is to adopt a high length to width ratio not less than 5 to 1 for the macrophyte zone. Length to width ratios less than this can lead to poor hydrodynamic conditions and reduced water quality treatment performance.

Persson et al. (1999) used the term hydraulic efficiency (λ) to define the expected hydrodynamic characteristics for a range of configurations of stormwater detention systems (Figure SC6.4.3.9.31). Engineers Australia (2006) recommend that constructed wetland systems should not have a hydraulic efficiency (λ) less than 0.5 and preferably should be greater than 0.7.

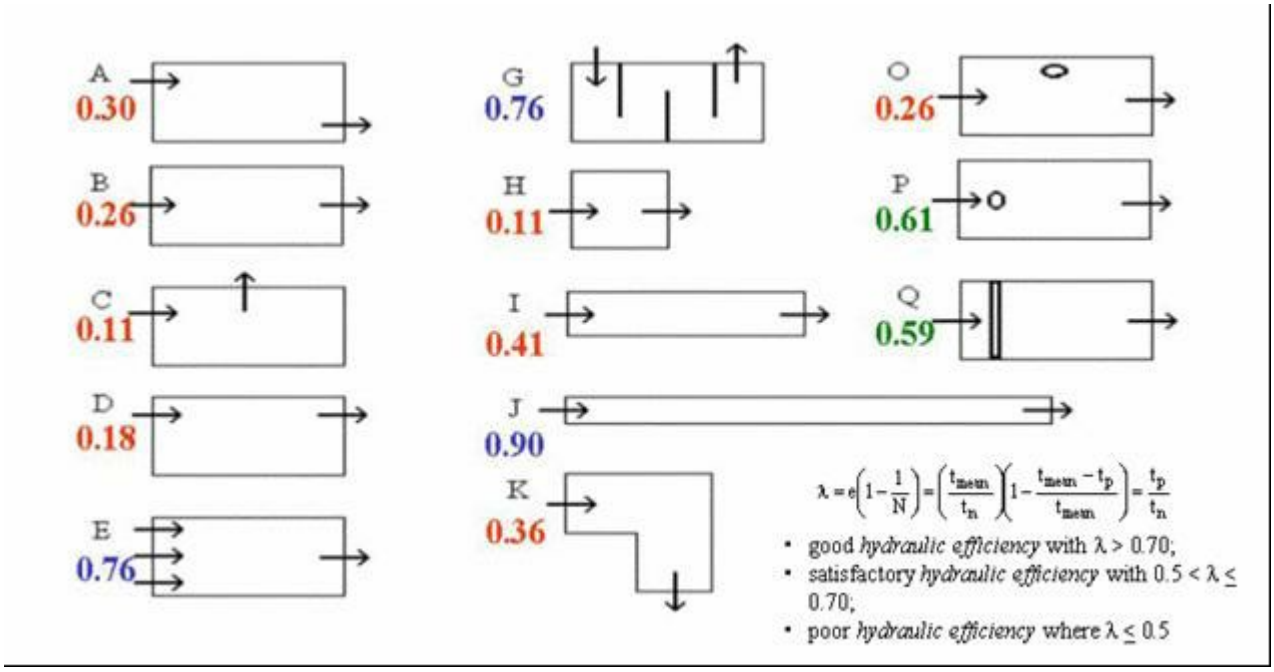


Figure SC6.4.3.9.31 Hydraulic effiency (λ) ranges

Hydraulic efficiency ranges from 0 to 1, with 1 representing the best hydrodynamic conditions for stormwater treatment. The o in diagrams O and P represent islands in the waterbody and the double line in diagram Q represents a weir structure to distribute flows evenly (Persson et al. 1999).

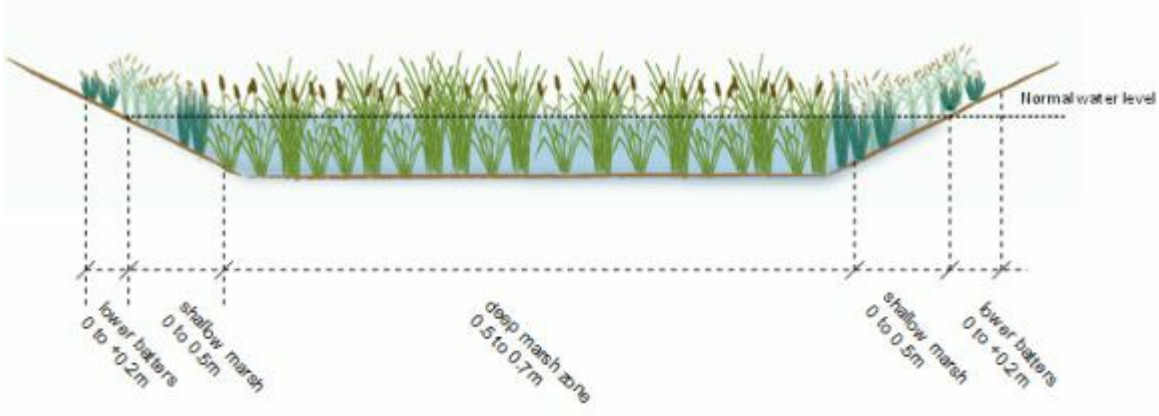
(ii) Designing the macrophyte zone bathymetry

The bathymetry of constructed wetlands in the coastal dry tropics are to be designed to ensure that macrophytes can provide adequate pollutant removal during the wet season and also be sustained during the dry season. To achieve this, the longitudinal bathymetry of the macrophyte zone should gently grade (min 0.5% grade) from 0.7 m in depth (based on design normal water level) up to a central crest 0.5 m in depth and then back down to a maximum of 0.7 m in depth. This ensures that isolated pools of water are not created during the dry season when the normal water level slowly draws down due to evapotranspiration. Smaller deep open water permanent pools at the inlet and outlet of the wetland are required to provide habitat for mosquito predators during the dry season (Refer to Figure SC6.4.3.9.23 Schematic layout of a contructed wetland system and Figure SC6.4.3.9.24 Wet and dry season conditions in a constrcted freshwater wetland). For large wetlands, this bathymetry could be repeated in series (i.e. a deep pool located between two macrophyte zones).

The macrophyte zone is to have a flat cross sectional bathymetry only grading up at the edge

batters (Figure SC6.4.3.9.32). This facilitates the even distribution of flows to avoid short circuiting, creates a uniform hydraulic conveyance and maximises stormwater contact with macrophyte stems and biofilms. This is also assisted by providing banded macrophyte planting perpendicular to the direction of flow (Figure SC6.4.3.9.33).

The deep open water pools should be 2 m in depth to ensure that a permanent pool of water is sustained throughout the dry season. This ensures habitat is retained for fish, macroinvertebrates (mosquito predators) and submerged macrophytes. Submerged macrophytes are important to provide habitat and for maintaining dissolved oxygen levels and therefore deeper pools (i.e. >2 m) should be avoided. A balance pipe connection between the deep pools is necessary to allow inflows in dry conditions to benefit and sustain the deep permanent pools. The surface area of deep refuge pool (excluding the sediment basin) within the wetland should be between 20% and 30% of the total macrophyte area. This ensures the volume of water within the pools is sufficient to maintain permanent water during the dry season but not so large that the macrophyte zone is likely to experience dry periods of greater than 60 days (due to larger inflows required to fill the pools before wetting the macrophyte zone).



Note—refer to SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for more detail on planting zones and suitable macrophyte species.

Figure SC6.4.3.9.32 Typical cross section of a constructed wetland system showing preferred bathymetry and planting zones.

Figure SC6.4.3.9.33 Macrophyte zone banded planting (direction of flow is from left to right)

(iii) Macrophyte zone edge design for safety

Consideration of public safety is required when wetlands are located in parklands/public open space or any areas readily accessible. Reducing public safety risk can be achieved in a number of ways and the measures adopted should respond to the level of perceived risk given the particular

site characteristics.

One method of reducing the risk posed by water bodies is to design batter slopes on approaches and immediately under the normal water level (refer Figure SC6.4.3.9.34). It is recommended that a gentle slope to the water edge and extending below the water line be adopted before the batter slope steepens into deeper areas.

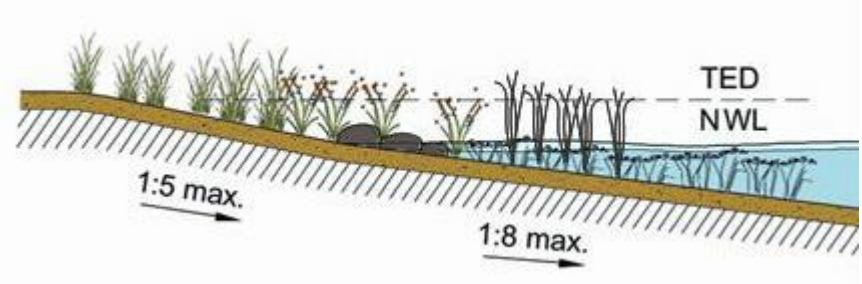


Figure SC6.4.3.9.34 Example of a wetland edge design for public safety

The safety requirements for individual wetlands will vary from site to site and requires careful consideration. The following requirements from the *Sediment Basin Design, Construction and Maintenance Guidelines* (BCC 2001) can be applied to constructed wetland systems:

- for water depths greater than 150 mm and maximum batter slope of 5:1 (H:V) or less, no fencing is required; and
- for water depths greater than 150 mm and maximum batter slope greater than 5:1 (H:V) fencing may be required.

In some cases, vertical edges are used for wetlands (refer to SC6.4.3.9.5(5) Landscape design notes). When vertical edges are used, a safety fencing/ barrier should be considered on top of concrete or stone walls where:

(A) there is a risk of serious injury in the event of a fall (over 0.5 m high and too steep to comfortably walk up/down or the lower surface has sharp or jagged edges);

(B) there is a high pedestrian or vehicular exposure (on footpaths, near bikeways, near playing/ sporting fields, near swings and playgrounds);

(C) where water ponds to a depth of greater than 300 mm on a constructed surface of concrete or stone;

(D) where the water is expected to contain concentrated pollutants; and

(E) where mowed grassed areas abut the asset.

The type of fence/ barrier to be considered should be a:

- dense vegetation at least 2 m wide and 1.2 m high (minimum) may be suitable; or
- pool fence (or similar) when there is a chance of drowning and the surrounding area is specifically intended for use by small children (swings, playgrounds, sporting fields etc.).

(iv) Macrophyte zone soil testing

Constructed wetlands are permanent water bodies and therefore the soils in the base must be capable of retaining water. Geotechnical investigations of the suitability of the in-situ soils are required to establish the water holding capacity of the soils. Where the infiltration rates are too high for permanent water retention, tilling and compaction of in-situ soils may be sufficient to create a suitable base for the wetland. Where in- situ soils are unsuitable for water retention, a compacted clay liner may be required (e.g. 300 mm thick). Specialist geotechnical testing and advice must be sought.

Wetland plants must be planted into suitable topsoil with a minimum depth of 200 mm (see SC6.4.3.9.5(6)(d) Topsoil specification and preparation). Most terrestrial topsoils provide a good substratum for wetlands, nonetheless laboratory soil testing (using Australian Standard testing procedures, e.g. AS 4419-2003: Soils for landscaping and garden use) of topsoil is necessary to ensure the topsoil will support plant and microbial growth and have a high potential for nutrient retention. Careful consideration should be given to the topsoil source and its propensity to contain weed seeds which may be viable in an ephemeral wetland habitat.

(e) Step 5: Design macrophyte zone outlet

A macrophyte zone outlet has two purposes: (1) hydrologic control of the water level and flows in the macrophyte zone to achieve the design detention time; and (2) to allow the wetland permanent pool to be drained for maintenance.

(i) Riser outlet – size and location of orifices

The riser outlet is designed to provide a uniform notional detention time in the macrophyte zone over the full range of the extended detention depths. The target maximum discharge ($Q_{max\ riser}$) may be computed as the ratio of the volume of the extended detention to the notional detention time as follows

$$Q_{max\ riser} = \frac{\text{extended detention storage volume } (m^3)}{\text{notional detention time (s)}}$$

The placement of orifices along the riser and determining their appropriate diameters is an iterative process. The orifice equation (Equation 6.2) is applied over discrete depths along the length of the riser starting at the normal water level and extending up to the riser maximum extended detention depth.

$$A_o = \frac{Q}{C_d\sqrt{2 \cdot g \cdot h}} \qquad \text{(Small orifice equation)}$$

Where

C_d	=	orifice discharge coefficient (0.67)
h	=	depth of water above the centroid of the orifice (m)
A_o	=	orifice area (m^2)
Q	=	required flow rate to achieve notional detention time (m^3/s) at the *given h*
g	=	9.79 m/s^2

As the outlet orifices can be expected to be small, it is important that they are prevented from clogging by debris. Some form of debris guard is recommended as illustrated in Figure SC6.4.3.9.35 below. An alternative to using a debris guard is to install a riser in a pit located in the embankment surrounding the wetland macrophyte zone (thus reducing any visual impact). A riser within the pit can also be configured with a weir plate (by drilling holes through the plate). An advantage of using a weir plate is that it provides an ability to drain the wetland simply by removing the weir plate entirely. Additionally, shorter weir plates may also be used during the vegetation establishment phase, thus providing more flexibility for water level manipulation.

Figure SC6.4.3.9.35 Example outlet riser assemblies with debris guards

The pit is connected to the deep pool of the macrophyte zone via a submerged pipe culvert. The connection should be adequately sized such that there is minimal water level difference between the water within the pit and the water level in the macrophyte zone. With the water entering into the outlet pit being drawn from below the normal water level (i.e. pipe obvert a minimum 0.3 m below normal water level), floating debris is generally prevented from entering the outlet pit, while heavier debris would normally settle onto the bottom of the wetland. The riser pipe should be

mounted upright on a socketed and flanged tee with the top of the pipe left open to allow overtopping of waters if any of the riser orifices become blocked. Figure SC6.4.3.9.36 and Figure SC6.4.3.9.37 show one possible configuration for a riser outlet pit.

Figure SC6.4.3.9.36 Macrophyte zone outlet arrangement

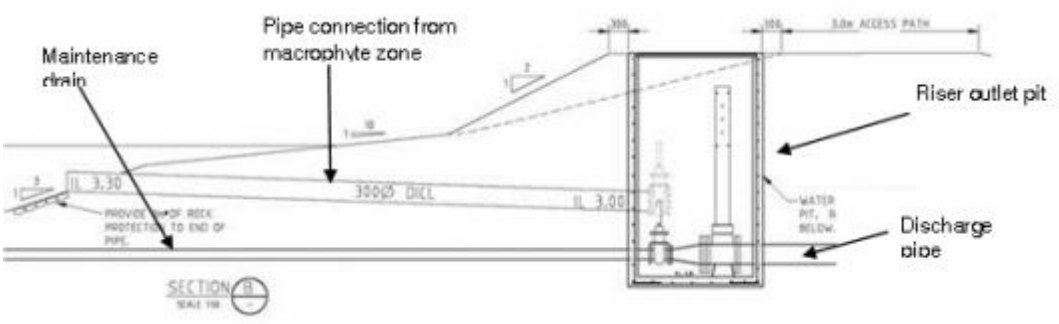


Figure SC6.4.3.9.37 Typical macrophyte zone outlet arrangement

(ii) Maintenance drains

To allow access for maintenance, the wetland should have appropriate allowance for draining. A maintenance drainage pipe should be provided that connects the low points in the macrophyte zone bathymetry to the macrophyte zone outlet. A valve is provided on the maintenance drainage pipe (typically located in the outlet pit as shown in Figure SC6.4.3.9.37), which can be operated manually. The maintenance drainage pipe should be sized to draw down the permanent pool within 12 hours (i.e. overnight). If a weir plate is used as a riser outlet, provision should be made to remove the weir plate and allow drainage for maintenance.

(iii) Discharge pipe

The discharge pipe of the wetland conveys the outflow of the macrophyte zone to the receiving waters (or existing drainage infrastructure). The conveyance capacity of the discharge pipe is to be sized to match the higher of the two discharges (i.e. maximum discharge from the riser or the maximum discharge from the maintenance drain).

(iv) Balance pipe

A balance pipe connection between the deep permanent pools in the wetland is necessary to allow inflows in dry conditions to benefit and sustain all deep pools rather than just the pool located at the inlet. The deep pools are generally 2 m in depth and may experience up to 1m of draw down during the dry season. The invert of the balance pipe should therefore be located approximately 1 m below the normal water level. A 300 mm diameter pipe is typically sufficient for a balance pipe.

(f) Step 6: Design high flow bypass channel

The bypass channel accepts “above design flow” from the inlet zone (sediment pond) of the wetland via the bypass weir (SC6.4.3.9.5(4)(c)) and conveys these flows downstream around the macrophyte zone of the wetland. The bypass channel should be designed using standard methods (i.e. Manning’s Equation) to convey the “above design flow” (SC6.4.3.9.5(4)(b)) and to avoid bed and bank erosion (see Chapter 2). Typically, a turf finish will provide appropriate protection for most bypass channel applications (but velocities need to be checked). Dense planting can be applied when appropriately designed for in terms of design roughness and management of velocities. Figure SC6.4.3.9.38 shows typical high flow bypass channel configurations.

Figure SC6.4.3.9.38 Turfed constructed wetland high flow bypass weir configuration.

(g) Step 7: Verify design

(i) Macrophyte zone resuspension protection

The principle pathway for biological uptake of soluble nutrients in wetlands is through biofilms (epiphytes) attached to the surface of the macrophyte vegetation. The biofilms, being mostly algae and bacteria, are susceptible to wash out under high flow conditions. Further, wetland surveys indicate that up to 90% of the total nutrients are stored in the sediments, therefore, the key to effective retention of pollutants is managing high velocity flows that could potentially resuspend and remobilise these stored pollutants.

A velocity check is to be conducted for design conditions, when the wetland water level is at the top of the extended detention level and the riser is operating at design capacity, to ensure velocities are less than 0.05 m/s through all zones of the wetland. The following condition must be met:

$$\frac{Q_{max\ riser}}{A_{section}} < 0.05 m/s$$

Where $Q_{max\ riser}$ = target maximum discharge (defined in Equation 6.1) (m^3/s)

Asection = minimum wetland cross-section area* (m^2) x 0.5 vegetation blockage factor**

*measured from top of extended detention

**blockage due to tall dense vegetation

(ii) Confirm treatment performance

If the basic wetland parameters established by the conceptual design phase have changed during the course of undertaking detailed design (e.g. macrophyte zone area, extended detention depth, etc.) then the designer should verify that the current design meets the required water quality improvement performance. This can be done by simulating the current design using a suitable quantitative modelling program.

(h) Step 8: Specify vegetation

Refer to SC6.4.3.9.5(5) Landscape design notes and SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics for advice on selecting suitable plant species for constructed wetlands.

(i) Step 9: Consider maintenance requirements

Consider how maintenance is to be performed on the wetland (e.g. how and where is access available, where is litter likely to collect etc.). A specific maintenance plan and schedule should be developed for the wetland, either as part of a maintenance plan for the whole treatment train, or for each individual asset. Guidance on maintenance plans is provided in SC6.4.3.9.5(7) Maintenance requirements - constructed wetlands.

(j) Design calculation summary

Following is Table SC6.4.3.9.16 Constructed wetlands design calculation summary, for the key design elements.

Click here to view **Table SC6.4.3.9.16 Constructed wetlands design calculation summary**

(5) Landscape design notes - constructed wetlands

Whilst constructed wetlands play a significant role in delivering stormwater quality objectives, they can also play an important role in creating a community landscapes and urban ecology. The following sections outline some of the landscape design issues that should be considered when designing constructed wetland systems.

(a) Objectives

Landscape design of wetlands generally requires consideration of the following objectives:

(i) integrated planning and design of constructed wetlands within the built and landscape environments ensuring that the overall landscape design for the wetland integrates with its host natural and/ or built environment;

(ii) achieving dense perennial littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season;

(iii) ensuring that the wetland planting strategy is based on the wetland design depths/zones, achieves dense perennial emergent macrophyte cover and has the structural characteristics to perform particular treatment processes (e.g. well distributed flows, enhance sedimentation, maximise surface area for the adhesion of particles and provide a substratum for algal epiphytes and biofilms);

(iv) providing maintenance access to allow for the prompt removal of weeds before they spread and/or set seed;

(v) incorporating crime prevention through environmental design (CPTED) principles; and

(vi) providing other landscape values, such as shade, amenity, character and place making.

Comprehensive site analysis should inform the landscape design as well as road layouts, maintenance access points and civil works. Existing site factors such as roads, buildings, landforms, soils, plants, microclimates, services and views should be considered. For further guidance refer to the *South East Queensland WSUD Conceptual Design Guidelines* (Healthy Waterways Partnership, 2008).

(b) Wetland siting and shapes

Constructed wetlands need to be arranged to meet hydrological and stormwater quality requirements, but also to integrate effectively into the surrounding existing landscape. The arrangement of wetland, basin and high flow bypass should be designed early in the concept design phase, to ensure that amenity of open space is enhanced.

The final shape of a wetland should provide landscape opportunities to create alternate useable spaces/recreation areas (see Figure SC6.4.3.9.39). Often different shapes to wetland edges can make pathway connections through and around these recreation areas more convenient and enhances the community perception of constructed wetlands. Pathways and bridges across planted earth bunds can be the best way of getting across or around wetlands (see Figure SC6.4.3.9.40). The materials on the bridge and pathways are important to be low maintenance and do not impede hydrological flows. Ease of access to the inlet basin for sediment and trash removal is also important to consider.

The area required for the high flow bypass can be manipulated to provide open spaces that only periodically convey stormwater flows. Further discussion of high flow bypass configuration is provided in SC6.4.3.9.5(5)(c)(iii) High flow bypass channel.

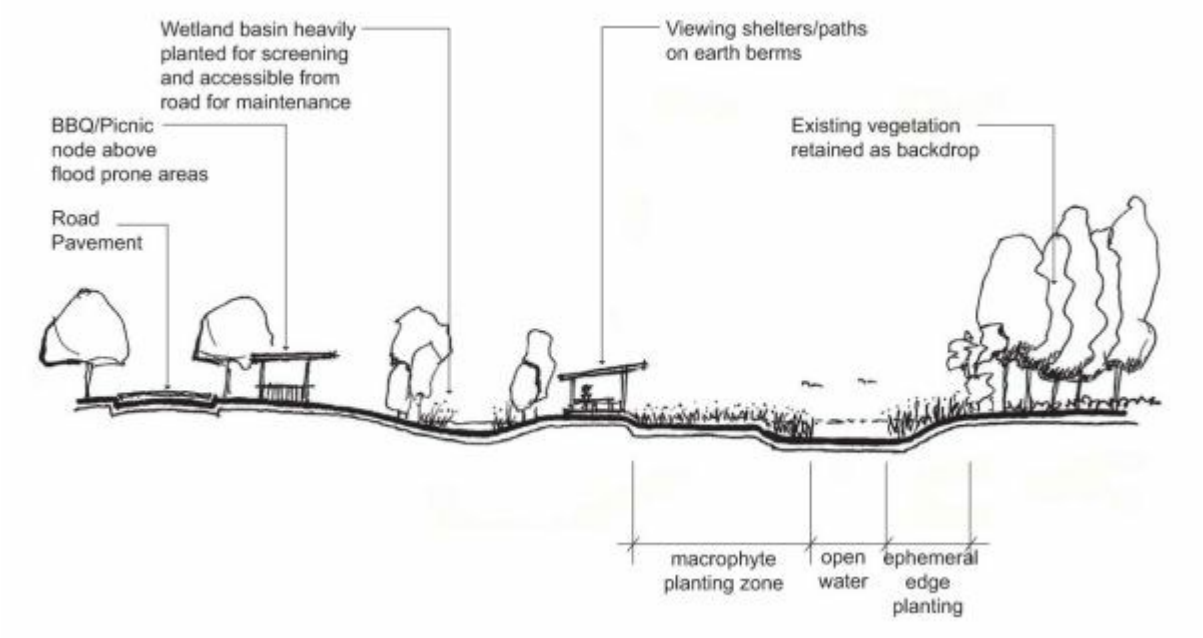


Figure SC6.4.3.9.39 Typical landscape treatments to constructed wetlands in open space areas

Figure SC6.4.3.9.40 Boardwalk treatment over wetland (left) and integration of urban art with wetland setting (right)

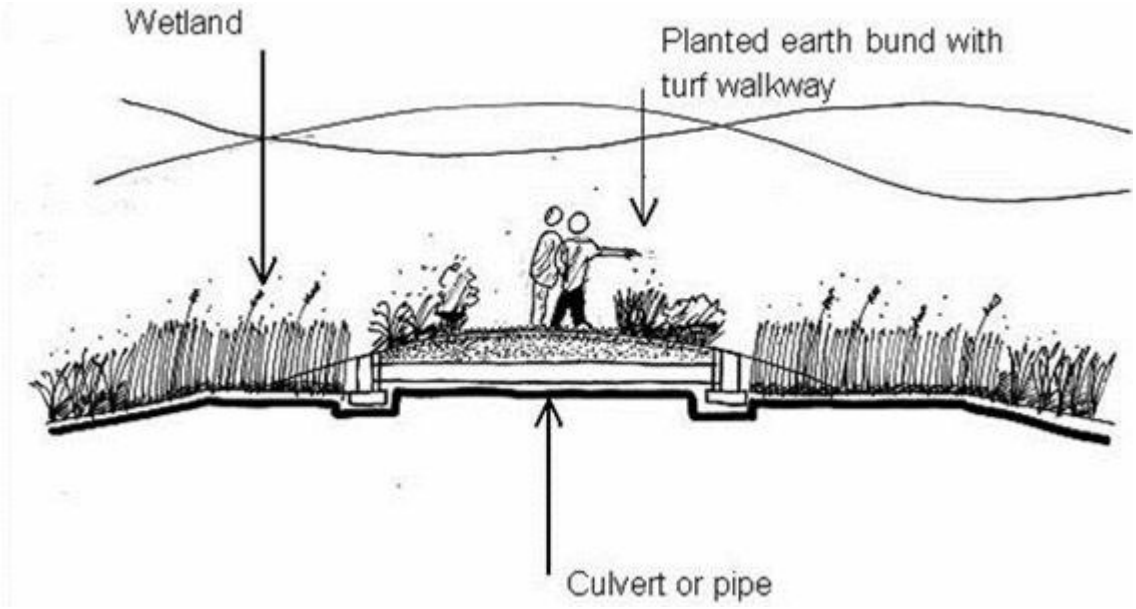


Figure SC6.4.3.9.41 Earth bund structure as wetland crossing

(c) Specific landscape considerations

Numerous opportunities are available for creative design solutions for specific elements. Close collaboration between landscape designer, hydraulic designer, civil/structural engineer and maintenance personnel is essential. In parklands and residential areas, the aim is to ensure elements are sympathetic to their surroundings and are not overly engineered or industrial in style and appearance. Additionally, landscape design to specific elements should aim to create places that local residents and visitors will come to enjoy and regard as an asset.

(i) Crossings

Given the size and location of wetland systems, it is important to consider if access is required across the wetland as part of an overall pathway network and maintenance requirement. Factors that should be considered include:

(A) the appropriateness of hardwood timber board walks given their life-cycle costs. Where walkway footings are in contact with water, council will not accept timber piers;

(B) if boardwalks are used, they should not be located near open water where they could encourage the public to feed wildlife; and

(C) earth bunds located between the sedimentation basin and macrophyte zone can be used as crossings and can be planted as a shaded walkways.

Figure SC6.4.3.9.41 illustrates a conceptual earth bund walkway.

(ii) Wetland embankments

The landscape design approach for the wetland embankments is similar to the approach taken for embankments in sedimentation basins.

(iii) High flow bypass channel

The high flow bypass channel will convey stormwater during above design flow and in some situations can form a large element in the landscape. Therefore the design of the high flow bypass needs to be carefully considered to provide recreational and landscape opportunities during times outside of above design flow events.

The key considerations for design of the high flow bypass area are as follows:

(A) no major park infrastructure including playgrounds, barbeques and amenity buildings to be located within the high flow bypass areas. Passive recreation infrastructure including seating and picnic tables are suitable provided they are of robust design;

(B) in many cases, the high flow bypass will be formed through the use of turf and in these cases the opportunity for creating more active spaces should be investigated;

(C) designers should investigate the opportunities for locating trees and other vegetation types within the bypass channel. Provided hydraulic efficiencies can be accommodated, grassed mounds and landform;

(D) grading of the embankment edge could also be explored to add variation and interest;

(E) where groundcover species other than turf are adopted, plant species should be selected to ensure appropriate response after periodic flooding;

(F) areas of large revegetation or garden beds that cut through the high flow bypass zone should use thick matting mulch types that bind well to the surface to minimise loss; and

(G) the relationship between the high flow bypass channel and the permanent water bodies should be considered in order to create interesting spaces and forms within the open space. For example, after consideration of site constraints and hydraulic parameters, designers could investigate options to separate the elements from each other or to channel both elements alongside each other. Opportunities should also be sought to achieve balanced cut and fill earthworks. Figure SC6.4.3.9.42 provides an illustration of creation of open spaces through configuration of key wetland components.

(iv) Macrophyte zone outlet structure

Landscape design approach for the macrophyte outlet zone is similar to the approach taken for overflow pits in sedimentation basins. Refer to Chapter 4, Section 4.4.3.6 for further guidance.

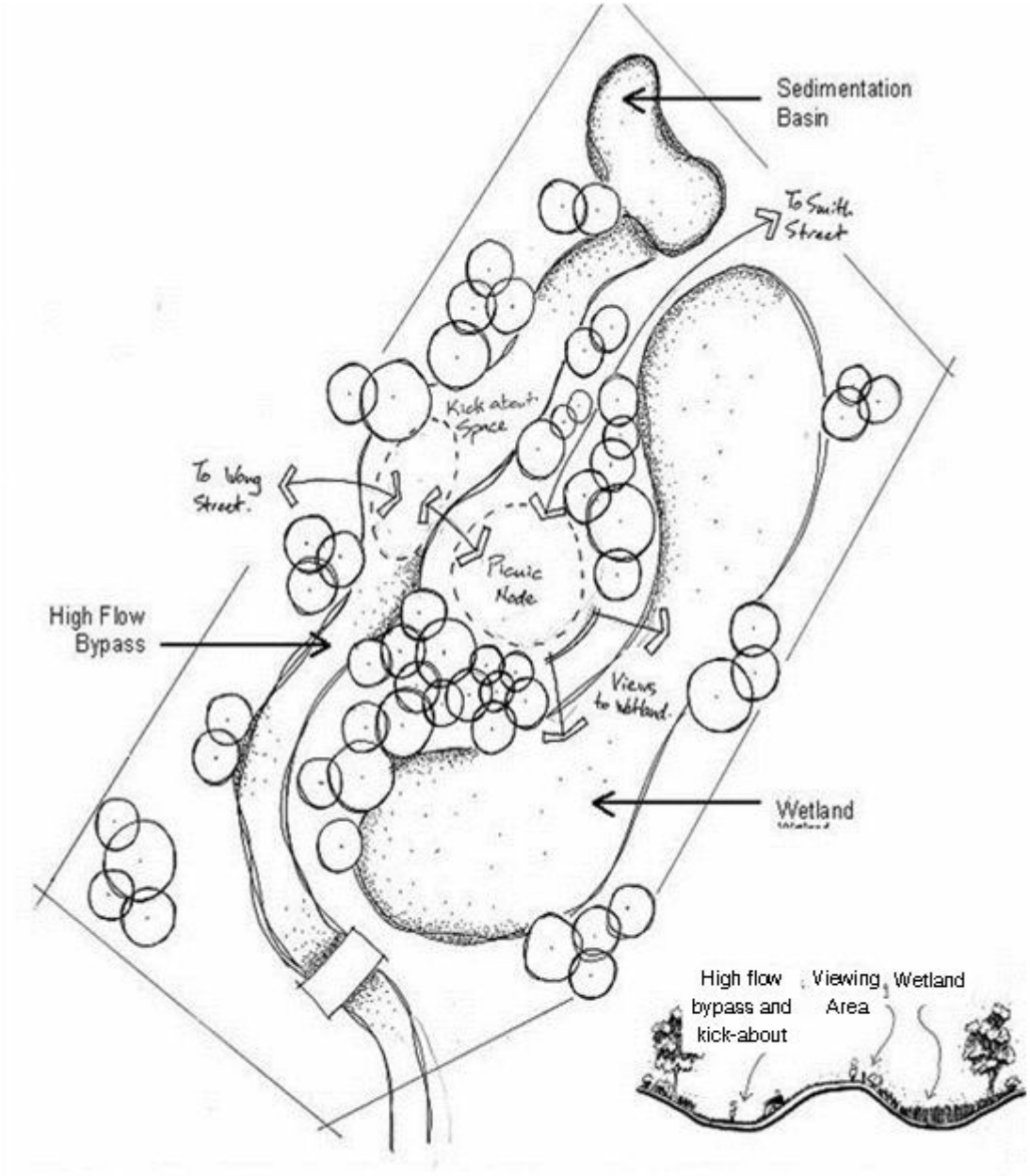
(v) Viewing areas

Refer to Chapter 4, Section 4.4.3.8 for guidance.

(vi) Fencing

Refer to Chapter 4, Section 4.4.3.9 for guidance.

Editor's note—these Chapter and Section references are to *Water Sensitive Urban Design Guidelines for South East Queensland*.



Landscape design should explore options for siting the bypass, wetland and basin and analyse the potential for enhanced amenity. This process should initially take place at the concept development phase and can be refined during the detailed design.

Figure SC6.4.3.9.42 Example relationship between high flow bypass wetland and basin and the creation of open space

(d) Constructed wetland vegetation

Planting for constructed wetlands systems may consist of up to three vegetation types:

(i) Macrophyte zone planting consisting of deep marsh (0.5 m – 0.7 m in depth at design normal water level) and shallow marsh (edges) (0.5 m – 0 m in depth at design normal water level);

Macrophyte zone planting (from 1.0 m below to 0.2 m above design water level)

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics provides guidance on selecting suitable plant species and cultivars that deliver the desired stormwater quality objectives for constructed wetlands. Often the most effective way to meet those objectives with the macrophyte planting is to create large bands of planting perpendicular to flow that respond to designed depth zones and local biodiversity.

In general, macrophyte vegetation should provide:

(A) well distributed flows;

(B) enhanced sedimentation;

(C) maximum surface area for the adhesion of particles;

(D) a substratum for algal epiphytes and biofilms; and

(E) habitat and refuge for fauna, both terrestrial and aquatic.

This is achieved by selecting species with many small diameter vertical leaves or stems and planting the vegetation in bands. When selecting suitable species it is important to also note the ability of some species to be highly self-sustaining. Littoral planting should provide a dense buffer between the wetland and publicly accessible open space to discourage contact with the water.

(ii) Littoral vegetation (embankment) (above design normal water level) and parkland vegetation

Between the macrophyte zone and the top of the embankment, establishment of trees, shrubs and groundcovers can occur in consideration of the following:

(A) selecting groundcovers, particularly for slopes greater than 1 in 3, with matting or rhizomatous root systems to assist in binding the soil surface during the establishment phase;

(B) achieving dense perennial littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season;

(C) preventing macrophyte zone plants and ground covers from being shaded out by minimising tree densities at the water's edge and choosing species such as Melaleuca that allow sunlight to penetrate the tree canopy;

(D) locating vegetation to allow views of the wetland and its surrounds whilst discouraging the public from accessing the water body; and

(E) parkland vegetation may be of a similar species to the embankments littoral vegetation and layout to visually integrate the wetland with its surrounds. Alternatively, vegetation of contrasting species and/ or layout may be selected to highlight the water body as a feature within the landscape. Turf may be considered to achieve this goal.

(iii) Terrestrial plants, including existing vegetation, adjacent to the upper littoral edge.

(e) Safety issues

(i) General

Constructed wetlands need to be generally consistent with public safety requirements for new developments. These include reasonable batter profiles for edges to facilitate public egress from areas with standing water and fencing where water depths and edge profile requires physical barriers to public access. Fences can be substituted where possible by using dense edge plantings to deter public access to areas of open water. Dense littoral vegetation that can grow to around 2 m high and 1.5 m wide are effective in deterring public access.

(ii) Restricting access to open water

Fences or vegetation barriers to restrict access should be incorporated into wetland areas, particularly on top of concrete or stone walls where:

(A) there is a risk of serious injury in the event of a fall (over 0.5 m high and too steep to comfortably walk up/ down or the lower surface or has sharp or jagged edges);

(B) there is a high pedestrian or vehicular exposure (on footpaths, near bikeways, near playing/ sporting fields, near swings and playgrounds etc.);

(C) where water ponds to a depth of greater than 300 mm on a constructed surface of concrete

or stone. Natural water features are exempt; and

(D) where grassed areas requiring mowing abut the asset.

Barriers that may be appropriate are:

- dense vegetation at least 2 m wide and 1.2 m high (minimum) may be suitable; and
- pool fence (or similar) when there is a chance of drowning and the surrounding area is specifically intended for use by small children (swings, playgrounds, sporting fields etc.).

Dense littoral planting around the wetland and particularly around the deeper open water pools of the sediment pond (with the exception of any maintenance access points), will deter public access to the open water and create a barrier to improve public safety. Careful selection of plant species (e.g. tall, dense or “spiky” species) and planting layouts can improve safety as well as preventing damage to the vegetation by trampling.

Dense vegetation (hedge) at least 2 m wide and 1.2 m high (minimum) may be suitable. A temporary fence may be required until the vegetation has established and becomes a deterrent to pedestrians.

An alternative to the adoption of a barrier/ fence is to provide a 2.4 m safety bench that is less than 0.2 m deep below the normal water level around the waterbody. This is discussed in Chapter 4 Section 4.3.3.3 with respect to appropriate batter slopes.

(6) Construction and establishment - constructed wetlands

This section provides general advice for the construction and establishment of constructed wetlands and key issues to be considered to ensure their successful establishment and operation. Some of the issues raised have been discussed in other sections of this chapter and are reiterated here to emphasise their importance based on observations from construction projects around Australia.

(a) Staged construction and establishment method

It is important to note that constructed wetlands, like most WSUD elements that employ soil and vegetation based treatment processes, require approximately two growing seasons (i.e. two years) before the vegetation in the systems has reached its design condition (i.e. height and density). In the context of a large development site and associated construction and building works, delivering constructed wetlands and establishing vegetation can be a challenging task. Therefore, constructed wetlands require a careful construction and establishment approach to ensure the wetland establishes in accordance with its design intent. The following sections outline a recommended staged construction and establishment methodology for constructed wetlands (Leinster, 2006).

(i) Construction and establishment challenges

There exist a number of challenges that must be appropriately considered to ensure successful construction and establishment of wetlands. These challenges are best described in the context of the typical phases in the development of a greenfield or infill development, namely the subdivision construction phase and the building phase.

(A) subdivision construction - involves the civil works required to create the landforms associated with a development and install the related services (roads, water, sewerage, power etc.) followed by the landscape works to create the softscape, streetscape and parkscape features. The risks to successful construction and establishment of the WSUD systems during this phase of work have generally related to the following:

- construction activities which can generate large sediment loads in runoff which can smother wetland vegetation; and
- construction traffic and other works can result in damage to the constructed wetlands.

Importantly, all works undertaken during subdivision construction are normally “controlled” through the principle contractor and site manager. This means the risks described above can be readily managed through appropriate guidance and supervision.

(B) building phase - once the subdivision construction works are complete and the development plans are sealed then the building phase can commence (i.e. construction of the houses or built form). This phase of development is effectively “uncontrolled” due to the number of building contractors and sub- contractors present on any given allotment. For this reason the allotment building phase represents the greatest risk to the successful establishment of constructed wetlands.

(ii) Staged construction and establishment method

To overcome the challenges associated within delivering constructed wetlands a staged construction and establishment method should be adopted (see Figure SC6.4.3.9.43):

(A) Stage 1: Functional installation - construction of the functional elements of the constructed wetland at the end of subdivision construction (i.e. during landscape works) and the installation of temporary protective measures.

(B) Stage 2: Sediment and erosion control – during the building phase the temporary protective measures preserve the functional infrastructure of the constructed wetland against damage whilst also providing a temporary erosion and sediment control facility throughout the building phase to protect downstream aquatic ecosystems.

(C) Stage 3: Operational establishment - at the completion of the building phase, the temporary measures protecting the functional elements of the constructed wetland can be removed along with all accumulated sediment.

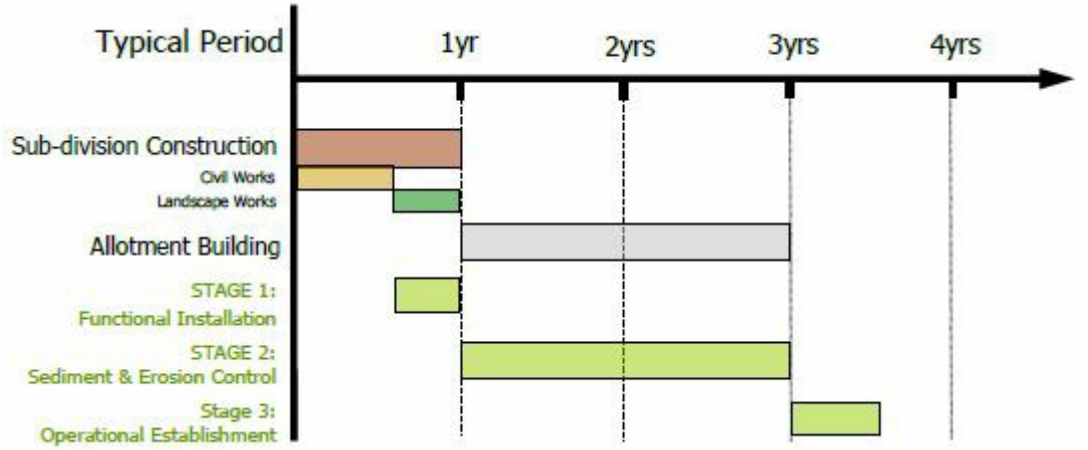


Figure SC6.4.3.9.43 Staged construction and establishment method

(iii) Functional installation

Functional installation of constructed wetlands occurs at the end of subdivision construction as part of landscape works and involves:

(A) earthworks to configure the bathymetry of the wetland;

(B) installation of the hydraulic control structures including inlet/outlet control and the high flow bypass weir;

(C) placement of topsoil, trimming and profiling;

(D) placement of turf in the High Flow Bypass channel to protect against erosion;

(E) disconnecting the Inlet Zone from Macrophyte Zone and allowing all stormwater to flow along High Flow Bypass. This effectively isolates the Macrophyte Zone from catchment flows and allows the establishment of wetland plants without the risk of being smothered with coarse sediment during the Subdivision Construction and Allotment Building Phases;

(F) planting of the Macrophyte Zone once the disconnection is in place;

(G) water level in the Macrophyte Zone can be varied as required by the rate of wetland plant maturity by opening the connection for short periods or opening the outlet control. Irrigation of edges may be required; and

(H) planting the littoral zone and providing irrigation to ensure fast establishment of dense vegetation to minimise weed growth.

Figure SC6.4.3.9.44 depicts the functional installation of a constructed wetland

(iv) Sediment and erosion control

During allotment building phases the sedimentation pond can be used to reduce the load of coarse sediment discharging to the receiving environment. The disconnection between the sediment pond and the macrophyte zone will remain in place to ensure the majority of flows from the catchment continue to bypass the macrophyte zone thus allowing the wetland plants to reach full maturity without the risk of being smothered with coarse sediment (see Figure SC6.4.3.9.45).

This means the macrophyte zone can be fully commissioned and made ready for operation once the allotment building phase is complete.

Figure SC6.4.3.9.45 Constructed wetland sediment and erosion control operation

(v) Operational establishment

At the completion of the allotment building phase the sediment pond is de-silted, the disconnection between the sediment pond and macrophyte zone is removed and the constructed wetland is allowed to operate in accordance with the design.

Figure SC6.4.3.9.46 Constructed wetland operational establishment

(b) Construction tolerances

It is important to emphasise the significance of tolerances in the construction of constructed wetland systems. Ensuring the relative levels of the control structures (inlet connection to macrophyte zone, bypass weir and macrophyte zone outlet) are correct is particularly important to achieve appropriate hydraulic functions. Generally control structure tolerance of plus or minus 5 mm is considered acceptable.

Additionally the bathymetry of the macrophyte zone must be free from localised depressions and low points resulting from earthworks. This is particularly important to achieve a well distributed flow path and to prevent isolated pools from forming (potentially creating mosquito habitat) when the wetland drains. Generally an earthworks tolerance of plus or minus 25 mm is considered acceptable.

(c) Sourcing wetland vegetation

To ensure the specified plant species are available in the required numbers and of adequate maturity in time for wetland planting, it is essential to notify nurseries early for contract growing. When early ordering is not undertaken, the planting specification may be compromised due to sourcing difficulties, resulting in poor vegetation establishment and increased initial maintenance costs. The species listed in SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics are generally available commercially from local native plant nurseries but availability is dependent upon many factors including demand, season and seed availability. To ensure the planting specification can be accommodated the minimum recommended lead time for ordering is 3-6 months. This generally allows adequate time for plants to be grown to the required size. The following sizes are recommended as the minimum:

(i) viro tubes 50 mm wide x 85 mm deep;

(ii) 50 mm tubes 50 mm wide x 75 mm deep; and

(iii) native tubes 50 mm wide x 125 mm deep.

“Floral Edges”, a system of interlocking plants within one long container is recommended for wetland planting, particularly for the deep marsh zone. The series of plants (usually five) are grown together in a single “strip” container. Generally, these “floral edges” are supplied as more mature plants with developing rhizomes (for rhizomatous species) and interlocking roots. This has been used very successfully in wetland planting previously because the larger more mature plants, often with a thick rhizome system, can survive in deeper water and are more tolerant to fluctuations in water level. The

structure of this system slows the movement of water and binds the substrate, helping to reduce erosion. The weight of the interlocking plants also prevents birds from removing them, a common problem encountered during wetland plant establishment. Nurseries require a minimum lead time of 6 months for supply of these systems.

(d) Topsoil specification and preparation

The provision of suitable topsoil in wetlands is crucial to successful macrophyte establishment and to the long term functional performance of the wetland. Wetland macrophytes typically prefer medium textured silty to sandy loams that allow for easy rhizome and root penetration. Although there are a few plants that can grow in in-situ heavy clays (e.g. phragmites), growth is slow and the resulting wetland system will have low species richness, which is undesirable. The wetland must therefore have a layer of topsoil no less than 200 mm deep and preferably 300 mm in depth for improved dry season moisture retention.

During the wetland construction process, topsoil is to be stripped and stockpiled for possible wetland reuse as a plant growth medium. Most terrestrial topsoils provide a good substratum for wetlands, nonetheless laboratory soil testing (using Australian Standard testing procedures, e.g. AS 4419-2003: *Soils for landscaping and garden use*) of the in-situ topsoil is necessary to ensure the topsoil will support plant and microbial growth and have a high potential for nutrient retention. Typically, standard horticultural soil analysis, which includes major nutrients and trace elements, is suitable for topsoils intended for wetland use. The laboratory report will indicate the soils suitability as a plant growth medium and if any amendments are required.

Careful consideration should be given to the topsoil source and its propensity to contain weed seeds which may be viable in an ephemeral wetland habitat. If a problematic weed bank is likely to be present within the topsoil then importing alternative topsoil should be considered. If the in-situ topsoil is found to contain high levels of salt, extremely low levels of organic carbon (<< 5%), or any other extremes that may be considered a retardant to plant growth, it should be rejected.

If the in-situ topsoil is not suitable and soil amendment is considered impractical or not cost effective, sandy loam topsoil should be purchased from a soil supplier. If the local topsoil is suitable but very shallow, mixing with an imported soil will be necessary to reach the required volume to ensure a minimum 200 mm deep topsoil for wetland planting.

Imported topsoils are generally suitable as wetland plant growth medium, however as for in-situ soils (above), testing is required to determine the appropriate gypsum or lime dosing rate. If the local topsoil was tested and found to be suitable but then mixed with an imported soil to meet the required volume, laboratory soil testing should be repeated.

(i) Topsoil treatments

The wetland topsoil should be tested in accordance with AS 4419-2003: *Soils for landscaping and garden use* to ensure it is appropriate for growth of vegetation. If testing finds the topsoil is not appropriate then an alternative source should be found.

Topsoils for wetlands generally do not require fertiliser treatment. Imported foreign loam will contain sufficient nutrients for vegetation growth and local terrestrial topsoil will release nutrients after the wetting process. Submersion of terrestrial soils in water causes a shift from aerobic to anaerobic processes, prompting mineralisation and decomposition of organic matter contained in the soil, thus increasing available nitrogen. When soils become anaerobic, reduction processes cause iron oxides to be released from the surface of soil particles leading to increased availability of phosphorus. The addition of nutrients (fertiliser application) can facilitate the growth of algae (including cyanobacteria (blue-green) algae), particularly when the competing macrophytes and submerged plants are in the early stages of development, increasing the likelihood of algal blooms.

The topsoil within the wetland (macrophyte zones and open water zones) may need to be treated with gypsum or lime. The application of gypsum is standard on most construction sites for the purpose of securing or flocculating dispersive soils if entrained in runoff. The use of gypsum in wetland should only occur within catchments with dispersive soils and applied at a maximum rate of 0.4 kg/m^2. The application of lime may be required where the AS4419 (2003) soil testing

identifies a potential soil pH problem (pH < 5) or where acid sulfate soils (ASS) exist in the vicinity of the wetland. The rate of lime application should be guided by soil test results, an ASS Management Plan and water quality (pH) monitoring of the wetland and inflow.

Gypsum/ lime should be applied about one week prior to vegetation planting. Subsequent application may be required at intervals depending on water quality monitoring. Application of gypsum/ lime too far in advance of planting may lead to aquatic conditions that promote algal growth (i.e. clear water with no aquatic plants competing for resources).

(e) Vegetation establishment

(i) Timing for planting

Timing of vegetation planting is dependent on a suitable time of year (and potential irrigation requirements) as well as timing in relation to the phases of development. October and November are considered ideal times to plant vegetation in treatment elements. This allows for adequate establishment/ root growth before the heavy summer rainfall period but also allows the plants to go through a growth period soon after planting, resulting in quicker establishment. Planting late in the year also avoids the dry winter months, reducing maintenance costs associated with watering. Construction planning and phasing should endeavour to correspond with suitable planting months wherever possible. However, as lead times from earthworks to planting can often be long, temporary erosion controls (e.g. use of matting or sterile grasses to stabilise exposed batters) should always be used prior to planting.

(ii) Water level manipulation

To maximise the chances of successful emergent macrophyte establishment, the water level of the wetland system is to be manipulated in the early stages of vegetation growth. When first planted, vegetation in the deep marsh zone may be too small to be able to exist in their prescribed water depths (depending on the maturity of the plant stock provided). Macrophytes intended for the deep marsh sections will need to have half of their form above the water level, which may not be possible if initially planted at their intended depth. Similarly, if planted too deep, the young submerged plants will not be able to access sufficient light in the open water zones. Without adequate competition from submerged plants, phytoplankton (algae) may proliferate.

The water depth must be controlled in the early establishment phase. This can be achieved by closing off the connection between the sediment pond and the macrophyte zone (i.e. covering the overflow pit) and opening the maintenance drain. The deep marsh zones should have a water depth of approximately 0.2 m for at least the first 6 - 8 weeks. This will ensure the deep marsh zones of the wetland are inundated to shallow depth and the shallow marsh edges remain moist (muddy) providing suitable conditions for plant establishment. Seedlings planted in the littoral zones of the wetland will require ongoing watering at a similar rate as the terrestrial landscape surrounding the wetland (SC6.4.3.9.5(5)(e)(ii) Restricting access to open water). When it is evident that the plants are establishing well and growing actively, a minimum of 6 - 8 weeks following planting, the plants should be of sufficient stature to endure deeper water. At this time, the connection between the inlet pond and the macrophyte zone can be temporarily opened to allow slow filling of the wetland to the design operating water level.

(iii) Weed control

To protect landscape amenity and the stormwater treatment efficiency of the wetland it is important to maintain, throughout the year, the design vegetation communities to avoid excessive colonisation of the wetland by weeds. Weed infestation is a major problem in the dry tropics, particularly within ephemeral waterways and stormwater treatment facilities, therefore, the design and management of the wetland to manage weed infestation takes on high importance. Management of weeds is achieved as follows:

(A) designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities;

(B) planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be

required, particularly during the dry season; and maintaining dense macrophyte vegetation in the wetland during prolonged dry conditions is necessary to avoid opening up habitat opportunities for weeds. When the macrophyte zone dries (i.e. the macrophyte zone sediments are exposed) for a period in excessive of 60 days, irrigation of the macrophyte zone may be required to achieve this.

During the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

Conventional surface mulching of the wetland littoral berms with organic material like tanbark is not recommended. Most organic mulch floats and water level fluctuations and runoff typically causes this material to be washed into the wetland with a risk of causing blockages to outlet structures. Mulch can also increase the wetland organic load, potentially increasing nutrient concentrations and the risk of algal blooms. Adopting high planting density rates and if necessary applying a suitable biodegradable erosion control matting to the wetland batters (where appropriate), will help to combat weed invasion and will reduce maintenance requirements for weed removal. If the use of mulch on the littoral zones is preferred, it must be secured in place with appropriate mesh or netting (e.g. jute mesh).

(iv) Watering

Regular watering of the littoral vegetation during the plant establishment phase is essential for successful establishment and vigorous growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water level within the wetland. However, the following watering program is generally adequate but should be adjusted (i.e. increased) as required to suit site conditions:

(A) week 1-2 3 visits/ week;

(B) week 3-6 2 visits/ week; and

(C) week 7-12 1 visit/ week.

After this initial 3 month period, irrigation will still be required, particularly during the dry season. Watering requirements to sustain healthy dense vegetation should be determined during ongoing monitoring and maintenance site visits.

(v) Bird protection

During the early stages of wetland establishment, water birds can be a major nuisance due to their habit of pulling out recently planted species. Interlocking planting systems (i.e. where several plants are grown together in a single container such as “floral edges”) can be used, as water birds find it difficult to lift the interlocking plants out of the substrate unlike single plants grown in tubes.

(7) Maintenance requirements - constructed wetlands

Wetlands treat runoff by filtering it through vegetation and providing extended detention to allow sedimentation to occur. In addition, they have a flow management role that needs to be maintained to ensure adequate flood protection for local properties and protection of the wetland ecosystem.

Maintaining healthy vegetation and adequate flow conditions in a wetland are the key maintenance considerations. Weeding, planting, mowing and debris removal are the dominant tasks (but should not include use of herbicides as this affects water quality). In addition, the wetland needs to be protected from high loads of sediment and debris and the inlet zone needs to be maintained in the same way as sedimentation basins (see Chapter 4). Routine maintenance of wetlands should be carried out once a month.

(a) The most intensive period of maintenance is during plant establishment period (first two years) when weed removal and replanting may be required. It is also the time when large loads of sediments could impact on plant growth, particularly in developing catchments with poor building controls. Debris removal is an ongoing maintenance function. If not removed, debris can block inlets or outlets, and can be unsightly if in a visible location. Inspection and removal of debris should be done regularly. Typical maintenance of constructed wetlands will involve:

(i) irrigation of the littoral zone plants (especially during dry periods) to prevent the ingress of invasive weeds;

(ii) prompt removal of weeds before they spread and/or set seed is of critical importance;

(iii) desilting the inlet zone following the construction/ building period;

(iv) routine inspection of the wetland to identify any damage to vegetation, weed growth, scouring, formation of isolated pools, litter and debris build up or excessive mosquitoes;

(v) routine inspection of inlet and outlet points to identify any areas of scour, litter build up and blockages;

(vi) removal of litter and debris;

(vii) removal and management of invasive weeds;

(viii) repair to wetland profile to prevent the formation of isolated pools;

(ix) periodic (usually every 5 years) draining and desilting of the inlet pond;

(x) watering of wetland macrophytes during prolonged dry periods (in excess of 60 days);

(xi) water level control during plant establishment;

(xii) replacement of plants that have died (from any cause) with plants of equivalent size and species as detailed in the planting schedule; and

(xiii) vegetation pest monitoring and control.

Inspections are recommended following large storm events to check for scour and damage.

(b) All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure (SC6.4.3.9.5(4)(i) Step 9: Consider maintenance requirements). Maintenance personnel and asset managers will use this plan to ensure the wetlands continue to function as designed. To ensure maintenance activities are appropriate for the wetland as it develops, maintenance plans should be updated a minimum of every three years. The maintenance plans and forms must address the following:

(i) inspection frequency;

(ii) maintenance frequency;

(iii) data collection/ storage requirements (i.e. during inspections);

(iv) detailed clean-out procedures (main element of the plans) including:

(A) equipment needs;

(B) maintenance techniques;

(C) occupational health and safety;

(D) public safety;

(E) environmental management considerations;

(F) disposal requirements (of material removed);

(G) access issues;

(H) stakeholder notification requirements; and

(I) data collection requirements (if any); and

(v) design details.

An approved maintenance plan is required prior to asset transfer to the local authority. Refer to the guidelines or direction from the relevant local authority for more specific guidance on requirements for asset transfer.

An example operation and maintenance inspection form is included in the checking tools provided in SC6.4.3.9.5(8)(c) Operation and maintenance inspection form. These forms must be developed on a site specific basis as the configuration and nature of constructed wetlands varies significantly.

(8) Checking tools - constructed wetlands

A number of checking aids has been developed for designers and council development assessment officers. In

addition, SC6.4.3.9.5(6) Construction and establishment provides general advice for the construction and establishment of wetlands and key issues to be considered to ensure their successful establishment and operation, based on observations from construction projects around Australia.

(a) Design assessment

The checklist in Table SC6.4.3.9.17 presents the key design features to be reviewed when assessing a design of a wetland. These considerations include configuration, safety, maintenance and operational issues that should be addressed during the design phase. Where an item results in an "N" when reviewing the design, referral should be made back to the design procedure to determine the impact of the omission or error. In addition to the checklist, a proposed design must have all necessary permits for its installations. Council development assessment officers will require supporting evidence/ proof from the developer that all relevant permits are in place.

Click here to view **Table SC6.4.3.9.17 Wetland design assessment checklist**

(b) Construction (during and post)

The checklist in Table SC6.4.3.9.18 presents the key items to be reviewed when inspecting the bioretention basin during and at the completion of construction. The checklist is to be used by Construction Site Supervisors and local authority Compliance Inspectors to ensure all the elements of the bioretention basin have been constructed in accordance with the design. If an item receives an "N" in Satisfactory criteria then appropriate actions must be specified and delivered to rectify the construction issue before final inspection sign-off is given.

Click here to view **Table SC6.4.3.9.18 Wetland construction inspection checklist**

(c) Operation and maintenance inspection

The example form in Table SC6.4.3.9.19 should be developed and used whenever an inspection is conducted and kept as a record on the asset condition and quantity of removed pollutants over time. Inspections should occur every 1 - 6 months depending on the size and complexity of the system. More detailed site specific maintenance schedules should be developed for major constructed wetland systems and include a brief overview of the operation of the system and key aspects to be checked during each inspection.

Click here to view **Table SC6.4.3.9.19 Wetland maintenance checklist**

(d) Asset transfer (following on maintenance period)

Land ownership and asset ownership are key considerations prior to construction of a stormwater treatment device. A proposed design should clearly identify the asset owner and who is responsible for its maintenance. The proposed owner should be responsible for performing the asset transfer checklist. Table SC6.4.3.9.20 provides an indicative asset transfer checklist.

Click here to view **Table SC6.4.3.9.20 Asset transfer checklist**

(9) References - constructed wetlands

BCC 2000 (with revisions 2004), *Subdivision and Development Guidelines*, BCC, Brisbane

BCC 2001, *Sediment Basin Design, Construction and Maintenance: Guidelines*, BCC, Brisbane

Engineers Australia 2006, *Australian Runoff Quality, Engineers Australia*, ACT

GBLA (Graeme Bentley Landscape Architects) 2004, *Preliminary drawings for Mernda Wetland*, report for Stockland, GBLA, Victoria

Leinster, S 2006, *Delivering the Final Product – Establishing Water Sensitive Urban Design Systems, 7th International Conference on Urban Drainage Modelling and 4th International Conference on Water Sensitive*

Urban Design Book of Proceedings, Volume 2, A Deletic and T Fletcher (eds), Melbourne.

LHCCREMS (Lower Hunter and Central Coast Regional Environmental Management Strategy) 2002, *Water Sensitive Urban Design in the Sydney Region: 'Practice Note 2 – Site Planning'*, LHCCREMS, NSW

McFarlane A 1997, *Successful Gardening in Warm Climates*, Kangaroo Press, Sydney

DNRW, IPWEA & BCC (Department of Natural Resources and Water, Institute of Public Works Engineering Australia – Qld Division & Brisbane City Council) 1998, *Queensland Urban Drainage Manual* (QUDM) Second Edition, prepared by Neville Jones & Associates and Australian Water Engineering for DNRW, IPWEA & BCC, Brisbane.

Persson J, Somes NLG and Wong THF 1999, *Hydraulic efficiency and constructed wetland and ponds*, Water Science and Technology, vol. 40 no. 3, pp. 291–289

Standards Australia 2003, AS 4419-2003: *Soils for landscaping and garden use*, Standards Australia

Townsville City Council, *Water sensitive urban design for the coastal dry tropics (Townsville): Technical design guidelines for stormwater management*, 2011

SC6.4.3.9.6 Plant selection for WSUD systems in the coastal dry tropics

(1) This clause provides guidance on selecting appropriate plant species for water sensitive urban design (WSUD) systems where the plants have a functional role in stormwater treatment and/ or erosion protection. Selecting suitable plant species is critical to the long term landscape amenity, functional performance and structural integrity of WSUD systems.

Due to the strong seasonal rainfall patterns in the dry tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities. The vegetation design to manage weed infestation takes on high importance and requires special consideration to achieve the following objectives:

(a) maintain, throughout the year, a dense cover of the design vegetation to occupy habitat and avoid excessive colonisation by weeds;

(b) manage potential weed ingress from edges by sustaining perennial littoral vegetation;

(c) in bioretention systems the vegetation must be able to tolerate long dry periods, periodic inundation and free draining sandy soils;

(d) provision of irrigation to wetland littoral zones; and

(e) provision of irrigation to bioretention systems designed without saturated zones.

Careful selection of plant species and by adopting suitably high planting densities can significantly reduce costs associated with weed management.

(2) A list of recommended plant species for various WSUD systems, including appropriate planting densities, is provided in the following tables:

(a) Table SC6.4.3.9.21 A1 Groundcover plant species list for swales (incorporating buffer strips), bioretention swales and bioretention basins and Table SC6.4.3.9.22 A2 Shrub and tree plant species list for bioretention basins:

(i) swales (incorporating buffer strips);

(ii) bioretention swales; and

(iii) bioretention basins; and

(b) Table SC6.4.3.9.23 A3 Macrophyte and groundcover plant species list for wetlands and sedimentation basins and Table SC6.4.3.9.24 A4 Shrub and tree plant species list for wetlands and sedimentation basins:

(i) sedimentation basins; and

(ii) wetlands.

The plant species lists in Table SC6.4.3.9.21 A1 and Table SC6.4.3.9.22 A2 are not exhaustive and other plants may be used provided their physiological and structural characteristics match the characteristics of the plant species listed in the tables.

Non-indigenous natives and exotics should only be considered when there is a specific landscape need and the species has the appropriate growth form and habit. If non-indigenous natives and exotics are chosen, careful consideration should be given to the potential impacts on downstream receiving ecosystems. Species (including natives) that have the potential to become invasive weeds should be avoided.

(3) Swales (and buffer strips), bioretention swales and bioretention basins - plant selection

(a) Required plant characteristics

Planting for bioretention basin elements may consist of up to three vegetation types:

- groundcovers for stormwater treatment and erosion protection;
- shrubbery for screening, glare reduction and character; and
- trees for shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table SC6.4.3.9.21 A1 and Table SC6.4.3.9.22 A2 which outline plant species suitable for the coastal dry tropics. The designer should also refer to any relevant local guidelines.

(i) Groundcovers

The plant (groundcover) species listed in Table SC6.4.3.9.21 A1 have been specifically selected, based on their life histories, physiological and structural characteristics, to meet the functional requirements of swales, buffer strips and bioretention systems (i.e. bioretention swales and bioretention basins). Bioretention systems must have filter media with a minimum depth of 400 mm for groundcover plants to provide an adequate depth of aerobic soil for healthy root development.

Plant species selected for bioretention systems must be able to tolerate free draining sandy soils and be capable of withstanding long dry periods punctuated by short periods of temporary inundation. The addition of saturated zones in bioretention systems will help retain moisture during the dry season where supplemental irrigation is not provided. Suitable plants species are listed in Table SC6.4.3.9.21 A1. Where irrigation of bioretention systems is provided, a more diverse range of species may be selected to achieve the desired landscape aesthetic provided they are tolerant of the filter media conditions and have the required features to fulfil the functional roles of the WSUD element. In general, the plant species in Table SC6.4.3.9.21 A1 have the following features:

(A) they are able to tolerate short periods of inundation punctuated by longer dry periods. For bioretention systems these dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the dry tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture;

(B) they generally have spreading rather than clumped growth forms;

(C) they are perennial rather than annual;

(D) they have deep, fibrous root systems;

(E) groundcover plants can be turf, prostrate or tufted;

(F) prostrate species would typically be low mat forming stoloniferous or rhizomatous plants; and

(G) tufted species would typically be rhizomatous plants with simple vertical leaves.

Most of the groundcovers listed in Table SC6.4.3.9.21 A1 are widespread, occurring throughout the coastal dry tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area

and to compliment surrounding vegetation communities.

(ii) Shrubs and trees

Shrubs and trees are not a functional requirement within swales, bioretention swales or bioretention basins, but can be integrated to provide amenity, character and landscape value. Planting trees and shrubs in bioretention systems requires the filter media to have a minimum depth of 800 mm to avoid root interference with the perforated subsurface drainage pipes. They must also be accompanied by densely planted shade tolerant groundcover species with the characteristics outlined above. Trees and shrubs are to be managed so that the ground cover layer is not out-competed. To avoid over-shading, trees and shrubs should be planted at low densities. Periodic thinning of the upper vegetation layers may also be required. In general, tree and shrub species that can be incorporated into bioretention systems have the following general features:

(A) trees need to be able to tolerate short periods of inundation punctuated by longer dry periods. These dry periods may be reasonably severe due to the free draining nature (relatively low water holding capacity) of bioretention filter media. In the dry tropics climate irrigation of bioretention vegetation will be required unless saturated zones are provided to maintain soil moisture;

(B) they need to have relatively sparse canopies to allow light penetration to support dense groundcover vegetation;

(C) have shallow root systems and root systems that are not known the be adventurous “water seekers” to reduce the risk of root intrusion into subsurface drainage pipes;

(D) trees must not be deciduous; and

(E) preferably native and occur naturally in the local area.

The shrubs and trees listed in Table SC6.4.3.9.22 A2 are recommended as they display the above features.

Most of the shrub and tree species listed in Table SC6.4.3.9.22 A2 are widespread, occurring throughout the coastal dry tropics. However, alternative locally occurring species that display the required features may be selected to tailor the species list to match the native vegetation associations of the area and to compliment surrounding vegetation communities.

(b) Plant species selection

Well established uniform groundcover vegetation is crucial to the successful operation of swale and bioretention system treatment elements. As a result, plant species selection needs to consider both the aesthetic and functional requirements. The functional plant traits required for effective water treatment are different for different devices. For example:

(i) swales – require plants with vigorous growth and a spreading habit to hold soil in place against flow. They should also be suited to growth in wet clay soils. Examples include turf grasses, tufted grasses and sedges;

(ii) bioretention swales - require plants with vigorous growth and a spreading habit to hold soil in place against flow. They should be drought tolerant and suited to growth in sandy soils. Examples include turf grasses, tufted grasses and sedges;

(iii) bioretention basins – plants should be drought tolerant and suited to growth in sandy soils. Examples include grasses, shrubs and trees. A diverse mix is recommended; and

(iv) when selecting plant species from Table SC6.4.3.9.21 A1, consideration must be given to the following factors:

(A) other WSUD objectives such as landscape, aesthetics, biodiversity, conservation and ecological value;

(B) region, climate, soil type and other abiotic factors;

(C) roughness of the channel (Manning’s *n* roughness factor) (for swales); and

(D) extended detention depth (for bioretention systems).

Typical heights of each plant species and comments relating to shade and salt tolerances and soil moisture requirements are provided in Table SC6.4.3.9.21 A1 and will help with the selection process.

The low growing and lawn species are suitable for swale elements that require a low hydraulic roughness. The treatment performance of bioretention systems, in particular, requires dense vegetation to a height equal to that of the extended detention depth. Therefore, a system with a 300 mm extended detention depth should have vegetation that will grow to at least 300 mm high. Turf is not considered to be suitable vegetation for bioretention basins. The stems do not grow high enough and the root structure of turf is not suitably robust to ensure the surface of the bioretention filter media is continuously broken up to prevent clogging.

Included in Table SC6.4.3.9.21 A1 is a recommended planting density for each plant species. The groundcover planting densities should ensure that 70-80 % cover is achieved after two growing seasons (2 years) given adequate irrigation and weed control. High density planting to avoid weed ingress is particularly important in the dry tropics due to the climatic conditions which favour opportunistic (colonising) seasonal weed species. High density planting also ensures runoff does not establish preferential flow paths around the plants and erode the swale/ bioretention surface. Dense vegetation is also required to ensure a uniform root zone, which is particularly important in bioretention systems.

If prostrate shrubs that form scrambling thickets are used (in place of or in conjunction with the plant species in Table SC6.4.3.9.21 A1) they should be planted at high densities (8-10 plants/m²) and may require pruning to ensure even plant cover and to maintain an even root distribution below ground.

(c) Vegetation establishment and maintenance

Swales, buffer strips and bioretention basins are living systems and require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. In addition, specific requirements for plant stock sourcing, topsoil selection and testing and vegetation establishment, as detailed in the relevant WSUD element chapters, are necessary to maximise successful vegetation establishment and system treatment performance. Particular reference is made to the sections titled “Landscape Design Notes”, “Maintenance Requirements” and “Construction and Establishment” for guidance on vegetation establishment and maintenance procedures. The “Construction and Establishment” section also details a staged implementation approach by which the functional elements of the WSUD system are protected from building site runoff and associated sedimentation, weeds and litter during the building phase.

Table SC6.4.3.9.21 A1 Groundcover plant species list for swales (incorporating buffer strips), bioretention swales and bioretention basins

S Swale,
BS Bioretention Swale,
BB Bioretention Basin
Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density[1] (Qty/m²)	Comments
Atriplex muelleri	Salt Bush	BB	Prostrate	100	2-3	Very common low prostrate mat in saline areas, silver foliage highly ornamental
Bacopa monnieri	Bacopa	BB	Prostrate	100	6-8	Not suitable for sandy soils with low water holding capacity, Native to region prostrate herb
Bothriochloa pertusa	Indian Couch	S, BS, BB	Turf		Seeded or rolled	Tolerates prolonged dry periods
Carex fascicularis	Tassel Sedge	S	Tufted	1000	6-8	Not suitable for sandy soils with low water holding capacity,
Carex polyantha	Creek Sedge	S	Tufted	To 900	6-8	Not suitable for sandy soils with low water holding capacity,

Scientific Name	Common Name	Application	Form	Height (mm)	Planting Density[1] (Qty/m^2)	Comments
Cymbopogon refractus	Barbed Wire Grass	S	Tufted	300	8-10	Does not tolerate prolonged dry periods
Cyperus haspan	Haspan Flatsedge	S	Tufted	400	8	Suitable for, sandy soils, perennial, native to region
Cyperus javanicus		S	Tufted	1400	8	Suitable for, sandy soils, perennial, native to region
Cyperus polystachyos	Bunchy Sedge	S	Tufted	600	8	Suitable for both sand and clay soils, perennial, native to region, tolerates salinity
Cyperus scariosis#		S		900	8	Suitable for, sandy soils, perennial, native to region, tolerates salinity levels may suppress *Urochloa mutica* (para grass)
Dianella longifolia var. longifolia	Pale Flax-lily	S, BS, BB,	Tufted	300-800	8	Shade tolerant, native to region
Eragrostis elongata	Lavender Grass	S, BS, BB			8	Annual or weak perennial, best in rockeries and roadsides
Fimbristylis dichotoma		BS, BB	Tufted	750	8	Suitable for, sandy soils, perennial, native to region
Fimbristylis ferruginea	Rusty Finger Rush	BS, BB	Tufted	650 -800	8	Suitable for, sandy soils, perennial, native to region, salt tolerant
Fimbristylis tristachya		BS, BB	Tufted	600	8	Suitable for, sandy soils, perennial, native to region
Gahnia aspera	Saw Sedge	S	Tufted	1000	6	Not suitable for sandy soils, native to region, difficult to propagate
Gahnia sieberiana	Red-fruited Sword Sedge	S	Tufted	1500-3000	6	Aesthetic, difficult to propagate
Imperata cylindrical#	Blady grass	S, BS, BB	Tufted	500	8	Only use when it occurs in natural surroundings, native to region,
Juncus usitatus#	Common Rush	S, BS, BB	Tufted	500	8-10	Not suitable for sandy soils
Lomandra hystrix	Creek Matt Rush	S, BS, BB	Tufted	1000	6	Shade tolerant, native to region
Lomandra longifolia	Matt Rush	S, BS, BB	Tufted	500-1000	6	Shade tolerant, native to region
Paspalum distichum	Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Not suitable for sandy soils, native to region
Paspalum vaginatum cv 'Saltene'	Salt Water Couch	S, BS, BB	Turf	To 500	Seeded or rolled	Salt tolerant, native to region
Platyzoma microphyllum	Fern	BB	Fern	150-500	8	Not suitable in areas expecting prolonged dry periods , Native to region
Eragrostis spartinoides	Love Grass	S, BS, BB	Grass	600	8	Native to region
Sporobolus virginicus	Marine Couch	S, BS, BB	Turf	To 400	Seeded or rolled	Salt tolerant, Native to region
Themeda triandra	Kangaroo Grass	S, BS, BB	Tufted	300-500	6-8	

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting

densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs. S = Swale, BS = Bioretention Swale, BB= Bioretention Basin

Table SC6.4.3.9.22 A2: Shrub and tree plant species list for bioretention basins

Note—trees not suitable for systems requiring flow conveyance (i.e. swales and bioretention swales) due to shading reducing growth of ground cover.

Scientific Name	Common Name	Form	Height (m)	Planting Density[2] (Qty/m[2])	Comments
Breynia oblongifolia	False Coffee Bush	Shrub	1-2	2-4	Native to region
Corymbia tessellaris	Moreton Bay Ash	Tree	10-20		Suitable for sandy soils, native to region
Aidia racemosa		Shrub	10-15		Native to region, tolerates high winds
Atractocarpus fitzalanii	Ivory Curl Tree	Shrub	3-10		Native to region
Eugenia reinwardtiana	Cedar Bay Cherry	Tree	1-3		Native to region
Leptospermum polygalifolium	Wild May	Shrub	1-4	2-4	Sunny position, native to region
Myoporum acuminatum	Coastal Boobialla	Shrub	0.5-6	2-4	Sun or semi-shade, salt tolerant, native to region
Albizia canescens	Townsville Siris	Tree			Native to region, rare
Buckinghamia celsissima		Tree	20-30		Native to region
Chionanthus ramiflorus	Native Olive	Tree	6-8		Native to region
Colubrina asiatica		Tree			Salt tolerant
Cupaniopsis anacaroides	Beach Tuckeroo	Tree	8-15		Suitable for sandy soils, native to region
Callistemon(Melaleuca) viminalis	Weeping Bottle Brush	Tree	5-10	<1	Requires moist soils during establishment but tolerates dry periods once established
Eucalyptus raveretiana	Black Ironbox	Tree			Tolerates high winds
Eucalyptus tereticornis	River Blue Gum	Tree	20-50m		Native to region
Ganophyllum falcatum		Tree	10-25		Native to region
Lophostemon grandiflorus		Tree	8-12		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca dealbata	Cloudy Tea Tree	Tree	5-15		Native to region, tolerates high winds, periods of flooding and fire
Melaleuca fluviatilis		Tree			Native to region, tolerates high winds and periods of flooding, forms a root mat good for erosion cotrol
Mimusops elengi		Tree	10-15		Suitable for all soil types, native to region, tolerates high winds

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

(4) Wetlands and sedimentation basins - plant selection

Due to the strong seasonal rainfall patterns in the dry tropics, weed infestation is a major problem, particularly within ephemeral waterways and stormwater treatment facilities such as wetlands and sediment basins. Therefore, the design and management of these systems to manage weed infestation takes on high importance. Management of weeds is achieved through the plant selection and landscape design as follows:

- planting dense littoral vegetation around the perimeter of the wetland to avoid the ingress of weed species. To maintain dense perennial littoral vegetation, irrigation is likely to be required, particularly during the dry season; and
- designing the macrophyte zone as predominately a deep marsh system (i.e. water depth 0.5 m - 0.7 m) to maintain the macrophyte vegetation by minimising the frequency and duration of wetland drying, thus permanently occupying the habitat and restricting weed colonisation opportunities.

During the establishment and ongoing maintenance of the wetland, prompt removal of weeds before they spread and/or set seed is of critical importance.

(a) Required plant characteristics

Planting for wetlands and sedimentation basins may consist of two vegetation types:

- macrophytes and groundcovers for stormwater treatment, erosion protection and weed management. The macrophytes are divided further into several different zones as outlined in Table SC6.4.3.9.23 A3; and
- shrubbery and trees for screening, shading, character and other landscape values.

For specific guidance on plant species the designer is directed to Table SC6.4.3.9.23 A3 and Table SC6.4.3.9.24 A4 which outline plant species suitable for the coastal dry tropics.

(i) Macrophytes and groundcovers

The plant species listed in Table SC6.4.3.9.23 A3 have been specifically selected based on their life histories and physiological and structural characteristics, to meet the functional requirements of wetland systems. Plant species suitable for wetlands will also be suitable for edge planting around sedimentation basins. The following sections address wetlands specifically as they have very defined vegetation requirements for stormwater treatment. This includes consideration of the wetland zone/ depth range, typical extended detention time (typically 48 hrs) and extended detention depth (typically 0.5 m).

Other species can be used to supplement the core species listed in Table SC6.4.3.9.23 A3 provided they have the required features to fulfill the functional roles of the wetland zone. Careful consideration of the water depth range and wetland hydrological regime (water depth and inundation period) is also required to assess the suitability of alternate species for constructed wetlands. Wetland plants in the dry tropics must be able to tolerate large water level variations and dry periods of up to 60 days. Short growing emergent macrophytes will not be suitable for the deep marsh zone as they will become over inundated. As a guide, emergent macrophytes require 1/3 of their foliage to extend above the water level 80% of the time. However, during the plant establishment phase emergent macrophytes require 50% of their foliage above the water level.

In general, the species in Table SC6.4.3.9.23 A3 have the following features:

(A) they grow in water as either submerged or emergent macrophytes, or they grow adjacent to water and tolerate periods of inundation (typically sedge, rush or reed species);

(B) they generally have spreading rather than clumped growth forms;

(C) they are perennial rather than annual;

(D) they generally have rhizomatous growth forms;

(E) they have fibrous root systems; and

(F) they are generally erect species with simple vertical leaves (e.g. Juncus spp, Baumea spp).

(ii) Shrubs and trees

Shrubs and trees are not a required element of wetlands or sedimentation basins but can be integrated to provide amenity, character and landscape value. Shrubs and trees (generally only planted in the littoral zones) should be accompanied by dense shade tolerant groundcover species

as an understorey to occupy habitat and provide a weed ingress barrier. Table SC6.4.3.9.24 A4 provides a list of shrubs and trees that are natives to the coastal dry tropics and are suitable for planting in the littoral zone (i.e. on the batters) around wetlands and sedimentation basins.

Littoral zone vegetation is primarily for weed management (to avoid weed ingress into the macrophyte zone), batter stabilisation, aesthetics and to restrict public access, rather than for stormwater treatment. For this reason, species that do not have all of the above structural features, but fulfill the primary littoral zone requirements (e.g. weed management and erosion protection) and landscape objectives may still be acceptable for inclusion in this zone (refer to the "Landscape Design Notes" section in the relevant WSUD chapter).

(b) Plant species selection

Plant species listed in Table SC6.4.3.9.23 A3 are recommended as core species for wetland planting. These plant species have been grouped into a wetland macrophyte zone according to their preferred water depth and the hydrologic conditions of the zone. The perennial wetland plants must be able to tolerate large water level variations and periodic drying (potentially of up to 60 days duration). In general, the deep marsh emergent macrophytes must be capable of a standing water level of 0.5 m – 0.7 m punctuated with short episodes of extended detention (up to 1.2 m in total water depth) and seasonal drying.

While individual plant species can have very specific water depth requirements other species can be quite adaptive to growing across various zones over time. It is however, recommended that the suggested zones and plant groups are adhered to for planting purposes. Plant species listed against the shallow marsh and lower batters are only suited for edge planting in wetlands and sedimentation basins. Planting densities recommended should ensure that 70-80 % cover is achieved after two growing seasons (2 years). This is particularly important for weed management and therefore the recommended planting densities should not be reduced.

Suitable plant species for the littoral zone that surrounds wetlands and sedimentation basins have also been recommended in Table SC6.4.3.9.23 A3. The littoral zone relates to the berms, batters or embankments around the systems. Plants that have a drier habit should be planted towards the top of batters, whereas those that are adapted to more moist conditions should be planted closer to the water line. High density planting of the littoral zone is required to provide a barrier (by occupying habitat) to prevent weed ingress into the wetland or sediment basin.

(c) Vegetation establishment and maintenance

To maximise the success of plant establishment in wetland macrophyte zones specific procedures are required in site preparation, stock sourcing, vegetation establishment and maintenance. Reference is to be made to procedures detailed in SC6.4.3.9.5(5) Sourcing wetland vegetation as follows:

(i) sourcing plant stock (SC6.4.3.9.5(6)(c) Sourcing wetland vegetation):

(A) lead times for ordering plants; and

(B) recommended planting systems/ products;

(ii) topsoil specification and preparation SC6.4.3.9.5(6)(d) Topsoil specification and preparation):

(A) sourcing, testing and amendment; and

(B) top soil treatments (e.g. gypsum, lime, fertiliser); and

(iii) vegetation establishment (SC6.4.3.9.5(6)(e) Vegetation establishment):

(A) weed control;

(B) watering; and

(C) water level manipulation.

Constructed wetlands are living systems and they require two years of establishment before the vegetation matures and reaches fully functional form. During this establishment period, regular site monitoring and maintenance is critical to the success of these systems. Reference must also be made to the SC6.4.3.9.5(7) Maintenance requirements – constructed wetlands and SC6.4.3.9.5(6) Construction and establishment – constructed wetlands for guidance on maintenance procedures and vegetation

establishment.

Similarly, the vegetation planted in sedimentation basins require an equivalent vegetation establishment period (i.e. 2 years) and level of attention to site preparation, stock sourcing, vegetation establishment and maintenance to ensure success. Reference must be made to the sections entitled “Landscape Design Notes”, “Maintenance Requirements” and “Construction and Establishment” in Chapter 4.

(d) Vegetation selection for mosquito management

Species selected should have a stiff, thin, upright growth habit. This allows mosquito predators to access all wet areas and control mosquito larvae. Species with a spreading habit such as turf grasses or wide strappy leaves such as Typha can isolate pockets of water where mosquitoes can breed and avoid predation.

Table SC6.4.3.9.23 A3: Macrophyte and groundcover plant species list for wetlands and sedimentation basins

Key to Table SC6.4.3.9.22 A3:

Zone		Depth*(m)	Form	
P	Permanent Pool	2.0– 0.7	S	Submerged macrophyte
DM	Deep Marsh	0.7 – 0.35	E	Emergent macrophyte
SM	Shallow Marsh	0.35 – 0	Am	Amphibious
LB	Lower Batters	0 – +0.5**	A	Annual Groundcover
UB	Upper Batters	+0.5- +1.0**	Sh	Shrub
			Tr	Trees

* ‘Depth’ refers to depth below permanent pool water level

** ‘+’ denotes levels above permanent pool water level

Strongly recommended – perennial, vigorously growing species with appropriate traits for good pollutant removal.

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m²)	Comments
Isolepis inundata	Swamp Club-rush	SM	Emergent Macrophyte		To 300	6-8	High surface area; rapid growth
Oryza australiensis	Native Rice	SM	Emergent Grass	Perennial	2500		Attracts birds, native to region
Actinoscirpus grossus		DM	Emergent	Perennial	3000	6	Suitable for clay soils
Baumea articulataarticulate#	Jointed Twig-rush	DM	Emergent	Perennial	1000-2000	6-8	Slow growth, plant solo
Eleocharis sphacelata#	Tall Spike-rush	DM	Emergent	Perennial	500-2000	6-8	Plant solo, rhizomes can restrict growth of other plants; slow establishment, flow resistant,
Leersia hexandra	Swamp Ricegrass	DM	Emergent	Perennial	2000	6	Tolerates periods of flooding, fire resistant
Lepironia articulataarticulate#	Grey Rush	DM	Emergent	Perennial	600-2300	4-6	Tall grey sedge from Hidden Valley, very ornamental, popular in wetland plantings
Phragmites australis#	Common Reed	DM	Emergent	Perennial	5000	6	Native to region, forms dense swards
Phragmites karka (vallatoria)#	Spiny MudgrassTropical Reed	DM	Emergent	Perennial	1000-2000	6	Native to region

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m[2])	Comments
Schoenoplectus litoralis	Shore Club-rush	DM	Emergent	Perennial	600-1500	4-6	Tolerates salinity
Schoenoplectus validus #	River Club-rush	DM	Emergent	Perennial	600-1600	4-6	
Scleria poiformis		DM	Emergent	Perennial	2200	6	Requires irrigation
Thoracostachyum sumatran	Sedge	DM	Emergent	Perennial	2500	6	
Eleocharis dulcis#	Water Chestnut	DM & SM	Emergent	Perennial	1000-1500	4-6	Plant solo, flow resistant
Oryza australiensis	Native Rice	DM & SM	Emergent	Perennial	2500	6	Attracts birds, native to region
Carex polyantha#	Creek Sedge	LB	Emergent Macrophyte	Perennial	To 900	6-8	
Cyperus digitatus	Sedge	LB	Amphibious Sedge	Wet Season Annual	500-1500	8	
Cyperus iria	Rice Flat Sedge	LB	Amphibious Sedge	Wet Season Annual	600	8	Tufted growth
Cyperus tenuispica		LB	Amphibious Sedge	Wet Season Annual	400	8	Suitable for sand and clay solids
Fimbristylis littoralis	Fimbry	LB	Amphibious Sedge	Wet Season Annual		8	Native to region
Juncus pristmatocarpus	Branching Rush	LB	Emergent Macrophyte	Perennial	300-600	6-8	
Phyla nodiflora		LB	Herb	Perennial	200		Native to region
Schoenoplectus lateriflorus		LB	Amphibious Sedge	Wet Season Annual	700	8	
Schoenoplectus praelongatus		LB	Amphibious Sedge	Wet Season Annual	350	8	
Ceratophyllum demersum	Hornwort	P	Submerged	Perennial	600		Native to region
Myriophyllum dicoccum	Water Milfoil	P	Submerged	Perennial or Annual	To 200	1	
Myriophyllum filiforme	Water Milfoil	P	Emergent Aquatic Herb	Dry Season Annual	150	1	
Myriophyllum verrucosum	Red Water-milfoil	P	Submerged	Perennial	100-1500	1	Native to region
Najas tenuifolia	Water Nymph	P	Submerged	Perennial	500	1	
Potamogeton crispus	Curly Pondweed	P	Submerged	Perennial	To 4500	1	Growth can be dense, native to region
Potamogeton octandrus	Pondweed	P	Submerged	Perennial	To 4500	1	
Potamogeton tricarinatus	Pondweed	P	Submerged	Perennial		1	

Scientific name	Common name	Zone	Type	Perennial or Annual	Height (mm)	Planting Density[2] (Qty/m[2])	Comments
Vallisneria gigantea	Ribbonweed	P	Submerged	Perennial	To 3000	1	Rapid growth; salt tolerant (1500 ppm),
Vallisneria nana	Ribbonweed	P	Submerged	Perennial	700	1	Native to region
Ischaemum australe	Zipper Grass	SM	Amphibious Grass	Perennial	1500	6	Forms dense swards
Ischaemum rugosum		SM	Amphibious Grass	Perennial	1200	6	Native to region
Schoenoplectus mucronatus#	Club Rush	SM		Perennial	0.35-1.0m	8	Native to region
Cyperus scariosis	Sedge	SM & LB	Amphibious Sedge	Perennial	800	8	Native to region, salt tolerant
Fimbristylis dichotoma#		SM & LB	Amphibious Sedge	Perennial	1000	8	Native to region
Juncus usitatus#	Common Rush	SM & LB	Emergent Macrophyte		300-1200	8-10	Rapid growth
Dianella longifolia var. longifolia	Pale Flax-lily	UB	GrassLily	Perennial	300-800	6-8	Aesthetic; shade tolerant
Lomandra filiformis spp. filiformis	Wattle Mat-rush	UB	Tufted	Perennial	150-500	6-8	Shade tolerant when established, native to region
Lomandra longifolia #	Spiny-headed Mat Rush	UB	Tufted	Perennial	500-1000	4-6	Shade tolerant, native to region
Sorghum plumosum	Plume Sorghum	UB	Grass		To 4000	6	Growth can be dense
Themeda triandra	Kangaroo Grass	UB	Grass	Perennial	750	8	Requires local propagation, does not tolerate water logged soils
Cyperus polystachyos#	Bunchy Sedge	UB & LB	Sedge	Perennial	To 600	6-8	Suitable for sand and clay soils, Native to region, salt tolerant
Gahnia siberiana	Red-fruited Sword Sedge	UB & LB	Tufted	Perennial	1500-3000	4-6	Aesthetic. difficult to germinate

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

Table SC6.4.3.9.24 A4: Shrub and tree plant species list for wetlands and sedimentation basins

Scientific name	Common name	Zone	Form	Height (mm)	Planting Density [3] (Qty/m2)	Comments
Callistemon viminalis	Weeping Bottle Brush	UB	Tree	5.0-10.0	<1	Moist, medium to heavy soils, tolerates dry periods once established
Eucalyptus coolabah		UB	Tree		<1	
Livistona decora		UB	Tree		<1	Native to region
Lophostemon suaveolens	Swamp Box	UB	Tree	5.0-25.0	<1	Moist sandy soils
Melaleuca leucadendron	Weeping Paperbark	UB	Tree		2-4	
Melaleuca nodosa	Prickly-leafed Paperbark	UB	Tree	2.0-7.0	2-4	Deep sands and moist sandy soils
Melaleuca viridiflora		UB	Tree		2-4	Native to region
Nauclea orientalis	Leichardt Tree	UB	Tree		<1	Native to region, tolerates high winds and periods of flooding
Pandanus cookii	Screw Pine	UB	Tree		<1	Native to region, tolerates high winds, periods of flooding, fire resistant, will drop leaves
Myoporum acuminatum	Coastal Boobialla	UB	Shrub	0.5-6.0	2-4	Sun or semi-shade, salt tolerant Native to region

Note—planting density indicates the mean number of plants per square metre for the species spatial distribution within the zone. The planting densities recommended are suggested minimums. Any reduction in planting density has the potential to reduce the rate of vegetation establishment, increase the risk of weed invasion, and increase maintenance costs.

(5) References - plant selection

BCC 2005, *Growing Native Plants in Brisbane, BCC,* Brisbane, accessed 25th July 2005

BCC, DMR & PRSC (Brisbane City Council, Queensland Department of Main Roads and Pine Rivers Shire Council) 2001, *Preferred Species Manual: Green Routes Program*, prepared for the Green Routes Program by BCC, DMR and PRSC, Brisbane

SC6.4.3.10 On-site sewerage facilities

SC6.4.3.10.1 Introduction

This sub-section provides standards, advice and guidelines for applicants in the design, installation and siting of wastewater treatment and disposal systems.

The principle underpinning the use of on-site wastewater treatment and disposal is that all design, installation and construction will meet the demands of a development, whilst having full consideration of the effects to public health and ensuring that adverse impacts on environmental values are avoided.

Council will apply these guidelines when processing applications involving on-site sewerage facilities or servicing of development outside of reticulated sewerage supply areas, or applications incorporating the use of an on-site sewerage facility.

Editor's note—development within SC2.5 Natural resources overlay map-Water resource catchments (OM-09) or Natural assets environmental importance overlay map (OM-08) will need to consider additional setback requirements, including requirements for exclusions of infrastructure in some instances when applying the standards of this policy.

Editor's note—before an on-site sewerage facility can be installed on a property, the applicant is required to apply for a permit to install the treatment facility on that property. Applications to install an onsite sewerage facility are to be lodged with the Hydraulic and Building Services Unit of council as part of the plumbing/drainage application. Applicants should also refer to the On-site sewerage facilities for non-sewered properties guidelines which provides details on the application and installation stages of an on-site sewerage facility. This document may be found on council's website.

(1) Terminology

Unless noted otherwise all terms have the same meaning as given in the *Plumbing and Drainage Act* 2002 (the PD Act), the *Standard Plumbing and Drainage Regulation* 2003 and the relevant Australian/New Zealand Standard or Australian Standard. If a definition given in the relevant Australian/New Zealand Standard or Australian Standard is inconsistent with the PD Act or Regulation, the PD Act or Regulation prevails to the extent of the inconsistency.

Intermittent water course	A natural or artificial channel, identifiable by recognisable bed and banks, along which rain water or storm water usually or occasionally flows. The term does not include a closed conduit for conveying storm water.
Top bank	The same meaning as outer bank as defined in the *Water Act 2000.*

(2) Reference and source documents that are to be read and applied in conjunction with this policy sub-section are as follows:

AS/NZS 1546.1 *On-site domestic wastewater treatment units-septic tanks*
AS/NZS 1547:2000 *On-site domestic wastewater management*
AS/NZS 3500.2:2003 *Sanitary Plumbing and Drainage*
Environmental Protection Act and all subordinate legislation, in particular the *Environmental Protection (Waste Management) Regulation 2000* (Design Rules)
National Construction Code Volume 3 – Plumbing Code of Australia
Plumbing and Drainage Act 2002 (and associated Regulations)
Queensland Plumbing and Wastewater Code

Editor's note—council has specifically referred to AS/NZS 1547:2000 *On-site domestic waste water management* and is, for the purpose of this policy, the adopted standard to be read and applied in conjunction with this policy sub-section.

SC6.4.3.10.2 Application guidelines

(1) The following section details the design standards and reporting requirements for wastewater treatment systems generally, to assist applicants in demonstrating they have met the requirements of the Townsville City Plan.

(2) Development which is not connected to council's sewerage system and is not within a reticulated service area will require an on-site sewerage disposal report to demonstrate the effective and safe disposal of sewerage on-site, having particular regard to the nature of the development proposed, demands the development will place on a system, the land and surrounding environment and known hydro-geologic, public health or otherwise constrained concerns.

The report should be prepared by a professional engineer or hydraulic consultant, to document a site and soil evaluation and design of disposal facility as per procedures, reporting requirements and standards outlined AS/NZS1547:2000.

(3) As a minimum, the on-site sewerage disposal report submitted in support of an application should provide detailed information on the following; the report should:

(a) provide sufficient information for deciding whether or not a development area, subdivision, or lot is suitable for on-site system(s);

(b) provide detailed site-specific information identifying the site-and-soil characteristics to be taken into account when selecting and designing an on-site system;

(c) identify, analyse, and evaluate any risks posed by site-and-soil characteristics which might compromise the long-term effectiveness of the on-site system(s);

(d) identify, analyse, and evaluate any risks of contamination of groundwater or surface water and of associated health risks; and

(e) specify measures required to reduce and monitor such risks.

Editor's note—the flow rates should be determined using Appendix 4.2D (H in 2012 standard) *Typical Domestic Wastewater Flow Design Allowances* in AS/NZS 1547:2000.

(4) The designer's report/design, at a minimum, must comply with the requirements of the AS/NZS 1547:2000. For the purposes of reporting, Table 3.1 of AS/NZS 1547:2000 Part B; Unsewered subdivision proposals, Sections 2 (Subdivision design) and Section 3 (System Design) as well as Section 4 of AS/NZS 1547:2000 are considered relevant and should be used as a primary guide for preparing reports as it outlines the essential stages and implementation processes required. To the extent relevant, reporting should also consider the requirements of the *Queensland Plumbing and Wastewater Code.*

(5) The designer must undertake (or have undertaken) soil testing as necessary to enable an appropriate design to be completed. This may include but not be limited to the following: soil percolation tests; bore holes; test pits and soil textural analysis. The report should consider the following points when carrying out a site and soil evaluation:

(a) the determination of potential effluent disposal problems. These may include gullies, rock formations, hollows, or inconsistent soil texture, both on and off the property;

(b) the consideration of previous and current weather conditions in the determination of the site's suitability for effluent disposal;

(c) the demonstration that the disposal area is located above the 5 per cent AEP;

(d) the site plan showing the setback requirements (for buildings, pools, bores, permanent and intermittent water courses, vehicular traffic areas and drains etcetera) both on and off the property, which may influence the location of the disposal area;

(e) a proposed land application area that shall not be cut, filled or modified in any way after the site evaluation has been carried out. If this does occur the designer must be informed so that appropriate amendments can be made to the design; and

(f) the designer is to make their recommendation based on the site and soil evaluation carried out.

In addition to the above, the following must also be reported on:

(i) topography and drainage;

(ii) climate data and statistics;

(iii) groundwater information (extractive bores, uses and quality);

(iv) infrastructure (existing and proposed);

(v) potential for cumulative effects on receiving environments;

(vi) off-site impacts;

(vii) presence of any fill material;

(viii) geotechnical hazards;

(ix) setback distances;

(x) potential for environmental or public health impacts; and

(xi) site plans (individual or multiple lots).

Much of the Townsville coastal plain is derived from Quaternary alluvium which in many places has been transported and reworked as a result of changes in drainage patterns over time. This has resulted in varying soil texture types occurring in both top and sub-soil zones with a variety of geometries that cannot be assumed on a broad-scale. In recognition of this fact, site soils assessments should form part of all future reports. This approach provides for a representative assessment of the respective area's soils and enables the determination of the land capability and hydraulic loading required for the development (eg LTAR, DIR/DLR).

The soil assessment should be able to provide information on the suitability of different methods of wastewater disposal based on soil textures and hydraulic properties of the actual soils in the area of interest. In order to develop an appropriate level of confidence in the results presented, the details, locations and results of soil sampling and hydraulic property testing should accompany any report submitted.

Site specific data relating to soil properties must be utilised for any method employed as this is the media through which any potential impacts or mitigation caused by wastewater disposal must pass through. Any assessment that does not include this data collection and input carries with it an inherent risk of inaccurate prediction of effluent transport and behaviour and may even accentuate the utilisation of inappropriate system and disposal methods.

(6) Water tables in tidal areas are to be determined to the minimum accepted tidal water table in seaside areas that experience tidal influence (for example Cungulla, Magnetic Island, Cleveland Palms). The minimum water table level is taken to be the contour level of 2.25 m (Australian Height Datum). This allows for an astronomical tide of 4.1 m. Therefore, to determine vertical separation distances, this level must be taken into consideration. A site and soil evaluation may indicate the presence of a higher water table. This, along with wet weather water tables, shall be taken into consideration.

To assist applicants, the following report structure can be used in preparing an On-site sewerage disposal report, when read and applied in conjunction with relevant provisions found in AS/NZS1547:2000, including procedures outlined in sections 4.1.3.4 and 4.2.3.2 of AS/NZS1547:2000

(a) Site and soil evaluation report (all references are to AS/NZS1547:2000)

(i) Details of the site and soil evaluation personnel confirming:

- past experience of site and soil evaluation assessments;
- successful completion of an accredited training program (if applicable);
- knowledge of the regulatory assessment requirements; and
- professional liability for the interpretation of, conclusions drawn from and recommendations made as a result of the site evaluation.

(ii) desk top study as per relevant section of 4.1A2;

(iii) site and soil check as per relevant section of 4.1A3;

(iv) soil assessment items as per relevant section of 4.1A4; and

(v) evaluation of results as per relevant section of 4.1.4.

(b) Design report

(i) Details of land application facility designer confirming:

- past experience designing on-site sewerage disposal facilities;
- successful completion of an accredited training program;
- knowledge of the regulatory design requirements; and
- professional liability for the interpretation of, conclusions drawn from and recommendations made as a result of the design.

(ii) Documentation of the design process, including:

- system selection as per section 4.2A4;
- soils and LTAR/DLR values as per section 4.2A5; and
- design flows as per section 4.2A6.

(iii) Reserve area as per section 4.2.3.4,

(iv) Distribution system as per section 4.2.3.6,

(v) Nutrients as per section 4.2.3.6

(vi) Rainfall surface flow control as per section 4.2.3.7

(vii) Land use activity as per section 4.2.3.8

(viii) Site plan

- north point;
- full property description;
- name of person who evaluated the site;
- scales of 1:200 or 1:500;
- predominant wind direction;
- location, height, density and type of vegetation;
- access roads, tracks, vehicle manoeuvring areas, storage areas;
- test boreholes/pits;
- fall of land;
- setbacks;
- water supply bores, top banks of water courses, lakes, ponds, unlined stormwater drainage channels, dams;
- buildings, fences, property boundaries, pedestrian paths, walkways, recreation areas, retaining walls, in-ground swimming pools, in-ground potable water tanks; and
- primary and reserve land application areas.

It is the designer's responsibility to carry out their duties in accordance with the AS/NZS 1547:2000, the *Queensland Plumbing and Wastewater Code* (where relevant), and any other relevant legislation and supported by good engineering practice.

(7) Design flows

Any consideration of design flow should utilise guideline appendices of AS/NZS1547:2000 and incorporate allowance for peak usage and occupancy.

(8) System selection and land application design

The selection of the appropriate wastewater treatment system and disposal method should be based on the individual characteristics of the lot in question and any reporting recommendations based on investigation (as outlined in this policy sub-section). The assumption of a single type wastewater system being utilised across all lots in any subdivision application is not recommended.

Any system proposed for a lot should comply with all relevant Codes and Standards such as AS/NZS1546.1 and the *Queensland Plumbing and Wastewater Code*. Water balance and nutrient loadings need to be considered prior to the determination of appropriate lot sizes.

The assessment of soil properties (texture and hydraulic) assists in determining ideal rates of application and

also the suitability of proposed methods of disposal. The Queensland Water Recycling Guidelines (2005) provide indicative concentrations of total nitrogen (TN), total phosphorous (TP) and total dissolved solids (TDS).

It is recommended that a two stage approach be undertaken for supporting the final determination of lot sizes in a given subdivision and which is based on the suitability of the soils to certain methods of wastewater disposal, as well as any requirements of Townsville City Plan, including any applicable overlay provisions. The results of the site and soil assessment inform the selection of an appropriate system and subsequent land application design

SC6.4.3.10.3 Design considerations

(1) Set back distances

Set back distances are to comply with the requirements of the Queensland Plumbing and Wastewater Code and AS/NZS1547:2000.

Council may consider viral die off and nutrient decay calculations as a means of justifying a reduced set back distance from the following features:

(a) top bank of an intermittent water course; or

(b) easement boundary of an unlined open stormwater drainage channel or drain.

The consideration of reduced setback distances are subject to the requirements of the Townsville City Plan, which may require increased setback distances to watercourses or in some instances, development to be placed outside of riparian or wetland buffer areas as detailed in the Water resources catchment overlay code or the Natural assets overlay code. Furthermore, it will be necessary for applications to demonstrate that there will be no adverse environmental impacts, taking into consideration cumulative impacts from other development, to place infrastructure near a watercourse, wetland or open stormwater drainage channel/drain.

SC6.4.3.11 On-site water supply

SC6.4.3.11.1 Introduction

(1) Objectives

(a) The objective of this sub-section is to outline the requirements for the design and supply of potable water and non-potable water where development is located outside of a reticulated water supply area.

(b) Specifically, the following overall objectives are sought to be achieved as identified by the Townsville City Plan:

(i) to ensure adequate water supplies are available for people and fire-fighters to defend buildings from bushfires and to suppress other property fire;

(ii) ensure that development is provided with a reliable and safe supply of on-site water supply when located outside of a reticulated water supply area;

(iii) ensure that on-site water supply facilities are efficient;

(iv) ensure that on-site water supply facilities do not compromise environmental values;

(v) ensure that on-site water supply facilities are not subject to sources of contamination; and

(vi) ensure the safety and wellbeing of residents and the protection of water quality and other environmental values.

(2) Scope

(a) This sub-section sets out the requirements for development located outside of reticulated water supply area for the provision of potable and non-potable water supply facilities.

(b) This sub-section contains guidelines and statements for the design of potable water supply facilities and non-potable supply, including for fire protection.

(c) This sub-section may be applied to areas where a reticulated water supply exists and an alternative supply is sought to supplement the reticulated supply.

(3) Applicability

(a) This sub-section is to be used for assessment against the following codes where development is required to provide water supply outside of a reticulated water supply area:

(i) 6.6.1 Rural zone code (Cungulla Precinct);

(ii) 8.2.2 Bushfire hazard overlay code;

(iii) 8.2.9 Water resource catchment overlay code;

(iv) 9.2.3 Reconfiguring a lot (subdividing one lot into two lots) and associated operational work code;

(v) 9.4.4 Reconfiguring a lot code;

(vi) 9.4.5 Self-assessable works requirements code; and

(vii) 9.4.7 Works code.

(4) Terminology

Available roof area	means the whole of the roof area of every building on the lot included in a development application
Blackwater	is defined as: - the waste discharged from the human body into a toilet; and - the waste used for discharge.

Drinking water or potable water	water of a quality suitable for drinking, cooking and personal bathing. The standards that define potable water are described in the Australian Drinking Water Guidelines.
Drinking water supply system (water supply system)	all aspects from the point of collection of water to the consumer (can include catchments, groundwater systems, source waters, storage reservoirs and intakes, treatment systems, services reservoirs and distribution systems, and consumers).
Greywater	means wastewater from a bath, basin, kitchen, laundry or shower), whether or not that wastewater is contaminated with human waste.
Greywater treatment plant	a treatment plant, approved and installed under the *Plumbing and Drainage Act 2002.*
Hazard	a biological, chemical, physical or radiological agent that has the potential to cause harm.
Non-potable water	water that is not of drinking water quality, but which may still be used for other purposes, depending on its quality.
On-site water supply	is defined as a private, non-mains supply, such as water that is not provided as a reticulated council supply.
Required fire-fighting capacity	the volume of water required to comply with Part E of the *Building Code of Australia*.
Service reservoir/tank	a storage for drinking water, generally within the distribution system, used to meet fluctuating demands, accommodate emergency requirements and/or equalise operating pressures.

(5) Reference and source documents

(a) Legislation
Food Act 2006
Plumbing and Drainage Act 2002 (and associated Regulations)
Public Health Act 2005
Water Act 2000
Water Supply (Safety and Reliability) Act 2008
Public Health Regulation 2005
Standard Plumbing and Drainage Regulation 2003

(b) National codes and standards
Australia New Zealand Food Standards Code
Building Code of Australia
National Construction Code Volume 3 – Plumbing Code of Australia

(c) Queensland government
Queensland Development Code
Queensland Plumbing and Wastewater Code
Department of Health - Guidance on use of Rainwater tanks
Department of Housing and Public Works – *Rainwater tanks. A Guide to keeping your tank safe*

(d) Standards
AS/NZS 5667.1:1998: *Water quality - Sampling - Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.*
AS/NZS 3500:2003: *Plumbing and drainage (Set)*
AS/NZS 4766:2006: *Polyethylene storage tanks for water and chemicals*
AS/NZS 3735:2001: *Concrete structures retaining liquids*

(e) Standard Australia
NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council,* National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
Water made clear: A consumer guide to accompany the Australian Drinking Water Guidelines 2004. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra
HB230-2008 *Rainwater tank design and installation handbook, S*tandards Australia

SC6.4.3.11.2 On-site water supply general requirements

(1) This section outlines the on-site water supply systems suitable for use in the Townsville local government area.

(2) The on-site systems may be used in combination with one another to deliver a reliable supply of potable and non-potable water.

(3) Any on-site water supply should use water efficiently and minimise the whole of lifecycle cost for that infrastructure.

(4) Any on-site water supply should not adversely affect environmental values.

(5) Unless water is known to be of potable quality (e.g. from a drinking water supply system) it should be regarded as non-potable and used appropriately (fire fighting, irrigation of landscaping).

(6) On-site water supplies must not be subject to hazards and hazards must be managed appropriately to ensure a safe supply is available at all times for potable use in addition to fire-fighting requirements.

(7) Water supplied to the public must not constitute a public health risk

(a) Under the *Food Act 2006*, food businesses must ensure water used in their business (which may include roof harvested rainwater) complies with the requirements of the *Australia New Zealand Food Standards Code*, Standard 3.2.3.

(b) The *Australia New Zealand Food Standards Code*, Food Safety Standard 3.2.3 – *Food Premises and Equipment*, requires food businesses to use potable water for activities conducted on the premises. Where businesses do not have access to a potable water source, they must be able to demonstrate that the water is safe to use. Non potable water may only be used when it will not affect food safety i.e. the washing of non-food contact surfaces such as floors.

(c) The water must be of a potable quality unless the food business can demonstrate that the non-potable water will not adversely affect the safety of the food handled by the business.

(d) Food businesses must ensure the water they use for food related activities conducted at their premises is potable (safe for human consumption).

These activities include:

(i) washing food or ingredients;

(ii) cooking;

(iii) adding to food and drinks;

(iv) making ice;

(v) cleaning of food contact surfaces;

(vi) cleaning of food containers and utensils; and

(vii) personal hygiene.

(8) Council may set conditions of approval dealing with the following matters (but not limited to):

(a) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;

(b) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;

(c) maintenance of safe access to bores for inspections by council staff; and

(d) on-going monitoring, including:

(i) provision of a report recording ground water levels each month for 6 months; and

(ii) regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

(9) The following on-site water supplies are permitted (SC6.4.3.11.12 Water resource catchment overlay):

(a) rainwater harvesting (tanks);

(b) groundwater (bore water);

(c) surface water;

(d) carted drinking water;

(e) recycled water (reclaimed water); and

(f) greywater (non-potable from manual supply service).

(10) The following on-site water supplies are not considered appropriate for supply:

(a) recycled carted water; and

(b) greywater – (potable supply from permanent structure).

SC6.4.3.11.3 Water quality for on-site supplies generally

(1) The *Australian Drinking Water Guidelines* (ADWG) are the standards for potable water for use in the Townsville area. SC6.4.3.11 Attachment A sets out the potable drinking water requirements to be achieved.

Editor's note—the current *Australian Drinking Water Guidelines* cover a range of topics, including management of water supply systems, water quality (microbiological, physical, chemical and radiological) and monitoring.

(2) The following information should be used in undertaking testing of water quality.
References:

(a) AS 5667.1:1998.

Editor's note—physical and chemical samples:
Use a bottle supplied by the laboratory or thoroughly clean a plastic bottle about one litre in volume (ie. Soft drink bottle), then rinse several times with the sample before filling.

Transport the sample directly to the laboratory on the day of sampling if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's note—microbiological samples
Collect sample in sterile bottle provided by the laboratory, or in a 250 ml sterile container which can be bought from a Pharmacy. Do not rinse out the bottle with sample.

Remove cap, fill bottle leaving a small air space, then replace cap without touching the insides of the cap or bottle.
Transport the sample directly to the laboratory on the day of sampling if possible, otherwise refrigerate and deliver within 24 hours of collection.

DO NOT FREEZE SAMPLE.

Editor's note—pumped supply:
Pump for four hours to remove stagnant water from the bore hole and pipes before sampling.

If the bore runs dry before four hours are up, let it stand until it can be pumped again, then pump again until dry, repeat this process once more, then sample.

Note pumping time, type of pump, type of casing, depth, age of bore, etc. (this information can be useful to the laboratory for

interpretation of results).

SC6.4.3.11.4 Rainwater harvesting (tanks)

Editor's note—HB 230:2008 Rainwater tank design and installation handbook—provides practical information for the collection, use and storage of rainwater.

(1) A tank installed for a building must have sufficient collection and storage capacity to provide an acceptable contribution for its external and/or internal connections and their associated water use, having regard to the following:

(a) the local rainfall pattern;

(b) the roof catchment area; and

(c) the area available for the location of the rainwater tank.

(2) Installed tanks must ensure they comply with the requirements of the *Public Health Regulation 2005*. The legislation stipulates a "relevant tank"— a tank or other receptacle that is used or intended to be used for holding or storing water — must have at every opening:

(a) mosquito-proof screens that:

(i) are made of brass, copper, aluminium or stainless steel gauze;

(ii) have a mesh size of not more than 1 mm;

(iii) are installed in a way that does not cause or accelerate corrosion; and

(iv) stop mosquitos passing through the openings; or

(b) flap valves that, when closed, stop mosquitoes passing through the openings.

(3) A tank must have suitable measures to prevent:

(a) insects (mosquitoes) and other fauna from breeding inside the tank;

(b) if a wet system supplies the tank— insect (mosquito) and fauna-proofing for each pipe opening that supplies the tank, with screen mesh with an aperture of no greater than 1 mm; and

(c) vermin from entering the tank.
The following are acceptable:

(i) screen mesh with an aperture of no greater than 1 mm, made of brass, copper, aluminium or stainless steel gauze to prevent the intrusion and breeding of insects (mosquitoes) and other fauna;

(ii) flap valves at each opening of the tank; and

(iii) a vermin trap.

(4) A tank must have suitable measures to prevent contaminants from entering the tank especially having regard to the potential nature and level of contaminants within the locality and on-site uses.

A tank must have a minimum of 20 litres of first flush from the roof catchment area so that potentially contaminated rainwater is diverted and discarded before entering the tank where the tank is connected to:

(a) a shower or wash basin; or

(b) a swimming pool; or

(c) kitchen or hot water service; or

(d) another fixture required by a local government in a local planning instrument.

Editor's note—for those with a rainwater supply, it is important to check regularly to ensure that first-flush devices are working properly. It is also important to keep the roof catchment clean — bird droppings, peeling paint and dirt on the roof are the biggest sources of contamination. Guttering should be cleared regularly and overhanging branches should be kept to a minimum, because they can be a source of debris and allow birds and small animals access to the roof.

Editor's note—HB 230:2008 *Rainwater tank design and installation handbook*—provides practical information for the collection, use

and storage of rainwater.

(5) The occupier of a place where a rainwater tank is installed (or if there is no occupier, the owner of the premises) must ensure that the tank is maintained at all times to ensure a reliable supply.

(6) Where in a reticulated water supply area, water from a tank must not contaminate the potable water within a reticulated town water supply system. Where tank/s are installed, the reticulated town water supply system is protected from the potential of back-flow by the installation of:

(a) a back-flow prevention device that complies with AS/NZS 3500:2003; or

(b) for a tank, a dual-check valve with an atmospheric port.

(7) A tank stand and the support base of a tank must be capable of withstanding loads likely to be imposed. The base of the tank is well supported by a ground treatment in accordance with the manufacturer's specifications and standard drawings for that tank.

(8) Where a premises is providing tank water supply and required to also install a static water supply for fire fighting purposes, applicants will need to also comply with SC6.4.3.11.11 Requirements for fire fighting.

(9) Where a tank is installed to supply water to the plumbing fixtures, the tank must have appropriate and clear signage to warn that the water in the tank is suitable for drinking.

(10) All water tank overflows are to be connected to or able to discharge to a lawful point of discharge.

(11) Development proposing to utilise a rainwater tank must determine that adequate rainwater volume can be collected to meet the annual water demand.

Editor's note—calculating the maximum amount of rainwater that can be collected from the available roof area can be completed using the following formula.

run-off (litres) = A x (Rainfall – B) x roof area

"A" is the efficiency of collection and values of 0.80-0.85 (that is, 80-85% efficiency).

"B" is the loss associated with absorption and wetting of surfaces and a typical value of 2 mm per month (24 mm per year) can been used.

"Rainfall" should be expressed in mm and "roof area" in square metres (m^2).

For example, the run off from a 200 m^2 roof which receives 750 mm of rain per year, with an efficiency of collection of 80% (A = 0.80) and loss of 2 mm per month (B = 24) would be: Run-off = 0.8 x (750-24) x 200 = 116,160 Litres (or 116.2 kL).

(12) If the maximum volumes are less than the annual water demand, then either the catchment area will need to be increased or water demand will need to be reduced or an alternative and supplementary source will need to be nominated.

SC6.4.3.11.5 Groundwater (bore water)

(1) In Queensland, the Department of Natural Resources and Mines (DNRM) manages access to and use of underground water.

The right to take underground water is either established under the *Water Act 2000* (the *Water Act*) or granted under a "licence" or "water allocation". The drillers' licensing arrangements under the *Water Act* ensure all water bore drillers are properly skilled and that their work meets minimum standards.

Editor's note—information on water bore drillers and bore drilling requirements can be found on the DNRM website.

(2) Each lot created or use proposed is to be provided with a proven and available long term sustainable resource of potable groundwater, properly licensed as required, supplemented where practical, with an alternative supply such as rainwater.

Editor's note—water from a deep, encased and well maintained bore and/or from a confined aquifer will generally not need treatment after addition to a rainwater tank, but the chemical quality of some groundwater is not suitable for drinking.

(3) Only groundwater that is compliant with values cited in the *Australian Drinking Water Guidelines* (ADWG) should be used.

Editor's note—key health parameters for groundwater are arsenic, nitrate, fluoride and health-related heavy metals. Salinity is an important aesthetic parameter.

Editor's note—groundwater from shallow or unconfined aquifers is readily contaminated by agricultural, industrial or urban activities and generally should not be used as a source of drinking water unless it has been recently tested for microbial and chemical quality and is compliant with guideline values cited in the ADWG.

(4) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all ground water achieves the guideline values cited in the ADWG. Methods used to treat groundwater must be certified by a registered professional in the field of ground water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with fire fighting water).

(5) Any proposed ground water extraction, when combined with existing levels of extraction in the area, is to be sustainable on both a local and regional level. The average annual demand for ground water must not exceed the average long term recharge in the area.

To demonstrate compliance with the above criteria, council may request that a Groundwater resource assessment be undertaken by a qualified hydro-geologist.

A Groundwater resource assessment should include, at a minimum:

(a) consideration of information available from previous studies and new information collected as part of the investigation;

(b) consideration of the maximum ground water extraction rate attainable, proposed pumping rates, land slope, flooding, drainage, geology, ground water recharge potential, local experience, proximity to and protection from potential contaminants, soil characteristics (colour, texture, structure, permeability and presence of rock), percolation testing, direction of ground water flow, seasonal fluctuation in ground water levels, and the current degree of district and local extraction;

(c) a comparison between the average annual ground water demand and the average annual ground water recharge, on a local and a district level;

(d) the results of drilling and testing of an adequate number of bores, supplemented with ground water modelling where necessary, to ensure a thorough and accurate investigation of the ground water resources available. Bores are required for two purposes, namely, for interference testing and for regional ground water level observation;

(e) results of independent and simultaneous pumping of test bores, and measurement of water levels to check for localised pumping interference with any existing and proposed neighbouring bores. Pumping tests should be undertaken for a minimum of 8 hours duration and pumped at the rate the pump is intended to be operated in the proposed development. The available draw down in neighbouring bores during the test must not be reduced by greater than 20% when compared to available draw down in these bores prior to pumping;

(f) if bore interference is found to be greater than 20% of the available draw down, supplementary pumping tests must be undertaken to measure the effect of reducing either the pumping rate, the duration of pumping, or both, until the resulting interference is within this level;

(g) water quality testing to determine whether extracted water will be of a potable quality, including where relevant, written advice from a registered professional in the field of ground water quality. Appendix A outlines appropriate standards for bore water testing (potable uses);

(h) investigation of previous land uses and the possibility of contamination of aquifers to determine the quality of ground water;

(i) details of the pump type, capacity and pumping curve for bores; and

(j) preparation of a report detailing all the studies and works undertaken, the resource assessment findings and assumptions made.

(6) Methods used to treat groundwater to meet health and aesthetic guidelines must be certified by a registered professional in the field of ground water quality.

(7) For licensing and construction requirements for underground water the local DNRM office should be consulted.

Editor's note—before considering sinking a water bore refer to fact sheet Drilling for water on the DNRM website.

(8) The bore shall be constructed to ensure that contamination of the groundwater source does not occur, either during construction or operation.

(9) The bore head shall be mounded to prevent ponding and stagnation of water around the bore to eliminate the possibility of mosquitoes breeding and problems caused by flies or odour.

(10) All drainage shall be directed away from the bore.

(11) Bores nominated to supply potable water supply are to be appropriately site away from sources of contamination, including on-site sewerage facilities. For further details relating to on-site sewerage facilities, refer to the sub-section SC6.4.3.10 On-site sewerage facilities for non-sewered properties.

(a) On-site sewerage treatment facilities shall be placed as far away as possible from ground water bores used for potable groundwater supply. Minimum allowable distances are to be in accordance with the *Plumbing and Drainage Act 2002* and relevant codes and regulations established pursuant to the *Plumbing and Drainage Act,* which are applicable at the time of making application for development approval.

(b) New land parcels or existing land within non-sewered areas must provide evidence prior to the sealing of the plan of survey or the commencement of the use that an appropriate on-site sewerage treatment facility can be designed and accommodated within each proposed lot in addition to the potable supply of ground water.

SC6.4.3.11.6 Surface water

(1) Surface water includes water derived from dams, creeks, rivers and streams.

(2) The use of surface water is generally considered permissible only when in a non-urban zone (excluding rural residential).

(3) Surface water supplies are more prone to contamination from sources such as animal and human waste and algal blooms.

(4) Due to the potential for contamination, surface water is not recommended as a source of drinking water unless additional treatment processes such as filtration and disinfection are in place.

(5) Unless drinking water quality can be assured through disinfection and routine testing, surface water should be utilised for purposes other than drinking such as irrigation and toilet flushing and fire fighting. Treatment may still be necessary for non-drinking uses.

(6) Water subject to potential contamination from human or livestock waste, such as dams, rivers and creeks, can contain a wide range of pathogenic organisms including chlorine-resistant Cryptosporidium. Water of this type may not be suitable for drinking even after disinfection.

(7) Surface water that is protected from human and livestock waste can be used and should be demonstrated.

(8) Surface water must be able to provide a reliable year round supply of water for both potable and fire-fighting purposes and should be demonstrated.

(9) Potable water quality:

(a) When used, pumped or captured surface water should be added to a storage tank in one action, then treated and allowed to stand for at least one hour before use.

(b) Where surface water is to be the primary source of a potable water supply, the quality of water extracted is to be of a potable quality and meet aesthetic, chemical and microbial requirements.

(c) Water treatment devices/technologies to improve the aesthetic values, microbial and chemical quality of water are to be installed to ensure that all surface water achieves the guideline values cited in the ADWG.

(d) Methods used to treat surface water must be certified by a registered professional in the field of water quality and must be installed and commissioned prior to occupation of the use (except where water supply is combined with fire fighting water).

(10) Each surface water pump point must be metered (or where there are multiple, collectively recorded), with the meter maintained, read and the volume pumped recorded on a quarterly basis.

(11) Any proposed surface water use is to be sustainable on both a local and regional level. The average annual demand for surface water must not exceed the average long term recharge in the area to ensure ground water supplies are maintained.

(12) To demonstrate compliance with the above criteria, council may request that a groundwater resource assessment be undertaken by a qualified hydro-geologist.

SC6.4.3.11.7 Carted drinking water

(1) The use of carted drinking water supply is only used as a supplementary/secondary supply measure to ensure a long term and sustainable supply of water to a premises.

(2) Water cartage is necessary in some instances to supplement existing rainwater supplies.

Editor's note—if rainwater collection is limited by the size of storage tanks or roof catchment areas or a lack of rain, drinking water supplies may need to be augmented with carted water.

(3) Carted water is not be used as a sole source of supply except as a temporary use.

(4) Carted water is to be stored in water tanks as outlined in SC6.4.3.11.8 Rainwater harvesting tanks.

(5) Drinking water is recognised as a food. Water carters/carriers may need to be registered as a food business if the supply of additional potable water is needed.

(6) When using carted water, it is advisable to ensure the water carter can provide evidence that water supplied will be safe to drink. This evidence could include: any authorisations issued for the purpose of supplying drinking water; the identity and quality of the source water; proof that tankers used are suitable for the purpose of carrying drinking water (for example, not likely to have carried other materials that would contaminate drinking water).

(7) Ensure that carted water supplied for drinking is disinfected at the point of supply (such as the rainwater tank) as this provides protection against contamination introduced during filling of the water tanker and during transport to the point of supply.

SC6.4.3.11.8 Recycled water

(1) Recycled water is any water that has been used at least once and then supplied for reuse, either treated or untreated. Without appropriate treatment, recycled water may contain a range of contaminants.

Editor's note—for example, water used for the final rinse in a commercial laundry is only lightly contaminated and thus may be used again, untreated, for the first wash cycle. On the other hand, sewage must be treated at a sewerage treatment plant before it can be recycled for any purpose.

Recycled water from sewerage treatment plants is put into different classes depending on its microbiological quality. These classes range from Class A+ (the highest) to Class D (the lowest).

(2) The use of recycled water can reduce the demand on alternative supplies that are potable.

(3) Recycled water can be used where it is demonstrated that it is safe to do so and does not adversely affect the environment, adjoining properties or constitute a public health risk.

(4) Recycled water is not to be used for potable water, food preparation or topping up of pools or spas, but may be appropriate for private and commercial purposes such as irrigation and possibly toilet flushing, car washing and dust suppression (or similar), including for fire-fighting.

(5) Recycled water when used for watering plants and lawns (source of irrigation) can be an effective means of saving water provided some sensible precautions are undertaken, including watering several locations to

prevent salts and other contaminants from accumulating in the soil and rotation of irrigation using mains or rainwater to help flush salts from the soil.

(6) Signage must be erected at sources of recycled water use to advise that the water is not suitable for drinking.

(7) The static storage of recycled water must be separately stored from other sources of potable water.

(8) The quality of the water will determine the permitted uses and businesses using recycled water are required to obtain approval and adhere to any specified conditions.

(9) The storage of untreated water for more than 24 hours (bacteria and organic contaminants in water will cause it to turn septic and produce strong and offensive odours).

(10) Recycled or untreated water is not allowed to pool or run-off onto other properties, into watercourses, public space or the stormwater system.

SC6.4.3.11.9 Non-restricted water supply risks

(1) Selecting an alternative supply, consideration must be given to the potential health concerns, sensible practices and disinfection options available as well as the location, rainfall patterns, supply required and overall cost (initial and maintenance).

Editor's note—advice on the use of on-site water supply:

- ensure water is collected from the most suitable and safest source available;
- determine what microbial or chemical contaminants are in the surrounding environments and what effects they may have on the water used;
- treat water if necessary to make it safe. This could involve the removal of solids, chemicals and microorganisms;
- ensure collection sources for rain water such as roofs and gutters are kept free of extraneous matter such as leaves and bird droppings;
- ensure a first flush system is used for all rain water collection to ensure that the first water collected during a rain fall event is discarded thereby reducing the amount of microorganisms entering the tank;
- ensure tanks which are used to store water are cleaned out regularly to remove any build up of sludge or debris. This reduces the potential risks of chemical or microbiological contamination of the water;
- where water is supplied by a water carrier, it should be sourced from a potable water supply. The carrier should have hoses which are in good operating condition and are capable of being effectively cleaned and sanitised. The water carriers should only used for the purpose of carrying potable water, the operator should be able to provide documentation showing this;
- ensure all equipment that is used to collect and store the water is suitable and well maintained;
- ensure all equipment used in the collection and storage of water is well positioned to minimise the risk of contamination;
- ensure all water storage equipment is vermin proof; and
- monitor the water regularly to ensure that the conditions of the water have not changed and any treatments being undertaken are appropriate to ensure its safety. It is important to remember that some water sources such as bore water may have a very high mineral load. While this may not affect the safety of the water, it may affect the quality, flavour and hardness and have an undesirable effect on the equipment that is used. It is recommended that water is tested by an accredited laboratory on a regular basis to ensure the steps that have been put in place are still adequate to maintain the safety of the water.

  For advice on what constitutes good quality water see the *Australian Drinking Water Guidelines 2011* available from the National Health and Medical Reserch Council's website.

SC6.4.3.11.10 Requirements for non-potable water supply

(1) The *Plumbing Code of Australia* requires that a non-drinking water supply:

  (a) must only be connected to outlets clearly identified for non-drinking use and must be limited to the uses specified in the Code; and

  (b) is not to have a cross connection with a drinking water service.

Editors note—if non-potable water is adequately treated, its quality will improve and it can be used for a wider range of purposes. Some examples of non-potable water used are:

- class A recycled water from a sewage treatment plant used for dust suppression, car washing, landscape irrigation or irrigation of sporting ovals;
- quarry water used for dust suppression and landscape irrigation;
- swimming pool backwash water used for toilet flushing;

- agricultural waste water used for crop irrigation; and
- creek, dam, and river water used for dust suppression.

SC6.4.3.11.11 Requirements for fire-fighting supply

Editor's note–fire fighting uses large amounts of water. If fire fighters need to leave a site to obtain more water, that site will be undefended and may be damaged or lost. If fire fighters don't have access to adequate water supplies at a site they may not even attempt to defend the site because it will be unsafe.

Editor's note - Where the building Code of Australia and applicable Queensland Building Codes provide standards for the installation of fire fighting appliances, the provisions of those standards shall prevail.

The purpose of this section is to outline adequate and accessible water supplies required for fire-fighting purpose and to ensure that they are available for people and fire-fighters to defend from fires. Suitable water supplies and appliances shall be provided and easily accessible at all times.

(1) The minimum dedicated amount of water for fire-fighting purposes is 10,000L of stored (static water) for a property less than 2500 square metres in area and at least 20,000L of stored (static water) for property greater than 2500 square metres. The amount of stored static water must be available and accessible at all times.

Editor's note—some development may require more water to comply with the Building Code of Australia or to ensure that an adequate supply to available to service a particular development where that development is likely to require increased fire fighting capacity.

(2) Fire-fighting water supply needs to be provided and easily accessible at all times, although it does not need to be drinkable (potable).

(3) A dedicated water tank for the storage of fire-fighting water is the accepted standard. Where alternatives are provided, it should be demonstrated that the water supply will be available and accessible at all times.

(4) Where not using a dedicated fire fighting storage tank, the outlet for the internal fixtures is located above the point at which the tank will contains the dedicated amount for fire-fighting purposes.

(5) Fire-fighting water supplies (including pipelines, hydrants, fittings and storages) are:

- (a) provided before building construction commences;
- (b) designed, located and fitted to ensure reliablity during a fire (eg: polypipes are buried or shielded - refer to the National Plumbing and Drainage Code AS3500);
- (c) properly maintained and accessible at all times by emergency vehicles;
- (d) tanks must be located so that a vertical clearance of 4m to overhanging obstructions is achieved (vegetation, power lines);
- (e) a cleared area on either side of the tanks, a minimum of 6m, to allow fire-fighting vehicles and crews access to the tanks; and
- (f) tanks should avoid be located on slopes, including access to, greater than 12 per cent.

Editor's note: A fire truck has to be within about 3 metres from a water supply to be able to pump from it.

Editor's note: Plastic tanks dedicated for fighting purposes are not recommended, however if they are submerged, they may be acceptable.

(6) At least one tank is within 100m of the building which has fire brigade tank fittings. If the tank is underground, it has an access hole of 200mm (minimum) to allow access for suction lines.

(7) A water supply for fire fighting purposes must be clearly marked and identified by emergency services and others. Where a dedicated tank for storage of fire fighting water is used, the tank must have appropriate signage to warn that the water in the tank is not suitable for drinking.

Editor's note—The following is applicable for development within the Water resource catchment overlay map OM-09 (Schedule 2 of Townsville City Plan) and where development is to address the assessment criteria of the Water resource catchment overlay code found in Part 8.2.9 of the Townsville City Plan.

SC6.4.3.11.12 Water resource catchment overlay

(1) To demonstrate the protection of water quality, ecological values and other environmental values, applicants may be asked to provide groundwater resource assessment where the proposed development is to use any ground resource as outlined in SC6.4.3.11.5(5).

(2) No on-site water supply infrastructure, including underground pipe, is to be located such that it will not change the physical integrity of waterways, wetlands, lakes, springs and riparian areas.

(3) On-site water supplies may only be from harvested rainwater (tanks) or ground water (where undertaken and demonstrated sustainable by a ground water assessment) and may be supplemented by carted water.

(4) Recycled water or greywater is not to be used to protect the water catchment from potential contamination.

(5) The capture of ground surface water is not permitted.

(6) A ground water level observation bore is to be installed adjacent to the site. The observation bore must be installed remote from all production bores to ensure there is no local interference to ground water levels at the observation bore.

(7) Council may set conditions of approval dealing with the following matters:

- (a) a maximum volume of ground water extraction for the development based on the findings of the groundwater resource assessment study;
- (b) annual review of the effect of the authorised level of extraction in light of regional ground water level data collected from all relevant observation bores in the district. If regional ground water levels are declining, council may limit the previously authorised level of extraction, in terms of pumping rate or duration or both;
- (c) maintenance of safe access to bores for inspections by council staff; and
- (d) on-going monitoring, including:
  - (i) provision of a report recording ground water levels each month for 6 months; and
  - (ii) regular testing of ground water quality (e.g. for nitrates and bacteria) if the ground water is to be used for potable purposes. If levels are found to be above the relevant drinking water quality standard, provision for an alternative potable source of water will be required.

(Source) NHMRC *Australian Drinking Water Guidelines 2011*

Physical and chemical tests	Health	Aesthetic
PH	n/a	6.5 - 8.5
TDS (mg/L)	n/a	<600
Hardness (mg/LCCO3) (incl Ca and Mg)	n/a	200
Aluminium (mg/L)	0.1 (dialysis patients)	0.2
Cadmium (mg/L)	0.002	n/a
Copper (mg/L)	2.0	1.0
Iron (mg/L)	n/a	0.3
Lead (mg/L)	0.01	n/a
Manganese (mg/L)	0.5	0.1
Zinc (mg/L)	n/a	3.0
Sodium (mg/L)	n/a	180
Chloride (mg/L)	n/a	250
Fluoride (mg/L)	1.5	n/a
Nitrate (mg/L)	50	n/a
Sulphate (mg/L)	500	250

SC6.4.3.12 Constructed lakes

SC6.4.3.12.1 Introduction

(1) Purpose

The purpose of the policy sub-section is to provide standards, advice and guidelines for the design, construction and maintenance of constructed lakes in the Townsville area.

Well designed and maintained lakes can add considerable value to the urban environment including improved visual amenity, recreational opportunities, and wildlife habitat.

Lakes built in the dry tropics region of Townsville operate under a range of challenging climatic conditions, and maintaining a healthy water body can be difficult to achieve. The extended dry season combined with high rainfall events during the wet season mean that lakes often undergo rapid changes in state. A healthy water body can very quickly develop poor water quality and algal blooms that are unsightly and a potential threat to public health.

A number of constructed lakes have been built in and around the Townsville area and are experiencing numerous problems. These include:

(a) weed infestations (terrestrial and aquatic);

(b) excessive siltation;

(c) highly turbid waters;

(d) poor water quality;

(e) stratification;

(f) frequent algal blooms;

(g) fish kills; and

(h) limited maintenance access to remove built up silt, debris and weeds.

The burden of rectifying these lakes and satisfying community expectations has been incurred by council. As a consequence, council has identified a need to regulate the construction of lakes within the Townsville area.

Editor's note—Part 9.4.2 Healthy waters code of the Townsville City Plan provides assessment matters for applications involving lakes to specifically consider, in addition to other relevant sections of the Townsville City Plan.

(2) Objectives

This sub-section outlines the information that should be lodged with a particular development application if that development includes a lake.

Note—this sub-section is intended to provide the necessary guidance to design a sustainable healthy lake in the Townsville area. However, due to the challenging climatic conditions experienced in Townsville and the low number of examples of constructed lakes, this sub-section does not guarantee performance, and proponents should be aware that lake designs in accordance with this sub-section do not exempt the proponent from any necessary post construction maintenance and rehabilitation prior to handover.

(3) Principles

(a) Lake designs should aim to enhance biodiversity through revegetation, establish linkages with existing vegetation communities, and be supportive of public interaction and education. Lakes designs should provide enhanced landscape aesthetic and amenity for surrounding residents through the installation of improved passive recreation facilities i.e. paths and trails.

(b) The primary intent and range of uses for the lake is to be clearly defined by the proponent. The design intent must be accompanied by concept plans showing location and layout with respect to the development. Council will consider applications that are sustainable for their intended use, have no negative impact on surrounding environments and have been designed to minimise on-going maintenance.

(c) Uses preferred by council:

(i) The preferred lake with regards to long term sustainability, weed and water level management is a saline lake. Although less diverse than fresh water lakes, the operation of saline lakes are considered more robust for Townsville conditions.

(ii) Where fresh water lakes are proposed, the proponent should consider other alternatives such as heavily vegetated constructed wetlands which can provide open water views and water treatment benefits (refer to SC6.4.3.9 Water sensitive urban design guidelines). The proponent must clearly indicate how water level variations will be managed and proposed alternative sources of water to maintain lake water levels within acceptable variations.

(iii) The following are not encouraged by council:

(A) brackish lakes, including saline lakes that receive large freshwater inflows;

(B) lakes that receive untreated stormwater (i.e. stormwater that has not been treated to achieve the requirements of the SC6.4.3.9 Water sensitive urban design guidelines, or untreated overflows);

(C) lakes that are greater than 3 m in depth from wet season normal water level to finished bed level;

(D) lakes that impact on the sustainability and health of local aquifers or adjacent waterways;

(E) lakes that promote primary and secondary human contact activities such as boating, swimming, fishing and skiing;

(F) lakes that are used for flood management purposes;

(G) lakes for stormwater harvesting;

(H) lakes that result in the removal of existing significant vegetation;

(I) lakes that disturb natural waterways i.e. are located within the natural waterway alignment; and

(J) lakes that are primarily designed as a source of fill for development (i.e. to raise the level of the development site).

(d) Lakes should be constructed off-line to minimise any disturbance to the passage of aquatic fauna. Off-line systems facilitate lake draining and maintenance, if necessary. Should in-line diversion structures be proposed to supply constructed lakes (e.g. diversion weirs) suitable arrangements must be made to maintain connectivity (i.e. fish passage) and stream base flows or environmental flows.

(4) Terminology

Aquifer	A geological formation saturated with water that contains and transmits water.
Brackish lake	A lake that is permanently or temporarily in a state between fresh and saline. For the purposes of this policy salinity levels range between 1,000 – 15,000 mg/L. Brackish lakes include fresh water lakes with saline intrusions, groundwater dominated brackish lakes or saline lakes with freshwater input. Brackish lakes are not encouraged Townsville.
Constructed lake	An artificial body of permanent open water with recreational values with either an edge fringed with emergent macrophytes or a hard edge. While submerged macrophytes may occur throughout the water column, the dominant feature is open water. For the purposes of comparing with a constructed wetland, a lake is a water body that has greater than 30% of its area as open water (i.e. less than 70% as emergent macrophytes). For the purposes of this document, a constructed lake is considered to be a receiving water body, and does not contribute to the mandatory water quality improvements outlined by the State Planning Policy.

Constructed wetland	An artificial, shallow body of water that consists of heavily vegetated macrophyte zones and deep pools that support a range of aquatic vegetation across the majority of the waterbody area. A constructed wetland has less than 30% of its area as open water (i.e. more than 70% as emergent macrophytes). The inlet zone and deep pools of a constructed wetland may, for instance, resemble a pond, but the dominant feature of the system is the macrophyte zone, containing emergent marsh, rush and reed vegetation that can withstand wetting and drying cycles. The structure and function of constructed wetland systems means they can remove pollutants from stormwater runoff through enhanced sedimentation, fine filtration and biological uptake (refer to SC6.4.3.9 Water sensitive urban design guidelines).
Dam	An artificial body of permanent open water provided as a source of water. In the context of this policy a dam can be used as a storage mechanism to provide lake top-up water.
Environmental value	Values or uses of water that support healthy ecosystems and contribute to public benefit, safety and health. Environmental values are typically determined through a transparent process involving government, industry groups and the community. Environmental values require protection from the effects of pollution and discharges.
Fresh water lake	A lake that receives treated stormwater runoff inflows only and is not influenced by tidal inundations or saline groundwater intrusions. Typically salinity levels are less than 1,000 mg/L
Lake catchment	The area from which all stormwater runoff flows into a lake.
Macrophytes	Large, submerged or emergent aquatic plants.
Normal water level (NWL)	The normal operating water level of the lake system, as defined by the lake outlet.
Primary contact	With regards to constructed lakes includes recreational activities that result in the immersion of the body in the water. These include swimming, skiing, diving and wading.
Receiving water body	A water body that receives stormwater runoff from the catchment under consideration. For the purposes of this policy constructed lakes and natural wetlands are included in the definition of receiving waters, but constructed wetlands that have been built primarily for the purpose of stormwater (or wastewater) treatment, are not. Saline lake - A lake that is permanently in a saline state, whether tidally influenced or as a result of groundwater intrusions. Salinity levels are at or above 15,000 mg/L permanently.
Secondary contact	With regards to constructed lakes includes recreational activities that result in some contact with the water but not the immersion of the body in the water. These include boating and fishing.
Sediment	Solids (typically sand, silt and clay) that are transported by water and deposited from suspension. Considered to be a "contaminant" as defined in the *Environmental Protection Act* (1994) or any latest version of this act / legislation / documents.
Stormwater	Surface water that runs off land or structures on land following a rain event (including piped flows).

Stormwater quality improvement devices (SQIDs)	Devices used to improve the health of the receiving waters by reducing the amounts of pollutants that enter waterways from stormwater runoff. Types of SQIDs include trash racks, gross pollutant traps, sediment basins, constructed wetlands, bio-retention devices and swales.
Water body	A water body, whether constructed or natural, that has defined bed and banks. A water body can be fresh or saline and can be tidally influenced.
Waterway	Means any of the following (whether or not temporarily dry: river, creek, stream, gully or drainage channel, including the bed and bank, whether modified or not. This term includes waterways indicated on the Townsville City Plan maps.
Water quality indicators	A water quality indicator is a physical, chemical and biological property of water that can be measured in a quantitative way (e.g. pH, temperature). The resulting water quality data enables trends or changes in water quality to be determined over time.
Water quality objectives (WQOs)	Measurable values for the quality of receiving waters to ensure that Environmental Values of those waters are safeguarded.
Water sensitive urban design (WSUD)	WSUD is an approach to water management in urban areas with the "interactions between the urban built form (including urban landscapes) and the urban water cycle as defined by the three urban water streams being potable water, wastewater and stormwater" (Engineers Australia 2003).

(5) Reference and source documents

(a) Queensland state legislation

Editor's note—design of a constructed lake may also need to consider relevant Queensland state legislative requirements as listed below or any latest version of these acts/legislation/documents.

Coastal Protection and Management Act 1995
Coastal Protection and Management Regulation 2003
Environmental Protection Act 1994
Environmental Protection Regulation 2008
Environmental Protection (Water) Policy 2009
Fisheries Act 1994
Local Government Act 2009
Soil Conservation Act 1986
State Planning Policy
Planning Act 2016
Vegetation Management Act 1999
Water Act 2000

(b) Queensland state authorities

Department of Environment and Heritage Protection, *Queensland Water Quality Guidelines 2009*
Department of Environment and Heritage Protection, *Urban Stormwater Quality Planning Guidelines*, 2010
Department of Environment and Heritage Protection,. Urban Stormwater *Quality Planning Guidelines, December* 2010.
Department of Energy and Water Supply, *Queensland Urban Drainage Manual*
Department of Transport and Main Roads, Road Drainage Manual: *A Guide to Planning, Design, Operation and Maintenance of Road Drainage Infrastructure*, 2010

(c) Australian Standards

AS/NZS ISO 31000 *Risk management - Principles and guidelines*
AS 1289 *Methods of testing soils for engineering purposes*

AS 1547 *On-site domestic wastewater management*
AS 4419 *Soils for landscaping and garden use*

(d) Other

ANZECC, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Australian and New Zealand Environment Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand,
Brisbane City Council (BCC), *Sediment Basin Design Guidelines* 2001
Brisbane City Council (BCC), *Stormwater Outlets in Parks and Waterways, Guidelines*, 2002
Brisbane City Council (BCC), *Natural Channel Design Guidelines*, 2000
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Institution of Engineers Australia, Queensland Division (IEAQ), *Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites*, 1996
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*, 2008
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Mackay City Council, *Engineering Design Guidelines Constructed Lakes Planning Scheme Policy No. 15.15*, 2008
Melbourne Water, *Constructed Shallow Lake Systems, Design Guidelines for Developers*, Version 2, November 2005
Melbourne Water, *WSUD Engineering Procedures*, 2005
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NHMRC, 2008. *Guidelines for Managing Risks in Recreational Waters*. National Health and Medical Research Council, Australian Government, Canberra.
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QDOT, 1998. *Tide Tables for Queensland*. Queensland Department of Transport
Scheffer, M., Rinaldi,S. Gragnani, A. Muir, L.R. and Van Nees, E.H. 1997. *On the dominance of filamentous Cyanobacteria in shallow, turbid lakes*. Ecology, 78: 272-282.
Scheffer, M., 1998. *Ecology of Shallow Lakes*. Kluwer Academic Publishers, Dordrecht.
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Scheffer, M., 2001. *Alternative attractors of Shallow Lakes*. The Scientific World 1: 254-263.
Townsville City Council, *Water sensitive urban design for the coastal dry tropics (Townsville): technical*

design guidelines for stormwater management, 2011
Wagner-Lotkowska, I., Izydorczyk, K., Jurczak, T., Tarczńska, M., Frankiewicz, P., and Jorgensen, S.E., 2004. Chapter 12 – *Management: Reservoirs and Lakes*. In: Integrated Watershed Management: Ecohydrology and Phytotechnology – Manual (Eds: M. Zalewski, R.D. Robarts, V. Santiago-Fandino and P. Pypaert) United Nations Environment Programme, Osaka.
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Witheridge G, *Erosion and Sediment Control – A Field Guide for Construction Site Managers*, 2010

SC6.4.3.12.2 Minimum requirements

(1) The proponent must clearly demonstrate through design, investigation and monitoring that the proposed lake will:

(a) be sustainable for its intended use;

(b) have no negative impact on surrounding environments;

(c) provide a high level of amenity to surrounding land uses;

(d) have no adverse impacts on flood capacity;

(e) be safe due to minimisation of hazards; and

(f) be designed to minimise on-going maintenance.

(2) General requirements

A suitably qualified and Registered Professional Engineer of Queensland (RPEQ), with specific water sensitive urban design and lake design experience, must undertake or oversee all aspects of the constructed lake design. As constructed lakes will often involve significant landscape input, a suitably qualified landscape architect registered with the Australian Institute of Landscape Architects (AILA) should also work with the RPEQ.

The design must comply with all relevant requirements of:

(a) the requirements of the Townsville City Plan and, specifically, Part 9.4.2 Healthy waters code and any other applicable development codes;

(b) this sub-section;

(c) reference and source documents listed in SC6.4.3.12.1(5), in general;

(d) any development approval conditions relevant to the design; and

(e) any specific relevant and reasonable request, sought by council in writing.

The RPEQ shall sign all plans associated with the lake, certifying that the design, subsequent construction and performance criteria complies with this section.
Regardless of final ownership of the proposed lake, the proponent is to follow the requirements of this sub-section.

(3) Minimum functional requirements

The following are considered minimum requirements for the sustainable healthy operation of a lake:

(a) lake depths of 1.5 m to 3 m to finished bed level at the wet season normal water level (preferably 2-2.5 m). A minimum lake depth of 1.5 m is considered necessary to allow maintenance equipment such as floating weed harvesters to access lakes;

(b) sufficient inflow to sustain lake water levels within acceptable variations;

(c) upstream water quality treatment devices (SQIDS) to ensure inflows to the lake meet the requirements of the State Planning Policy and SC6.4.3.9 Water sensitive urban design guidelines. Untreated overflows must by-pass constructed lakes;

(d) floating aquatic vegetation minimised within the lake to reduce potential organic carbon loads;

(e) shaped and oriented to minimise dead spots. Where possible lake shapes should be orientated in the direction of the prevailing wind to improve mixing;

(f) suitable outlet configuration to manage lake water levels to facilitate plant and lake establishment, and on-going management actions (i.e. lower lake level by gravity);

(g) measures to pass high flows (i.e. untreated over flows) around the lake;

(h) sufficient liner (e.g. clay) at the lake floor to ensure the system minimises seepage losses, and in some cases to stabilise the lake bed (i.e. cover marine clays);

(i) integration of the lake within the site constraints;

(j) sufficiently strong embankments and overflow structures to manage peak flows and erosion;

(k) suitable access for heavy machinery in various locations to enable management actions (i.e.de-silting, weed and debris removal);

(l) edge treatments that minimise potential weed ingress;

(m) consideration of public safety issues and hazards (i.e. edge treatments, access to water, CPTED principles, flood capacity);

(n) sufficient measures to minimise algal bloom development (e.g. sufficient lake turnover and/or other strategies for managing algal growth such as mechanical aerators and mixers, ultrasonic treatments etc.);

(o) protection and appreciation of existing natural assets such as significant trees, marine plants, billabongs and wetlands;

Editor's note—applicants should also refer to Part 8.2.5 Natural assets overlay code and SC6.9 Natural assets planning scheme policy for additional information.

(p) sufficient measures to control pests (including bird population control) and mosquitoes including providing a habitat for predators;

(q) enhanced biodiversity through revegetation; and

(r) enhanced landscape aesthetic and amenity for surrounding residents through installation of improved passive recreation facilities i.e. paths and trails.

SC6.4.3.12.3 Development application requirements for constructed lakes

(1) Information for development applications

All drawings and documents submitted to council for approval shall be prepared by a suitably qualified person.

(a) MCU/ROL applications

The proponent will be required to submit a constructed lake concept design report with comprehensive management plans to support a development application for reconfiguring a lot (ROL) or material change of use (MCU) or operational works, where the proposed development includes a lake.

A separate stormwater quality management plan will be required to support the concept design report where a fresh water lake is proposed.

Table SC6.4.3.12.1 provides a checklist of items for submission at the MCU/ROL stage.
Additional plans/reports may be required to meet necessary state legislation requirements due to the proposed works, or other requirements of the Townsville City Plan.

(b) Operational works applications

Following approval from council and other relevant government agencies of concepts submitted as part of the ROL/MCU application, detailed design documents will be required for operational works approval. Detailed design documents shall be in both graphic and written form and contain sufficient information to enable council to assess compliance with the applicable codes.

The detailed design submission for operational works approval must include:

(i) constructed lake detail design report (updated from the ROL/MCU submission);

(ii) construction drawings – civil/landscape;

(iii) constructed lake technical specifications;

(iv) soil erosion sediment control plan;

(v) constructed lake monitoring plan (updated from the ROL/MCU submission);

(vi) constructed lake maintenance plan (updated from the ROL/MCU submission);

(vii) groundwater assessment and management plan (updated from the ROL/MCU submission); and

(viii) acid sulfate soils management plan, where required, and generally in accordance with the relevant State Planning Policy and its referenced documents.

Editor's note—additional reports/plans may be required to meet necessary regulatory and/or Townsville City Plan requirements due to the proposed works.

(2) Construction

Construction can only commence following operational works approval. Works are to be carried out in accordance with the approved drawings and specifications and any associated management plans as a result of the development assessment process.

(3) Constructed lake landscape plan

A constructed lake landscape plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council.

Constructed lakes will most likely be included in developments to provide a high amenity focal point for residents. The lake designs should aim to enhance biodiversity through re-vegetation and establishing linkages with existing vegetation communities, public interaction and education.

Landscape plans are to be provided and prepared by a suitably qualified landscape architect/designer, registered with AILA.

The landscape plan should demonstrate that the lake blends into surrounding environment (built and natural) and protects and enhances natural features such as significant trees and existing aquatic habitats (i.e. streams, billabongs, freshwater wetlands, saltmarshes). Landscape designs are to consider the principles of crime prevention through environmental design (CPTED).

At the ROL/MCU stage plans are to be developed that show:

(a) existing ground levels;

(b) the proposed lake footprint with respect to the development;

(c) road and lot layout;

(d) existing and retained vegetation;

(e) natural features and receiving environments;

(f) edge batter treatments including provision for irrigation where applicable;

(g) proposed lake operating levels (dry, normal and wet) and base levels;

(h) topsoiling and lining;

(i) adjacent levels including roads, property boundaries and floor levels;

(j) setbacks, buffers and landscaping;

(k) accesses;

(l) inlets and outlets including treatments to minimise visual impact;

(m) activities to be carried out in the area adjacent to the lakes e.g. parks and car parks;

(n) photographs showing examples of design intent and character;

(o) educational opportunities such as signage and public art; and

(p) highest astronomical tide and 50 year flood levels.

Figure SC6.4.3.12.1 Example of a lake landscape plan

Constructed lake landscape plans are to be updated as part of the operational works submission, including planting details (refer to SC6.4.3.12.5(12) Step 12), landscape surface treatment plans, landscape details and specifications. The use of endemic plant species is to be encouraged.

Landscape design can play an important role in overcoming negative community perceptions to certain lake treatments such as tree plantings where residents in the past have deliberately removed trees and shrubs due to concerns with pests. Signage explaining the function of each element in the overall design can help educate local residents.

(4) Constructed lake recreation plan

A constructed lake recreation plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council.

A recreational management plan is to be developed by a suitable qualified landscape architect/designer registered with AILA in association with a recreational consultant and must include details on proposed activities including pedestrian movement and signage.

Lakes designs should provide enhanced landscape aesthetic and amenity for surrounding residents through the installation of improved passive recreation facilities such as paths, trails, viewing platforms, picnic and playground nodes. Lake recreational areas are to be designed so that they are available to all groups of the population, i.e. it should consider all abilities. The lake design and associated parklands must be:

(a) consistent with the area's social and recreational master plans; and

(b) cognisant with local planning and other issues.

Designs should also be mindful of the amount of space a proposed lake will take and how this will impact on other recreational activities to ensure a balance land use outcome. Consideration should also be made to other amenity values such as shade, character and multi-use.

Linkages between the lake and recreational master plans are also to be provided (e.g. footpaths, cycleways, etc.).

(5) Constructed lake monitoring plan

A constructed lake monitoring plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission. The monitoring plan is to set out the testing schedule and frequency for monitoring lake health. Water quality monitoring will be critical in assessing the on-going performance of the lake and provide the basis for remedial and adaptive management activities. Costs associated with monitoring must be included in the life cycle costing (SC6.4.3.12.5(18) Step 18) and must be separated from other costs.

The proponent will be required to develop a water quality strategy including water quality objectives to maintain environmental values of the lake, receiving waters and ground water, where applicable. Water quality objectives will be required to be derived for local conditions in accordance with the *Queensland Water Quality Guidelines 2009.* When deriving suitable values for the water quality strategy the proponent must take into consideration local water quality values of source and receiving waters, together with local aquifer water quality, if applicable.

A summary of all water quality results will also be required for handover purposes. Council will not consider handover until all monitoring results and reports are received.

Minimum monitoring requirements

(a) weekly in-situ testing using a multi-probe for pH, turbidity, DO, temperature and EC at 0.5 m depth intervals from surface to lake bed at the lake inlet and outlet;

(b) weekly laboratory testing (NATA approved) for algal counts, TN and TP. Surface samples at the inlet and outlet are required;

(c) weekly measurements of lake water level;

(d) monthly laboratory testing (NATA approved) for E.coli, TSS, turbidity, NH3, TKN, Nitrate/Nitrite, TN, TP, FRP, Al (soluble). Surface samples at the inlet and outlet are required;

(e) trapping of adult mosquitoes at the lake site (weekly during the wet season from the on-set of the first wet season rains, fortnightly to monthly other times);

(f) larval surveys from shallow flooded vegetated areas around the lake (weekly during the wet season from the on-set of the first wet season rains, fortnightly to monthly other times);

(g) fortnightly water level and EC measurements of groundwater from installed monitoring wells (where shallow groundwater is observed); and

(h) annual bathymetry of lake bed to determine sediment accumulation.

Reporting

Quarterly reports are to be submitted to council summarising the water quality monitoring results. The reports shall also include summaries of local climatic conditions, including daily rainfall and shall also include any observations made during the period (e.g. visual water quality, odours, algal biomass, fish kills etc.). Copies of lab testing results are to be included in an appendix to the report. Water quality exceedences (considering trigger values derived to maintain environmental values of the lake, receiving water body and groundwater, if applicable) are to be clearly identified. The reports shall also detail any corrective measures that may have been taken.

Quarterly reports are to be submitted within 1 month of the last monitoring event in the quarter.

An annual report will be required to assess the overall performance of the lake based on the monitored and observed data throughout the monitoring period. The report should detail performance with respect to the intended design and actions taken to meet the intended performance.

Corrective actions and adaptive management

Table SC6.4.3.12.2 provides indicative target values for lake health relevant for Townsville for the range of physico-chemical indicators to be tested on a weekly basis. The values have been derived from the *Queensland Water Quality Guidelines* and are provided for guidance only.

The proponent must derive local water quality objectives in accordance with the procedures outlined in the

Queensland Water Quality Guidelines (DERM, 2009). This will involve definition of the water type, selection of indicators, selection of reference sites, collection of reference data and derivation of guideline values based on the reference data.

Parameter	Freshwater	Mid-Upper Estuarine
pH	6.5 - 8.0	7.0 - 8.4
DO	>6 mg/L	>6 mg/L
TDS	<1,000 mg/L	>15,000 mg/L
TN	0.35 mg/L	0.3 – 0.4 mg/L
TP	0.01 mg/L	0.025 – 0.04 mg/L
Turbidity	1 - 20 NTU	8 - 25 NTU
Chl-a	5 ug/L	4- 10 ug/L

Table SC6.4.3.12.2 Suggested target values for physico-chemical indicators.

Table SC6.4.3.12.3 provides target values for the management of cyanobacteria (blue green algae) and mosquitoes. The presence of cyanobacteria can present a significant hazard to lake users. The values for cyanobacteria have been derived from the *Guidelines for Managing Risks in Recreational Water.*

Parameter	Freshwater lake	Saline lake
Cyanobacteria	≤500 cells/mL *Microcystis aeruginosa* or biovolume equivalent ≤0.04 mm^3/mL combined total of all cyanobacteria	Refer to guidance provided in the 'Guidelines for Managing Risks in Recreational Water' (National Health and Medical Research Council, 2008)
Mosquito larvae	1 larvae per 2 ladle dips (300mL ladle)	1 larvae per 2 ladle dips (300mL ladle)

Table SC6.4.3.12.3 Suggested target values for cyanobacteria and mosquito populations.

Where weekly testing indicates values above derived water quality objectives or biological indicators, corrective actions are to be taken as soon as possible. Exceedance or other lake health issues such as fish kills and odour problems shall be reported immediately to council and the Department of Environment and Heritage Protection (EHP). The source of the exceedance should be identified as soon as possible.
Typical corrective actions include:

- contacting council and EHP as soon as an exceedance is identified;
- identifying the cause of the water quality or biological indicator problem. This includes reviewing monitoring and operational data, climatic data, upstream sources, internal lake processes etc. Discussions with designers, council/EHP may be required to gain a better understanding of the problem and determine possible actions;
- increasing the frequency of monitoring of parameters of concern;
- minimising potential impacts to downstream receiving environments e.g. temporarily block outlets; and
- undertaking remedial action on items identified as potential sources e.g. upstream water quality improvement devices.

An important component of the monitoring plan will be the adaptive management strategies to be developed for algal blooms and mosquito outbreaks. The following provides guidance on suitable adaptive management strategies for a adaptive management of algal blooms and adaptive management of mosquito outbreaks.

Adaptive management of algal blooms
Design of lakes in Townsville must include an algal management strategy as defined in SC6.4.2.12.5(8) Step 8. The algal management strategy is intended as a proactive response and not a reactive response to cyanobacterial blooms.

When a cyanobacterial bloom occurs in a freshwater lake, it will be necessary to follow the recommended actions detailed in the *Queensland Water Quality Guidelines*. For algal blooms in saline lakes, refer to the algal guidelines for coastal and estuarine waters in the *Guidelines for Managing Risks in Recreational Waters.*

Adaptive management of mosquito outbreaks
Larval counts of 1 per 2 ladles (300 mL ladle) are indicative of possible mosquito problems for adjacent residents (Warchot and Whelan, 2008), however resident complaints or significant numbers of mosquitoes in adult trapping may also be cause for mosquito control.

Where mosquito problems are encountered a number of actions can be followed:
- identifying the source and cause of the breeding;
- rectification of surface depressions that may lead to isolated pools;
- clearing collected debris that may be in and around the lake;
- draining areas identified with large mosquito breeding;
- ensuring suitable native fish species are present in the lake; and
- use of a suitable insecticide/larvicides.

Use of insecticides can quickly control mosquito breeding, but is not recommended as a long term strategy due to potential issues with insecticide resistance, long term cost of maintaining a mosquito control program and the possibility of the insecticide applications not being able to target all areas of breeding (Warchot and Whelan, 2008).

Ecologically friendly insecticides include (Whelan and Warchot, 2008):
- Bacillus thuringiensis var. Israelensis;
- Bacillus sphaericus; and
- Methoprene.

(6) Constructed lake maintenance plans

A constructed lake maintenance plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission in consultation with council. A final approved constructed lake maintenance plan will be required prior to asset handover.

The constructed lake maintenance plan shall be a living document that can be updated should there be any changes during construction. The plan must include all expected maintenance associated with the constructed lake and associated infrastructure such as pumps, recirculating wetland and landscape treatments.

The maintenance plan is intended to ensure that the lake functions as intended and is not prone to weed

infestations or decreased amenity values. The maintenance plan must clearly set out:

(a) expected maintenance activities;

(b) frequencies;

(c) roles and responsibilities;

(d) maintenance procedures;

(e) equipment requirements;

(f) product specifications;

(g) occupational health and safety;

(h) public safety;

(i) environmental protection;

(j) disposal;

(k) accesses;

(l) emergency responses; and

(m) notification requirements.

Maintenance forms must be developed as part of the plan and filled in and stored during inspections and maintenance.

The costs of expected maintenance activities must be included in life cycle costing (SC6.4.2.12.5(18) Step18), and must be separated from other costs. The maintenance plan will need to consider lake monitoring and adaptive management to ensure maintenance responses to monitoring exceedences.

The maintenance plan must clearly describe activities required during establishment, defects liability period and those following asset handover. Intensive maintenance will most likely be required during the first few years during lake and plant establishment. This is also the time when the lake is most vulnerable to sediment loads from construction activities. Design drawings are to be included as part of the maintenance plan.

The maintenance plan must consider lake accesses as detailed in SC6.4.2.12.5(14) Step 14, and maintenance draining as outlined in SC6.4.2.12.5(10) Step 10.

Typical maintenance actions include:

- routine inspections of the lake for vegetation health, weed infestations, scour, litter and debris and mosquitoes;
- routine inspection of inlets and outlets for sediment build up, scour, litter and blockages;
- removal of litter and debris;
- removal and management of invasive weeds;
- periodic de-silting;
- replacement of plants that are damaged or have died with equivalent plants;
- regular irrigation of plants during establishment;
- repairs due to vandalism; and
- mosquito control including repair to lake edges to prevent the formation of isolated pools.

Inspections for removal of debris should be done regularly and removed whenever observed. Scour around the inlets and outlets should be checked following large storm events.

Construction drawings

All drawings submitted to council for approval shall be prepared by a suitably qualified person and shall conform to the standards detailed in SC6.4.2.5 Details on drawings.

Annual lake bathymetry surveys are to be provided to council with estimates of sediment accumulation from the original constructed levels.

As constructed plans are to be provided following handover to council either as an annotated set of the original plans (where variations to the original design are minor) or otherwise as a new site survey.

(7) Constructed lake technical specification

The technical specification shall clearly set out the scope of the works, roles and responsibilities, certification and sign-off and construction hold points. The specifications shall be in accordance with the construction plans and provide flexibility to allow additional field investigation and design modification due to unexpected conditions encountered during construction

(8) Soil erosion management plan

A soil erosion management plan shall clearly identify measures to manage erosion and sediment control during construction and be guided by principles set out in:

- *Best Practice Erosion and Sediment Control*; and
- *Erosion and Sediment Control – A Field Guide for Construction Site Managers*.

The soil erosion management plan shall include:

(a) project and site description (topography, drainage, soils, rainfall);

(b) potential impacts from construction activities including a risk assessment;

(c) soil management measures including a plan showing proposed measures; and

(d) responsibilities, monitoring and maintenance.

The plan must also detail contingencies in the event of unplanned discharges including remediation.

The plan should be a living document that can be modified if site conditions change or if the adopted measures fail to perform as expected.

(9) Soil and groundwater assessment and management plan

A soil and groundwater assessment management plan is required at the ROL/MCU stage and is to be refined as part of the operational works submission. This will be an update from the concept design phase in consultation with council and shall include assessment of any additional soil and groundwater information gained since the concept design stage. Refer to SC6.4.3.12.5(3) Step 3. The soil and groundwater assessment plan should include:

(a) site description including local soil and groundwater characteristics;

(b) field investigation work including any test pitting, monitoring well installation etc.;

(c) laboratory testing and interpretation;

(d) monitoring data and interpretation;

(e) assessment of acid sulfate potential;

(f) identification of problematic soils e.g. sodicity, dispersive soils, peats etc.;

(g) assessment of the shallow groundwater regime, if present; and

(h) groundwater risks and management options

(10) Acid sulfate management plan

When an acid sulfate management plan is deemed necessary, the plan should clearly identify the risk of contamination to the environment and measures to manage the risk. The plan must detail:

(a) construction sequences;

(b) impacts of dewatering;

(c) liming requirements;

(d) exposure of materials;

(e) monitoring requirements;

(f) action plans for unplanned acidification of ground or surface waters; and

(g) responsibilities, reporting and auditing.

(11) Maintenance and handover

(a) Necessary maintenance will be defined in the maintenance plans provided during the ROL/MCU submission and updated during the operational works approval stage. Updates may be required should the designs change during construction and may require the approval of council.

For the purposes of maintenance and the handover, a constructed lake is deemed to include the lake open water body and edge treatments. The limits of each are defined below:

(i) lake water body: all areas to wet season normal water level; and

(ii) edge treatments: all areas from lake wet season normal water level to the edge of the buffer zone (see below).

The lake buffer zone is considered necessary to provide sufficient width to allow maintenance activities (including access by machinery) to be undertaken to all areas of the lake, provide a passage for fauna and provide water quality buffering for untreated overflows entering the lake. A minimum width of 25 m is suggested. Where the proponent proposes a reduced width they must clearly demonstrate that the width is sufficient to maintain the aforementioned functional requirements of this edge treatment.

The proponent is also responsible for any rectification works on areas outside of the constructed lake should the operation of the lake negatively impact on outside areas.

(b) Defects liability period

The defects liability period for the lake water body and edge treatments will commence following practical completion and continue for at least:

(i) 5 years after 90% of all houses are constructed within the lake stormwater catchment, provided the lake is constructed, established and functioning at plan sealing; or

(ii) 5 years after the lake is constructed, established and functioning where the lake is not directly fed from stormwater runoff.

Prior to establishing the lake system, the lake shall be drained and de-silted, where necessary, to establish the lake system as per the detail design.

(c) Handover

At the completion of the defects liability period, a handover meeting will be scheduled between the developer (or representative), maintenance personnel and council.

The council may engage an independent auditor to assess handover and is under no obligation to accept the asset if it does not meet the performance requirements as described in the constructed lake conceptual design report, detailed design report and this sub-section.

Council will only accept the lake once the lake is demonstrated to meet the performance requirements as detailed in the design reports and monitoring plans. The council will require demonstration through a minimum of 5 years of continuous monitoring data (as defined in the monitoring plan) on the performance of the lake system.

Council will require a final survey of the lake floor prior to handover. Where sediment accumulation is in excess of that anticipated the proponent will be required to drain and de-silt the lake and re-establish the lake as per the design. Handover cannot occur until the re-established lake performance is demonstrated over a continuous 5 year period.

As constructed plans are to be provided following handover to council either as an annotated set of the original plans (where variations to the original design are minor) or otherwise as a new site survey.

SC6.4.3.12.4 Lake health considerations

(1) A constructed lake is an artificial body of permanent water with either an edge fringed with emergent macrophytes or a hard edge. While submerged macrophytes may occur throughout the water column, the dominant feature is open water (typically at least 30% of the total area).

Urban runoff entering a constructed lake must have sufficient treatment.

For the Townsville region this includes load reduction from the urban runoff component of:

- 80% reduction in total suspended solids;
- 65% reduction in total phosphorous;
- 40% reduction in total nitrogen; and
- 90% reduction in gross pollutants.

The design of constructed lakes needs to consider the complex behaviour, in particular, the alternate states that lakes can operate under depending on a number of influences and stressors.

Key factors affecting lake health:

(a) nutrients;

(b) light and turbidity;

(c) organic carbon loads;

(d) lake detention time;

(e) salinity;

(f) water level and depth;

(g) mixing; and

(h) temperature.

The designer must also be aware that constructed lakes are community assets and issues such as pest and weed control and integration into the overall landscape design should be considered at the concept design and planning stage.

(2) Lake conceptual model – alternate states

The conceptual model of how lakes transition between alternate states is presented in Figure SC6.4.3.12.2.

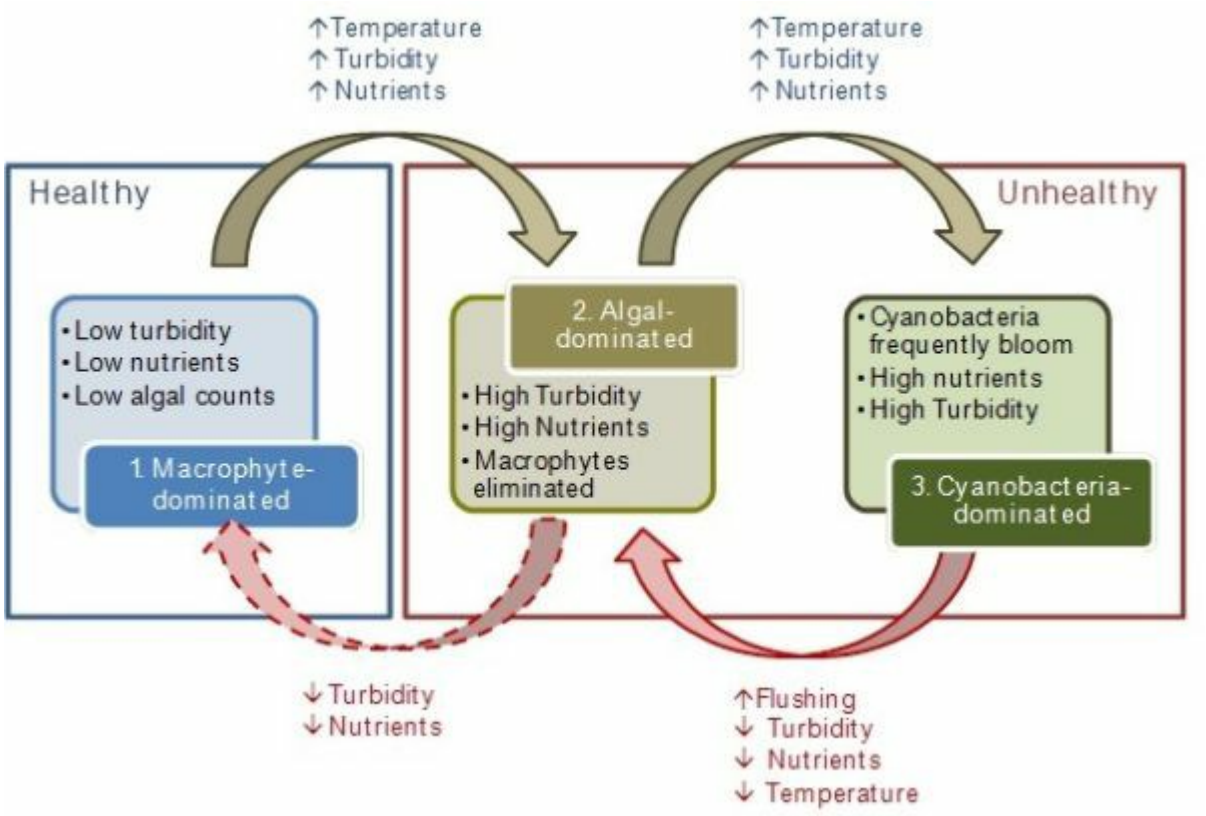


Figure SC6.4.3.12.2 Conceptual model of the alternative states observed in shallow lakes

The alternate states model considers that freshwater shallow lakes may exist as (after Moss, 1998):

- a macrophyte dominated state with clear water; or
- a turbid state dominated by phytoplankton; or
- a cynobacterial (blue-green algae) dominated state

The key driving mechanisms between each of the alternative states are nutrient levels and turbidity. The switch between the alternative states is typically triggered by the exceedance of a critical turbidity threshold. The critical turbidity thresholds required to trigger a switch from one state to another are likely to differ between lake systems and are also influenced by other environmental factors, such as lake detention times and temperature (Scheffer, 1998). Figure SC6.4.3.12.3 (below) illustrates the switch between alternative states.

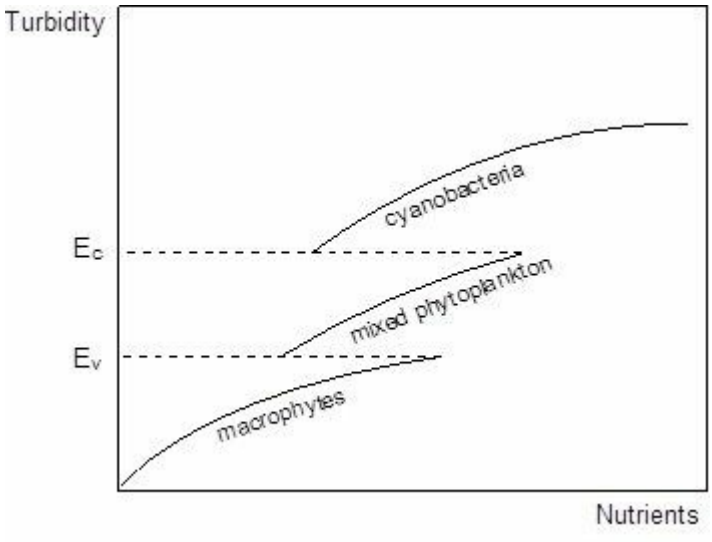


Figure SC6.4.3.12.3 Switch between alternative states

(a) Macrophyte dominated lake

A healthy lake is typically dominated by macrophytes (emergent and submerged water plants).

Macrophyte dominated lakes help maintain low turbidity via the uptake of nutrients, prevention of re-suspension of sediments and provision of refugia for zooplankton against predators (Scheffer, 2001).

Macrophyte dominated lakes are reasonably robust to increased nutrient loads, which allows the macrophyte biomass to increase and thereby maintain low turbidity (Scheffer et al., 2001) i.e. the macrophyte dominated system provides positive feedback to increases in nutrients, enhancing their own growing conditions (Scheffer et al, 2001).

(b) Macrophyte to Phytoplankton state

High nutrient concentrations can lead to an increase in phytoplankton biomass and biofilm growth on the macrophytes, leading to increased turbidity and decreased light penetration which can cause a rapid collapse of the macrophyte community (Scheffer, 2001).

The switch to a phytoplankton state is considered problematic with regards to lake heath as this state inhibits the growth of macrophytes (mainly due to low light penetration) and maintains high turbidity levels. Once a lake has switched to a phytoplankton dominated state, restorative efforts to reduce turbidity and re-establish macrophyte communities are extremely difficult.

(c) Phytoplankton to Cynobacteria state

The switch from a phytoplankton dominated state to a Cynobacterial dominated state is generally triggered in response to increased turbidity and water temperatures (Scheffer, 1998). Whilst both Cyanobacterial and phytoplankton (non-Cyanobacterial) communities may dominate over a range of nutrient concentrations, a critical turbidity level exists above which the Cynobacteria will become dominant (refer to Figure SC6.4.3.12.4).

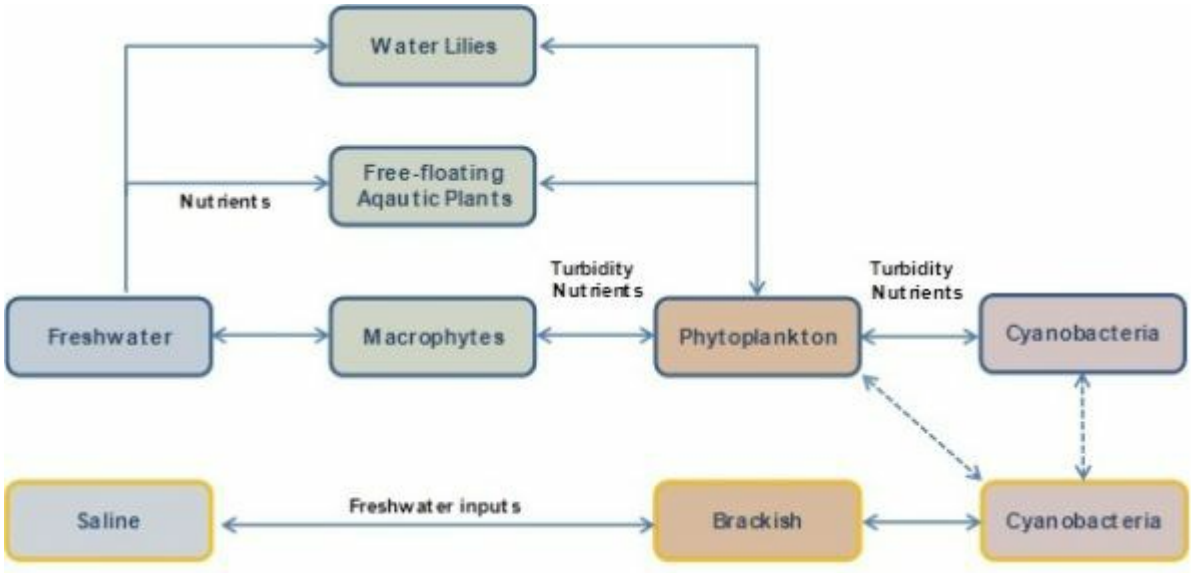


Figure SC6.4.3.12.4 Fresh and saline lakes alternate states

In saline lakes, alternate states are triggered by freshwater inputs, which result in brackish lakes that are highly susceptible to Cyanobacteria blooms. Brackish lakes do not tend to develop a phytoplankton state in response to freshwater inputs, unless salinity levels are reduced to fresh water levels (i.e. 1,000 mg/L TDS salinity or less).

(3) Factors affecting lake health

The following section relates to freshwater lakes, where algal management can be difficult to achieve in Townsville.

Saline lakes are generally less susceptible to algal blooms, although marine species of algae do exist. Saline lakes are less likely to experience aquatic weed infestations and seasonal water level variations are less problematic to manage.

(a) Nutrients

Nutrients of concern for urban lake health include nitrogen, phosphorous and trace metals. Nutrients (particulate and soluble) are typically delivered to lakes through stormwater runoff. Nutrients may also be delivered to lakes via in-situ soils, breakdown of organic matter and groundwater processes. Other site conditions such as perched water tables and waterlogged areas (e.g. where anaerobic condition exists) can also promote the formation of nutrients into bio-available forms.

Particulate nutrients associated with suspended solids will typically settle to the bottom of lakes and provide a reservoir of nutrients, which can be released back to the water column under appropriate conditions, whereas soluble inorganic nutrients are readily bio-available to phytoplankton.

High nutrient levels also favour growth of aquatic weeds such as Salvinia (Salvinia molesta), Water hyacinth (Eichhornia crassipes) and Water lettuce (Pistia stratiotes) and other floating species such as native and introduced water lillies. These floating species provide a continual source of organic matter (carbon) to lake sediments. The decomposition of organic matter can deplete oxygen within the lake water column and sediments, resulting in the release of soluble nutrients back to the water column which is then available for phytoplantkton and Cyanobacterial growth. Depletion of oxygen and/or the development of Cyanobacterial blooms can also lead to fish kills, animal death and a risk to public health.

Many Cyanobacteria species are able to obtain nitrogen from the atmosphere, thus nutrient management in lakes typically focuses on phosphorous.

Note—guidance on suitable treatments is included in SC6.4.3.9 Water sensitive urban design guidelines. Areas close to the coast or water draining to the coast can be more susceptible to nutrient hazards. Regional hazard maps can be used to identify potential areas of concern where more detailed mapping and investigation (e.g. soil and groundwater analysis) can occur.

(b) Light and turbidity

Light penetration and turbidity are important factors that trigger switches between alternate states, as described earlier. Recent studies (Scheffer et al., 1997) have shown that the abundance of Cyanobacteria is more highly correlated to underwater light conditions than to phosphorous concentrations. In shallow lakes, the probability that Cyanobacteria will dominate the algal community will depend strongly upon diminishing light levels attributed to increases in turbidity (Scheffer, 1998). Increases in Cyanobacterial biomass therefore provides a positive feedback, further favouring the development of Cyanobacterial blooms.

Note—macrophyte dominated lakes help to maintain low turbidity, as well as providing a mechanism for nutrient uptake. This reduces the opportunity for phytoplankton or Cyanobacterial dominated states which are characterised by high turbidity. Submerged and emergent macrophytes should be encouraged, and floating aquatic plants which contribute to shading and organic carbon loads discouraged. In Townsville, constructed lake depths are limited to 3 m below wet season normal water level, which should encourage light penetration and establishment of submerged plants.

(c) Organic carbon loads

The primary source of organic carbon in urban lakes is typically from leaf litter in stormwater runoff, floating aquatic plants and emergent and submerged macrophytes when within the lake when they decompose. Floating aquatic plants provide a highly bio-available carbon source as they tend to have soft and non-fibrous tissues. Aerobic decomposition of accumulated organic loads at lake beds result in a depletion of oxygen and can cause anaerobic conditions (depending on the amount of organic load available). In situations where organic material is still available under anaerobic conditions, anaerobic bacterial activity can lead to the release of highly bio-available nutrients back to the water column (Lawrence and Breen, 1998). This can result in subsequent algal blooms and poor water quality.

Note—minimise the input of leaf litter into urban lakes through upstream treatment measures. Avoid floating aquatic plants where possible. Creating lake edges that encourage emergent macrophytes will inhibit the establishment of floating attached plants such as water lilies, which tend to grow from lake edges to the centre.

Floating aquatic weeds such as Salvinia molesta are more difficult to manage. Maintaining low lake nutrient levels will minimise proliferation. This includes the provision of submerged macrophytes, which maintain oxygen to lake sediments, reducing opportunities for nutrients to be available for floating plants and phytoplankton.

The lake design should provide suitable access to the lake water body for removal of floating aquatic weeds by mechanical harvesters. A minimum water depth of 1.5 m should be provided for harvesting equipment. Suitable access must also be provided heavy machinery to manoeuvre when collecting the weed and debris.

(d) Lake detention times

Lake detention time plays an important role in managing lake algal biomass and thus reducing the risk of Cyanobacterial growth. Lake detention time, simply put, is the time it takes for the entire lake volume to be displaced via inflows to the lake. Generally there are two ways in which lake water is displaced, either via episodic events that displace the entire lake volume (washout) or from constant inflows (flushing).

Algal growth rates are dependent on nutrients, light, temperature and hydrologic conditions. Algal population growth can occur rapidly, and algal bloom concentrations may develop within weeks. It is possible to manage the formation of algal blooms by removing algal biomass from lake systems via the manipulation of lake detention times.

In Townsville, urban lakes that rely on catchment inflows will typically experience long detention times (>100 days) during the dry season, significantly longer than the time required for algal populations to reach bloom concentrations. Probabilistic approaches, such as those used in Brisbane and Mackay (20 percentile detention time for a constructed lake should not exceed 20 days), are not particularly relevant for Townsville conditions, as these conditions cannot be demonstrated to be achieved on average, regardless of catchment to lake size, unless alternative sources of top up water are available.

Algal management is thus a key design consideration for urban lakes reliant on catchment inflows in Townsville. A number of options are available to the designer including a flushing and/or recirculation strategy. These are discussed in more detail in SC6.4.3.12.15(8) Step 8 – Algal management and SC6.4.3.12 Attachment A Alternative Strategies for Managing Cyanobacterial Growth.

During the short wet season, lake detention times are significantly shorter and the risk of algal blooms are less, although the potential still exists during summer drought conditions.

Note—where possible the designer should consider saline lakes with tidal flushes or consider alternative options to freshwater lakes such as constructed wetlands. Where freshwater lakes are proposed, a suitable algal management strategy will be a key design consideration. Lake depths should also be minimised where possible (preferably between 1.5 and 2.5 m) to reduce any necessary pumping requirements for recirculation.

(e) Salinity

Cyanobacteria dominance is highly sensitive to changes in salinity (Paerl, 1988). Brackish lakes are often dominated by Cyanobacteria due to the tolerance of many Cyanobacterial species to low salinity. Saline lakes subject to freshwater inflows, particularly during the wet season, are thus highly susceptible to Cyanobacteria blooms. In Townsville, brackish lakes (1,000 to 15,000 mg/L TDS), or saline lakes with freshwater inputs should be avoided.

Note—avoid brackish lakes or brackish conditions that may occur in lakes (e.g. saline lakes subjected to large freshwater inflows). Preference is for lakes to permanently operate as either saline (>15,000 mg/L TDS) or fresh (<1,000 mg/L TDS) at all times.

(f) Water level and depth

Lake water level variation and depth play an important role in maintaining macrophyte dominance, and thus resistance to algal blooms. Shallow lakes (<3 m) are more favourable to macrophyte growth, where light penetration is higher and conditions suitable for macrophyte reproduction and establishment. Shallow lakes will typically have a higher threshold turbidity level before switching to a phytoplankton

state (Scheffer, 1998), and therefore have more resistance to increased turbidity and nutrient levels.

Shallow lake depths (<3 m) are also less prone to stratification and subsequent problems associated with the release of nutrients from anaerobic sediments.

Water level variation due to evaporation in Townsville can be greater than 1 m in lakes reliant on catchment inflows. This has direct implications for the health and survival of edge treatments such as emergent macrophytes, which help to reduce the proliferation of floating aquatic plants and ingress of weeds, and thus play an important role in managing the health of urban lakes.

Alternately, saline lake edge treatments such as salt couch are highly sensitive to water level variations and do not survive well when exposed to extended periods of inundation.

Note—lake depths from normal wet season operating levels to finished bed level are limited to 3 m in Townsville, but preferably in the range of 2.0 to 2.5 m. A suitable impervious base (e.g. compacted clay liner) should be provided to minimise seepage losses for lakes reliant on catchment inflows. Lake edge treatments should be such that the width of the exposed batter due to water level variations is minimised. Within the zone of water level variation edge batters at 1V:3H are preferred.

For saline lakes water level variations should be minimised as far as possible, preferable to less than 0.3 m. Salt couch edge treatments are particularly sensitive to long periods of inundation.

(g) Mixing

Mixing and turbulence within lake systems limits the formation and accumulation of Cyanobacterial blooms (Wagner-Lotkowska, 2004). Well mixed conditions can be achieved by ensuring good hydraulic efficiency, shallow lakes (<3 m), maximising wind induced turbulence and providing lake flushing. Mixing can also be accomplished by mechanical means including aerators, mechanical mixers and internal recirculation.

Note—lake configurations should provide length to width rations of 3L:1W or greater. Inlets and outlets should be at opposite ends of the lake. Dead end zones or square edges are to be avoided.

Where possible, align lakes in the direction of the prevailing winds to maximise wind induced turbulence. The prevailing wind for Townsville during the critical winter dry season is south easterly. The base of the lake should be flat to promote even wind mixing. Isolated deep pockets should be avoided.

(h) Weed control

Weed infestation is a major problem in the dry tropics and has been observed to be a significant maintenance burden for existing lakes in the Townsville area. To maintain amenity and minimise on-going maintenance the proponent must detail specific actions (design and management) to address potential weed ingress, both terrestrial and aquatic. Aquatic weed problems are mainly associated with fresh water lakes in the Townsville region and the following design notes are primarily related to weed control in fresh water lakes.

Note—provide a densely vegetated perennial lake edge to create a barrier for weed ingress. This vegetative barrier must be designed so as to be capable of surviving expected water level variations. This may include the provision of irrigation during the dry season.

Include submerged macrophytes to fresh water lakes, to maintain oxygen to lake sediments, thus minimising the opportunities for highly bio-available nutrients to be released and available for floating plants.

Minimise nutrient and organic loads to the lake.

Avoid the inclusion of floating aquatic vegetation (e.g. water lilies) that can contribute to organic loads to the lake, thus supporting weed infestations such as Salvinia, Water hyancinth and Water lettuce.

Provide suitable access for prompt removal of terrestrial and aquatic weeds.

Figure SC6.4.3.12.5 Examples of aquatic weeds - Salvinia (L) and Water Lettuce (R)

Figure SC6.4.3.12.6 Example of water lilies (L) and weed infestation at a lake edge (R)

SC6.4.3.12.5 Constructed lakes design steps

These guidelines are a step by step outline to support development applications where involving reconfiguring a lot (ROL) or material change of use (MCU), where a proposed development includes a lake, and subsequent Operational Works requirements. Council will require considerable detail at the ROL/MCU stage to fully assess the merits of proposed lake. This includes field investigations to characterise the soils and groundwater at the proposed site.

(1) Step 1: Design intent

The primary intent for the lake is to be clearly defined. The design intent must be accompanied by concept plans showing location and layout with respect to the development as well as existing vegetation and receiving environments. The principles in SC6.4.3.12.1(3) include constructed lake uses preferred by council.

(2) Step 2: Determine lake type

(a) Saline lake

In Townsville, due to the extended dry season, the preferred constructed lake with regards to long term sustainability, weed and water level management is a saline lake, where possible. Although less diverse than fresh water lakes, the operation of saline lakes are considered more robust for Townsville conditions. Saline lakes should not be configured to receive fresh water inflows as this can result in brackish conditions which are highly susceptible to the development of Cyanobacterial blooms. This can include stormwater runoff or pumped fresher inputs during the wet season where the source water is from estuaries. The proposed method of inflow, control and water level management must also be stated. Refer to SC6.4.3.12.5(4) Step 4 (e.g. pumped or gravity control).

(b) Fresh water lake

Where fresh water lakes are proposed, the proponent should consider other alternatives such as heavily vegetated constructed wetland systems which can provide open water views and water treatment benefits (refer to SC6.4.3.9 Water sensitive urban design guidelines).

In the case that a fresh water lake is decided upon, the proponent must demonstrate that the lake is configured to receive treated stormwater inflows only (as per the requirements of SC6.4.3.9 Water

sensitive urban design guidelines). Untreated overflows should by-pass constructed fresh water lakes. A separate Stormwater quality management plan (SQMP) must be submitted detailing upstream water quality devices and expected improvements via MUSIC modelling.

Editor's note—SC6.4.3.8 Stormwater quality management plans for development provides guidance to applicants on the preparation of SQMPs, including the use of MUSIC modelling.

The proponent must also clearly demonstrate how water level variations will be managed and proposed alternative sources of water to maintain lake water levels within acceptable variations (refer to SC6.4.2.12.15(7) Step 7).

(c) Brackish lakes
Brackish lakes should be avoided in Townsville. Freshwater Cyanobacteria are particularly responsive to changes in salinity, often resulting in dramatic alterations in dominance (Paerl, 1988). Brackish lakes are often dominated by Cyanobacteria due to the tolerance of many Cyanobacterial species to low salinity.

(3) Step 3 – Site soil and groundwater assessment
A soil and groundwater assessment will be required to characterise local soil and groundwater and demonstrate that the proposed lake will not negatively impact on the local groundwater (considering seasonal fluctuations) and avoids problematic soil areas (e.g. high organic contents, peats, sodic soils).

Where contaminated sites are identified, thorough soil and groundwater assessments will be required and remediation plans developed. Groundwater modelling will also be required to demonstrate that proposed lakes do not or are not negatively impacted by adjacent contaminated sites. Specialist geotechnical/hydrogeological advice will be required to assess risks and develop remediation plans.

A site and soil evaluation must be undertaken in accordance with AS/NZS 1547. Field investigations and laboratory testing are required to sufficiently classify soils, determine the requirements for lining, identify possible PASS and sodicity issues and seasonal groundwater fluctuations. More detailed investigations such as Acid sulfate soils testing will be required in the detailed design stage, if deemed necessary.

Editor's note—Part 9.4.2 Healthy waters code sets out requirements for acid sulfate soils, including the reporting and management requirements to be achieved.

Installation of a series of shallow groundwater wells will be required to sufficiently characterise the shallow groundwater regime (if this occurs) and possible groundwater related impacts and risks due to the proposed lake. Monitoring of water levels at fortnightly intervals over a continuous full dry and wet season will be required as a minimum to support the lake design. The monitoring wells will be required to be available following the lake construction for monitoring purposes, and should be provided with lockable standpipes. A typical shallow monitoring well is indicated in Figure SC6.4.3.12.7 below.

Soil and groundwater investigations must identify potential risks and possible management options and further testing and monitoring required. This also includes assessments on nutrient hazard, which will require soil and groundwater nutrient characterisation. Other site conditions such as perched water tables, waterlogged areas where anaerobic condition exists are to be identified as these can promote the formation of nutrients into bio-available forms.

Additional design and investigation may be required during the detail design stage to manage identified risks.

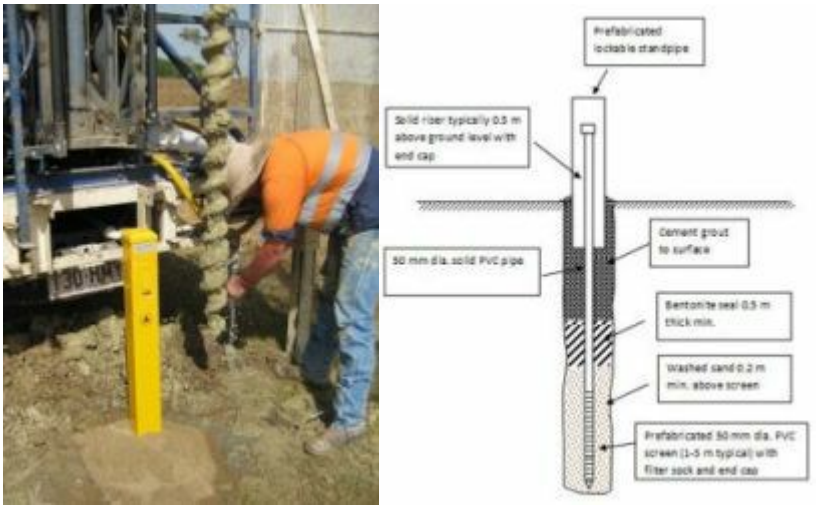


Figure SC6.4.3.12.7 Typical monitoring well installation

(4) Step 4 – Lake inflows and outflows

(a) Lake inflows will depend on the type of lake proposed. Inflows to fresh water lakes will be governed by catchment dependent stormwater runoff. As the source of inflow is typically limited to urban runoff entering the lake, water level variations of one metre or more could be expected throughout the year.

Saline lakes typically have a constant source of water available, and as such water level variations will depend on the configuration of inlets and outlets in such cases. For example water level fluctuations can be maintained constant throughout the year with pumped delivery.

Whether designing saline or fresh water lakes, inlets and outlets must be configured to maintain the intended operation of the lake as either a saline or fresh water system, this includes preventing tidal influences to fresh water lakes, and large fresh water inputs to saline lakes (e.g. stormwater inflows or pumped fresh water during the wet season where the source of water is from estuaries).

Maintaining the intended type of lake (i.e. fresh or saline) will minimise possible detrimental impacts to the aquatic flora and fauna that establishes within the lake.

Lake outflows are typically associated with evaporation and seepage losses as well as overflows controlled by the lake outlet.

Depending on the lake system proposed sufficient information must be provided to council to define both inflow and outflow. Typical details that should be defined (where relevant) include:

(i) catchment area draining to the lake, including characteristics (land use, per cent impervious);

(ii) drainage network connecting to the lake (existing and proposed);

(iii) upstream water quality improvements (applicable to freshwater lakes only);

(iv) source of water, quality and sustainability;

(v) pump or gravity diversions to the lake including required rates and necessary controls; and

(vi) outflow type including provision for water level manipulation and maintenance draining.

(b) Freshwater lake considerations

(i) Water quality improvements

Catchment inflows contributing to freshwater lakes must be demonstrated to achieve the minimum water quality improvement targets. A separate Stormwater quality management plan is required detailing upstream stormwater quality improvement devices and demonstrates through MUSIC modelling expected water quality improvements.

Editor's note: SC6.4.3.8 Stormwater quality management plans for development provides guidance to applicants on the preparation of SQMPs, including the use of MUSIC modelling.

Target pollutant load reductions for new developments relevant to Townsville are:

(A) 80% reduction in Total Suspended Solid;

(B) 65% reduction in Total Phosphorous;

(C) 40% reduction in Total Nitrogen; and

(D) 0% reduction in gross pollutants (>5 mm particles).

Modelling is to consider 6 minute rainfall data for Townsville for the period 1970-1983 (mean rainfall 1,165 mm). Upstream stormwater quality improvement devices must be designed in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(i) Modelled catchment inflows

The expected inflow volume and seasonal variation is to be modelled, considering catchment characteristics and upstream treatment devices. Modelled inflows must only account for treated flows entering the lake, overflows are not to be included. Modelling of catchment inflows must be undertaken at a suitable time step to accurately model diversions to treatment devices. Typically this is at 6 minute intervals for urban catchments. Modelled inflows can be transformed to daily aggregates for further interrogation such as water balance modelling to review lake water level variation. MUSIC modelling used to demonstrate upstream water quality improvements can be adapted to provide catchment inflow series at daily time steps.

(5) Step 5 – Determine a preliminary lake layout

Develop a preliminary layout within the site constraints. The preliminary layout should consider:

(a) soils and groundwater;

(b) topography;

(c) waterways and flood plains;

(d) existing vegetation;

(e) surrounding environments;

(f) flora and fauna;

(g) natural features such as significant trees, exiting aquatic environments (billabongs, wetlands, marine plants);

(h) coastal management and erosion prone zones;

(i) buffer distances; and

(j) easements and service corridors.

Baseline surveys are critical at this stage to fully understand site constraints and opportunities. These include topographic, drainage, vegetation and flora and fauna surveys. Soils and groundwater assessments must be presented in a separate report as detailed in SC6.4.3.12.5(2) Step 2. Delineation of the highest astronomical tide (HAT) level and mean high water spring tide level (MHWS) will also inform the potential impact on erosion prone zones. For Townsville these levels correspond to:

- HAT = 2.254m AHD; and
- MHWS = 1.254m AHD.

Site reconnaissance and review of aerial photographs must be undertaken at this stage to fully understand the site constraints and opportunities.

Based on climatic conditions for Townsville, the maximum fresh water lake area (at wet season normal water level) is considered at 2.5% of the contributory catchment (considering 50% impervious fraction). Refer to SC6.4.3.12.5(7) Step 7. Smaller areas may be necessary for algal management (refer to SC6.4.3.12.5(8) Step 8).

The lake configuration should consider shapes that avoid dead end zones or result in poorly mixed waters.

Minimum length to width ratios of 3L:1W are recommended to ensure good hydraulic efficiency.

Where possible the orientation of lakes should be in a north west/south east alignment corresponding with the dry season prevailing wind. Lakes should not include islands as these can create poor water circulation and provide a refuge for birds that can contribute to nutrient loads to the lake.

Preliminary layouts should make provision for batters, edge treatments and buffers (refer to SC6.4.3.12.5(11) Step 11). These can add considerably to the overall lake area above the normal lake water level and can impact on the final layout.

Lakes should avoid areas where poorly structured soils (e.g. high organic content, peats, sodic soils), high acid sulfate potential and/or high nutrient hazard is identified.

Lake layouts must also demonstrate that the lake blends into surrounding environments and enhances natural features. Consideration must also be given to linking with recreational and landscape master plans for the area as well as public interaction and education opportunities.

Lakes should also avoid constricted flood ways where flow velocities can be high during flood events.

Editor's note: Applicants should refer to Part 8.2.6 Flood hazard overlay code for details of flood across the Townsville region.

(6) Step 6 –Lake bathymetry

A lake stage/storage/area curve must be developed for council review, including allowance for lake batters (refer to to SC6.4.3.12.5(11) Step 11 for typical acceptable edge treatments). The bathymetry should consider the proposed shape within the site constraints. The depth of the lake must be between 1.5 and 3 m, preferably in the range of 2-2.5 m. Lake depth is considered from wet season normal water level to finished lake bed level.

Depths greater than 3 m are more prone to stratification, which can potentially lead to the release of nutrients to upper waters when they de-stratify, potentially increasing the risk of phytoplankton blooms, particularly Cyanobacteria (toxic blue green algae). A minimum depth of 1.5 m must be provided to allow maintenance equipment such as floating weed harvesters to access lakes.

(7) Step 7 – Undertake water balance modelling

Water balance modelling is required to review the seasonal water level variation of lakes. The proponent must demonstrate to council the expected water level variation over a minimum 10 year continuous modelling period.

The general form of the water balance equation is given by:

$S=I-O$

where

S=storage, I=inflow, O-outflow

(a) Inflows:

(i) catchment runoff entering the wetland (see SC6.4.3.12.5(4) Step 4); and

(ii) direct precipitation over the lake.

Other inflows such as groundwater and base flow are difficult to quantify and can only be considered where sufficient data supports their use. As a conservative approach these can be ignored.

(b) Outflows:

(i) evaporation losses (determined from the stage/storage/area curve, as derived from SC6.4.3.12.5(6) Step 6 and typical daily evaporation rates for Townsville);

(ii) lake outflows/overflows; and

(iii) seepage losses.

(c) Water level variation

Water balance modelling must demonstrate that lake water level drawdown from wet season normal water level does not exceed 1 m once every 10 years on average and less than 0.7 m on a more frequent

basis (on average once every 2 years or less).

Based on climatic conditions for Townsville, the maximum fresh water lake area (at wet season normal water level) is considered at 2.5% of the contributory catchment (considering 50% impervious fraction).

(d) The overall size of the lake will also need to consider algal management issues, as described in SC6.4.3.12.5(8) Step 8. Where algal management options consider recirculation through a wetland, water balance modelling must also include the impacts from inclusion of the recirculation wetland. Refer to SC6.4.3.12.5(8) Step 8.

Designers must be aware of the implications of water level variations with respect to edge treatment survival and visual amenity. Design steps should be taken to limit water level variation to no more than 1 m once every 10 years and 0.7 m once every 2 years, and this may require the inclusion of:

(i) a lake liner to minimise seepage losses; or

(ii) provision for lake top-up.

Designers may need to consider hard edge treatments to minimise visual impact in high amenity areas or supplementary irrigation to maintain lake edge vegetation. SC6.4.3.12.5(11) Step 11.

Photos: Shaun Leinster

Figure SC6.4.3.12.8 Examples of impacts due water level variations

(e) Lake top-up

Where designers consider lake top-up to maintain lake water levels, suitable sustainable sources are to be considered. These may include the use of harvested stormwater and groundwater for fresh water lakes. Where groundwater is proposed the proponent must undertake necessary hydrogeological investigations to demonstrate that the proposed pumping does not detrimentally impact on the local groundwater resource. The quality of the groundwater must also be demonstrated to not negatively impact on the health of the lake.

Lake top-up for saline lakes must maintain the salinity of the lake at greater than 15,000 mg/L. This may require the provision for salinity control on pumped delivery to lakes from estuaries to ensure wet season fresh water pulses are not delivered to the lake.

Potable mains supply is not considered an acceptable source for lake top-up.

Where harvested stormwater is considered for lake top-up for fresh water lakes sufficient storage must be available. The volume of storage required can be estimated from the water balance modelling, but as a general guide is in the order of 15 ML per hectare of lake per annum to maintain constant water levels throughout the year, where the lake area is taken at the wet season normal operating level.

Storages can be constructed storages or use of natural underground aquifers. Constructed storages to provide sufficient top up for Townsville fresh water lakes are typically not considered practical due to the significant volumes that would be required (typically in the order of the total lake volume), although dedicated storage dams may be considered.

When considering aquifer storage opportunities, hydrogeological investigations will be required to determine the feasibility, which will include assessing the capacity of the aquifer to store water and the potential impact on the native groundwater and other users. Storage of water in shallow aquifers is not recommended due to the possible impact on adjacent structures and possible water logging. Design guidance on aquifer storage and recovery (ASR) is outside the scope of this guideline. Specialist hydrogeological advice must be sought should this option be pursued.

(8) Step 8 - Algal management

A key design consideration for algal management in lakes is the management of trigger mechanisms such as nutrients and turbidity, and the removal of algal biomass from the lake water body before bloom concentrations occur. Algal biomass removal rates should be at least equal to the in-situ algal growth rate. Algal biomass removal can be facilitated via a number of methods including lake flushing or removal through a recirculating wetland. Other methods are available and are included in SC6.4.3.12 Attachment A: Alternative strategies for managing Cyanobacterial growth.

Photos: Shaun Leinster

Figure SC6.4.3.12.9 Examples of blue-green algae

A probabilistic approach based on lake residence time has been adopted in Queensland, such as the Brisbane City Council's *WSUD guidelines for Pond and Lake Design* and also *Mackay Planning Scheme Policy 15.15* – Constructed lakes for minimising the risk of Cyanobacterial growth in constructed lakes. These recommend a 20th percentile residence time for lakes not exceeding 20 days.

The Mackay Planning Scheme Policy 15.15 – Constructed lakes also stipulates that where the lake residence time criteria is exceeded, then water can be recirculated through a wetland at a rate that ensures lake turnover every 20 days. A minimum wetland residence time of 5 days is also stipulated to provide sufficient contact time (two growing cycles) for algal biomass removal.

The effectiveness of a recirculation strategy using surface wetlands for algal management in Townsville is still largely unknown and the required recirculation rates for Townsville conditions are also currently unknown. However recirculating lake water through surface flow wetlands is considered a sound approach with respect to removal of suspended solids (and thus turbidity) and nutrients in lake water, two key triggers for changes in state for shallow lakes.

Whichever algal management method is proposed, the proponent must clearly demonstrate that the strategy is effective in removing algal biomass to minimise the opportunities for algal blooms.

In the absence of further information, proponents proposing constructed lakes in Townsville must demonstrate that the entire lake volume is "flushed" through the lake within a 20 day period for the control of algal biomass. As rainfall dependent catchment inflows in Townsville will result in extended periods where full lake volume turnover is not achieved (e.g. >100 days during the dry season), other sources such as diverted surface water and groundwater will be required. The rate of diversion can be estimated simply as follows:

Required lake inflow rate (m3/d) = lake volume (m3)/20 days

Where flushing is adopted, the source of water used must have a nutrient, turbidity, algal bio-mass less than or equal to the lake water and salinity ranges should be maintained for the intended lake type (refer to Table SC6.4.3.12.2 Suggested target values for physico-chemical indicators).

(a) Recirculating wetlands

Where no external flushing supply is available, provision for a recirculating wetland for algal management should be made. The following design criteria are considered:

(i) recirculation of the full volume of lake water through the wetland every 20 days;

(ii) minimum wetland contact time of 5 days;

(iii) treated water re-entering the lake must have turbidity, nutrient and algal biomass levels less than or equal to the lake water; and

(iv) water re-entering the lake must be at opposite ends from where water is abstracted from the lake to avoid short circuiting of treated flows.

This strategy does not guarantee that no algal blooms will occur and proponents must also develop an adaptive management plan for algal blooms.

For the above design considerations, the approximate size of the recirculating wetland is 1.5 times the area of the lake based on an average wetland depth of 0.3 m. Smaller recirculating wetlands can be considered where the proponent can demonstrate that algal biomass removal rates are greater rates than those assumed in the above derivation. For example, ultrasonic treatments of recirculated lake flows can potentially reduce algal biomass concentrations, thus reducing the recirculating wetland size. A further alternative may be the use of floating macrophyte beds, which can remove bio-available nutrients from the water column, and can be used within the lake or as part of the recirculation strategy. This option will require regular harvesting of the floating macrophytes to reduce nutrient loads from the lake.

Design of the recirculating wetland must consider maintaining the health of the wetland and associated vegetation. This requires the recirculating wetland to be operated continuously throughout the dry season to maintain a permanent pool of water over the majority of the wetland area. To minimise recirculation rates the recirculating wetland is considered as a shallow planted system, without deep pool areas. This differs from stormwater treatment wetlands where deep pool zones are included, and typically cover up to 20% of the total area in the dry tropics (refer to SC6.4.3.9 Water sensitive urban design guidelines).

An average wetland depth of 0.3 m is considered sufficient for recirculating wetlands and will include shallow to deeper zones supporting a range of emergent macrophytes from shallow marsh (0-0.2 m), marsh (0.2-0.35 m) and deep marsh (0.35-0.5 m). The wetland area needs to be sized to provide a 5 day treatment time, considering the minimum recirculation rate determined for the lake volume (refer to above). In this case the wetland area can be estimated as follows:

Recirculating wetland area = 5 days x recirculating pump rate (m3/d)/ave wetland depth (0.3 m)

The overall configuration of the recirculating wetland must consider inlets and outlets at opposite ends and minimum length the width ratios of 5L:1W to maintain good hydraulic efficiency and thus mixing throughout the wetland. Wetland shapes must avoid dead end zones and possible short circuiting. Designers are directed to SC6.4.3.9 Water sensitive urban design guidelines for further advice on the design of constructed wetlands.

(9) Step 9 – Select final lake layout

Following approval of concepts presented to council, the final lake area must be selected considering the soil and site constraints from SC6.4.3.12.5(3) Step 3 and SC6.4.3.12.5(5) Step 5, depth ranges within those indicated SC6.4.3.12.5 (6) Step 6, acceptable water level variations derived from SC6.4.3.12.15(7) Step 7 and additional allowances where recirculating wetlands are proposed for algal management SC6.4.3.12.5(8) (Step 8).

The final lake configuration must consider shapes that avoid dead end zones or result in poorly mixed waters. Minimum length to width ratios of 3L:1W are to be provided to ensure good hydraulic efficiency.

The final lake layout will need to integrate with the approved landscape and amenity plans for the development, development road layouts, accesses and required civil works.

(10) Step 10 –Design of inlets, outlets and other hydraulic structures

Lake inlets and outlets should be located at opposite ends of the lake to promote uniform movement of water through the lake and avoid short circuiting of flow. The design of inlet and outlet structures will depend on the type of lake proposed. Inlets and outlets must be designed for minimum maintenance and must make provision for scour control at pipe outlets.

Inlets and outlets must not be subject to blockage through excessive silt and debris build up and/or excessive vegetation. Design actions may include:

- provision of stone pitching at inlets and outlets to prevent vegetation growth; or
- suitable screens to minimise debris ingress.

Inlets and outlets structures are to result in minimal visual impact and may be hidden under boardwalks or amongst rocks, for example.

The proponent is to provide engineering calculations for the design of lake hydraulic structures, the design of which will differ depending on whether a fresh water or saline lake is proposed. The designer is directed to other parts of SC6.4 Development manual planning scheme policy as relevant, the *Queensland Urban Drainage Manual*, and the *Road Drainage Manual* for more design guidance on specific hydraulic design of pipes and pits and erosion protection at pipe outfalls.

The influence of tidal variation including storm surge, wave setup and impacts of climate change must be detailed to council. For the purposes of design the following tide levels are noted for the Townsville region (Townsville Harbour, QDOT, 1998):

Tidal plane	mAHD
Highest Astronomical Tide (HAT)	2.254
Mean High Water Springs (MHWS)	1.254
Mean Sea Level (MSL)	0.1
Mean Low Water Springs (MLWS)	-1.13
Lowest Astronomical Tide (LAT)	-1.86

The designer must consider the potential impacts of sea level rises due to climate change and make provisions in the design for such increases.

In the case of saline lakes proponents must clearly indicate how lake flushing will be achieved and any necessary pumping equipment, control and telemetry systems that may be required to facilitate operation.

(a) Inlets

Inlets to lakes may be gravity diversion of treated stormwater runoff or pumped delivery from adjacent water bodies (e.g. from estuarine river systems).

Stormwater inflows

In the case of piped stormwater flows to lakes, pipe inverts from upstream catchments should be set no lower than lake wet season normal operating level. This will avoid permanent water within the pipe drainage system and maintain hydraulic capacity of the connecting pipe drainage. Suitable erosion protection at the pipe outfall must be provided to prevent scour. Refer to QUDM, 2007.

Photos: Shaun Leinster

Figure SC6.4.3.12.10 Examples of concealed inlets to lakes

Provision for a gross pollutant trap may also be required to capture litter and leaf matter prior to discharge to the lake.

Where a separate inlet sedimentation zone is proposed, the designer is directed to the SC6.4.3.9 Water sensitive urban design guidelines for further advice.

Pumped inflows

Pipe outfalls to lakes for pumped delivery may be submerged, however suitable backflow prevention devices must be installed to prevent possible draining of the lake.

Photos: Ralph Williams

Figure SC6.4.3.12.11 Pump intake from Ross River – note blocked screen (L), and pumping infrastructure including sump and control equipment (R)

Pumped delivery systems must consider aspects such as the control of delivery to the lake. This may include the control of the pumping regime through tidal cycles and preventing fresh water being pumped to the lake. The expected pumped volumes with respect to the lake volume should be demonstrated to allow sufficient flushing. A flow meter on the discharge side of the pump is recommended. Suitable arrangements must be made in case of pump failure to ensure minimum flushing rates are maintained. This may include a standby pump. Provision for internal lake recirculation may also be required where extended periods of fresh water during the wet season at the source of pumping prevent delivery to the lake.

(b) Outlets

Lake outlets can be configured in a number of ways and will determine the normal wet season operating level. Lakes for flood mitigation purposes are not encouraged in Townsville region and should by-pass high flows, thus the design of lake outlets will only need to consider design inflows (e.g. connecting pipe capacity or pumped diversion rate) and any incidental rain over the lake.

Impacts of possible tailwater effects at pipe outlets must be considered when sizing outlet pipes. Refer to QUDM, 2007 for further guidance.

In the case of fresh water lakes, ingress of tidal waters to the lakes must be prevented. Water levels to HAT (2.15 m AHD) must be considered in this case. Allowances for tidal surges should also be made.

Outlets must be designed to minimise potential blockage. An overflow path (e.g. weir) should be provided in case of outlet structure blockage. This will minimise potential damage to vegetated edge treatments.

Overflow pit and discharge pipe
Overflow pits can be located within the lake water body, with the crest of the pit defining the normal lake wet season operating level.
The design should consider:

(i) pit dimensions such that pit capacity is greater than the connecting culvert capacity;

(ii) suitable pit grate to protect against clogging by debris;

(iii) minimal visual impact;

(iv) prevent local fauna such as ducks from entering the pit; and

(v) capacity to drain the lake for maintenance.

Additional guidance is provided in the SC6.4.3.9 Water sensitive urban design guidelines.

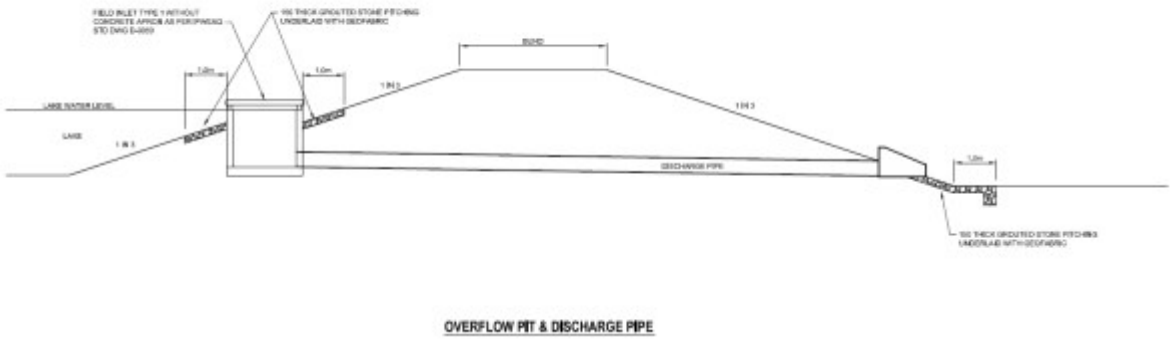


Figure SC6.4.3.12.12 Typical overflow pit and discharge pipe details

Outlet pit and discharge pipe
Outlets may also consider submerged pipes connecting the lake to an outlet pit with a discharge pipe. The lake normal water level may be set via an open ended riser pipe or a weir plate in the outlet pit. Either can be configured to be easily removed to facilitate maintenance draining.

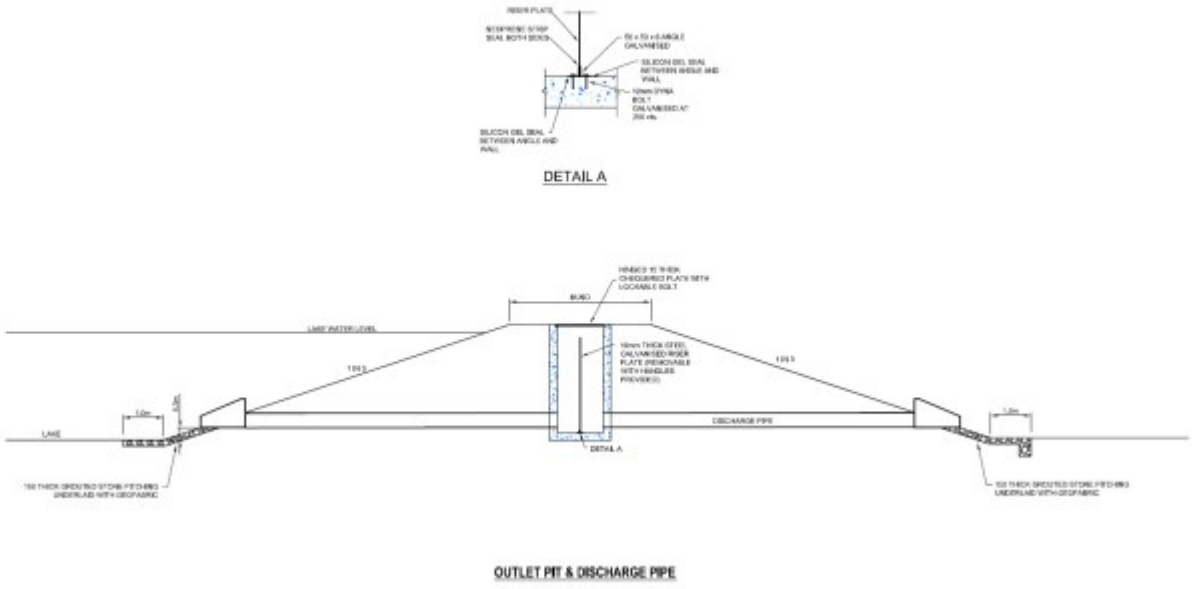


Figure SC6.4.3.12.13 Typical outlet pit and discharge pipe details

Overflow weir

Lake outlets may also be controlled via an overflow weir with weir levels set at the normal wet season operating level. This may also include outlet culverts that effectively operate similar to a weir i.e. the culvert invert defines the normal wet season operating level.

Suitable erosion protection such as rock pitching must be provided at lake outlets and overflows.

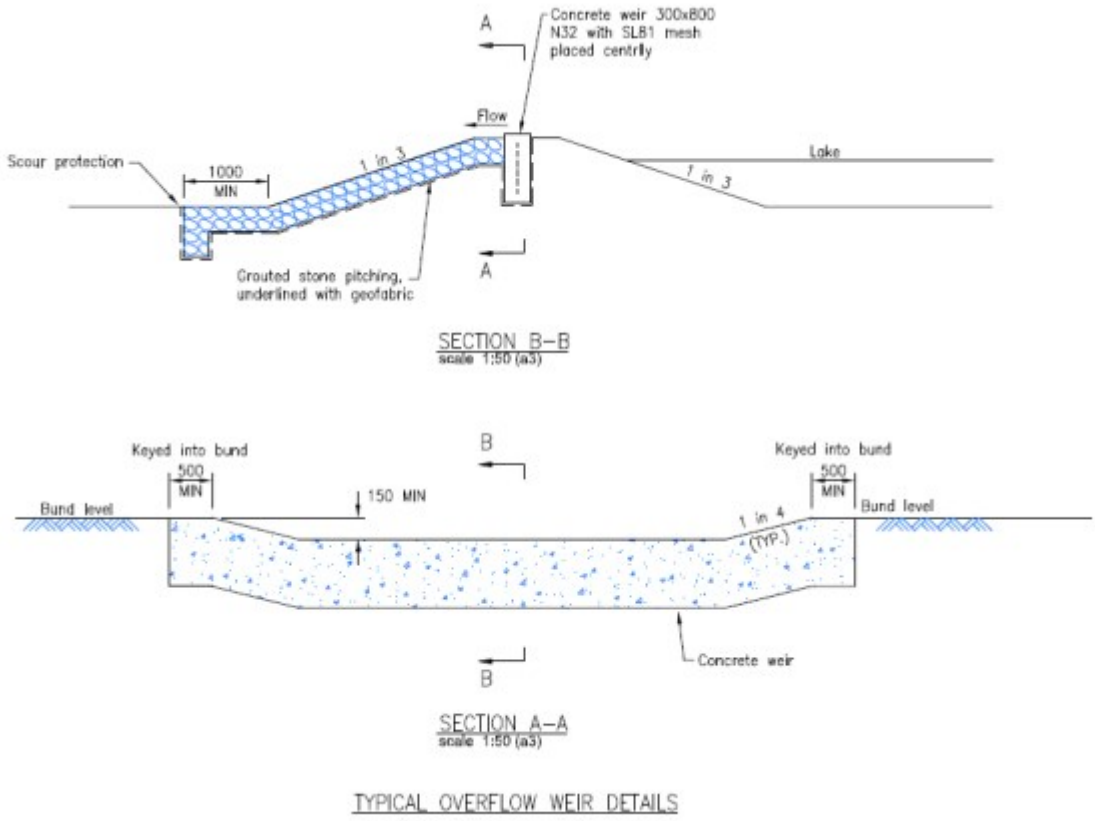


Figure SC6.4.3.12.14 Typical overflow weir detail

(c) Interconnections between lakes

Where separate interconnected lakes are proposed, suitable connections between lake water bodies must be provided. This may include open channel/weir connections or culvert connections. The design

must consider:

(i) maintaining good hydraulic efficiency and mixing between water bodies;

(ii) minimising head losses between water bodies during operation;

(iii) maintaining access between the lake water bodies; and

(iv) provision for lake drawdown during maintenance.

Where open channel/weir connections are proposed, the designer must consider the potential impact of any necessary recirculation strategy. In such instances, preference is for submerged pipe connections, to maintain hydraulic interconnection between lake water bodies during the dry season when lake operating levels are below wet season normal water levels. As lake water level variations of up to 1 m are considered, submerged pipes obverts should be at least 1 m below normal wet season operating levels.

Where gravity drainage is proposed for lake maintenance, interconnecting pipes will need to consider inverts that facilitate adequate drawdown of all connected water bodies.

(d) Maintenance drain

Provision for a maintenance drain must be made to allow the lake to be drained for periodic maintenance. This drain can be a manually driven gravity drain or where gravity drainage is not possible provision for pumping must be made. The proponent must state the proposed method of draining and where pumping is proposed suitable access must be allowed for pump maintenance. The cost of pumping must also be considered in any life cycle costing (refer to SC6.4.3.12.5(18) Step 18).

The operation of the maintenance drain should ideally allow lake drawdown within seven days, although for large lakes this may not be possible.

The proponent must considered impacts of lake draining on potential acid generating conditions that may occur as well as the potential impacts on downstream receiving bodies due to the draining.

The maintenance drain must also facilitate water level management during establishment, particularly for establishing lake edge vegetation.

(11) Step 11 - Design of lake edges and batters

Lake edges play an important role in weed management for lakes. Edge treatments must also consider large water level variations (up to 1 m are allowed on an infrequent basis and 0.7 m on a more frequent basis, refer to SC6.4.3.12.5(7) Step 7), including visual amenity aspects and survival of edge vegetation. Edge treatments must consider public safety (refer to SC6.4.3.12.5(17) Step 17).

To minimise exposed edge width due to water level variations, batters slopes at a minimum 3H:1V are preferred. Flatter slopes above wet season normal water level are permitted depending on the final treatment. Where turf areas are proposed batter slopes of no more than 5H:1V must be provided to allow mowing. Typical edge treatments for both fresh and saline lakes are indicated in Figure SC6.4.3.12.15.

At the ROL/MCU stage the proponent must indicate the type of edge treatments proposed, including the structure and mix of edge treatment (refer to SC6.4.3.12.5(12) Step 12).

At the operational works stage, lake edges must be considered based on an updated water balance based on the final lake layout to confirm expected water level variations established from preliminary layouts.

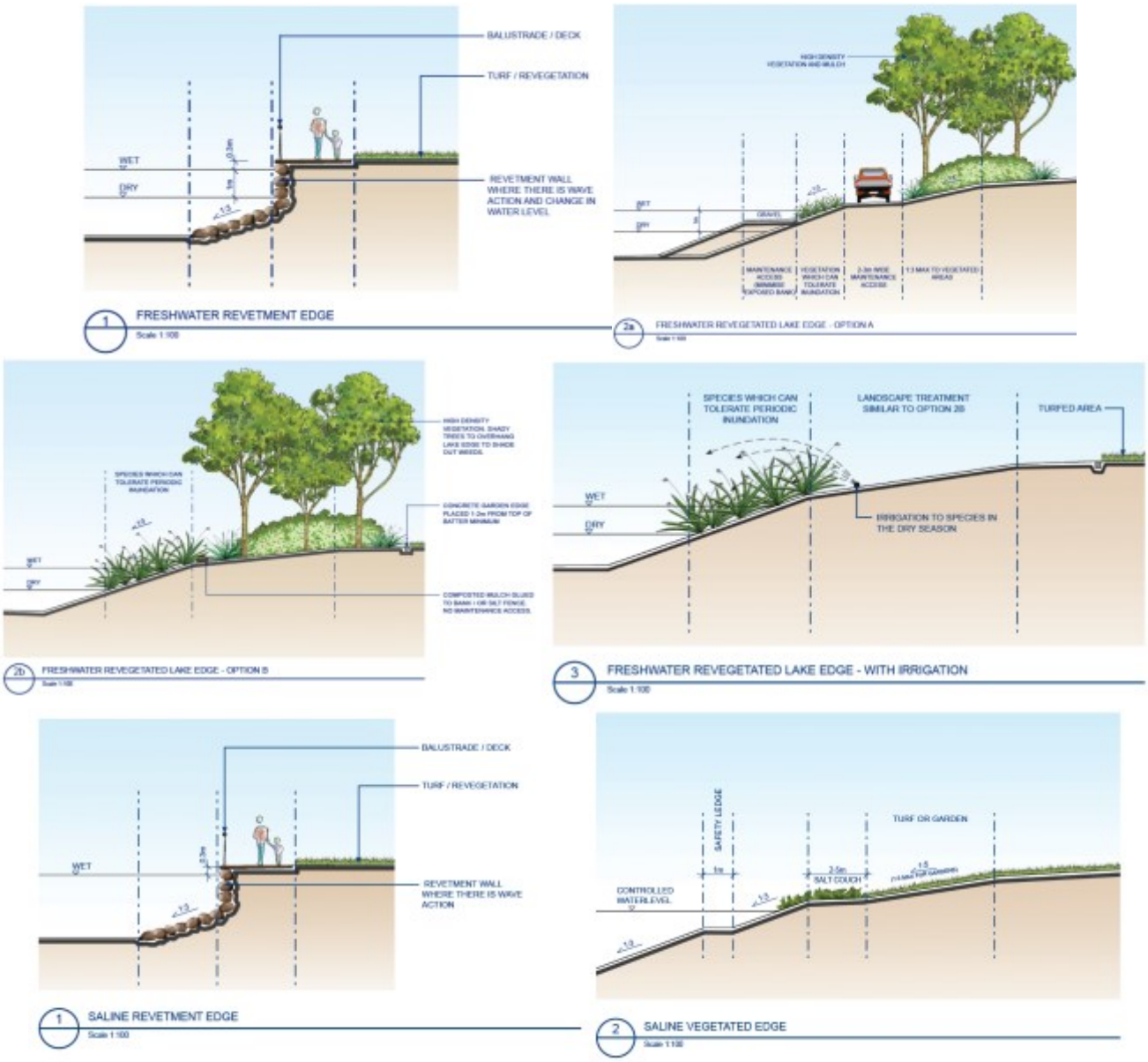


Figure SC6.4.3.12.15 Typical examples of edge treatments for fresh and saline lakes

(12) Step 12 –Vegetated lake edge treatments

Editor's note—applicants should also refer to 9.4.3 Landscape Code and Development manual planning scheme policy sub section SC6.4.3.6 Landscape policy.

The structure and mixture of vegetation of the proposed lake edge will be a key design consideration for a well performing edge treatment. Lake edge treatments should aim to re-establish a mix of local indigenous species including trees, shrubs, groundcovers and grasses that complement and enhance the amenity of the area. Adjacent parkland vegetation may consider similar species to lake edges to integrate the lake with the surrounds, or alternatively different species may be used to provide a contrast to highlight the lake as a feature within the landscape.

At the ROL/MCU stage the proponent should indicate the proposed structure and mix of vegetation for the proposed lake, together with the proposed methods for establishing and maintaining healthy vegetation. The expected lake water level variations are also required.

Editor's note—guidance on typical options for varying lake edge conditions are presented previously in SC6.4.2.12.5(11) Step 11, and can be adapted to suit specific requirements of the proposed lake.

For operational works approval the proponent should clearly detail proposed treatments including:

- plant species;
- location with respect to lake water level;
- planting density and layout; and
- planting methods.

Planting details should be indicated in plan and section in the detail design drawings. Guidance on plant species suitable for the Townsville region is provided in SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.3.6 Landscape policy.

Various types of treatments can be used and the type and density will be a key design consideration for the effective performance of the treatments. Broadly edge treatments can include:

- perennial sedges and rushes (emergent macrophytes);
- ground covers;
- shrubs;
- turf;
- trees; and
- mulches.

A minimum planting of 1 m vertically above wet season normal water level is considered necessary to provide stable edge treatments.

Successful establishment of vegetated lake edges will include:
Good soil preparation including a minimum 200 mm topsoil. Soils are to be amended where necessary to be considered as agronomically acceptable. Topsoils are to be laboratory tested to AS4419-2003 *Soils for landscaping and garden use* to ensure topsoil suitability for plant growth. Topsoils must not contain weeds or susceptible to acid generation which may kill off plants. Amendments such as lime and gypsum may be required.

- selection of an appropriate planting time. Planting toward the end of the dry season is preferred to take advantage of early wet season rains.

- maintaining good moisture for plant growth during establishment. This may include; supplementary irrigation and mulching;
- protection from disturbance during establishment;
- replacing damaged or dead plants; and
- removing weeds both prior to and during establishment.

(a) Perennial sedges and rushes (1.0 m below to 0.2 m above wet season NWL)
Sedges and rushes provide a soft natural edge to lakes. The use of sedges and rushes are important in minimising weed ingress and provide a dense barrier to the lake edge minimising human contact with water and thus reducing safety risks. It is important that sedges and rushes are planted in high densities (20 plants/m^2) and permanently occupy the edge to limit the opportunities for weed establishment. Typically dense vegetation at least 1.2 m high and 2-3 m wide will be suitable.

Photos: Shaun Leinster

Figure SC6.4.3.12.16 Examples of edges treatments with sedges and rushes

Plant selection must be able to survive the expected water level variations and may require supplementary irrigation to ensure survivability during the dry season. Tall, small diameter stemmed, self-sustaining plants that distribute themselves by producing large quantity of seed are preferred.

Where possible, shade should be provided over sedges and rushes to minimise the potential ingress of weed species such as Para grass. Shade can be provided through planting of trees species adjacent to the lake edge. Aspect also plays an important role for shade considerations, with south facing banks providing good shade opportunities to lake edges.

(b) Ground covers and shrubs (greater than 0.2 m above wet season NWL)
Groundcovers and shrubs can be provided above the lake normal water level to help stabilise lake batters and provide aesthetic/landscape feature. Groundcovers and shrubs should be less than 1 m in height to maintain open visible areas. Groundcovers and shrubs are particularly useful where batter slopes greater than 3H:1V are proposed. For slopes greater than 3H:1V, ground covers with matting and rhizomatous root systems can assist binding the soil surface during establishment.

Photos: Shaun Leinster

Figure SC6.4.3.12.17 Examples of edge treatments using ground covers

(c) Turf
Turf treatments can be used to highlight the water body as a feature within the landscape and encourage recreational use adjacent to the lake. For maintenance purposes, batter slopes for turf treatments must be not greater than 5H:1V. Supplementary irrigation will most likely be required to maintain turf health.

For saline lakes, salt couch is a typical suitable edge treatment. Salt couch is particularly sensitive to extended periods of inundation and should be above the normal wet season water level. Salt couch extending 2-5 m from the water edge over a wide flat (10H:1V) area is preferred.

Photos: Shaun Leinster

Figure SC6.4.3.12.18 Example of a turf and salt couch edge treatment

(d) Trees

Trees provide an important function in the overall performance of lake edges where perennial sedges, rushes and shrubs are proposed. Trees provide shade which helps minimise ingress of weeds such as Para grass. In such cases, the tree location must be within close proximity to the edge such that shading is achieved. Tree densities of 1 2 per m^2 are recommended.

When selecting tree species, preference is for deep rooted species. Careful consideration must be made when grass and tree species are mixed together as grasses can kill off trees when establishing. Use of ground covers around trees are preferred. Ground cover legume species are preferred with trees, however legume tree species should be avoided (e.g. acacias).

It is likely that suitable education signage will be required around areas with tree planting to describe the function of trees with respect to the lake. Past experience with lakes in residential areas around Townsville has seen residents removing trees due to the desire for increased lake views and the perception that the native vegetation encourages snakes.

(e) Mulches

A variety of mulches are available to provide erosion protection and aid vegetation establishment at lake edges. The suitability of mulches will depend on the vegetation proposed and batter slopes. Typically, mulches should be bio-degradable and are usually 50-100 mm thick. Typical mulches include:

(i) straw/sugar cane mulches: are particularly useful for grass establishment where water for irrigation is limited. They are also useful where dispersive clay soils exist. Typically used in flat slope areas (less than 10H:1V), but can be used on steeper;

(ii) slopes with the use of tackifiers or with biodegradable mesh anchoring;

(iii) hydromulching: typically used for grass establishment, but will usually require greater watering requirements than straw mulch treatments. Adhesive binders and fertilizers are typically incorporated into hydromulch mixtures, together with fibrous matrix of wood or paper pulp and grass seed. Hydromulching is particularly suited to steeply sloping sites or areas with difficult access;

(iv) bush mulches: includes mulches such as bush mulch, bark and wood chip and are most suited to shrub and tree areas. They are not suited to areas where grasses are proposed and should only be used where tube stock planting is planned;

(v) compost blankets: particularly suited to revegetation of steep slopes with grasses and plants. Also useful when topsoil placement is difficult or insufficient topsoil is available;

(vi) bonded fibre matrix: a fibrous glued type mulch, highly suitable for vegetating steep slopes, particularly in wet environments. This form of mulch treatment can be moulded to form effective erosion control barriers, and may be suitable in lieu of silt fences near lake edges; and

(vii) rock mulching: mostly applicable to areas where plants establishment is difficult or in high amenity areas. Rock mulches are prone to siltation and should only be used when absolutely necessary.

Photos: Shaun Leinster

Figure SC6.4.3.12.19 Examples of the use of mulches at or near lake edges

(13) Step 13 – Maintaining flood capacity

The proponent must demonstrate to council that the operation of the lake must have no adverse impact on flood capacity, this includes the capacity of upstream catchments contributing to the lake and regional flooding where lakes are located on floodplain areas. Specialist hydraulic advice will need to be sought to confirm flood capacity.

Lakes in Townsville are not intended for flood management purposes. High flow by-pass provisions will be required where applicable. Standard design procedures such as Manning's equation can be used to size the high flow channels. Suitable stabilisation such as turfing must be provided and must be suitable for the expected velocity ranges.

Lakes must also make provision for an emergency overflow in the case outlets become blocked. This may include an overflow spillway (refer toSC6.4.3.12.5(10) Step 10) or demonstration that embankments are sufficiently strong to withstand overtopping. Erosion protection must be provided at overflow points.

(14) Step 14 - Lake maintenance access

The proponent must clearly indicate the location of accesses for lake maintenance. The minimum access requirements for lakes include:

(a) de-silting including dewatering pads at specified locations;

(b) debris removal;

(c) weed removal (floating and terrestrial);

(d) inlets and outlets and other hydraulic structures; and

(e) pumps and switch gear, where applicable.

Accesses should be blended into the general landscape of the lake so as to soften the impact. This may include incorporating perimeter access track as walking trails, screening of high impact accesses or incorporating into viewing areas.

Accesses must be sized to provide sufficient space to undertake the work, including sufficient turnaround areas.

Accesses for heavy machinery (e.g. excavator) must be designed for a 20 tonne capacity and of sufficient width to allow turnaround. Access provisions must also consider the maximum reach of heavy machinery (e.g. 10 m for an excavator). Access ramp slopes are to be no greater than 5H:1V. Public access to heavy machinery access points must be restricted.

The location of accesses for debris removal will need to consider prevailing wind conditions during both the wet and dry season together with lake orientation. This will determine likely collection zones for debris. Prevailing wind directions for Townsville are:

- April to November: South easterly; and
- December to March: North easterly.

Note—dewatering pads must be of sufficient distance from residential dwellings and commercial premises so that odours are unlikely to cause offense.

Provision for access to the main lake water body must be made to allow access for mechanical weed harvesters for removal of floating or submerged weed. A boat ramp type access is considered acceptable.

Photos: Jason Lange, and Sunshine Coast Regional Council and Ecologoical Engineering

Figure SC6.4.3.12.20 Examples of aquatic weed removal methods

Provision for de-silting must be made at lake inlet zones. This includes a suitable ramp to the base on the inlet zone. Provision of a hard base to the inlet bay must be made to indicate when the floor of inlet zone is reached by machinery operators. A hardstand dewatering pad at the inlet zone must be provided and graded to drain back to the inlet zone. Other de-silting accesses may be necessary should sediment accumulation be anticipated at other areas of the lake.

Suitable access must be available at all inlet and outlet structures. Where inlets and outlets are concealed under decks, amongst rocks and plantings, the proponent must demonstrate how access will be achieved at these points.

Vehicle access around the lake perimeter is to be provided for incidental monitoring and maintenance such as mowing, weed removal, mosquito larvae monitoring and removal. This can be incorporated as part of pedestrian trails around the lake.

Access to all pump and switch gear installations must be made and must allow for provision for pump replacement (i.e. crane access).

Where lake fountains are proposed pumping equipment should be located at the shoreline and not within the lake to allow easier access for maintenance.

Sufficient accesses must be provided to minimise vehicles driving on lake edges where wheel ruts can form. These can potentially provide a habitat for mosquito breeding.

(15) Step 15 - Vector control

A mosquito baseline survey/audit must be completed for all proposed lakes to establish the existing mosquito populations prior to construction. This baseline information should consider seasonal variations in mosquito populations and would likely require regular monitoring for an entire wet and dry season period prior to lake construction.

The proponent must detail design actions that minimise the occurrence of mosquitoes due to the proposed lake and associated installations such as any necessary recirculating wetlands and pump sumps. Standard design practices to minimise mosquito breeding include (adapted fromSC6.4.3.9.5(2)(i) Designing to avoid mosquitoes):

(a) providing access for mosquito predators, such as fish and predatory insects, to all parts of the water body (avoid stagnant isolated areas of water). Native fish species must be used;

(b) where possible, incorporating a steep slope into the water, preferably greater than 3H:1V;

(c) wave action from wind over open water will discourage mosquito egg laying and disrupt the ability of larvae to breathe;

(d) providing a bathymetry such that water draws down evenly so isolated pools are avoided;

(e) providing sufficient gross pollutant control at the inlet such that human delivered litter does not accumulate and provide a breeding habitat;

(f) providing suitable access to likely debris collection points (refer to SC6.4.3.12.5(14) Step 14) for removal of any accumulated debris;

(g) providing ready access for field operators to monitor and treat mosquito larvae, if required;

(h) ensuring maintenance procedures do not result in wheel rut and other localised depressions that create isolated pools when water levels fall;

(i) ensuring pits and sumps are provided with lockable galvanised lids that prevent access to mosquito adults;

(j) ensuring overflow channels do not have depressions that will hold water after a storm event;

(k) aquatic plants such as Water Hyacinth, Salvinia and water lilies can provide a breeding medium for some mosquito species whose larvae attach to these plants under water. These plants should be removed immediately if encountered. Suitable access must be provided to facilitate floating weed removal (refer to SC6.4.3.12.5(14) Step 14);

(l) appropriate landscaping in areas surrounding lakes to ensure proper drainage. Surrounding areas with poor drainage (e.g. flat lake edge batters) can become mosquito breeding grounds; and

(m) limit water level variations where possible.

Further advice on suitable native fish species for mosquito control is available from the Department of Primary Industries. Permits for stocking lakes with native fish local to the area are not required. Care must be taken with the suitable fish selection to ensure no environmental harm from fish stocked in lakes, which can easily make their way into downstream rivers and creeks etc.

A mosquito monitoring program must be established for the proposed lake. Monitoring is to include adult trapping, at the lake site and larval surveys for areas that include water retained in shallow flooded vegetated areas. Typically monitoring frequencies will be intensive (weekly) during the wet season (December to March), and less frequent during other times (fortnightly to monthly).

Larval surveys can be undertaken by sampling water with a 300 mL ladle. As a general guide a larval density of 1 larvae per 2 ladle dips or higher is likely to indicate a potential mosquito problem for adjacent residents (Warchot and Whelan, 2008). Mosquito problems may also be identified from adult trapping indicating significant pest numbers or resident complaints.

An adaptive management strategy must also be developed for control of mosquitoes.

(16) Step 16 - Bird control

Lake designs must consider actions that discourage the establishment of large waterbird populations. Large bird populations can cause lake water quality issues due to additional nutrient and faecal contamination, and reduce local biodiversity by damaging native vegetation. Large bird populations in urban residential areas also can create nuisance issues such as noise and faecal droppings.

A number of design actions are available to control bird populations. These include:

(a) densely vegetating lake edges with sedges and rushes to inhibit access to shallow water for feeding;

(b) selecting non-roosting trees such as eucalyptus;

(c) avoiding ground covers and shrubs that support roosting or breeding of species such as ibis (e.g. some melaleuca species);

(d) discouraging opportunities for feeding including educational signage; and

(e) providing suitable refuse collection around picnic areas.

Note—islands in lakes should not be provided in lakes as these can attract and create a refuge for birds, for example Ibis.

(17) Step 17 - Public safety

Lake designs must consider public safety and be designed in accordance with the crime prevention through environmental design (CPTED) principles. The proponent must demonstrate how the lake will achieve and manage these outcomes.

Lake edge treatments play an important role in public safety. Various suitable lake edge treatments are provided in SC6.4.3.12.5(11) Step 11 and SC6.4.3.12.5(12) Step 12. Lake edge treatments can be formed to create a barrier to open water access through dense edge plantings or balustrades where revetment edges are planned.

Where vegetated edges are proposed, the designer must consider the requirement for steeper batter slopes (3H:1V) below normal operating levels to minimise exposed edge width. Suitable vegetation selection will be important where a vegetated barrier is provided. Safety ledges can also be provided just below normal operating level where access to the water body is available. Refer to SC6.4.3.12.5(11) Step 11.

Lake designs must minimise areas of concealment and ground covers should be chosen to maintain an open visible aspect.

Lake boardwalks and viewing platforms must be demonstrated to be safe for public use, including suitable barriers for children.

Adequate signage must be provided to indicate suitability for recreation activities (e.g. no swimming), and potential threats from local fauna (e.g. beware of crocodiles).

Passive recreation facilities such as paths and trials must not create a trip hazard and designed so that they are available to all groups of the population i.e. it should consider all abilities. Safe distances from paths to lake edges should be considered.

(18) Step 18 –Life cycle costing

Life cycle costs for the proposed lake must be determined over a life span of 30 years. The life cycle costs must include acquisition, construction, establishment, operation, monitoring, maintenance, replacement and disposal costs. The costs must also clearly indicate “who pays,” i.e. developer costs and council costs. This includes costs associated with pumping infrastructure, including power and carbon offsetting costs and those associated with monitoring (e.g. water quality, mosquito monitoring).

Comparisons of lake life cycle costs with a similar parkland area not containing a lake are to be provided to council.

The life cycle cost plan is to include an extended dry season and a longer than normal wet season every 5 years.

This information will be used by council to assess the financial sustainability of the lake system, to make design refinements with the proponent and to identify whether additional funds will be sought from proponents to manage the lake following handover to council ownership.

SC6.4.3.12 Appendix A - Alternative strategies for managing Cyanobacterial growth

The following is taken from DesignFlow, 2010. *“Constructed Water Bodies in Urban Areas of SEQ – Critical Analysis of Recirculation Strategy”*. Prepared for Water by Design.

Mechanical removal

Cyanobacterial surface scums may be mechanically removed using booms dragged behind boats and the concentrated Cyanobacterial scum on the surface pumped off. This technique is not widely used for the management of Cyanobacterial blooms as Cyanobacterial biomass will be present throughout the water column, and therefore only a small proportion of the algal biomass will be removed.

Atkins *et al.* (2001) reported the use of flocculation and mechanical removal techniques to manage a *Microcystis aeruginosa* bloom in the Swan River, Perth. A mixture of bentonite clay and polyaluminium chloride was used to flocculate and sink the *Microcystis cells* prior to mechanical removal using oil spill equipment.

The mechanical removal of Cyanobacterial biomass offers the advantage of also removing nutrient loads from the water body, however the disposal of the odorous and often toxic biomass may be problematic.

Ultrasonic treatment

Ultrasonic irradiation of Cyanobacterial cells is a relatively new strategy that has been proposed for managing Cyanobacterial growth in lakes. Many of the common bloom forming Cyanobacteria are characterised by the presence of gas vacuoles which enable the Cyanobacterial cells to regulate their position within the water column. The presence of gas vacuoles provides a competitive advantage to Cyanobacteria over the majority of other algal groups, as it enables the Cyanobacteria to scavenge nutrients from the hypolimnion (lower strata of the water column) and to optimise their exposure to light within the epilimnion (upper strata of the water column).

Lee *et al.*, (2001) investigated the use of ultrasonic irradiation as an alternative strategy for controlling Cyanobacteria, and found that the gas vacuoles of Cyanobacteria (*Microcystis viridis* and *M. aeruginosa*) were disrupted following brief exposure to ultrasonic irradiation, resulting in about 80% of the Cyanobacterial cells settling out. Decreased photosynthetic activity was observed following irradiation, suggesting that the ultrasonic treatment also inflicted damage to the photosynthetic apparatus of the Cyanobacteria.

A potential risk associated by exposing Cyanobacterial cells to ultrasonic irradiation is that the cell membranes may rupture, potentially releasing cyanotoxins into the water column. Interestingly, Lee *et al*., (2001) observed that ultrasonication of the *Microcystis* cells did not increase the concentration of cyanotoxins in the water column. More recent research has shown that ultrasonication of Cyanobacterial cells (for periods less than 5 mins) does not increase cyanotoxins (in this case Microcystins) but cyanotoxins may also degrade in the ultrasonic fields (Ma et al., 2005). The effects of ultrasonic irradiation upon other cyanotoxins such as cylindrospermopsin (*Cylindrospermopsis* and *Aphanizomenon*) and saxitoxins (Anabaena) have not been tested.

The evaluation of ultrasonic irradiation to control Cyanobacterial growth in lakes thus far has resulted in mixed outcomes. Nakano, et al. (2001) trialled the use of ultrasonic irradiation coupled with flushing in a large shallow hyper-eutrophic lake (1 m depth, 33 Ha) that was plagued by Cyanobacterial blooms. Whilst the use of the ultrasonic irradiation of reduced peak concentrations for chl-a from 200 ug/L to 130 ug/L (Lee, et al. 2002), the study was unable to conclusively demonstrate the effectiveness of the ultrasonic treatment upon Cyanobacterial growth.

Ahn, *et al.* (2007) used ultrasonic irradiation to control Cyanobacteria in a small eutrophic lake (2 m depth, 0.9 Ha). During the period of the year when Cyanobacterial blooms dominated the lake, chl-a concentrations remained low at approximately 10 ug/L compared to an adjacent control lake where chl-a concentrations varied between 20-87 ug/L.

The potential impacts of utilising ultrasonic irradiation to control Cyanobacteria upon other aquatic organisms are hitherto largely unknown. Ahn et al. (2007) reported that larger organisms (fishes and aquatic insects) did not seem to be affected by ultrasonication. Kotopoulis *et al.* (2009) found that acoustic pressures produced during ultrasonication surpassed the Nato Undersea Research Centre rules and proceedures (NURC) by 35 dB, and cautioned the use of ultrasonication in aquatic environments.

The use of ultrasonic irradiation of Cyanobacterial cells appears to offer a potential strategy to control of Cyanobacterial growth in small lakes where lake water can be readily recirculated through an ultrasonic unit. Further research is required to determine how this strategy might best be applied to small lakes, and to the effects of ultrasonication on aquatic ecosystems and cyanotoxin release and decay.

Sediment removal

The removal of the upper sediment layers from the lake bottom is a commonly used strategy for removing phosphorus loads from highly eutrophic lakes. One of the advantages in removing the upper sediment layer is that any Cyanobacterial resting cells (e.g. akinetes) will be also be removed.

Sediment removal should be considered a "last resort" option for reducing the risk of Cyanobacterial growth in constructed lakes. The removal of sediments from a lake may have a profound influence upon benthic organisms,

including the removal of macrophytes and fauna from the lake. In addition, sediment removal is generally confined to small lakes due to the costs associated with the removal and disposal of the contaminated sediments.

The removal of upper sediment layers may not be an effective strategy for managing Cyanobacteria in constructed lakes, particularly where stormwater inputs contribute nutrient loads sufficient for Cyanobacterial growth to occur. Lake systems with high submerged macrophyte cover are particularly susceptible to sediment removal, as the ensuing turbidity following the sediment removal may inhibit macrophyte recolonisation, which results in the reversion of the lake to an algal/CyanobacteriaCyanobacterial-dominated state.

Sediment capping
Sediment capping of in situ sediments involves the placement of a cover over the sediment to seal it off, thereby minimising the release of contaminants (nutrients) to the water column (Hart et al., 2003). Sediment capping may involve placing a physical barrier over the sediment (e.g sand or gravel) or providing an active barrier (Hart et al., 2003).

Active barrier systems are generally pervious geochemical materials that are capable of actively demobilising contaminants in the sediment pore water by adsorption or precipitation processes. A number of active barrier systems have been tested in lakes including calcium carbonate, zeolites, modified clays and kaolin amorphous derivatives (Jacobs and Forstner, 1999; Hart et al., 2003).

Both sediment capping methods offer effective strategies for reducing phosphorus release from sediments. Generally, physical barriers need to be placed during construction or following drawdown of lake water levels. Active barrier systems can be very expensive to use, and there is little information available detailing the long term effectiveness of these systems. The use of sediment capping in constructed urban lakes is unlikely to be a successful long-term strategy for managing Cyanobacterial growth due to the influence of stormwater pollutant loads upon in like water quality.

Phosphorus precipitation and inactivation
The strategy involves the use coagulants to reduce the overall available load of phosphorus available for Cyanobacterial growth. The coagulants are added to the lake water, where the coagulant binds to the bio-available phosphorus, then precipitates out of the water column as "flocs". The flocs settle down to the sediments where the phosphorus is effectively removed from the water column and locked up in a form that is unavailable for phytoplankton growth.

Coagulants commonly used to precipitate phosphorus within lakes include aluminium-sulphate, zirconium, iron and calcium salts, and some clay materials (Cooke, *et al*., 2005; Scheffer, 1998),

The effectiveness of coagulants in shallow lakes is generally low where macrophytes are present, or when the external loading of phosphorus (via stormwater) exceeds the phosphorus binding capacity of the coagulate (Welch and Cooke, 1999). The constant re-suspension of sediments due to wind action in shallow lakes also renders the use of coagulants ineffective.

Artificial destratification
Artificial destratification refers to the mixing of the hypolimnetic and epilimnetic layers within stratified lakes. Stratification generally occurs within deep lakes >5 m, although diurnal stratification will often occur in much shallower lakes.

Stratification occurs when a density gradient develops within the water column between the warmer upper layer (epilimnion) and the colder and denser bottom layer (hypolimnion). When lakes are stratified, the hypolimnion becomes depleted of oxygen and reducing conditions develop, releasing nutrients such as ammonia and phosphorus from the sediments. Under stratified conditions, Cyanobacterial species that are able to regulate their buoyancy are able to access both nutrients in the nutrient-rich hypolimnion and sunlight for photosynthesis in the epilimnion.

Aerators are commonly used in stratified lakes continually mix the water column, thus eliminating the competitive advantage of Cyanobacterial buoyancy over other non-buoyant algae (Reynolds et al., 1984). Whilst artificial destratification has been used successfully in Australia for controlling the release of nutrients from lake sediments, only limited success has been achieved controlling Cyanobacteria (McAuliffe and Rosich, 1990). It is expected that

improvements in destratification technology (e.g. mixer design) will increase mixing efficiency and improve the control of Cyanobacterial growth (Brookes et al., 2002).

Hypolimnetic withdrawal

Hypolimnetic withdrawal involves the removal of nutrient rich hypolimnetic water from stratified lakes (Nurnberg, 1987). The removal of hypolimnetic water effectively decreases phosphorus concentrations in the epilimnetic layers of stratified lake systems, thereby limiting the potential for excessive Cyanobacterial growth to occur (Nurnberg, 1987).

Hypolimnetic withdrawal is a widely used strategy for managing water quality (risk of Cyanobacterial growth) in a range lakes, varying in depth from 4.5 – 25 m (Cooke *et al*., 2005). Hypolimnetic withdrawl is only applicable to lake systems where the amount of discharged water can be replaced with sufficient inflow, so that the water level remains constant (Cooke et al., 2005).

Whilst hypolimnetic withdrawal is a relatively simple and cost effective strategy, it is unlikely that this technique could be used to effectively manage water quality within constructed urban lakes. Most urban lakes have a shallow depth profile and are relatively well mixed (in some cases shallow lakes may also exhibit diurnal stratification). Furthermore, hydraulic retention times in urban lakes are usually high, and sufficient inflow is unlikely to be available in order to maintain constant water levels.

Constructed urban lakes which regularly exhibit stratification may benefit from hypolimnetic withdrawal, however due consideration would also need to be given to the disposal of the poor quality hypolimnetic water downstream.

Algicides

Chemical control of algal and Cyanobacterial growth within reservoirs has been a widespread water quality management practice for over 100 years (Burch et al., 2002).

The most common algicides used to control Cyanobacteria in reservoirs are copper sulfate or chelated forms of copper. These are extremely effective as they act rapidly and are toxic phytoplankton (and Cyanobacteria) at concentrations that do not represent a health risk to humans (Steffensen *et al*., 1999). The chemical composition of the receiving water, particularly pH, alkalinity and dissolved organic carbon influence copper speciation and complexation, thus greatly influencing copper toxicity. Copper algicides are economical, easy to apply and are generally considered to not to cause extensive environmental damage (Burch et al., 2002).

Recent studies have shown however, that sediment bound copper and other heavy metals may impact benthic communities, zooplankton, fish and invertebrates. Copper is not biodegradable, and once it has entered the environment, its potential toxicity is controlled by its speciation or physico-chemical form (Burch et al., 2002). One of the major problems associated with the use of copper-based algicides to control Cyanobacterial growth is that copper lyses the algal cells, resulting in the release of intracellular toxins and other odorous compounds into the surrounding water (if present). This can exacerbate health risks to humans and other animals. Currently, there is little information on the minimum withholding period in relation to toxin degradation (Burch et al., 2002).

Other algicides used to control Cyanobacterial growth in lakes include potassium permanganate, simazine compounds, chlorine, lime and barley straw (Burch et al., 2002; House and Burch, 2002). Potassium permanganate, simazine and chlorine are lethal to algal cells and may result in the release of cyanotoxins. Lime is used as an algicide to coagulate and precipitate algal cells from the water column, and does not appear to cause cell lysis and toxin release (Burch et al., 2002). Recent studies have shown that the use of lime is most effective in hard water lakes (Murphy and Prepas, 1990), however dosing rates are quite high and this technique has not been extensively tested within Australian waters (considered soft waters) (Burch et al., 2002).

Considering the potential environmental and human health risks, the use of algicides is not recommended for the sustainable long-term management of Cyanobacterial growth in constructed lakes.

Biomanipulation

The biomanipulation method is often referred to as “top-down control”, and refers to the management of higher trophic organisms to maximise grazing of algae, and therefore a reduction in Cyanobacterial biomass in the lake system. There is no information on the use of biomanipulation to manage Cyanobacteria in constructed lakes.

In a review of 33 whole-lake biomanipulation experiments, Reynolds (1994) concluded that top-down effects on the lower trophic levels (phytoplankton) were inconclusive. Reynolds (2006) postulated that the manipulable linkages between phytoplankton, zooplankton, planktivorous fish and piscivores apply only to truly pelagic systems.

Boon et al. (1994) reviewed the potential use of top-down control of Cyanobacteria and concluded that zooplankton assemblages in Australian waters are quite different in composition from those of the Northern Hemisphere, and therefore unlikely to respond to manipulations of trophic structure in a similar way. The study concluded that the manipulation of trophic structure in Australian fresh waters to control Cyanobacterial blooms is therefore unlikely to be effective.

Floating macrophyte beds

Floating macrophyte beds have been increasingly used to manage water quality in lakes where other methods of water quality treatment may be constrained. This is particularly the case in many golf courses, where high nutrient concentrations in the stormwater runoff often stimulates excessive algal growth in the waterways.

The use of floating macrophytes has been widely used within the United States for well over 20 years to treat wastewater and stormwater runoff (Reddy and DeBusk, 1987). Floating macrophyte beds can be effective for managing algal growth in lakes as they remove bioavailable nutrients from the water column, thereby reducing nutrient availability to Cyanobacteria or other algae. Floating macrophyte beds are relatively simple and cost effective, and regular harvesting of the macrophytes serves to further reduce nutrient loads from the lake system.

Basil, tomato and silver beet plants growing in aquaponic units (floating plant beds) were recently trialled at Rio Tinto's Kestal Mine (Central Queensland) in order to control blue-green algal growth in a number of lake systems (Fabbro and Duivenvoorden, 2004; L. Fabbro pers. comm.). The research showed that the basil, tomato and silver beet plants were particularly effective at removing phosphorus and molybdenum from the water, essential elements that are required for Cyanobacterial growth (L. Fabbro pers. comm.).

The use of floating macrophyte beds offers a range of potential options for managing water quality in constructed urban lakes. Floating macrophyte beds could be used in situ (within the lake) or within dedicated bays as part of a lake recirculation system.

Sub-surface wetlands

Recirculating lake water through sub-surface flow wetlands may be an alternative option for removing Cyanobacterial biomass from lake systems. Sub-surface wetlands are most commonly used to treat municipal sewage, and also wastewaters from agriculture, industry and landfill, and less commonly to treat stormwater runoff.

Sub-surface wetlands remove a wide range of pollutants including nutrients, suspended solids and organic matter from the water by fine filtration, adsorption and biological processes (uptake, aerobic/anaerobic degradation, nitrification/denitrification) (Vymazal, 2005).

SC6.4.3.13 Townsville road hierarchy

SC6.4.3.13.1 Introduction

The Townsville road hierarchy is a planning tool to guide good-practice transport planning and management, with the aim of balancing the needs of both the land use and the roadway system. A road hierarchy establishes each roadway function such that appropriate objectives for that roadway and design criteria, can be developed and implemented. These objectives and design criteria are aimed at achieving an efficient road system whereby conflicts between the roadway and the adjacent land use are minimised, and the appropriate level of interaction between the roadway and land use is permitted. The road hierarchy also forms the basis of ongoing planning and system management aimed at reducing the conflict between existing incompatible functions.

The use of road hierarchy categories as part of the land use and transport network planning process enables optimisation of the relationships and key roles associated with accessibility, connectivity, amenity, and safety for all road/land users, including vehicles, bicycles, pedestrians, and public transport. The road hierarchy categories and sub-categories contained herein are pertinent and appropriate with the current transport environment in the Townsville area. As time passes, and the transport system and its relationship with land uses changes, these road hierarchy principles will require further development and refinement.

Editor's note—this sub-section deals mainly with issues relating to "Roads". Issues relating to 'Streets" are dealt with in more detail in other parts of the Development manual planning scheme policy.

(1) Integrated Regional Transport Planning Framework

Integrated land use and transport planning must be embedded and applied in a wide range of circumstances – from strategic planning to detailed design for one mode or across all modes. This road hierarchy sub-section contains specific information for managing the interface between land use and roadway systems. This sub-section is to be used with regard for the overarching planning framework. The Integrated Regional Transport Planning (IRTP) Framework for Queensland (Queensland Government, 2003) is a preliminary transport planning guide that can provide the more general guidance not covered by this road hierarchy sub-section and has been adopted by Townsville City Council.

The IRTP Framework, applies to all facets of transport planning, including:

(a) public transport, walking and cycling networks;

(b) road upgrades;

(c) new road, rail or multi-modal corridors;

(d) heavy-vehicle safety and efficiency;

(e) policy positions; and

(f) entire local government areas or regions.

The IRTP Framework aims to:

(a) reduce the need to travel and the length of trips;

(b) provide a choice of travel options for people and goods, and promote sustainable choices;

(c) make it safe and easy for people to access goods, services and destinations, particularly by public transport, walking and cycling;

(d) increase the share of trips by public transport, walking and cycling;

(e) provide for the safe and efficient delivery of freight;

(f) minimise the need for new transport infrastructure; and

(g) achieve desired outcomes using the most cost-effective package of measures.

(2) Structure of the road hierarchy

Based on the desired outcomes, directions and principles contained in the IRTP Framework, this sub-section establishes a four level road hierarchy that manages the interface between land use and roadway system and

guides system planning and management in urban and rural areas. Figure SC6.4.3.13.1 shows the basic structure of the four level road hierarchy, and the four levels are explored in more detail in SC6.4.3.13.3, and in SC6.4.3.13 Attachment A: Urban and rural traffic environments map, SC6.4.3.13 Attachment B.1: Road hierarchy elements and their objectives in urban areas, B.2: Road hierarchy elements and their objectives in rural areas, C.1: Townsville road hierarchy map (existing), C.2: Townsville road hierarchy map (future), D.1: Road hierarchy desirable performance criteria in urban areas and D.2: Road hierarchy desirable performance criteria in rural areas.

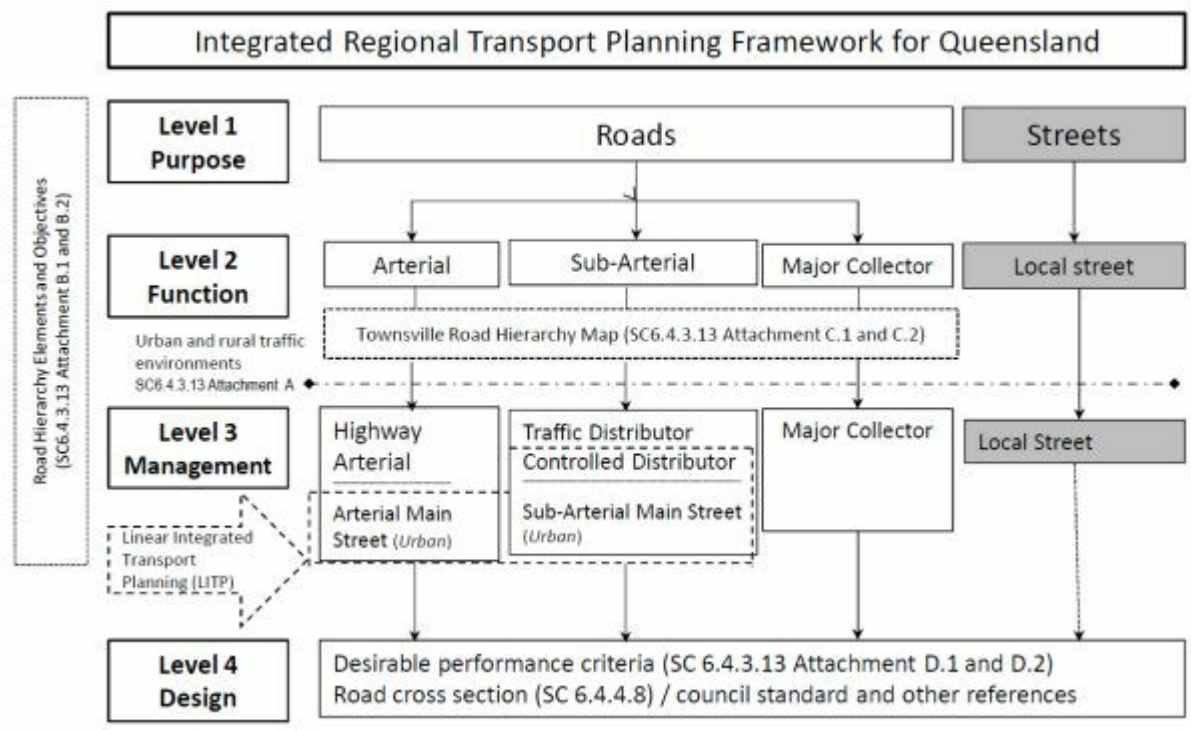


Figure SC6.4.3.13.1 Structure of the four level road hierarchy

(3) Road hierarchy objectives

The four level road hierarchy aims to meet the following objectives, and will assist council and the state government with meeting appropriate standards for roadway construction:

(a) to systematically classify roads into a framework around which council and the state government can plan and implement various land use, infrastructure construction, maintenance, and management schemes and projects such as:

(i) identifying the effects of development decisions in and on surrounding areas and roadways within the hierarchy; and

(ii) developing design that facilitates urban design principles such as accessibility, connectivity, efficiency, amenity and safety;

(b) to guide network planning and management for all modes (private, passenger and commercial/industrial transport) and users (motorised and non-motorised); and

(c) to clarify policies and decisions in designing new networks and in managing existing road systems in order to provide a rational basis for management of the network under the current or future planning schemes, for example:

(i) enabling investment and traffic management efforts to be concentrated on those links able to cope efficiently with transport needs;

(ii) enabling council and the state government to adopt appropriate standards of construction on traffic routes; and

(iii) enabling the network to be optimised to accommodate access and non-transport functions.

(d) The ways in which these objectives may be implemented within a well-formed road hierarchy include:

(i) concentrating longer distance flow onto routes in less sensitive locations;

(ii) ensuring land uses and activities that are incompatible with traffic flow are restricted from routes where traffic movement should predominate;

(iii) preserving areas where through traffic is discouraged;

(iv) identifying treatments such as barriers, buffers, and landscaping to preserve amenity for adjacent land uses;

(v) ensuring activities most closely related to frontage development, including social interaction and parking, can be given more space when environmental and access functions are allowed to predominate;

(vi) ensuring safe traffic operation by controlling access onto roads, and separating different types of traffic in higher order road corridors;

(vii) ensuring efficient traffic operation for through traffic whilst designing new roads as part of a safe system approach;

(viii) enabling the orderly planning of heavy vehicle and dangerous goods routes;

(ix) planning for and providing public transport routes;

(x) planning for and providing pedestrian and bicycle routes; and

(xi) identifying facilities for pedestrians, cycles and public transport.

(4) Scope

This document is a planning tool for all road agencies and authorities involved in land use and transport planning/management processes in Townsville. The road hierarchy elements can be applied in areas such as:

(a) planning – in designating a Strategic Transport Network for a region, consisting of roadways and other facilities for the movement of goods and people;

(b) management - in designating and programming improvements to achieve the desirable performance criteria over time for each element of the road network;

(c) environment – in managing the road network to facilitate efficient operation, which will assist in achieving environmental sustainability and improve amenity to the region's inhabitants;

(d) safety – in managing the road network by controlling access onto traffic carrying roads, providing appropriate design standards, and proper use of the network by the vehicle fleet to facilitate safe movement of all road users; and

(e) congestion management – in planning and managing the road network to ensure traffic volumes carried are appropriate to roadway functional and management attributes.

(5) Definition of urban and rural

The application of the road hierarchy requires the terms urban and rural to be defined for the purpose of this policy.

Urban	developed area which may comprise densely developed uses such as residential, commercial, industrial, education, recreation or a mix of these. In general, this is characterised by evenly spaced street lighting, kerbed streets, frequent closely spaced driveways (preferably none on traffic carrying roads). This will also include land designated for future urban development.
Rural	sparsely developed area which may comprise rural development, rural residential development, isolated pocket of urban development and environmental area. In general this is characterised by unkerbed streets, both sealed and unsealed roads, infrequent driveways and large tracts of undeveloped land. Street lighting may only be at intersections and points of safety concerns.

These terms do not necessarily align with definitions within legislation but relate to the character of the land for the purpose of providing access and thoroughfare. For the specific purpose of showing urban and rural traffic

environments for the Townsville road hierarchy, a map has been provided in SC6.4.3.13 Attachment A.

If a rural development is located in the adjacent urban fringe area or adjoined/contained a part of continuous existing network connection, it may be required to be designed similar to the adjacent road network environment, e.g. urban road cross section.

(6) Terminology

Category	Those elements of the road hierarchy defined at Level 2 of the road hierarchy.
DTMR	Department of Transport and Main Roads.
Environmental cell	Contains local streets with a slow speed and pedestrian priority environment, and generally bounded by major collector roads.
LITP	Linear Integrated Transport Plans: a means of planning between the roadway and the adjacent environment in an integrated manner.
MUTCD	*Manual of Uniform Traffic Control Devices.*
RPT	Regular public transport.
Specific cell	A part of the urban fabric that is contained within a block bordered by traffic carrying roads or other physical boundaries.
Sub-category	Those elements of the road hierarchy defined at Level 3 of the road hierarchy.
VPD	Vehicles per day.

SC6.4.3.13.2 General principles

(1) Network Linkage
Ideally, only roadway elements with the same place in the hierarchy, or one position higher or lower in Level 2 of the hierarchy, should intersect.

For example:

(a) arterial roads should only intersect with sub arterial roads and other arterials;

(b) sub-arterial roads should only intersect with arterials, other sub-arterials, or major collectors;

(c) major collectors should only intersect with sub-arterials, other major collectors, or local streets; and

(d) local streets should only intersect with collectors or other local streets.

However, road networks have evolved out of step with this linkage principle in practice.

In certain situations it may be acceptable for roadway categories separated by two positions within Level 2 of the hierarchy to intersect. For instance, a local street may intersect with a sub arterial road, or a collector with an arterial, without significant adverse ramifications. In other cases, a permeable grid local network creates too many street-road intersections, and some of these have to be blocked off to limit points of access for vehicles (creating cul-de-sacs). Paved footpath access into the local area for pedestrians and cyclists could be maintained, providing the desired pedestrian and cyclist access onto the arterial roads, without adverse impact on traffic flow, safety and local amenity.

It may even be acceptable for roadway categories separated by three positions in Level 2 of the hierarchy to intersect in certain cases. That is, a local street may intersect with an arterial road, provided it is not an uninterrupted flow facility, without significant adverse effects. This may be the case, for example, where a service road provides access directly to a two or four lane arterial road in an urban area, or two lane highway in a rural area.

Despite their development history and desired function in the road hierarchy, local streets may need to be compromised to provide connectivity for the public transport network.

(2) Size of precincts free from unwanted traffic

The spacing of arterials or traffic routes has the effect of defining the size of development areas that are penetrated only by streets. The size of these "cells" has a direct influence on issues such as the local traffic environment, whether or not "difficult traffic routes" can be avoided, the feasibility of sustaining low vehicle speeds in the local area, the number and frequency of connections to surrounding arterials, and access to bus routes around and through the area. Traffic should be distributed appropriately amongst the local streets to ensure that amenity levels are not exceeded and adequate connectivity is maintained.

The specific area and environmental cell concepts can be accommodated with relative ease as part of a new subdivision plan but it is often more difficult to impose the specific area concept onto an existing system. However, it is important to have a target in mind when assessing the requirements of the road systems in a particular area.

(a) Urban areas

While the size and shape of a specific area is commonly constrained by fixed elements such as existing infrastructure, topography and property boundaries, the idealised form is of the order of 1 km × 1 km for an urban specific area. This size would typically encompass four environmental cells, each 0.5 km × 0.5 km. The boundaries of the specific areas will be partially defined by the existing major road system, which in turn has generally been developed to a large extent as a result of historical events rather than recent planning initiatives. Other features may also be used as boundaries.

The aim is to define specific areas which:

(i) are relatively homogeneous in land use;

(ii) have only that traffic necessary for the functioning of the area, i.e. they are free of non-essential or through traffic; and

(iii) have a balance between the volume of essential traffic and the nature of the area. For example, higher volumes may be more acceptable in industrial areas than in residential areas.

(b) Rural areas

While the specific area concept is most relevant to an urban area, it also applies to rural areas, although in a slightly different context. Specific areas in rural areas should be linked by a system of through traffic carrying roads. The dimensions and form of a specific area will vary in rural areas due to the reduced development densities. As a result, specific area sizes in rural areas will be significantly larger than in urban areas.

(3) Abutting development and access to it

Restriction of access points to abutting land uses is one of the key parameters in the road hierarchy. Decisions on access points to new developments are linked to the strategic function of the road and the types of traffic and trips that it serves, as well as the type of environment intended to result. The allocation of accesses as part of a management regime is not identical to a "road classification" system, but may supplement it.

Decisions on network types, especially at the local level, will have long-term effects on the traffic character of an area, and inevitably the quality of service on the surrounding traffic routes. The road hierarchy provides a means of classifying and designing a roadway according to its purpose, function and management. It is intended that this process be carried out within the constraints of the network, as it is imperative that corridor continuity be considered. Notwithstanding past decisions that have resulted in existing constraints, this may mean that corridor continuity may need to be targeted as a long term goal.

In addition to corridor continuity, future development potential should also be addressed in the road hierarchy. The planning scheme earmarks a considerable quantity of land for future urban development, industrial, commercial or residential. Classification of existing roadways in these areas should support future amendments to the hierarchy and the associated changes in performance criteria. For example, an existing road may currently serve a collector function, but as the area is subdivided into urban development in the future, the potential future function of the road may require allowances to be conformed at an earlier time so that the

performance criteria of its future function can be met.

It is important to note that some non-residential land uses such as schools, parks and local shops have to be located within or near the specific areas they serve. These may be accessed by a sub-arterial road, or, if this is not possible, it is desirable that they are accessed via a major collector road rather than the local street environment. The conflicting land use requirements in these circumstances mean that network considerations must be carefully examined in terms of connectivity, network efficiency and compatibility between private vehicle, public transport, non-motorised and freight networks. Integrated land use and hierarchical transport planning can overcome this shortcoming to a large extent.

(4) Relationships between networks

"Cells" may be sized and have access limited to manage entry of unwanted traffic. However, different networks will have different entry criteria. As mentioned in SC6.4.3.13.2(1) above, network linkage principles may vary between motorised vehicles and active transport modes such as public transport, pedestrian and bicycle. For example, passenger transport networks are often focused on middle order roads to balance point to point travel times, network reach, connectivity and passenger safety. Similarly, freight networks will be based on specific freight criteria and result in different networks for freight when compared to other traffic networks. In some areas, freight networks may enter into small industrial cells and utilise low order roads to access depots. The overlay of modal networks is a key consideration in establishing the functional category for a specific link in the road network.

SC6.4.3.13.3 Four level road hierarchy

A four level road hierarchy has been developed, based on the functional objectives of each category or sub-category within the hierarchy. Level 1 begins with a broad distinction between roads and streets, and the following three levels listed with an increasing degree of detail with respect to functional objectives. The Levels are defined as follows:

Level 1. Purpose relates to the primary objective of the element, whether to carry through traffic or provide direct property access.

Level 2. Function relates to the relationship between the roadway and land use it serves (i.e. how the roadway serves the land use). This level of the hierarchy is common to traditional road hierarchy concepts.

Level 3. Management relates to the implementation of policies to achieve the envisaged function based upon the attributes of the element and of the adjacent land uses.

Level 4. Design relates to specification of the form of the element in order to achieve its functional objectives.

Note—the relevant standard drawings include SD-002 Typical Road Cross Sections – Collector Roads , SD-003 Typical Road Cross Sections – Sub Arterial Roads and SD-004 Typical Road Cross Sections – Arterial Roads.

(1) Hierarchy Level 1 - Purpose

Level 1 of the hierarchy defines roadways as either:

(a) roads to carry through traffic; or

(b) streets for access to property and collection of local traffic.

This classification applies to both rural and urban areas.

The definition of a roadway in one particular category serves to indicate a planning intent in relation to the functions that will be permitted on that roadway. Thus, measures are likely to be adopted on streets that relate to amenity and environmental capacity, for example, by removal of through traffic, or direction of local traffic to a particular collector road. At the other end of the scale, treatments on arterial roads will principally be related to increasing traffic carrying capacity. This would tend to be by removal of some incompatible lower order functions, such as limiting access to properties, disallowing any further new accesses, or reducing the number of intersecting roads.

Figure SC6.4.3.13.2 below illustrates the relationship between traffic mobility and land access in a functionally

classified roadway system.

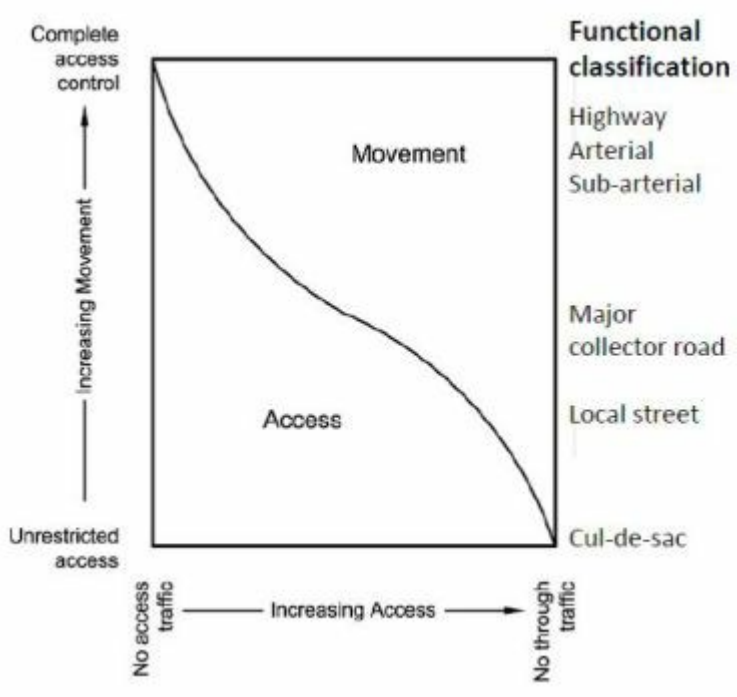


Figure SC6.4.3.13.2 Relationship between traffic mobility and accessibility

Source: Adapted from a figure in NCHRP Report 348, Access management Policies and Guidelines for Activity Centres, Transportation Research Board, Washington DC, 1993.

Note—the functional classification has been modified to suit the Townsville context.

(2) Hierarchy Level 2 - Function

Within the two broad groups of roads and streets in the first level of the hierarchy, four functional roadway categories have been identified, reflecting the different ways in which they serve land use and carry traffic.

The functional classification indicates the relative importance of the traffic mobility function as opposed to the amenity/access functions, and how these conflicting aims are to be prioritised and managed.

The four functional categories in Level 2 of the hierarchy are:

- arterial road – to carry long distance through traffic external to specific areas;
- sub arterial road – to carry through traffic between specific areas and arterial roads in a supporting role to the latter;
- collector road – to provide connectivity between the environmental cells and the traffic carrying road and to provide grouped property access; and
- local street – to provide direct property access and immediate local movements.

Based on the current and future land use zoning in the Townsville City Plan, the Townsville road hierarchy map (see SC6.4.3.13 Attachment C.1 Townsville road hierarchy map (existing) and SC6.4.3.13 Attachment C.2 Townsville road hierarchy map (future)) has been developed all Level 2 categories. To enable easier application of the road hierarchy, the same overarching objectives and category names have been applied for both urban and rural areas. It should be noted that some links are identified as a conceptual location with respect to spacing, hierarchical connectivity and continuation of links between start and end points. Therefore, if significant development is planned to occur in a large or multiple parcels of undeveloped land in either an urban or rural area, then it may be necessary to reassess that area road hierarchy plan within a whole network.

(a) Arterial road

The primary objective of arterial roads is to provide major through routes for traffic. All longer distance traffic movements should be directed onto the arterial roads. Arterial roads should form a principal

connection between major regional centres and towns. It can also serve a line haul function for public transport. Arterial roads will often be elements of the various networks with high order functions. For instance, the network of over dimension freight routes is likely to be primarily on arterial roads.

These corridors should provide for regional cycle movements, but travel speed, volume and composition is such that cycle movements should desirably be kept separate from general traffic. In general, arterial roads have high design standards for efficiency and no direct frontage access.

In rural areas it is recognised that many arterial roads have direct property access. This results from the large size of properties, the reality of limited road infrastructure and the infrequent number of vehicles with direct access. On such roadways the main goal is to provide a highly efficient traffic flow (increased speed and increased capacity), balanced with safe access.

For all arterial roads it is desirable that, over time, no new accesses are permitted and that existing accesses be removed, or at least consolidated, or turning movement restricted.

(b) Sub-arterial road

Sub-arterial roads carry through traffic and should be more convenient than using the "streets" network; therefore a high level of efficiency and safety should be provided. In general, sub-arterials do not serve the longer distance regional movements and do not provide continuity across arterials. However, they do serve to provide connections between arterial roads and may be used to provide such additional connections for through movements.

In urban areas, sub-arterial roads typically provide connection between residential, commercial or industrial areas and arterial roads. They will normally be the lowest order of road to be traversed by scheduled public transport in performing a line haul function. They may also serve to provide access to public transport at stops. These corridors may provide for cycle and pedestrian connections between local areas and the regional cycle system (if such exists). These connections would preferably be bicycle lanes on the shoulder or outer lane of sub-arterial roads rather than on the roadway with general traffic. These roads can provide consolidated access to commercial and retail developments and as a result can also cater for pedestrian movements, especially in the vicinity of such developments. The provision of consolidated access allows for turning movements to be focussed at specific, controlled locations rather than at high frequency along the roadway, thus minimising interruptions to through traffic.

In rural areas, sub-arterial roads in particular provide connections between adjacent suburbs and/or between arterials. Access may also occur, and be necessary, but these will be more widely spaced due to the larger lots.

(c) Major collector road

The objective of collector roads is to provide for the connection between the local area (local streets) and the traffic carrying roads. The form of linkage provided should predicate against the usage of collector roads within a particular area by longer distance traffic unless the trip is relevant to the area. In residential areas particularly, amenity and safety should be the most important consideration, as these roads are also intended to provide direct access to grouped properties, commercial premises, schools or community facilities.

These roads will carry public transport operating in a sweeper role, and these are likely to be school bus routes. It is necessary to ensure that the connectivity to achieve an efficient bus route does not encourage penetration by through traffic. Typically, scheduled bus routes would begin a service on collector roads, as a sweeper service, and then move to higher order links in the bus network to run as limited stop or express services.

As these roads serve as access to adjacent grouped properties, whether in residential or commercial/industrial areas, pedestrian movements need to be accommodated off the roadway. Traffic volumes should be balanced to accommodate local cycle movements on the road, and road design should create a safe environment for these vulnerable road users.

(d) Local street

The objective of local streets is to provide access to properties. In residential areas, these should be in a form to encourage a liveable and safe street environment where the motor vehicle is secondary to the pedestrian and cyclist. Through traffic should be discouraged on these streets and a lower speed environment is desirable for safety. Given the low traffic volume and potentially lower speed environment, it is appropriate for cyclists and pedestrians to share the road space. Similarly, specific facilities for pedestrians (crossings or concrete footpaths) are generally not required due to low traffic volumes and speeds. However, depending on the degree of abutting land use activity or pathway network planning, concrete pathways would provide for safety and a continuation of the pathway network.

The role of collector and local streets is complicated further as all freight, and motorised and non-motorised passenger networks can ultimately operate on these roadways, often without specific treatments.

(3) Hierarchy Level 3 - Management

Ideally, all roadways within the same category of Level 2 would be treated in the same manner. This may be achievable in a new development but existing situations or other constraints often dictate that a variety of treatments need to be available. These situations may arise for a number of reasons, not the least of which is the mixture of access and traffic functions already prevalent on many roadways.

Level 3 manages these issues through splitting the Level 2 categories into sub categories, which relate to more particular attributes of the roadway. Each sub category has objectives that are more specific than the category objectives for Level 2. The management sub categories are described broadly as follows (listed under each Level 2 category):

Arterial road

- Highway - serves longer distance movements as well as regionally and nationally significant movements. (A motorway is a highway that provides for a very high standard of travel by restricting non-motorised traffic and using only grade separated intersections.).
- Arterial - caters for longer distance movements, for example, connections between major centres.
- Arterial Main Street - caters for through traffic and, due to past land use decisions, serves adjacent retail/commercial land uses. This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions.

Sub-arterial road

- Traffic distributor - connects traffic generated in specific areas to the arterial roads and provides access to major developments.
- Controlled distributor - serves a similar function to traffic distributors but needs to be controlled for a particular reason, for example, it may provide frequent access for existing individual residential properties.
- Sub-arterial main street - connects traffic generated in specific areas to the arterial roads and, due to past land use decisions, serves adjacent retail/commercial land uses. This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions.

Major collector road

- Major collector - provides a connection between the other streets in a specific area and the traffic carrying roads, and provides access to large sites with restricted or controlled access (for example, schools, shops and multi-unit residential developments).

Local street

- Provides a connection between the other streets in a specific area and the low traffic carrying streets, i.e. less than 3,000 vpd. As it has low traffic volumes, a lower speed or a shorter length, it is better suited to

providing access to individual properties. It also provides pedestrian and recreation use service with a local traffic or pedestrian priority.

It should be noted that the arterial main street and sub arterial main street sub categories have been excluded from rural areas on the basis that these are characterised by adjacent land use/activities that are associated with urban development.

(a) Performance criteria

The preceding sections and SC6.4.3.13 Attachment B.1 and SC6.4.3.13 B.2 identify individual road hierarchy categories and their functional objectives. For the hierarchy to be an effective planning tool, means of achieving these objectives need to be identified. This has been done by specifying desirable performance criteria for each classification in Level 3 of the road hierarchy framework. It is apparent that for some management categories, a distinction needs to be drawn, with respect to performance criteria, between roadways in an urban or rural environment. Accordingly, the thresholds of the performance criteria differ between the urban and rural areas for Level 4 of the road hierarchy.
The desirable performance criteria are subdivided into three groups and described below.

(i) Functional Characteristics specify the functions or functional aspects of a roadway element.

(A) dominant linkage – what type of areas should the roadway provide service to/from;

(B) traffic carrying function – whilst volumes are not intended to define the category into which the roadway falls, this criterion provides some guidance as to the maximum volumes anticipated. These maximum volumes may not be met in non-urban areas due to the low density of development;

(C) residential, commercial, industrial access – what degree of access to each of the land use types is appropriate;

(D) desirable traffic speed environment – the desirable speed anticipated. This is not intended to define the maximum speed limit, which should be done in accordance with the MUTCD;

(E) heavy vehicle movement – whether the roadway is appropriate for heavy vehicles, other than for local access. Note that heavy vehicle volume will be important in defining road pavement and design form;

(F) dangerous goods movement – whether the roadway is appropriate for the passage of dangerous goods vehicles, other than for local access;

(G) public transport facilities – what role should the roadway serve for public transport (consistent with any public transport network planning);

(H) cycle facilities – what type of cycle facilities should be provided in the roadway corridor (consistent with any bikeway network planning). Cycle facilities would only be provided where sufficient demand is proven; and

(I) paved footpath – what type of paved footpaths (not for crossing the roadway) should be provided along the roadway. These should only be provided to satisfy a proven demand.

Note—the term paved footpath refers to a paved concrete footpath as per council standard.

The desirable performance criteria for these functional characteristics have been set to ensure the network operates effectively, efficiently and safely for its users.

(ii) Frictional Characteristics relate to the way roadside activity affects traffic use.

(A) access control – constraints imposed on direct access to adjacent development sites;

(B) parking provision – what provision for parking within the road reserve is appropriate;

(C) bus stopping provision – what provision for bus stops within the road reserve should be made

Note—indented bays also refer to bays which are clear of the through lanes as per council standard.

(D) pedestrian crossings – what type of facilities should be provided to allow pedestrians and

cyclists to cross the roadway, for example, signalised crossings, zebra crossings or pedestrian refuge islands;

Note—crossings must meet council standards and MUTCD guidelines.

(E) typical intersection spacing – the typical distance between successive intersections along that roadway;

Note—generally, 300m intersection spacing is not favourable for a corridor signal coordination plan.

(F) preferred intersection treatments – what form of intersection control is appropriate where the roadway intersects another of equal or higher classification; and

(G) number of traffic lanes – what function of road hierarchy and ultimate traffic demand should be considered.

Note—a road cross section is identified in terms of a type of kerb and channel, divided or undivided carriageways, parking, bike lanes and verge in Level 4 of the hierarchy (see SC6.4.3.13 Attachment D.1 and SC6.4.3.13 D.2).

The desirable performance criteria for these frictional characteristics are set with the intent of improving the efficiency of traffic flow and thus reducing its environmental consequences, in balance with access needs.

(iii) Impact characteristics relate to the relationship between a roadway element and amenity for adjacent land use:

(A) abutting land use types – in general, what type of land use would be appropriate or compatible with the roadway function; and

(B) land use impact amelioration – in general, what type of measures are appropriate on this roadway to reduce the immediate social and environmental impacts of traffic. Such treatments include barriers (fences, walls), buffers (vegetation), setbacks (distance to property lines and/or building fascias), streetscaping and environmental street design.

To achieve the desired traffic levels and conditions, a combination of actions will often be necessary to reduce traffic flows on some elements of the network and to increase traffic flows on other elements of the network. In order to minimise the use of lower order roads, such as local residential streets, it will be necessary to manage arterial roads in a way that makes their use more attractive than the lower order roads. Lower order roads must then be managed in a way that discourages traffic through environmental street design, such as street closures, street element length and design speed. If reactivity treatments are applied in existing areas, they must be undertaken on an area-wide basis to ensure that problems are not simply shifted from one street to another.

The desirable performance criteria for these impact characteristics are set with the intent of reducing negative social and environmental impacts of traffic flow on adjacent land uses.

The impact characteristics are important in making the adjacent land use areas more liveable and to address issues associated with the social interaction between transport and land use. Level 3 management principles for urban and rural roads are reflected in the design principles in Level 4 of the road hierarchy.

(b) Linear integrated transport plans (LITP)

There may be cases where a roadway does not readily fit into any category within the road hierarchy, due to incompatibility with the performance criteria. Under these cases, it is recommended that an LITP be developed specifically for the roadway under consideration. For example, with a key public transport corridor such as Ross River Road and Charters Towers Road, there is a need to satisfy both the traffic carrying roadway objectives, as well as the access and amenity to adjacent properties objectives. Each LITP will need to assess the roadway under consideration on an individual basis, and will therefore have

to satisfy individually tailored criteria. Figure SC6.4.3.13.3 below describes a general methodology for developing an LITP.

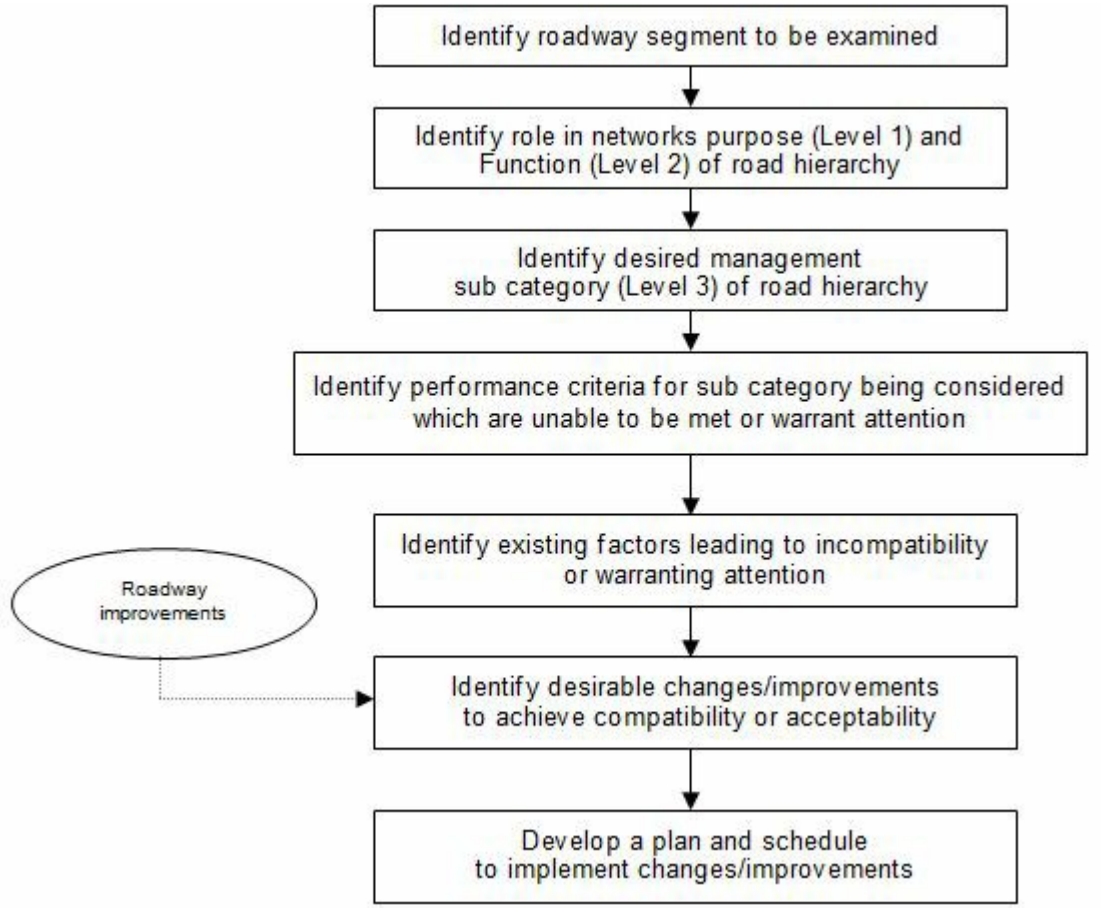


Figure SC6.4.3.13.3 Linear integrated transport planning (LITP) process

(4) Hierarchy Level 4 - Design

The fourth level of the road hierarchy framework relates to specific design criteria that are applicable to each sub category in Level 3. Level 4 aims to provide the tools with which to specify the form required of individual road hierarchy elements in order that they achieve their functional objectives. The roadway design should meet safety objectives as well as capacity and amenity objectives, where relevant. In conjunction with Level 3 objectives, it should also dictate the type of facility and design form for pedestrians, cyclists and public transport.

For each roadway, there are design elements that combine to produce a cross section or form for the roadway. SC6.4.3.13 Attachment D.1 and SC6.4.3.13 Attachment D.2 provide a set of desirable performance criteria for urban and rural areas and SC6.4.4.8 Standard drawings also includes a set of road cross sections. The design elements identified are those applicable to the road cross section away from intersections (i.e. mid-block cross section). Intersection requirements will dictate other specifications. For example, widening at intersections and future planning are an important part of defining these overall requirements. These design element details and the cross sections have been prepared for new roadways; council recognises that there will need to be variations to this to suit existing roadways (i.e. existing road forms and existing road reserve widths) in the process of network design.

It is important to note that the Level 4 specifications represent preferable specifications. There will be other constraints (e.g. topography, role in the range of networks, existing land uses, road reserve, and physical elements), which mean that the specifications may be varied from time to time. Whilst this flexibility needs to exist, it is important to keep an appropriate balance between mandatory standards, desirable objectives and constraints in order to develop an appropriate road form for each individual situation whilst still maintaining some consistency in the overall road network. The objectives and performance criteria should be maintained wherever possible.

In any case, all design criteria should be considered in line with relevant documents and proper guidelines, for example, other parts of the Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, Australian Standards, Queensland Streets, and Complete Streets for the local street level.

Note—posted speed limits are to be designated in accordance with the MUTCD-Part 4, and are required to be approved by council.

(a) **Arterial**

Administrative responsibility for roads is based on historical and political decisions as well as function within the hierarchy. Highways are administered by DTMR. The need to combine local activity planning with road planning could lead to greater local government involvement in the management of Arterial main streets. Arterials span these areas and responsibility may lie with either the state or local government.

Highway/motorway in urban/rural areas

These roads serve regionally and nationally significant movements and longer distance movements. To provide for a high standard of travel, speed environments of 100km/h or more are desirable, together with no frontage access. If frontage access does occur, then elimination of direct access from the abutting land use should be pursued.

These roads should also provide the primary freight routes and dangerous goods routes, and carry coach traffic between centres and regular public transport (RPT) bus traffic under a line haul mode. Any pedestrian and cycle facilities in urban areas should be located separately from the carriageways and protected accordingly. Crossing provisions should be grade separated. Grade separated intersections are desirable for all facilities in this category, although this will essentially be driven by volume demand or safety issues rather than hierarchy.

The road reserve width will often be dictated by the need for adjacent service roads, buffer zones and ancillary uses in the road corridor (e.g. cycle facilities, bus lanes). Divided carriageways are desirable to optimise safety and driver comfort. However, a two lane undivided cross section may be appropriate for low traffic volumes on a rural highway, provided there are sufficient overtaking opportunities. Whilst cycle facilities, pedestrian paths and bus lanes may be provided in the overall corridor, these facilities should desirably be separated from the through roadway and therefore represent an additional carriageway within the overall corridor. In rural areas, it is recognised that the demand for these adjacent facilities will generally be low.

Abutting land use types should be non-sensitive to vehicular traffic and generally not have frontage or direct access to the roadway. Uses associated with traffic such as highway service centres with amenities may be deemed appropriate in some locations based upon a needs assessment. In such cases, these would be provided with high quality direct access. Design standards for highways will primarily be set according to a high design speed and to maximise road user safety. In particular, the provision of wider shoulders is important in high speed locations.

In urban areas, grade separated intersections on urban roadways should be spaced at least 2 km apart. Intersections at grade on existing highways should be spaced no less than 1 km apart and are generally found to be between 1 km and 2 km apart.

In rural areas, if some land use provides for frontage access due to historic events, then any works undertaken to reduce this frontage access will enhance the traffic carrying capability of the highway in terms of both volume and speed. Whilst volumes may be low, the high traffic speeds mean that safety issues are important at access locations and reductions in the frequency of accesses will reduce the crash rate. Provision of pedestrian and cycle facilities will generally be related to demand and the need for a link associated with network planning. Grade separated intersections should be spaced between 4 km and 8 km, with a maximum spacing of 12 km.

Arterial in urban/rural

Arterials cater for external or intra-regional traffic and traffic between suburbs or major centres. These facilities should preferably have no direct access for all land uses. However, they often do have direct

accesses due to past land use decisions, so longer term access limitations and land use amalgamation should be pursued so that the traffic carrying role can be progressively enhanced.

The design standards are set to achieve a balance between safety and efficiency. In this case, spacing of intersections will often control the design speed and hence other design elements. There will be many existing situations where the road design is constrained by elements such as the road reserve, property access and road width. In such situations, an individual design form will need to be developed to suit the constraints, whilst still achieving the arterial road objectives.

The policy is to pursue no direct access from individual properties to arterial roads. Examples of alternative treatments include:

(i) side street entry to corner blocks; and/or

(ii) combining driveways; and/or

(iii) creating rear lane access; and/or

(iv) creating easements to service multiple properties.

To facilitate efficient traffic movement, a higher speed environment is desirable. Limits of 80 km/h for new arterial roads and 70 km/h for existing arterial roads and where physical constraints exist in urban areas, and up to 100 km/h in rural areas are recommended. Speeds in excess of the above stated speed are generally not appropriate with intersections at grade and high traffic volumes.

These roads may provide the primary freight routes and often provide secondary freight routes. Selected routes may be appropriate for dangerous goods movement. They accommodate inter urban and inter centre coach traffic and RPT bus traffic under a line haul mode with priority treatment. Any bus stops should be separate from the through traffic lanes.

Pedestrians should preferably be located separately from the carriageways, and pedestrian crossings provided at signalised points. Cycle facilities can be provided in exclusive bike lanes or on the road shoulder on roads with a speed limit less than 80 km/h, provided AUSTROADS guidelines are met. In locations where the speed limit is higher than 80 km/h, and where a high percentage of school cyclists are likely, or where there is a cycle accident history or identified potential, consideration should be given to locating these facilities separate from the carriageway.

A number of traffic lanes have to be acquired, with a minimum of a four to six lane carriageway for ultimate traffic growth, and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping or turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

The abutting land use should preferably be less noise sensitive, or alternatively should include building and site designs that minimise impacts from adjacent traffic flows.

In urban areas, intersections are generally configured at grade for this sub-category. Signalised or roundabout control is generally appropriate although high volumes may necessitate grade separation. Intersections should be spaced a minimum of 500 m apart.

In rural areas, direct access can be tolerated due to low volumes and limited frequency. However, appropriate safety levels must be achieved and the aim should be to remove such accesses over time. Intersections are generally configured at grade for this sub-category. Priority control is generally appropriate and intersections should be spaced a minimum of 1km apart due to the higher speed environments. However, a proper intersection type has to be assessed and determined using traffic analysis.

Arterial main street in urban areas

This category is directed at existing situations in urban areas, including villages, where a group of commercial land uses exists, generally on both sides of an arterial road. In these situations a decision

needs to be made, dependent on the value of these uses, whether the traffic carrying and access functions should coexist, or whether a bypass or parallel route upgrade is warranted. If it is decided that these functions should coexist, whether in the short or long term, measures will need to be developed as part of an LITP to address this mix.

These design standards are primarily aimed at safety and ensuring pedestrian mobility in conjunction with parking and vehicle access. Traffic volumes may be so high that amenity to roadside activities is limited. However, as these are arterial roads, traffic volumes should not be moderated except by bypassing where feasible.

Speeds on these facilities should be kept sufficiently low to provide for safe pedestrian crossing at controlled points and to maintain environmental amenity for adjacent land uses, but still allow for efficient traffic movement. These roads should provide for pedestrian movement on both sides with crossing at controlled points, and with bicycle lanes on the road to avoid mixing with denser pedestrian traffic.

Limiting the frequency of property access is important for the traffic carrying capacity and also for the amenity levels associated with significant pedestrian traffic in the 'main street precinct'. Streetscaping would assist in ameliorating visual and audible land use impacts.

A number of traffic lanes will have to be acquired to enable four lane or six lane carriageways (if a corridor is likely to take a key public transport route associated with the adjacent land use, e.g. potential exclusive PT lane) for ultimate traffic growth and provision made for proper width to cater for kerb and channel, medians, indented bus bays to reduce delay to through traffic and bike lanes. Opportunities should be sought to bypass freight movements. This category is generally inappropriate as a dangerous goods route.

Intersections may be closely spaced along these facilities due to past planning and land use decisions. Desirably, to avoid queue interaction, intersections should be spaced a minimum of 150m apart.

This sub category is included in order to acknowledge its existence, and to provide for special cases, but it is not an option recommended for the future due to the difficulties of managing the conflicting access and mobility functions. Within the rural road hierarchy, "Arterial Main Street" is not considered appropriate.

(b) **Sub arterial road design standards**

(i) **Traffic distributor in urban/rural**

These traffic carrying roads are the key supplement to the arterial road network. They should connect between arterials and specific areas and should be more convenient than using the internal streets. Consequently, a higher level of efficiency and safety should be provided. Volumes are carrying preferably up to 25,000 vpd for amenity, as abutting land uses should be non-sensitive.

To make these roadways more attractive than internal streets, a higher speed environment is desirable. Speed environments of between 70 km/h~80 km/h in urban and up to 100 km/h in rural areas are recommended. The policy is to pursue no direct access to individual properties. Examples of treatments include:

(A) side street entry to corner blocks;

(B) combining driveways;

(C) creating rear lane access;

(D) creating easements to service multiple properties.

In the preferred design form, access should be restricted and be managed through treatments such as amalgamated entry points or side streets as discussed above. This would be the treatment pursued as part of any new development. Access for major developments, multi-unit

dwellings, schools, child care centres, and/or commercial uses may be provided along these routes, provided it is controlled through channelisation or signals.

These roads may serve as secondary freight routes. Nominated routes may be appropriate for dangerous goods movement. They could accommodate RPT traffic under a sweeper mode. Any bus stops should be located separately from the through traffic lanes.

In most circumstances, specific provision for control of pedestrian movements should be provided and roadside parking will be discouraged. Usually, the prime concern will be the movement of traffic, so traffic management techniques could be applied (such as access minimised by consolidation of development accesses or side road access to sites). Noise and visual amenity impacts on surrounding uses should be managed through site considerations and/or road treatents.

Cycle facilities can be provided in exclusive bike lanes or on the road shoulder on roads with a speed limit less than 80 km/h, provided AUSTROADS guidelines are met. In locations where the speed limit is higher than 80 km/h, where a high percentage of school cyclists are likely or where there is a cycle accident history or identified potential, consideration should be given to locating these facilities separate from the carriageway.

A number of traffic lanes have to be acquired, with a four lane carriageway for ultimate traffic growth, and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two-lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping or turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

In urban areas, paved footpaths are required on one or both sides depending on the demand of pathway usage to abutting land use and traffic facilities (e.g. bus stops) with pedestrian crossings at controlled points. Intersections at grade are appropriate for this management type. Signalised or roundabout control is generally appropriate although priority controlled intersections may be acceptable; this will be determined by a traffic analysis study. Intersections are typically spaced 250~400m apart.

In non-urban areas, although access is restricted in the preferred design form, individual lot accesses are acceptable, particularly if the access points are widely spaced and properties are well set back. Pathways are only required where the road serves an identified pedestrian linkage, with pedestrian crossings at controlled points. Roundabouts or priority control are generally appropriate, although this will be determined by a traffic analysis study.

(ii) **Controlled distributor in urban/rural**

The hierarchical objective of this sub-category is to maintain the traffic carrying function as a primary role but also to allow frontage and parking (with appropriate conditions) to achieve an environment whereby "overlooking" can enhance personal safety. The controlled distributor should be used where adjacent frontage development exists, or is planned. It can be expected to be used where residences are within reasonable walking and cycling distance of regularly accessed community destinations, e.g. schools, shops.

A number of traffic lanes have to be acquired, with a four lane carriageway for ultimate traffic growth and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping and turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

To satisfy the competing demands of traffic carrying efficiency and property access/on street parking, it is important to separate parked cars and turning vehicles from the through traffic lanes.

This will require carriageway widths greater than a traffic distributor. The verge widths need to include landscaping, pathways and separation. This will be an important factor in subdivision planning when determining the lot layout and road reserve needs.

These design standards are primarily aimed at safety and ensuring pedestrian mobility in conjunction with parking and vehicle access.

In the conventional sub-arterial design case it is desirable to have no direct access to individual properties; however, consolidated access along the controlled distributor would be acceptable if the appropriate form of traffic control can be provided at these points.

This category of road is a response to relatively unique situations and often evolves as a result of previous planning decisions. By definition, these are roads where an aspect such as speed or vehicle composition up to 20,000 vpd is controlled. Such control may be:

(A) limiting speed to 60 km/h where frequent direct residential or commercial frontage exists;

(B) limiting volumes to avoid excessive pressure on abutting land uses;

(C) limiting heavy vehicle usage to protect the amenity of abutting uses; and

(D) limiting speed and/or usage of particular vehicle types where alignment constraints exist.

On roads where frequent access to adjacent land uses exists and cannot be removed or consolidated, measures should seek to achieve safe access while retaining the convenience and efficiency of the route for through traffic. This may include a lower speed environment, but it should not be so low as to cause rat running elsewhere, for example, 60 km/hr in urban areas and 60~80 km/h in rural areas. Other measures could include the protection of adjacent parking by indented bays, bicycle paths, and landscaping. A longer term aim should be to reduce access if opportunities arise.

Access for individual lots should be controlled using one or more of the following measures:

- central median (no right turns) ;
- turning lane separate from through traffic lane;
- large lot frontage;
- lot layout to avoid on street visitor parking (large lots); and
- adjacent properties having adjacent driveways.

When a road is designated as a controlled distributor, an LITP should be prepared to identify the need to control any aspect(s) of this road, and the most appropriate form(s) of control.

(iii) **Sub arterial main street in urban areas**

This category is directed at situations where a group of commercial land uses exists, generally on both sides of a sub arterial road. On these stretches of road a decision needs to be made, dependent on the value of these uses, whether the traffic carrying and access functions should coexist, or whether a bypass or parallel route upgrade is warranted.

If the traffic carrying and access functions need to, or should coexist, whether in the shorter or longer term, management measures will need to be developed as part of an LITP to address the coexistence of these two functions.

In contrast to the arterial sub-category, the traffic environment on sub arterial roads may be restricted to improve the amenity for pedestrians and users of the adjacent developments. Measures may be taken to reduce some traffic use of the road, for example, during peak periods, and opportunities should be sought to bypass freight movements.

This category is generally appropriate as a bus route, and indented bays should be provided to reduce delay to through traffic. This category is generally inappropriate as a dangerous goods route.

Speeds should be kept low to improve amenity to pedestrians and abutting land uses, and should be no greater than 60 km/h. Volumes should be no greater than 15,000 vpd in order to maintain amenity to abutting land uses. These roads required a balance between accessibility and mobility, using environmental street design or streetscaping.

In special cases, a number of traffic lanes will have to be acquired to enable four lane or six lane carriageways for ultimate traffic growth (if a corridor is likely to take a key public transport route associated with the adjacent land use, e.g. potential exclusive PT lane), and provision made for a proper width to cater for kerb and channel, medians, bus stops and bike lanes. For the interim, a two lane undivided cross section may be appropriate for a low traffic volume environment, whilst achieving affordability, sufficient overtaking opportunities, vehicle breakdown, stopping and turning vehicles and bicycles. However, divided carriageways are desirable to optimise safety and driver comfort.

This category should provide for pedestrian movement on both sides with crossings at controlled points, and with bicycle lanes on the road to avoid mixing with denser pedestrian traffic. Intersections should be controlled by way of signalisation or roundabouts, although priority intersections may be appropriate. Spacing of intersections is site specific, based on past planning and land use decisions, although a minimum spacing of 150m is desirable to avoid queue interaction. Within the non-urban road hierarchy the ‘Sub-Arterial Main Street’ is not considered appropriate.

(c) **Major collector road**

Major collector roads provide a connection between the local streets and the traffic carrying roads and mark a shift in the environment between roads and streets. The design standards place a greater emphasis on travel time efficiency and strict guidelines for safety and environmental amenity should be adhered to on these roads.

Traffic flow levels commonly accepted range from 3,000 vpd up to 12,000 vpd. Access to multi-unit residential developments, schools or shopping centres may well be via major collectors. Individual residential lot access to these roads should be restricted, and generally a speed environment of 60 km/h to provide for safety and amenity while ensuring travel times are reasonable. Heavy vehicle and dangerous goods movement should be restricted in residential areas, with the exception of service vehicle movement. Buses will generally operate in a sweeper role and indented bays may be required to maintain safety at some locations.

Pathways and bicycle lanes should be provided on one or both sides of the road. However, in non-urban areas, pathways are generally not required unless network planning deems it appropriate. Some controlled pedestrian crossing points may be required in urban areas, particularly where traffic volumes are higher. Kerbside parking could be provided for in urban areas.

Intersections are typically spaced 80m to 100m in urban areas and up to a maximum 200m in non-urban areas. Intersection control would generally be either by roundabout or priority control. These roads should have two or four lane carriageways, depending on the degree of frictional and impact characteristics criteria that apply.

Environmental street design may be required in urban areas to moderate speeds and minimise through traffic penetration. Streetscaping would also assist in ameliorating visual and noise impacts to abutting land uses.

(d) **Local streets**

Level 3 sub categories mainly relate to managing and providing treatments for residential streets in the road hierarchy. However, consideration must also be given to non-residential local streets, e.g. in industrial and commercial areas. It should be noted that this document will not deal specifically with

"streets" (as per Level 1), but the following principles may be appropriate for general application across various council standards and requirements.

Streets have as their function to facilitate public interaction and movement through a place or neighbourhood. Local Streets must allow for the safe and efficient movement of all users, provision for parked vehicles, the provision of public utilities, access to allotments and streetscaping.

The management of these streets is less restrictive due to low traffic volumes, property access and parking. Volumes should be limited to below 3,000 vpd and the speed environment to 30~50 km/h in urban areas to ensure amenity for abutting land uses, it is noted that posted speeds will be at 50 km/hr, and to a maximum 60 km/h in rural areas to ensure reasonable travel times.

Heavy vehicles and dangerous goods movement should be restricted in residential areas, with the exception of service vehicles and public transport. Kerbside bus stops are generally appropriate, although indented bays may be required to maintain safety at some locations.

The provision of pathways is generally not necessary, although this may be appropriate in some instances as a requirement of network planning. No specific pedestrian crossing provision is required. No special cycle facilities are needed as these users should be able to share the road space due to the low traffic volumes and speeds.

No specific parking provision is required on these streets.

Intersection spacing is a minimum of 40~60m in urban areas and 100m in rural areas. Some intersections may be controlled by roundabouts; otherwise, priority control should be sufficient. These streets should have a two lane cross section, or one lane where necessary, with reasonable travel efficiency.

Environmental street design may be required in urban areas to moderate speeds and minimise through traffic penetration. Streetscaping would also assist in ameliorating visual impacts on abutting land uses.

If significant development occurs in the future in rural areas, then it may be appropriate to reclassify these streets as ‘major collector’ if the catchment size or density increases significantly. Accordingly, allocations should be made in the network planning.

In urban areas, the primary design objective is to maximise safety and amenity for adjacent properties and adjacent activities/users (i.e. pedestrians, cyclists, car parking, children playing). The most important design standard in this regard is the maximum design speed. Travel time efficiency will be compromised over safety and amenity aspects by appropriate subdivision design. Such design includes consideration of the maximum volume (by catchment size), the design speed (by street length) and the travel time efficiency (by connectivity of streets). It is this category of roadway whereby design standards are well defined because of the clear principles set out in such documents as *Queensland Streets* and *Complete Streets.*

In rural areas, the primary design objective is to minimise the cost of roadway provision whilst still maintaining acceptable performance levels (as a result of the very low volume use). Travel time efficiency will be compromised over safety and amenity aspects. There may be an issue with dust nuisance, which may be one of the factors considered when determining whether the road should be sealed or not. The low traffic volumes anticipated on some collector streets requires the need for a single lane cross section alternative, as well as the two lane form. There may also be a demand for the provision of horse trails within the road verge, and in this case a widened verge may be required to cater for these.

(e) **Non residential local street**

Similar roles apply to collector streets in commercial (including CBD) and industrial areas. Generally, higher traffic volumes can be tolerated on such streets than accepted in residential areas. Fewer lots would be served in commercial and industrial areas by these streets than low density residential areas,

due to the high trip generation of the land uses. Significantly higher heavy vehicle proportions and tolerances for environmental factors such as noise would be acceptable on such streets in industrial areas.

Key performance criteria for collector streets in industrial areas are as follows:

(i) traffic volumes not greater than 3,000~6,000 vpd depending on the environmental cell type;

(ii) speed environment of 50~60 km/h;

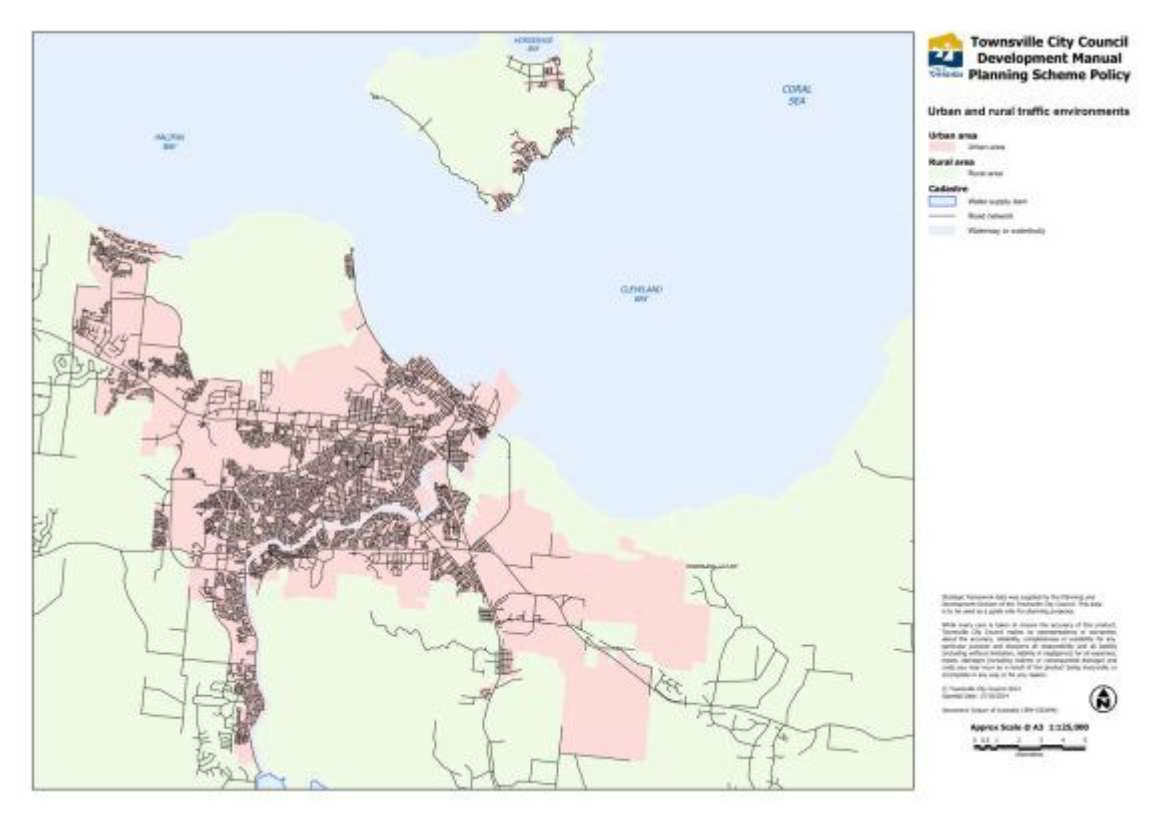
(iii) provision of parking lanes on both sides of the street;

(iv) provision of bike lane on the carriageway;

(v) provision of paved pathway on either or both sides of the street; and

(vi) sufficient heavy vehicle turning radius at access points or in cul-de-sacs.

SC6.4.3.13 Attachment A Urban and rural traffic environments map



Click here to view PDF high resolution map.

SC6.4.3.13 Attachment B1 Road hierarchy elements and their objectives in urban areas

LEVEL 1: PURPOSE							
	Roads						Streets
• to carry through traffic							• to provide local property access; and • to collect local traffic
LEVEL 2: FUNCTION							
Arterial roads			**Sub-arterial roads**			**Major collector roads**	**Local streets**
• through traffic movements across town; • longer distance strategic traffic movements; • primary connection between suburbs and employment, economic, education or entertainment centres; • line haul public transport task; • primary freight and dangerous goods routes; and • regional cycle movements.			• through traffic between arterial roads; • connections between local areas and arterial roads; • access to public transport; • through movement of public transport; • regional – local cycle movements; and • pedestrian movements.			• balance between carry traffic and access within the specific area; • direct access to grouped properties; • access to public transport; • pedestrian movements; and • local cycle movements.	• direct access to properties; • pedestrian movements; and • local cycle movements.
LEVEL 3: MANAGEMENT							
Highway/ Motorway	**Arterial**	**Arterial main street***	**Traffic distributor**	**Controlled distributor***	**Sub-arterial main street***	**Major collector**	**Local street**
The aim of management policies for these categories will be to facilitate:							
• longer distance traffic movements between towns; and • regionally and nationally significant movements.	• longer distance traffic movements between suburbs and other centres.	• longer distance traffic movements; • access to commercial properties; • car parking; • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operation*	• connection of local areas to arterial roads; • through movements between arterial roads; and • access to major developments	• connection of local areas to arterial roads; • access to properties (certain existing cases) • car parking; and • pedestrian movements. *Treatment may control some aspects of traffic operations to ameliorate impacts*	• connection of local areas to arterial roads; • access to commercial properties; • car parking; and • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operations.*	• connection of local streets to arterial roads; • access to grouped/ commercial properties and community facilities; • car parking; and • pedestrian movements *Treatment may involve preservation of aspects of local amenity in balance with traffic operations.*	• connection of local streets with traffic carrying roads; and • access to individual adjacent properties • connection to other local streets.
LEVEL 4: DESIGN							
According to relevant guidelines and codes including SC6.4 Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, *Queensland Streets*, Australian Standards and *Complete Streets* for the local streets level.							

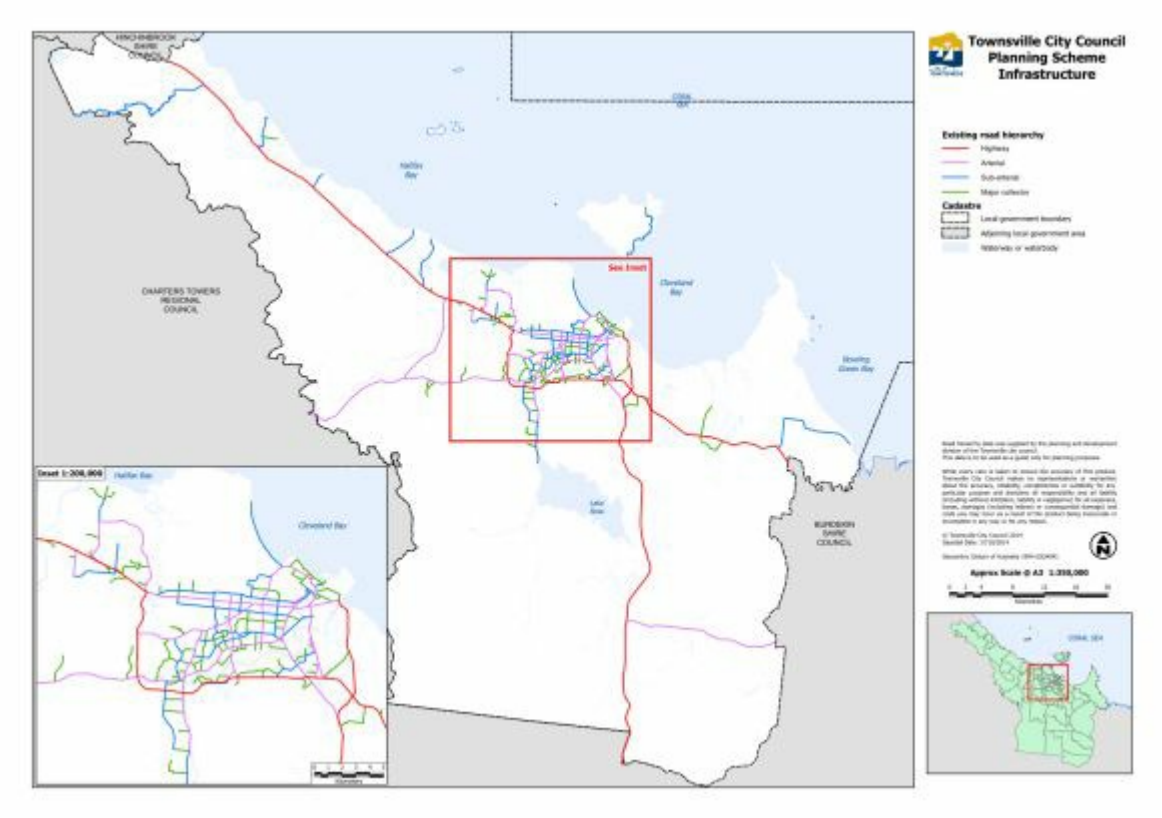
Note—* Only permitted in existing cases or special cases. Therefore treatment may involve preservation of existing land use but discouraging further access points to the adjacent land development.

SC6.4.3.13 Attachment B2 Road hierarchy elements and their objectives in rural areas

LEVEL 1: PURPOSE						
	Roads					Streets
• to carry through traffic						• to provide local property access; and • to collect local traffic
LEVEL 2: FUNCTION						
Arterial roads		**Sub-arterial roads**		**Major collector roads**		**Local streets**
• through traffic movements between towns; • longer distance strategic traffic movements; • primary connection between town and employment, economic, education or entertainment centres; • line haul public transport task; • primary freight and dangerous goods routes; and • regional cycle movements.		• through traffic between arterial roads; • connections between local areas and arterial roads; • access to public transport; • through movement of public transport; and • regional – local cycle movements.		• connections between local streets and arterial/sub-arterial roads; • carry traffic having a trip end within the specific area; • direct access to grouped properties; • access to public transport; and • local cycle movements.		• direct access to properties; • pedestrian movements; and • local cycle movements.
LEVEL 3: MANAGEMENT						
Highway/ Motorway	**Arterial**	**Traffic distributor**	**Controlled distributor***	**Major collector**	**Local street**	
The aim of management policies for these categories will be to facilitate:						
• longer distance traffic movements between towns; and • regionally and nationally significant movements.	• longer distance traffic movements between town and other centres.	• connection of local areas to arterial roads; • through movements between arterial roads.	• connection of local areas to arterial roads; • through movements between arterial roads; • access to properties (certain existing cases) or industrial/commercial properties; • car parking; and • pedestrian movements. *Treatment may involve preservation of aspects of local amenity in balance with traffic operation*	• connection of local streets with traffic carrying roads; and • access to individual adjacent properties.	• access to individual adjacent properties; and • connection to other local streets	
LEVEL 4: DESIGN						
According to relevant guidelines and codes including the SC6.4 Development manual planning scheme policy, DTMR guidelines, AUSTROADS, MUTCD, Queensland Streets and Australian Standards.						

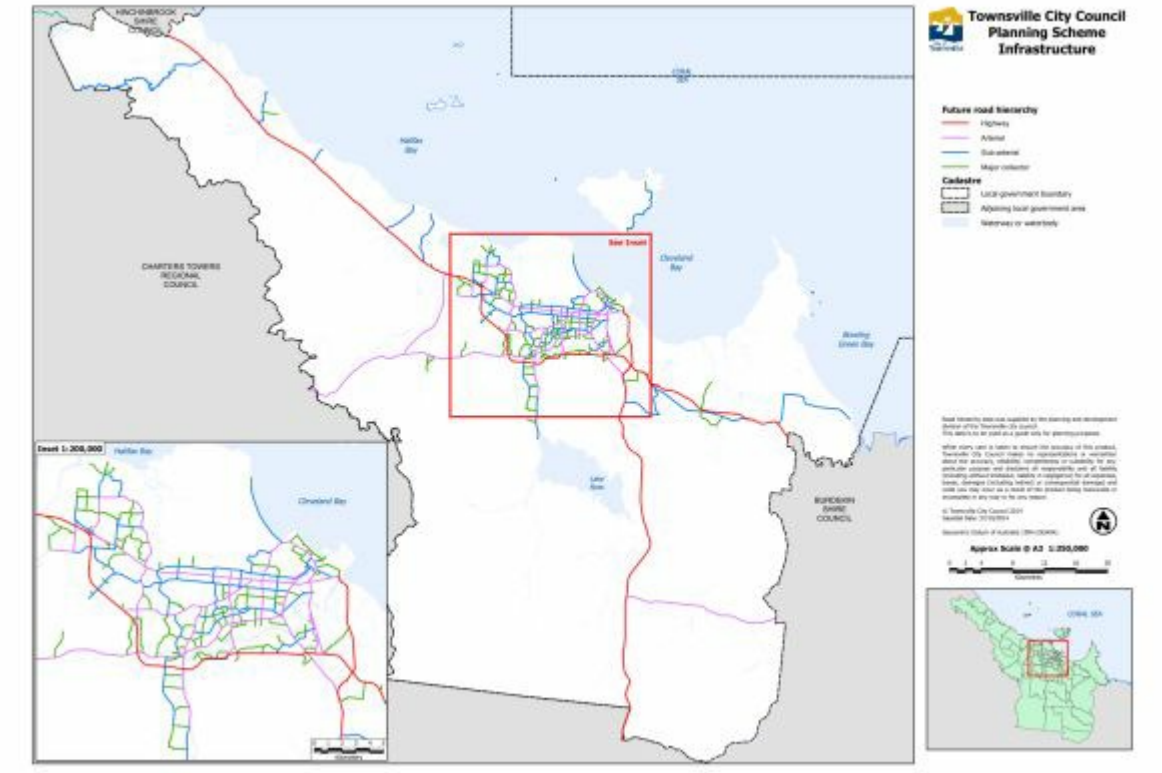
Note—* Only permitted in existing cases or special cases. Therefore treatment may involve preservation of existing land use but discouraging further access points to the adjacent land development.

SC6.4.3.13 Attachment C1 Townsville road hierarchy map (existing)



Click here to view PDF high resolution map.

SC6.4.3.13 Attachment C2 Townsville road hierarchy map (future)



Click here to view PDF high resolution map

SC6.4.3.13 Attachment D1 Road hierarchy desirable performance criteria in urban areas

Criterion	Roads							Streets
	Arterial roads			Sub arterial roads			Major collector roads	Local streets
	Highway/ motorway	Arterial	Arterial main street*	Traffic distributor	Controlled distributor*	Sub arterial main street*	Major collector	
Functional Characteristics								
Dominant linkage	Regional	City, Suburbs, Major centres	City, Suburbs, Major centres	Specific area	Specific area	Specific area/ main sites	Main Sites/ Environmental cell	
Traffic carrying function	Volumes not restricted	Volumes not restricted	Volumes not restricted	preferably <25,000vpd	preferably <20,000vpd	preferably <15,000vpd	<12,000vpd	
Residential access function	Nil	Nil	Nil, consolidated/ no new access	Nil	Nil desirable, site specific-subject to negotiation with council/ no new access	Nil desirable, site specific-subject to negotiation with council/ no new access	Limited-subject to negotiation with council	
Commercial access function	Nil	Nil	Site specific	site specific-subject to negotiation with council	site specific-subject to negotiation with council	site specific-subject to negotiation with council	site specific-subject to negotiation with council	
Industrial access function	Nil	Nil	Nil	Nil	Nil	Nil	site specific-subject to negotiation with council	
Desirable traffic speed environment	>=100km/h	70-80km/h	60km/h	60-80km/h	60km/h	60km/h	50~60km/h	
Heavy traffic movement	Primary freight routes	Primary/ secondary freight routes	Should bypass except for access	Secondary routes	Should bypass except for destination or return only	Should bypass except for destination or return only	Destination or return only	
Dangerous goods movement	Primary routes	Selected routes only	Inappropriate except for access	Selected routes only	Selected routes only	Inappropriate except for destination or return only	Inappropriate except for destination or return only	Refer to SC6.4.4 Design specification and standard drawings
Public transport facilities	Line haul, priority treatments use high frequency, limited stops, peak express, local and feeder	Line haul, priority treatments	Bus route, bus lanes where required	Bus route	Bus route, bus lanes where required	Bus route, bus lanes where required	Bus route	

Cycle facilities	Trunk Routes, off carriageway	Trunk Routes, off carriageway or cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	Trunk/ District routes, cycle lanes on road	District/ Neighbourhood routes, cycle lanes on road
Paved footpath *As per council standard*	Only where linkage required, separate from road	Only where linkage required	Both sides	One or both sides	One or both sides	Both sides	One or both sides
Frictional Characteristics							
Preferred access control	No access	No access	Selective access control	Combined sites only tolerated	Selective access control tolerated	Selective access control tolerated	Combined site access preferred
Parking provision	No parking on roadway	No parking on roadway	Selective routes or corridors	No parking on roadway	Selective routes or corridors	Selective routes or corridors	Provide for kerbside parking
Bus stop provision	None on road	None on road	Indented bays	Indented bays	Indented bays	Indented bays	Indented bays
Pedestrian crossing Locations	Grade separated	Signalised	Controlled points	Controlled points	Controlled points	Controlled points	Some controlled points
Typ. Intersection spacing	1-2km highway >=2km motorway	500-1000m	500m desirable, 150m minimum	200~500m	200~500m	150-500m	80-200m
Preferred intersection treatments	Grade separated	signal/ roundabout	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority	Signal/ roundabout/ priority
Number of traffic lanes	Volume driven, desirably divided	4~6 lanes, desirably divided	4~6 lanes, desirably divided	4 lanes, desirably divided	4 lanes, desirably divided	4 lanes or 6 lanes where PT needed, desirably divided	2~4 lanes, could be divided
Impact Characteristics							
Abutting land use types	Non sensitive	Non sensitive, vehicle associated	Retail/ commercial	Non sensitive to traffic	Preferably non sensitive to traffic	Retail/commercial	As specified under zoning
Land use impact amelioration	Barriers/ buffers/ Setbacks	Buffers/ streetscape/ setbacks	Streetscape	Streetscape/ Setbacks	Streetscape	Environmental street design/ streetscape	Environmental street design/ streetscape

Note— Only applied in existing cases or special cases.

A bus stop provision is required to be integrated with the paved footpath system

traffic study will determine. e.g. TIA (Traffic Impact Assessment).

SC6.4.3.13 Attachment D2 Road hierarchy desirable performance criteria in rural areas

Criterion	Roads					Streets
	Arterial Roads		Sub Arterial Roads		Collector Roads	Local Streets
	Highway/ Motorway	Arterial	Traffic Distributor	Controlled Distributor*	Major Collector	
Functional Characteristics						
Dominant linkage	Regional	Intra-regional, suburbs	Specific area	Specific area	Local area	Refer to SC6.4.4 Design specification and standard drawings
Traffic carrying function	Volumes not restricted	Volumes not restricted	Volumes not restricted	preferably <15,000~25,000vpd	preferably <10,000~15,000vpd	
Residential access function	Nil	Nil	Nil	Nil desirable, consolidated/ no new access	Consolidated	
Commercial access function	Nil	Nil	Consolidated	Consolidated	Desirably consolidated, site specific	
Industrial access function	Nil	Nil	Nil	Nil desirable, consolidated/no new access	Desirably consolidated, site specific	
Desirable traffic speed environment	>=100km/h	80-100km/h	80-100km/h	60~80km/h	60km/h	
Heavy traffic movement	Primary freight routes	Primary/secondary freight routes	Secondary routes	Should bypass except for access	Access only	
Dangerous goods movement	Primary routes	Primary/secondary routes	Nominated routes only	Nominated routes only	Inappropriate except for access	
Public transport facilities	Line haul, priority treatments	Line haul, priority treatments	Bus route	Bus route	Bus route	
Cycle facilities	Regional, off carriageway	Regional, on or off carriageway	Regional/local, on or off carriageway	Regional/local, on or off carriageway	Local on or off carriageway	
Pedestrian movement facilities	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	Separate from road where linkage required	
Frictional Characteristics						
Preferred access control	No access	No access	Selective access control	Selective access control	Combined site access preferred	
Parking provision	Nil	Nil	Nil	Nil	No specific provision	
Bus stopping provision	None on road	Dedicated bays where appropriate	Dedicated bays where appropriate	Dedicated bays where appropriate	Dedicated bays where appropriate	
Pedestrian crossing Locations	Grade separated	Controlled points	Controlled points	Controlled points	May require controlled points	
Typ. Intersection spacing	4-8km (maximum 12km)	>1km	>300m	>300m	>200m	

Preferred intersection treatments**	Grade separated/ priority	Roundabout/ priority	Roundabout/ priority	Roundabout/ priority	Roundabout/ priority	
Number of traffic lanes	Volume driven	Reservation for 4~6 lanes	Reservation for 4 lanes	Reservation for 4 lanes	Reservation for 2~4 lanes	
Impact Characteristics						
Abutting land use types	Non sensitive, vehicle associated	Non sensitive, vehicle associated	Non sensitive to traffic	Preferably non sensitive to traffic	As specified under zoning	
Land use impact amelioration	Setbacks	Setbacks	Setbacks	Setbacks	Setbacks	

Note— Only applied in existing cases.

A bus stop provision is required to be integrated with the paved footpath system

Traffic study will determine, e.g. TIA (Traffic Impact Assessment)

SC6.4.3.14 Traffic impact assessments

SC6.4.3.14.1 Introduction

A traffic impact assessment (TIA) is a process of compiling and analysing information on the impacts that a specific development proposal is likely to have on the operation of roads and transport networks. The assessment will not only consider general impacts relating to traffic management (road efficiency and safety), but will also consider specific impacts on land use environment and all road users including on-road public transport, pedestrians, cyclists and heavy vehicles.

Developers should refer to the *Guide to Traffic Management* produced by Austroads as a primary reference, and in particular, *Part 12: Traffic Impacts of Development.* The TIA sub-section has been produced to supplement Part 12 by establishing criteria for low, moderate and high traffic impact developments, and to supply additional information pertinent to particular land uses, climate and traffic characteristics in Townsville. If a discrepancy exists between this document and the *Guide to Traffic Management*, this sub-section will prevail.

(1) TIA scope and purpose

(a) TIA purpose

Council requires a TIA in order to:

(i) assess the adequacy of the existing or future transportation system to accommodate additional traffic generated by a proposed development, redevelopment or land use change; and

(ii) to assist in determining what improvements may be required to transport infrastructure (e.g. roadways, pathways, public transport and traffic facilities, parking, etc.) to maintain a satisfactory level of service for the Townsville community.

Within the context of the matters outlined above, the aim of this sub-section is to ensure that:

- traffic impact assessment of developments is undertaken in a uniform manner leading to consistent treatment of similar developments;
- the level of impact assessment is appropriate for the level of potential impacts;
- a road or a road network continues to operate at an agreed level of service following the opening of a development;
- both "soft" solutions (e.g. road use management such as alternative routes) and "hard" solutions (e.g. changes to infrastructure) are considered when mitigating impacts;
- the needs of all road users are considered and appropriate facilities (e.g. bicycle lanes, footpaths, bus lanes, intersection widening or upgraded intersection controls) are provided in a timely manner;
- a development is considered within its proposed environment and not in isolation from nearby features such as intersections, footpaths and other driveways;
- cumulative impacts on transport networks of other developments in an area or region are considered; and
- road safety and environmental impacts (both natural and built) are considered.

(b) TIA scope

A TIA may be required where a development affects the function, safety and efficiency of the transport network. The requirements for a TIA are outlined in this policy sub-section.

The scope of a TIA will depend on the location, type and size of the development and the ability of the road network to handle traffic generated by the development. Therefore, some developments will require an extensive and detailed TIA, while others will require only a brief TIA.

(2) How to use this document

The following steps will guide the applicant in determining the level of TIA required with regard to land use and traffic environment perspectives.

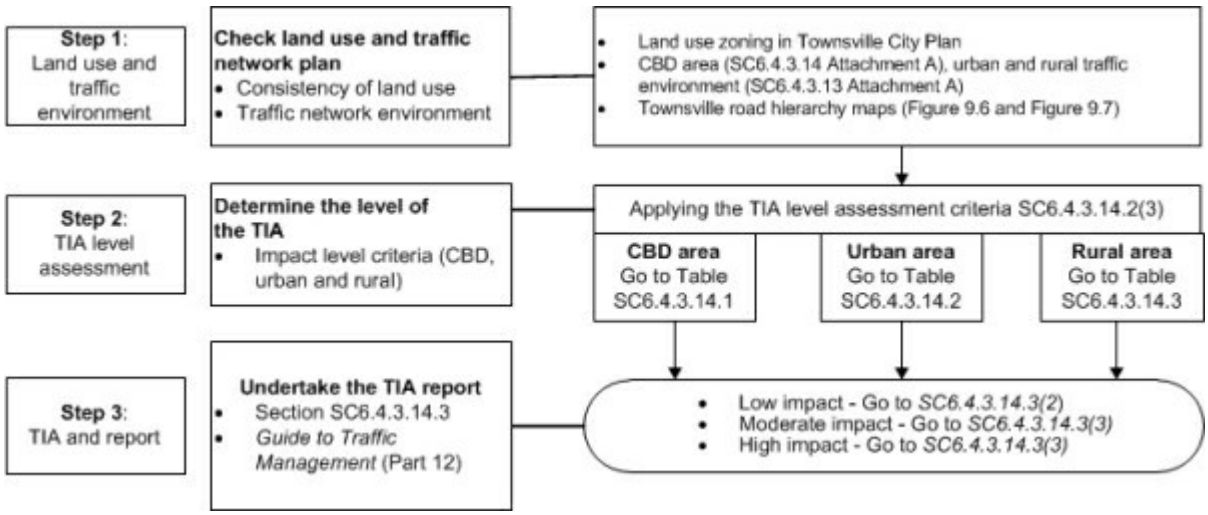


Figure SC6.4.3.14.1 How to use SC6.4.3.14 Traffic impact assessment guidelines

(3) Terminology

AADT	Annual Average Daily Traffic
CBD	Central Business District as per the *Townsville CBD Master Plan* or Attachment A.
DTMR	Queensland Department of Transport and Main Roads
DoS	Degree of saturation
Inconsistent development	development that is not consistent with the planning scheme, or development that is inconsistent as described in Section 650 in the *Planning Act 2016*.
Level of dervice (LOS)	a qualitative measure using a sequence of letters from A through F to describe the quality of operational conditions within an intersection, transit or a roadway link. Refer to the *Highway Capacity Manual for details*.
PCE	Passenger Car Equivalent
PCU	Passenger car unit
PT	Public transport
TIA	Traffic impact assessment
Traffic facility	roads, streets, bikeways, highways, their networks, terminals, traffic signs, public transport/car park and abutting lands related to all modes of transportation, i.e. people, vehicles, goods.
Transportation demand management (TDM)	the application of strategies and policies to reduce travel demand (specifically that of single-occupancy private vehicle), or to redistribute this demand in space or time.
Trip	a single or one-direction person or vehicle movement.

Trip generation	the total number of trips measured in trip ends (i.e. trip production or trip attraction) entering and exiting the site for the defined period, e.g. one hour, one day etc.
VPD	Vehicles per day

(4) Reference and source documents

(a) Legislation

Planning Act 2016
Transport Infrastructure Act 1994

(b) Australian Standards

AS2890 Parking facilities (Part 1: Off-street car parking, Part 2: Off-street commercial vehicle facilities, Part 3: Bicycle parking facilities, Part 5: On-street parking, Part 6: Off-street parking for people with disabilities).

(c) Austroads

Cycling Aspects of Austroads Guides, 2011
Guide to Traffic Management, 2009 (in particular, Part 12)

(d) Townsville City Council

CBD Master Plan (2013)
SC6.4.3.5 Car parking and public transport facilities
SC6.4.3.13 Townsville road hierarchy

(e) Queensland Department of Transport and Main Roads,

Guidelines for Assessment of Road Impacts of Development, 2006 *(GARID)*
Manual of Uniform Traffic Control Devices (MUTCD), 2003
Traffic and Road Use Management Manual (TRUM)
Road Planning and Design Manual (TRUM)
Roads and Maritime Services NSW (RMS), Guide to Traffic Generating Developments 2002 Version 2.2

(f) Other

Transportation Research Board, *Highway Capacity Manual* (HCM), 2010

SC6.4.3.14.2 Determining the level of the TIA

The scope, intent and degree of traffic impact will vary. This will depend on the land use of the proposed development, direct access locations and current land use zoning. For example:

- development based on the current land use zoning and character of the locality;
- location of the development: CBD, urban, rural area;
- the existing and future planned transport network;
- direct access to the external road hierarchy system;
- staging, size and type of the development;
- the traffic environment at the time of the proposal;
- existing approved (but not delivered) development within the area;
- current development applications within the area; and
- any strategic planning determining future land uses such as the Townsville State Development Area.

(1) Land use environment

Due to the different desirable service standards in the CBD/Urban and Non-urban areas, council has different impact assessment thresholds depending on whether the development is in the CBD, urban or rural traffic environments. These areas are defined as follows:

(a) *The CBD* (see SC6.4.3.14 Attachment A); or

(b) *Urban* area – with the exception of the CBD, refer to the map in SC6.4.3.13 Attachment A; or

(c) *Rural area* – areas not in the urban area, or CBD, refer to the map in SC6.4.3.13 Attachment A.

These TIA land use traffic environment definitions relate to the character of the land for the purpose of assessing the traffic impacts on the site and the adjacent network.

(2) Three levels of the TIA

For each of the development locations identified above, and in conjunction with the defined Townsville Road Hierarchy system, (SC6.4.3.13 Townsville road hierarchy) there are three different levels of traffic impact assessment. The anticipated level of impact will require different methodologies of traffic forecasting and analysis, as described below.

Low impact (SC6.4.3.14.3(2) Low TIA report):

The development is likely to have a very minor impact as the land use is consistent with the Townsville City Plan but a review is still required to ensure potential traffic issues are assessed in terms of traffic safety and amenity issues, etc. A low level TIA report will comprise of a statement of impact, and a corresponding statement of proposed mitigation measures and measures to optimise the network.

Moderate impact (SC6.4.3.14.3(3) Moderate/High TIA Report):

The development is likely to have a moderate traffic impact on the surrounding existing and future land uses, traffic network and operations. For a moderate level TIA Report, either a manual forecasting or mesoscopic traffic simulation modelling (e.g. SIDRA Network, Aimsun or an equivalent model) or microscopic traffic simulation modelling (e.g. Aimsun or an equivalent model) (Refer to SC6.4.3.14.4.2(a)) may be a suitable methodology of traffic forecasting due to:

- a moderate threshold, in terms of additional or new traffic generated as defined by the CBD/Urban/Non-urban TIA impact level assessment criteria;
- insignificant impact on existing and future transport and traffic systems, e.g. no additions or changes to the road hierarchy system; and
- the characteristics of the road network in the immediate vicinity of the development.

Note—if broader traffic network modelling (e.g. masterplan) has been recently done in that area (i.e. less than two years old), a high impact assessment may be assessed at the moderate level (upon confirmation with council), as long as the development is consistent with the land use or assumptions made within the previous modelling study.

High impact (SC6.4.3.14.3(3) Moderate/High TIA Report):

The development is likely to have a high impact on the surrounding existing and future land uses, traffic network and operations. For a high level TIA report, which does require a comprehensive assessment approach, council encourages the use of an appropriate traffic modelling program, e.g. EMME (for strategic traffic modelling), Aimsun, or an equivalent model, (Refer to SC6.4.3.14.4.2(a)) particularly where:

- additions or changes to the road hierarchy system are proposed, i.e. a new/changed arterial, sub-arterial or major collector road; or
- significant trip behaviour changes and impacts are expected, as defined by the CBD/Urban/Non-ruban TIA impact level assessment criteria, e.g. trip generation, trip distribution, mode choice and trip assignment; or
- changes to council's and/or DTMR's future major traffic network programmes are proposed.

Note—occasionally a TIA may have a high anticipated impact, but the area of impact is restricted to a corridor rather than a network within the TIA area. In this circumstance, either a manual forecasting or mesoscopic traffic simulation modelling may be a suitable methodology of traffic forecasting.

(3) Applying the TIA impact level assessment criteria

Use Table SC6.4.3.14.1 to Table SC6.4.3.14.3, whichever is relevant to the location of the development, i.e. CBD, Urban, or Non-urban area, and assess the development against the TIA impact level assessment criteria whilst also taking into account the following:

(a) the applicant must consider the actual or potential traffic impacts of all land/development under their common ownership or control (for example, by a joint venture agreement), at one location.

Editor's note—The phrase "at one location" means all adjacent land of the applicant, the property lines of which are contiguous or nearly contiguous at any point, or separated by other land of the applicant, or a public or private street, road, highway, or utility right-of-way or other public or private right-of-way.

Editor's note—"All land/development" includes existing development and planned/potential development.

An applicant must not avoid the intent of this policy sub-section, and that of Townsville City Plan, by submitting partial or segmented applications or approval requests for development plans, subdivisions, etc. If the properties will form an integrated or complementary development, council expects the applicant to submit one consolidated TIA report based on the integrated level of impact;

(b) if the criteria that apply are spread across two or more impact columns, the highest level of impact will apply. For example, if the development is low for all criteria, except for one criterion that is in the high column, a high level TIA will be required;

(c) Council may require additional information as part of the traffic impact assessment at the Information and Referral stage of an application for a Development Permit, which will be decided on a case by case basis;

(d) if the proposed development land is zoned for rural purposes but the development proposed is an urban land use that will either be surrounded by a rural traffic environment or adjoin an urban area, Table SC6.4.3.14.2 Urban TIA impact level assessment criteria must be used, rather than Table SC6.4.3.14.3 Rural area TIA impact level assessment criteria;

(e) council may request a more thorough analysis if negative impacts on traffic facilities have been identified, or if particular factors of the development cause concern to the safety, efficiency and operation of the transport network; and

(f) if the proposed development has roads that are not identified in the Road Hierarchy Map (e.g. in the development of new subdivision plans), a new link(s) road hierarchy in the subjected development area may be proposed by the developer, with council's agreement.

Note—if any of the above conditions apply, or more details are required, council encourages a pre-lodgement meeting to be arranged prior to commencing the TIA.

Table SC6.4.3.14.1 CBD area TIA impact level assessment criteria

Criteria	Impact		
	Low	Moderate	High
Trip generation	New or additional trip generation in a peak hour of <10 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 10 to 100 trips directly accessing a street. New or additional trip generation in a peak hour <100 trips directly accessing a major collector, sub-arterial, arterial, or highway[1].	New or additional trip generation in a peak hour of more than 100 trips.
Commercial vehicles	3 or less new or additional commercial vehicles per day.	More than 3 and up to 100 new or additional commercial vehicles per day.	More than 100 new or additional commercial vehicles per day.
Car parking	An increase or decrease of 9 or less on-site car park spaces. Loss of 2 or less line marked on-street car parks and no loss of loading zones.	An increase or decrease of 10 or more on-site car park spaces. Loss of 3 or more line marked on-street car parks, or any loading zones.	

Public transport	No impact on any bus zone or taxi operations.	Relocation of any bus zone or taxi rank. Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Change to permitted vehicle movements at a T-intersection.	Change of permitted vehicle movements at a crossroads or multiple intersections.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

Table SC6.4.3.14.2 Urban area TIA impact level assessment criteria

Criteria	Impact		
	Low	**Moderate**	**High**
Trip generation	New or additional trip generation in a peak hour of <20 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 20 to 300 trips directly accessing a street. New or additional trip generation to a major collector, sub-arterial, arterial, or highway[1].	New or additional trip generation in a peak hour of more than 300 trips directly accessing a road system.
Commercial vehicles	5 or less new or additional commercial vehicles per day in a residential area. Less than 10 new or additional commercial vehicles per day in a non-residential area.	More than 5 and up to 300 new or additional commercial vehicles per day in a residential area. More than 10 and up to 300 new or additional commercial vehicles per day in a non-residential area.	More than 300 new or additional commercial vehicles per day.
Car parking	Increase or decrease of 9 or less on-site car park spaces. Loss of 2 or less line marked on-street car parks, or loading zones.	Increase or decrease of 10 or more on-site car park spaces Loss of between 3 or more line marked on-street car parks, or loading zones.	
Public transport	Relocation of any bus zone or taxi rank.	Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Changes to the connectivity between local streets and collector roads.	Changes to the connectivity between arterial and sub-arterial roads.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

Table SC6.4.3.14.3 Rural area TIA impact level assessment criteria

Criteria	Impact		
	Low	**Moderate**	**High**
Trip generation	New or additional trip generation in a peak hour of less than 30 trips directly accessing a street[1].	New or additional trip generation in a peak hour of 30 to 300 trips directly accessing a street. New or additional trip generation directly accessing a sub-arterial, arterial, or highway[1] <300.	New or additional trip generation in a peak hour of more than 300 trips.
Commercial vehicles	Less than 30 new or additional commercial vehicles per day.	More than 30 and up to 300 new or additional commercial vehicles per day.	More than 300 new or additional commercial vehicles per day.
Public transport	Relocation of any bus zone or taxi rank.	Impacts on the bus interchange or bus routes.	
Transport system	No change to existing transport network operation.	Changes to the connectivity between local streets and collector roads.	Changes to the connectivity between arterial and sub-arterial roads.

Note—1. Refer to Figure 9.6 Townsville road hierarchy map (existing) and Figure: 9.7 Townsville road hierarchy map (future).

(4) Collaborative traffic impact assessments
If the anticipated traffic impact is determined to be of significant impact on the existing or future transportation system due to its location, development type, or land use characteristics, the traffic impact assessment may require a more strategic and holistic assessment to be prepared collaboratively with council and any other relevant stakeholders.

(5) Associated reports
Road Safety Audit - If the TIA Report indicates that significant safety issues may occur, the developer must engage a qualified road safety engineer to undertake an independent Road Safety Audit, in line with the *Guide to Road Safety Part 6*, Austroads 2006-2009c.

Noise - A road noise assessment may be required if there is a forecasted volume that will increase traffic over 3000 VPD (link traffic) in the subjected TIA study scope, or if noise sensitive receptors are identified. Refer to sub-section SC6.4.3.15 Noise and vibration assessment guidelines for more information.

SC6.4.3.14.3 TIA report requirements
The TIA will be used to help evaluate whether the development is appropriate for the site and what type of transportation improvements may be required. The TIA Report should address any traffic issues outlined in this document and the *Guide to Traffic Management Part 12*: *Traffic Impacts of Development* (Austroads, 2009).

The TIA report must identify the type and amount of additional traffic expected to be generated by the proposed development on the adjacent transport network and include recommendations on any site specific and external upgrading or network management works required to cater for short-term and long-term traffic and transportation planning.

It is important that early contact be made with the Planning and Development Division of council during the TIA process. This should commence at the outset and continue as required during the course of TIA preparation. For example, if council's concerns about access to the council road network are identified early, this may be able to be addressed through minor amendments to the on-site layout of the development. For larger developments, it may be appropriate to consult with council regarding consideration of the project's scope, methodology and other possible planning consideration during the development of the initial project concept.

(1) General requirements

The TIA Report must demonstrate that the proposed development is consistent with the traffic and transportation aims of the planning scheme for that area. The intent of the TIA is to evaluate *worst case traffic scenarios*. For example, if several different uses are proposed, the land use with the greatest overall traffic impact must be assumed in the study, unless the applicant specifies the uses for the site.

(a) TIA consultant qualifications

A low impact TIA report may generally be prepared by the developer. However, if existing traffic facilities need to be changed, then recommendations for mitigation must be made by a Registered Professional Engineer of Queensland (RPEQ) qualified person at a minimum. The moderate or high impact TIA is to be prepared by an impartial professional traffic/transportation consultant who is appropriately experienced and holds current RPEQ qualification. The document must be certified by the appropriately qualified and experienced RPEQ.

(b) Report documentation

The TIA Report must fully document the approach, methodology, and assumptions of the analysis. It must clearly explain the reasons for any adjustments to the trip generation rates and assumptions used for trip distribution and assignment. Figures (drawings and maps) are to be used to help illustrate these assumptions. The report must summarise the results of the Level of Service (LOS) calculations in tabular or map form, and include figures showing the traffic volumes for the project alone and for each scenario. The report must also include any mitigation measures, appropriately tested by the model. All worksheet and analysis input and output data must be included as appendices to the report, if applicable.

(c) Impact on other stakeholders

If there are other jurisdictions or stakeholders impacted within the area of influence, for example, DTMR, Queensland Rail (QR), or Bus/taxi companies, the consultant should arrange a scoping meeting with all relevant agencies to discuss the issues. This will provide improved coordination and reduce the potential for later revisions to the TIA.

(d) Updating an existing TIA

A TIA requires updating when the amount or character of traffic is significantly different from an earlier study; for example, changes to the land use, road hierarchy or road networks. Any traffic study may also need to be revised if the study is older than 2 years and council determines that the existing conditions have changed enough to invalidate the study results or if the initial study assumes an incorrect build out period. A TIA may require updating sooner in rapidly developing areas and not as often in slower developing areas. In these cases, consultation with council is recommended.

(e) Possible additional requirements

At times, council may extend the study to additional street segments and/or intersections on the public street system. Council will make this determination based on the scale, location, and/or nature of the proposed development and the condition or state of development of the street network in the vicinity of the site.

(2) Low TIA report

1. Justification for low impact assessment;
2. A brief description of the development in terms of site location, direct site access(es), land use, size and expected year of completion;
3. Analysis/Findings, e.g. impact on existing traffic facilities, heavy vehicles turning path and other safety issues;
4. Recommendations and Mitigation; and
5. Appendices if applicable.

(3) Moderate/high TIA report

Executive summary

- a brief description of the development (site location, internal layout, all site access(es), land use/size and year of completion);
- a brief overview of trip generation and analysis result (LOS), Degree of Saturation (DoS) and Average Delay;
- parking demand; and
- mitigation plan and conclusion/recommendation.

Note—desirably, the executive summary should be no longer than five pages, complete in itself, and not dependent on supplementary data included by reference.

1. Introduction and summary

1.1 Justification for moderate or high impact assessment

1.2 Study objectives and scope

- Time horizon - year of completion assuming full build-out and occupancy and 10 years after total completion. This also needs to be assessed at key stages of the development, or if traffic environment changes have occurred in the meantime
- TIA Area – where:
  - (a) the amount of additional traffic likely to be generated is more than 5% of existing total links and intersection volumes during a peak hour; or
  - (b) the likely increase in the proportion of heavy vehicle traffic is more than 5% during a peak hour associated with the development.

2. Proposed development

2.1 Land use and intensity;

2.2 Site plan/layout;

2.3 Phasing and timing; and

2.4 Specific information of the proposed development (operation hours, number of employees, type of service vehicles, etc.).

3. Existing conditions

3.1 Study area land use:

- existing land use/zoning; and
- anticipated future development (background); land use/traffic network.

3.2 Existing traffic analysis:

- roadway system;
- traffic volumes and analysis;
- active mode facilities (public transport stops/route, pathway, bike lane, trip end facilities);
- parking (car park type, operation, existing/potential car park demand);
- traffic accident data (traffic safety); and
- other.

4. Traffic forecasting and analysis

4.1 Method of projection.

4.2 Background traffic (each horizon year):

- traffic model calibration or validation if applicable; and
- forecasting and analysis.

4.3 Site traffic (each horizon year):
- trip generation;
- trip distribution;
- modal split;
- trip assignment; and
- analysis.

4.4 Summary of analysis (with/without development scenario).

5. Improvement analysis

5.1 Improvements to accommodate background traffic.
5.2 Additional improvements to accommodate all site traffic.
5.3 Alternative improvement.
5.4 Need for any improvements (e.g. TDM).
5.5 Status of improvements already funded, programmed, or planned.
5.6 Independent road safety audit, if required.
5.7 Summary.

6. Parking

6.1 Method of projections
6.2 Parking demand forecasting and analysis (including all service vehicles and bikes)
6.3 Site circulation and parking layout (including all service vehicles)

7. Public transport and pathway

7.1 Possible/desirable PT system.
7.2 Internal/external pathway network system (type, location).

8. Recommendation

8.1 Site access/circulation plan.
8.2 Roadway improvement:
- on-site;
- off-site; and
- phasing, if appropriate.

8.3 PT, bicycle and pathway system.
8.4 Other.

9. Conclusion

10. Special analysis/issues (if applicable, refer to SC6.4.3.14.4(8))

11. RPEQ Certification

Appendices

SC6.4.3.14.4 Essential technical guidance

(1) Existing conditions

(a) Traffic count data
Traffic trends and counts data may be available from DTMR and council. Traffic data must reflect existing normal conditions and should not be used if more than two years old at the time of the TIA submission or if significant changes have occurred at or near the count location or as otherwise requested by council. The traffic consultant or the applicant is responsible for providing traffic counts that are not available through DTMR or council.

(b) Traffic accident and safety
Accident data is available from the State traffic accident reporting system and can be obtained through Data Analysis at the Queensland Department of Transport and Main Roads. Accident data requests should be made as early as possible to enable the information to be provided in a timely manner.

(2) Traffic forecasting and analysing

(a) Townsville Strategic Traffic Model 2011 (TSTM11)

Townsville Strategic Traffic Model 2011 (TSTM11 on the Emme platform) has been developed and calibrated with various Townsville traffic survey results, 2011 demographics and network conditions. Its ownership has been established between council and DTMR.

Associated with land use development, council has used the Townsville Growth Model to develop future demographic data, in 5 year intervals up to 2036.

Upon request, or following a pre-lodgement meeting agreement, TSTM11 and future demographic data are available to use under license among council/DTMR and the applicant. Also, depending on the process of council/DTMR traffic model development, meso/micro simulation models for other areas will be available, such as CBD SATURN. Council encourages the use of these models, as they have been developed for the agreed network structure and their methodology is transparent and consistent for all users. For background traffic forecasting, the use o f data TSTM11 must be used in the first instance. Data obtained from TSTM11 for background traffic forecasting must be calibrated to existing traffic volumes at the time of analysis.

All traffic modelling data should be calibrated and validated at the time of the assessment prior to using the data and details of this process are required to be included in the report. It should be acknowledged that TSTM11, especially, is intended for use with high level traffic network modelling and is not designed for small size or individual lots of development. It is important to apply the correct level of traffic modelling work/methodology to forecast the traffic demand associated with the development.

Council retains intellectual property ownership rights to the latest data for council purposes. Applicant must ensure that any consultants engaged to undertake this work are aware of this stipulation.

Any updated or developed input/output traffic modelling data as part of the TIA study, must be submitted. If the applicant intends to develop new traffic modelling as part of the TIA report, council encourages the use of the same platform of traffic modelling, i.e. EMME, Sidra Intersection and Aimsun. If the applicant uses an alternative equivalent traffic model, this must be agreed to by council prior to the TIA commencing. The agreement will cover issues such as network structure, demographic data and methodology.

(b) Trip generation rates

The trip generation rates for the residential component of dwellings are 8 VPD per dwelling in non-urban areas and 10 VPD per dwelling in CBD/Urban areas, unless actual survey data is available. In the same manner, all considered trip generation rate data must be provided in the TIA Report as source or reference data. Consideration must also be given for other ancillary uses proposed on the land. In the absence of specified trip generation rates within council documentation, the DTMR's Guidelines for Assessment of Road Impacts of Development, 2006 and Road Planning and Design Manual must be used.

(3) Traffic analysis performance criteria

The results of the traffic analysis must be compared using the Measure of Effectiveness (MOE), as set out in Table SC6.4.3.14.4 below.

Table SC6.4.3.14.4 MOE based on the traffic characteristics and type

Facility	Type	Measure of effectiveness (MOE)
Intersections	Unsignalised or prioritised control	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
	Traffic signals	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
	Roundabouts	Average delay (seconds per vehicle) Delay to critical movements (seconds) Degree of Saturation (DOS) Queue length for critical movements (metres or vehicles)
Interrupted flow, e.g. Urban/CBD network		Average travel speed (km/hr) Volume/Capacity ratio
Uninterrupted flow, e.g. Non-urban/highway network		Density (PCU/km/lane) Volume/Capacity ratio
Two-lane uninterrupted flow, e.g. Non-urban/highway network		Average travel speed (km/hr) Volume/Capacity ratio
Pedestrian		Space (m^2/person) in queuing area Speed (person/min/m) in walkway
Transit		Headway (minutes or veh/hr) Passenger loading (m^2/person) Reliability (%)

Source :*Transportation Research Board, Highway Capacity Manual,* 2010.

The type and level of analysis and evaluation will include documentation of LOS for intersections. A saturation flow rate and all parameters for analysis should be considered in accordance with the SIDRA Intersection user guide and default parameters unless field measurements at the study area would indicate a more appropriate value. In this case, all source or reference data must be provided in the TIA report.

(4) The conversion of vehicle numbers to PCE
Table SC6.4.3.14.5 shows the conversion of vehicles (as classified by Austroads) to comparative number of passenger car equivalent (PCE) for the determination of trip generation, intersection capacity and LOS analysis.

Table SC6.4.3.14.5 Calculating passenger car equivalent

Austroads *Guide to Traffic Management Part 12* **vehicles classifications**	**Passenger Car Equivalent (PCE)**
Classes 1 to 2 i.e. short vehicles	1 PCU
Classes 3 to 5 i.e. light to medium trucks	2 PCU
Classes 6 to 9 i.e. heavy trucks	3 PCU
Classes 10 to 12 i.e. B-doubles, Triple Road Train	5 PCU

(5) Desirable service standard for links
According to the given MOE in Table SC6.4.3.14.4, the threshold for acceptable operation is the upper limit of LOS ‘D’ for CBD/urban roads and LOS ‘C’ for rural roads although the next level of LOS ‘E’ or ‘D’ could be accepted where weekend peaks are the defining event and occur on recreational routes.

(6) Desirable service standard for intersection/access
Any intersection analysis should demonstrate that the delays would be less than that shown in Table SC6.4.3.14.614.6 up to the ten year horizon after completion of the development. If they are not, improvements to the intersection layout and/or changes to the proper method of control must be assessed.

Table SC6.4.3.14.6 Desirable Service Standard for intersection/access operation

Criteria	Acceptable levels	
	CBD and urban	**Rural**
Signalised intersection	Control delay less than 55 seconds per vehicle (LOS D) or Degree of Saturation less than 0.9	NA
Roundabout	Control delay less than 35 seconds per vehicle (LOS D) or Degree of Saturation less than 0.85	Control delay less than 25 seconds per vehicle (LOS C) or Degree of Saturation less than 0.8
Priority intersection or give-way stop controlled intersection	Control delay less than 35 seconds per vehicle (LOS D)or Degree of Saturation less than 0.8	Control delay less than 25 seconds per vehicle (LOS C) or Degree of Saturation less than 0.7
Left or right turning lanes	Less than available storage length within 95 percentile queue	Less than available storage length within 90 percentile queue

Note—The delays above equate to the upper limit delay of Level of Service C or D for approach-based and intersection wide assessment. LOS is defined solely by control delay (2010 *Highway Capacity Manual*). LOS E means the intersection/approaches are at capacity.

(7) Parking

Adequate parking must be provided to meet site-generated demands and be consistent with the most current version of the references. If the consultant conducts a survey, or uses other source data, the car parking demand must be compared against SC6.4.3.5 Car parking and public transport facilities guidelines, with the greater car parking demand being applied. In considering car parking for a specific type of development, the consultant must use data from at least two different sources, or use the data compiled from both a survey and one source data, with the greater level of car parking demand being applied. All surveys or source data must be from a similar land use to the proposed development.

Specific dimensions, parking angles, and parking ratio requirements are addressed in the planning scheme and planning scheme policies (SC6.4.3.5 Car parking and public transport facilities guidelines), and Austroads Cycling Aspects of Austroads Guides.

Editor's note - From time to time, council may introduce incentive programmes that impact on parking requirements. Information on any incentive programmes is available from council.

(8) Special analysis/issues

Council may request specific traffic analyses relevant to the proposed development. These include details about access management, a TDM plan, cut-through traffic and residential quality of life analysis, truck estimates, Intelligent Transport System (ITS) strategies, pedestrian/bicycle safety, signage and access, safe routes to school, emergency routes, etc.

(9) Mitigation plans and conclusion

All mitigation plans identified as necessary to serve the proposed development should be listed in the TIA report, along with the timing of implementation.

During construction, private approaches should be located, and configured in such a manner as to avoid disruption to the public street system. If changes to traffic controls are proposed, warrants should be reviewed and documented in the report. Reference should also be made to SC6.4.6.30 Control of traffic.

The TIA report must provide a preliminary overall master plan map, and recommendations, and include the status (funded, programmed, or unfunded) of any existing traffic upgrading plans.

(10) TIA report appendices

The following appendices should be included in the TIA report submitted to council:

(a) raw traffic count data - average daily and peak hour turning movement traffic count data collected and/or obtained from other sources;

(b) printouts of analysis results - input/output; e.g. aaSIDRA;

(c) all traffic network modelling work as an electronic copy - e.g. network attribute data, demographic data and other relevant files (macro, excel etc);

(d) photographs of the site;

(e) additional tables or figures not included in the TIA report;

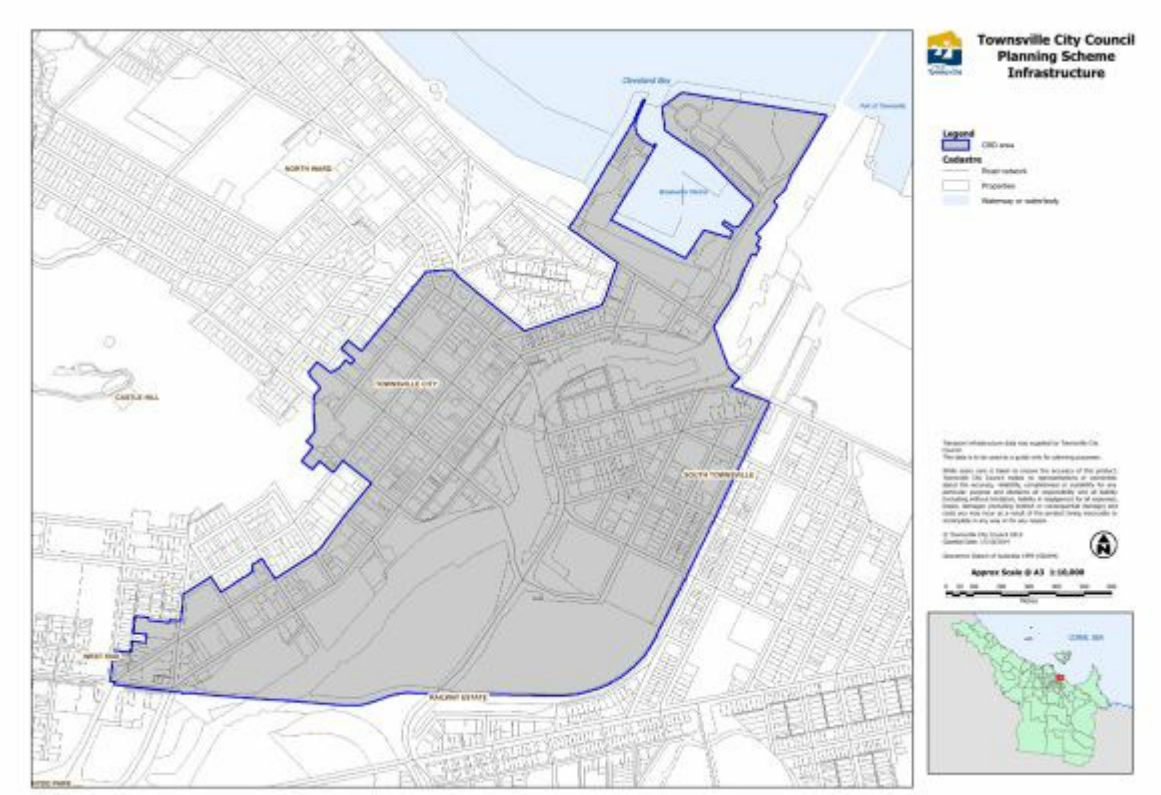
(f) description of methodologies and assumptions used in analysis;

(g) worksheets used in analysis - i.e. signal warrant, LOS, queuing, capacity etc.;

(h) notes on the outcomes of any meetings in regards to the development; and

(i) variations to the standard report (template) – RPEQ certification of any non-conformances with requirements.

SC6.4.3.14 Attachment A: Map of the CBD



Click here to view PDF high resolution map.

SC6.4.3.15 Noise and vibration assessments

SC6.4.3.15.1 Introduction

(1) Purpose

The purpose of this sub-section is to:

(a) provide information to developers and other related parties for use during the planning, construction, and operational stages of a development;

(b) provide guidance on preparing a noise or vibration impact assessment report; and

(c) ensure that development is managed in a way which prevents nuisance from the effects of noise and vibration on the health, community well-being and quality of life of an individual or the community, and wildlife.

(2) Terminology

Unless noted otherwise all terms have the same meaning as given in the most recent version of the *Environmental Protection Act 1994*, the E*nvironmental Protection Regulation 2008*, the *Environmental Protection (Noise) Policy 2008* and the relevant standards. If a definition given in the relevant standards is inconsistent with the Act or Regulation, the Act or Regulation prevails to the extent of the inconsistency.

Background creep	a progressive increase in background noise levels due to new noise generating activities locating in an area.

(3) Reference and source documents

(a) Queensland authorities/legislation:

Department of Transport and Main Roads (DTMR) – *Policy for development on land affected by environmental emissions from transport and transport infrastructure,* 10 May 2013
Department of Transport and Main Roads (DTMR) – *Road Traffic Noise Management: Code of Practice*
Department of Transport and Main Roads, Main Roads Technical Standard, *MRTS15 Noise Fences*
Environmental Protection Act 1994
Environmental Protection (Noise) Policy 2008 (EPP Noise).
Queensland Development Code MP Part 4.4 – Buildings in a Transport Noise Corridor.

(b) Australian standard/guideline:
Department Environment Heritage Protection - *Noise Measurement Manual 2013*
Department Environment Heritage Protection - *Planning for Noise Control 2016*
Environment Protection Authority (NSW) NSW Industrial Noise Policy 2000
AS1055.2: *Acoustics – Description and measurement of environmental noise – Application to specific situations.*
AS2107: *Acoustics – Recommended design sound levels and reverberation times for building interiors.*

(c) Austroads

AP-R277/05 - Modelling, Measuring and Mitigating Road Traffic Noise
Guide to Road Design Part 6B: Roadside Environment

SC6.4.3.15.2 Noise and vibration

Noise is often described as unwanted sound and, by its very nature, can cause varying degrees of nuisance. Some sounds are considered to be annoying by some people but not by others. However, in general, the louder the sound, the greater the annoyance or nuisance caused.

The nature and character of a sound, even at low levels, may also cause annoyance. Sound can have a number of characteristics and can be described in many ways. It is not possible to fully categorise every form of sound. However, this policy is intended to provide guidance for the majority of commonly experienced sounds. "Noise" has become synonymous with "sound" in common language. In this policy, noise will generally mean sound.

Furthermore, sound is defined in Queensland legislation to include vibration and therefore levels of acceptable vibration

are also included.

SC6.4.3.15.3 Development assessment

Preventing noise problems is always better than attempting to rectify noise impacts after the development and trying to resolve problems may not be always possible and can be costly. The management hierarchy under the Environment Protection (Noise) Policy 2008 (EPP Noise) is "to the extent that is reasonable to do so".

(1) Firstly - avoid; or

(2) Secondly - minimise; or

(3) Lastly - manage.

Council encourages development that is sympathetic to the amenity of a location, and minimises the occurrence of background creep. Where proposed uses are likely to increase noise levels at a locality, or be affected by existing noise sources, a noise (and vibration) impact assessment may be required or requested.

If the noise impact assessment report reveals that the use or activity has the potential to create nuisance or exceed acoustic quality objectives as prescribed by *Environmental Protection (Noise) Policy 2008* (EPP Noise), the developer will need to demonstrate by way of a noise (and vibration) control plan how the environmental values (noise) will be enhanced or protected to meet the standard as part of any submission for an operational works permit, or a compliance permit.

SC6.4.3.15.4 Noise and vibration impact assessments

(1) Subdivision layouts must be designed to ensure that acoustic mounds and acoustic fences over 1.8m are not included in lots with setbacks adjacent to the acoustic structure of 3m or less.

In support of the assessment provisions specified in the Townsville City Plan, a noise (and/or vibration) impact assessment report maybe in situations where:

(a) a new development is proposed that will create significant noise (e.g. new industry, or commercial premises with refrigeration, air conditioning or exhaust equipment); or

(b) a new noise-sensitive development is proposed in an area where existing noise sources are present (e.g. an existing industrial site, or a future or existing major road, is located nearby); or

(c) a new development will generate a significant amount of traffic noise, i.e. traffic volumes increase by around 3000 vehicles per day or more (determined by a Traffic Study Assessment); or

(d) building work including rock breaking, drilling or piling or other noisy activities are proposed; or

(e) it is required by council in order to complete an assessment of the proposed development.

The assessments are to be undertaken by a suitably qualified and experienced acoustic practitioner (e.g. a member of the Australian Acoustical Society, the Institution of Engineers, the Association of Australian Acoustical Consultants or a person with other appropriate professional qualifications).

(2) Information provided in an assessment report should include at least the following:

(a) background:

(i) the name and qualifications or experience of the person(s) preparing the assessment;

(ii) the project description, including proposed or approved hours of operation; and

(iii) the relevant guideline or policy that has been applied.

(b) impact assessment process:

(i) results of background and any other noise measurements (noise impact assessments need to consider not only existing developed property adjacent to the planned facility, but also any nearby undeveloped residential land);

(ii) meteorological conditions (wind speed and direction, temperature, atmospheric pressure and humidity) and other relevant details at the time of the measurements;

(iii) details of instruments and methodology used for noise measurements (including reasons for

settings and descriptors used, frequency weighting, height of microphone above the ground and distance to reflective surfaces calibration details);

(iv) a site map showing all noise sources, measurement locations and potential noise receivers; and

(v) any tonality impulsiveness or other noise characterises and all assumptions of noise propagation and attenuation due to distance, topography, barrier, etc, and

(vi) noise criteria applied to the project.

(c) impact mitigation and compliance:

(i) noise predictions for the proposed activity;

(ii) a comparison of noise predictions against noise criteria;

(iii) a discussion of proposed mitigation measures, the noise reduction likely and the feasibility and reasonableness of these measures; and

(iv) how compliance can be determined practically.

Editor's note—where it is demonstrated that noise and/or vibration is to have an adverse impact on a sensitive development to an acceptable and manageable level, attenuation treatments will need to be incorporated into the development to ensure that the sensitive development is protected from the identified adverse impacts. Treatments may need to address specific zone code requirements, particularly where street activation is sought from development.

SC6.4.3.15.5 Noise and vibration control plans

Where an impact assessment demonstrates that noise is likely to exceed thresholds contained within the *Environmental Protection (Noise) Policy 2008* or other relevant document or Australian Standard, a noise (and vibration) control plan will need to be submitted.

Editor's note—the noise assessment should have regard to the following – Queensland Development Code Part 4.4 – *Buildings in a Transport Noise Corridor*. Australian Standards AS1055.2 and AS2107;*or Department Environment Heritage Protection Noise Measurement Manual 2013* or *Environmental Protection Act 1994* and *Environmental Protection (Noise) Policy 2008* (EPP Noise); or *Department of Main Roads Road Traffic Noise Management – Code of Practice.*

Note—where in the vicinity of an airport, detailed designs showing how construction can ameliorate noise impacts are to be submitted in accordance with AS2107.

SC6.4.3.15.6 Information to include in a noise and vibration control plan

Aim	Typical actions
Community Relations **Editor's note—**noise and vibration control plans should describe the approaches to be applied when consulting with, and notifying the community where necessary. Large projects may also be required to develop a community relations plan which includes consultation, notification, and complaint management. Where this is the case the following is to be included in any noise (and vibration) control plan.	(a) Identify all noise and vibration sensitive receivers. Include characteristics of, and risks exposed to, existing buildings, fences, trees, property boundaries and services (within at least 1km for blasting operations). (b) Contingency actions must be developed if the relevant noise/vibration limits will be exceeded. (c) A complaints management system should be devised which includes corrective and preventative actions. (d) Consultation with and information supplied to nearby residents and other sensitive uses.
Hours of operation/construction schedule	Information regarding opening hours or hours of operation in accordance with the relevant planning scheme provisions. For construction hours, refer to SC6.4.5.2.1(2) Hours of work. Scheduling works at periods where people are least affected will also reduce impacts, and should flow on from consultation with the community (as above).

Potential noise and vibration generating activities	The choice of plant and equipment employed on the project can have a direct effect on noise and vibration levels. By selecting equipment of an appropriate size with low vibration generation characteristics, and by ensuring that the equipment is being operated correctly and that noise and vibration reduction devices are operating efficiently, the number of complaints received can be greatly reduced.
Potential noise and vibration mitigation methods	For construction, rock breaking, drilling, and/or piling the following mitigation methods should be considered: (a) maximising the distance between the noisy activities and noise sensitive land uses; (b) undertaking noisy fabrication work offsite where possible; (c) maintaining any pre-existing barriers or walls onsite as long as possible; (d) including construction barriers in the project design; (e) using building and stockpile materials as noise barriers during the earthworks phase which may be used in the final landscape design; and (f) installing purpose built noise barriers, acoustic sheds and enclosures. Road and rail noise attenuation will be considered in the following order of preference; a combination may also be provided: (g) a buffer between noise receptor and receiver; (h) service roads between noise receptor and receiver; (i) larger lots closest to the noise source that allow dwelling units to be set back from the noise source to achieve the applicable reduction level; (j) architectural treatments For class 1-4 buildings see *MP 4.4 Buildings in a transport noise corridor.* (k) incorporating mounding and landscaping into the design Noise barriers are to be provided in accordance with the principles of the Department of Transport and Main Roads *Code of Practice Chapter 5: Integrated Noise Barrier Design;* and (l) providing an acoustic fence: A detailed design is to be submitted as soon as possible in the planning process. Design and construction of barriers must meet MRTS15 *Noise Fences*. The acoustic fence must not be located on the road reserve, but within the boundary line of the abutting property. Refer to SC6.4.4.8 Standard drawings SD002, SD003 and SD004. Where acoustic reports identify that levels will be exceeded, all uses should be provided with attenuation requirements designed by suitably qualified consultants that will enable the use to meet the prescribed standard.
Noise and vibration monitoring	Where appropriate in relation to the use or activity. Include details such as monitoring equipment, standard employed, monitoring frequency, on-site meteorology, activity logs, and results handling procedure.

SC6.4.3.16 Rear lane design

SC6.4.3.16.1 Introduction

The following design principles set out standards, advice and guidelines for consideration where a proposed development includes the creation of a new rear lane or development of land that has a frontage to an existing or historic rear lane.

(1) Purpose of rear lanes:

- (a) to provide vehicular access to the rear of premises;
- (b) by nature and by design, to provide streets where pedestrians, cyclists and vehicles have shared use, but which do not create a more direct through route than provided by the adjoining street network;
- (c) used to alleviate access difficulties along frontage roads, such as where the lots are narrow, or along roads or streets carrying high volumes of traffic; and
- (d) in some cases, to improve both the streetscape and to relate the domestic environment more closely to the street frontage;

(2) Design of rear lanes should be undertaken in accordance with other relevant sections of the Development manual planning scheme policy including SC6.4.4.1 Geometric road design, SC6.4.4.2 Pavement design and SC6.4.3.6 Landscape policy.

(3) Design of rear lanes should have regard to the *Crime Prevention through Environmental Design Guidelines for Queensland* (CPTED).

Editor's note—for all setbacks, please refer to the relevant parts of the Queensland Development Code.

SC6.4.3.16.2 New rear lanes - development standards

This section outlines development standards and provides guidance and advice to inform appropriate development outcomes for the creation rear lanes associated with new development.

(1) Design outcomes

- (a) Rear lanes should be functional and provide good visibility and manoeuvrability. Development of rear lanes should:
  - (i) provide enough width to allow safe vehicle passage and turning into an out of garages, movement of pedestrians and cyclists, and with sufficient room for service vehicles;
  - (ii) enable easy and safe access from driveways;
  - (iii) utility services must be located with easy access for maintenance (including water, sewerage, stormwater drainage, gas, electricity, telecommunications, etc.) with appropriate clearances in accordance with minimum requirements;
  - (iv) ensure that subdivision of lots with rear lane frontage addresses the principal street, for example, that the letterbox is on the street and not the rear lane; and
  - (v) a minimum of one and a half on-street car spaces (unmarked) must be provided within 25m walking distance to each allotment. The car park may not be located within the rear lane.
- (b) Rear lanes are to be designed having regard to *Crime Prevention Through Environmental Design Guidelines for Queensland* (CPTED) principles, in particular:
  - (i) ensure rear yards of properties can be fenced in accordance with CPTED principles;
  - (ii) lighting of the rear lane is to meet road safety requirements and CPTED principles, while minimising overspill of light into abutting properties, impacting on amenity; and
  - (iii) ensure that boundary treatment and landscaping do not conceal recesses or provide opportunities for anti-social behaviour.
- (c) Rear lanes should be designed to accommodate the needs of abutting property owners and the streetscape, in particular:
  - (i) landscaping is to be designed to be low maintenance, without impacting on CPTED requirements;
  - (ii) landscaping to rear lanes should not impede any pedestrian or vehicle access; and

(iii) landscaping within rear lanes should not create recesses or provide uninvited opportunities for anti-social behaviour. As a guide, grass, ground cover, or visually permeable low-level vegetation are acceptable. Trees and shrubs that provide visual screening of activity are to be discouraged;

Editor's note—landscaping should otherwise be undertaken in accordance with the 9.4.3 Landscape code of Townsville City Plan.

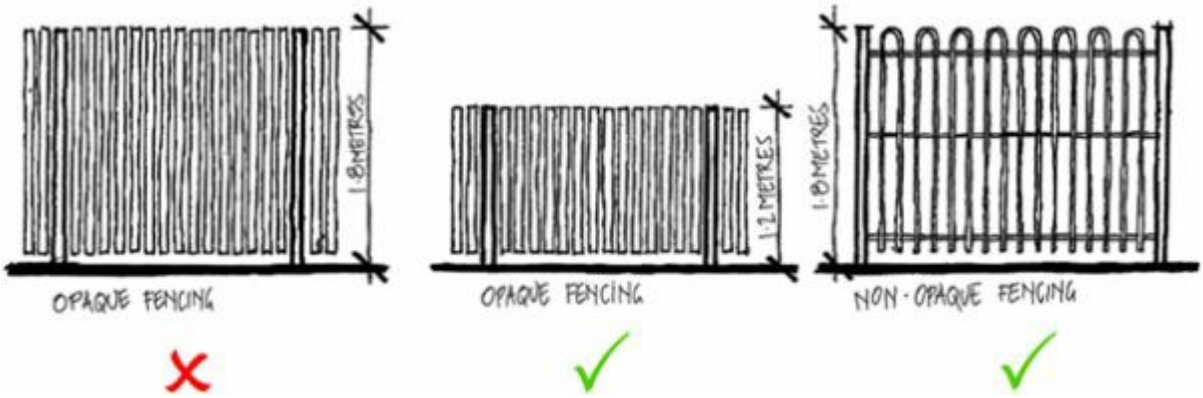


Figure SC.6.4.3.16.1 Inappropriate and appropriate screen fencing types at various heights

(iv) landscaping must not obstruct traffic movements and sightlines, particularly at driveways and intersections;

(v) the use of rear lanes as a short-cut route should be discouraged, as this may introduce through traffic travelling at high and unsafe speeds and reduce the amenity; and

(vi) a minimum of one off-street car park is to be provided per allotment.

(vii) fencing can be provided to the boundary fronting rear lanes to provide security, discourage uninvited access and enhanced amenity. The following advice is provided in respect of fencing, which should be in accordance with CPTED principles. Figure SC6.4.3.16.1 provides examples of inappropriate and appropriate fencing for rear lanes, in addition to the following:

(A) screen fencing and gates that are opaque should not be more that 1.2m in height;

(B) screen fencing and gates may be more 1.2m in height if they are non-opaque (e.g. pool fencing) but should not be greater than 1.8m in height;

(C) screen fencing and gates that are opaque and higher than 1.2m should be setback a minimum of 3 m from the rear lane boundary; and

(D) boundary fencing between properties, if opaque and higher than 1.2m, is to taper down to 1.2m to the rear lane boundary from a setback distance of 3m.

(2) Rear lane design standards

(a) Traffic flows on rear lanes should not exceed 100 vpd.

(b) Reserve widths for rear lanes must allow for:

(i) a road reserve width appropriate to allow for vehicle turning paths to access allotments and to contain stormwater drainage flows;

(ii) all services located within the rear lane maintaining appropriate clearance as per relevant standards and requirements;

(iii) water mains and connections for allotments provided to correlate to the addressing of the properties;

(iv) sewer mains and connections for allotments provided in accordance with SC6.4.3.21; and

(v) stormwater in accordance with SC6.4.4.4 Stormwater drainage design.

(c) Rear laneways should not exceed 75m in length, in order to maintain a maximum design speed of 30km/hr based on an intersection speed of 20km/hr.

(d) Horizontal and vertical alignment should incorporate curves to encourage low vehicle speeds by creating an environment where drivers are actively discouraged from driving above 30 km/hr.

(e) Traffic calming can be achieved through acceptable geometric methods.

(f) Rear lanes must be designed so that they are used as a short-cut between streets.

(g) street lighting must comply with SC6.4.3.20.

(h) intersections of rear lanes with other lanes and other streets must comply with SC6.4.4.1.

(3) Consideration of the final desired built form of adjacent lots being serviced will be a consideration to ensure sufficient operating space and clearance is achievable for waste collection vehicles. Access for emergency vehicles must also be a consideration.

Editor's note—the Development manual planning scheme policy sub-section SC6.4.3.22 Waste management provides additional information regarding waste collection standards.

SC6.4.3.16.3 Historic rear lanes

(1) The following design standards, advice and guidance are provided for consideration when addressing applications for reconfiguring a lot and involving a historic rear lane and where a historic rear lane forms a road frontage to the development.

Editor's note—while the following information is provided to guide development involving the historic rear lanes of Townsville, the principles may be useful for consideration of other existing rear lanes that are not historic.

SC6.4.3.16.4 Development intent for historic rear lanes

(1) Rear lanes are an inherent part of the historic make-up and character of some of Townsville's oldest suburbs, particularly South Townsville and Railway Estate. Historic rear lanes have been identified through studies undertaken by council as being worthy of preservation, as they contribute towards the unique character and amenity of Townsville's older suburbs. Importantly, historic rear lanes have influenced the character and built form.

(2) The purpose of this section is to ensure the character of historic rear lanes does not diminish, and to enhance the existing character provided by the rear lanes. Further, it is intended to discourage inappropriate development outcomes adjacent to these rear lanes.

(3) This part seeks to clarify the characteristics of development that are appropriate to historic rear lanes and therefore provide guidance and certainty to all stakeholders, whilst also adhering to best practice with regard to CPTED principles.

SC6.4.3.16.5 Description of historic rear lanes

(1) Description

Principally, rear lanes are found in Railway Estate and South Townsville. The use of the term "historic rear lanes" generally refers to historic rear lanes associated with land zoned as Character residential zone under Townsville City Plan.

The dominant physical characteristics of the historic rear lanes are as follows:

(a) rear lanes are typically 6m wide;

(b) they are between 50m and 350m long, with the majority being approximately 110m long;

(c) rear lanes are straight and occasionally intersect with other rear lanes;

(d) where sealed, the bitumen is approximately 2.7m to 3m wide and is in the centre of the rear lane. The space on either side of the bitumen is an unsealed landscaped grass verge;

(e) some rear lanes have not been sealed;

(f) rear lanes are generally one lane with two-way access;

(g) most properties with access to a rear lane have primary access via the street, however, some properties fronting Boundary Street, for example, have primary access via the rear lane only; and

(h) rear lanes are sometimes the primary point of access for local infrastructure such as sewerage and

water.

SC6.4.3.16.6 Development standards

(1) This section outlines development standards to guide appropriate development to retain and enhance the historic character of rear lanes.

Development affecting rear lanes should:

(a) ensure rear lanes remain functional and provide good visibility and manoeuvrability;

(b) provide appropriate width to enable safe and efficient vehicle movement, including for service vehicles;

(c) enable easy and safe access into and out of sheds, carports and garages;

(d) not create a more direct through-route alternative for vehicles, cyclists or pedestrians than the adjoining street network;

(e) be designed to ensure rear yards of properties can be fenced in accordance with CPTED principles (Queensland);

(f) ensure that boundary treatment and landscaping do not conceal recesses or provide opportunities for anti-social behaviour; and

(g) ensure that subdivision of lots with rear lanes addresses the principal street, for example, that the letterbox and water connection are on the street and not the rear lane.

(2) Waste collection vehicles will not service a rear lane unless the design facilitates safe vehicle access and operating conditions for a waste collection vehicle.

Editor's note—the Development manual planning scheme policy sub-section SC6.4.3.22 Waste management provides additional information regarding waste collection.

(3) Subdivision of lots in areas with rear lanes should be "vertical", down the centre of the block (see "b" in Figure SC6.4.3.16.2), creating two similar-sized rectangular blocks (approximately 10 m wide). This is consistent with lot sizes in parts of Workers Cottage precinct and South Townsville precinct in the Character residential zone, where the existing character of the lot sizes of some sites in Townsville's older suburbs is 10m wide by either 40m or 50m deep.

(4) Where subdivision of lots in areas with rear lanes is proposed to be "vertical", down the centre of the block, primary vehicular access via the rear lane is permitted.

(5) Where lots are configured in a "hatchet" configuration, as shown in "a", "c" and "d" in Figure SC6.4.3.16.2, primary vehicular access is not permitted via the rear lane. Generally, primary vehicular access to the block is to be from the street, with the exceptions as noted in Figure SC6.4.3.16.2 (b and c).

(6) Some properties that border Boundary Street in South Townsville may have exceptional circumstances in relation to the scenarios outlined in Figure SC6.4.3.16.2. These will be assessed on their individual merits.

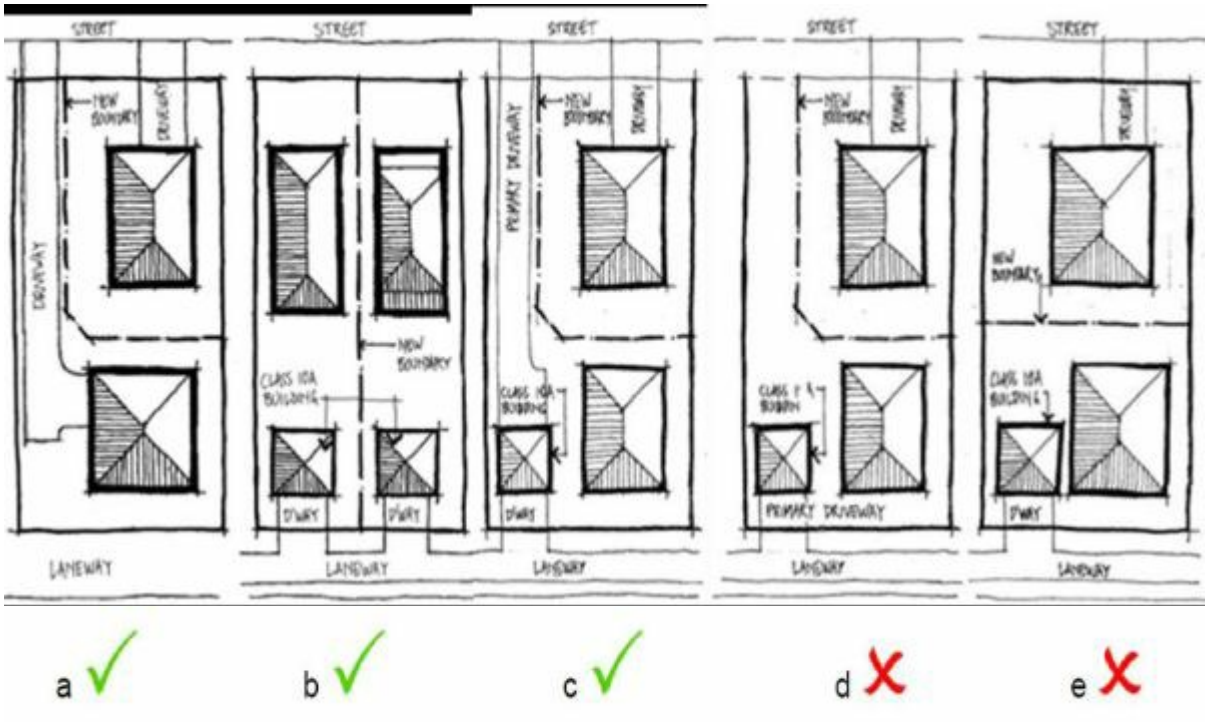


Figure SC6.4.3.16.2 Unacceptable and acceptable lot reconfiguration and access for properties adjacent to rear lane

(7) Crime prevention through environmental design considerations.

Editor's note—applicants should also have regard to *Crime Prevention through Environmental Design Guidelines for Queensland* in addition to the below specific guidelines.

(a) Lighting should be provided for buildings with vehicular or pedestrian access to rear lanes. Appropriate lighting may include sensor lighting, installed overlooking the driveway or pathway respectively.

(b) Tilt panel doors or other doors should not open directly onto the rear lane.

(c) Rear yards of properties may be fenced to support CPTED principles and improve amenity, security (casual surveillance) and vistas.

(d) Rear boundary fence gates to rear lanes are encouraged to increase activation of the space.

(e) Fencing can be provided to the boundary fronting rear lanes to provide security, discourage uninvited access and enhanced amenity. The following advice is provided in respect of fencing and should be provided with regards to the principles of CPTED. Figure SC6.4.3.16.1 provides an example of inappropriate and appropriate fencing for rear lanes, in addition to the following:

  (i) Fences or walls along a street frontage have a maximum height of 1.2m where solid, or 1.8m where that portion of the fence above 1.2m high is at least 50% transparent.

(f) Historic rear lanes are generally not used for on-street parking with the exception of short-term parking by service vehicles. Parking should be discouraged through approved treatments, including landscaping, surface finish and limited signage (if necessary).

(8) Landscaping and driveways

(a) Landscaping, where provided to rear lanes should create local amenity and beautification of its environs and must be in keeping with established character of the particular rear lane.

(b) Landscaping, where provided within rear lanes should not conceal recesses or provide uninvited opportunities for anti-social behaviour. This can be achieved with grass, ground cover, or visually permeable low-level vegetation. Trees and shrubs that provide visual screening of activity are to be discouraged.

(c) Landscaping must not obstruct traffic movements and sightlines, particularly at driveways and

intersections.

(d) Driveways are to be constructed in accordance with the sub-section SC6.4.3.17 Driveways.

SC6.4.3.17 Driveways

SC6.4.3.17.1 Introduction

This sub-section details standards and provides advice and guidelines to assist in the design and construction of driveways (domestic, industrial, commercial and rural property access), location, and other aspects in relation to their impact on pedestrians, cyclists, other vehicles, stormwater and neighbours.

Note—the technical details depicted and described in SC6.4.4.8 Standard drawings must be adhered to.

(1) Reference and source documents to be read and applied in conjunction with this policy sub-section are as follows:

(a) SC6.4.4.8 Standard drawings

SD-006 *Typical Road Cross Sections – B-Double Turning Path and Access Plan Example Drawing*
SD-020 *Concrete kerbing*
SD-025 *Kerb Ramp*
SD-030 *Driveway access urban residential properties*
SD-031 *Driveway access industrial*
SD-032 *Driveway crossovers urban residential*
SD-090 *Driveway Access Rural Properties Type 1 - Access With Invert Slab H<300mm*
SD-091 *Driveway Access Rural Properties Type 2 - Conc. Access With Culvert Cast Insitu With Grate H≥300mm*
SD-092 *Driveway Access Rural Properties Type 3 - Gravel Access With Culvert Cast Insitu With Grate H≥300mm*
SD-093 *Driveway Access Rural Properties Type 4 - Conc. Access With Culvert Inverted Pre-cast Box Culvert H≥325mm*
SD-094 *Driveway Access Rural Properties Type 5 - Gravel Access With Culvert Inverted Pre-cast Box Culvert H≥325mm*
SD-095 *Driveway Access Rural Properties Type 6 – Access With Culvert Cast Insitu H≥450mm*
SD-096 *Driveway Access Rural Properties Type 7 - Conc. Access With Culvert 535mm<H<685mm*
SD-097 *Driveway Access Rural Properties Type 8 - Gravel Access With Culvert 535mm<H<685mm*

(b) Townsville City Council Local Laws
Local Law No. 1 *(Administration) 2011*
Local Law No. 4 *(Local Government Controlled Areas, Facilities and Roads) 2011*
Subordinate Local Law No. 1.1 *(Alteration or Improvement to Local Government Controlled Areas and Roads) 2011*
Subordinate Local Law No. 1.15 *(Carrying Out Works on a Road or Interfering with a Road or its Operation) 2011*

(c) Australian Standards: AS2890.1 *Off-street car parking*

(d) Queensland Development Code: NMP1.1 *Driveways*

(e) Austroads
Guide to Road Design Part 3 – Geometric Design
Guide to Road Design Part 4 - Intersections and Crossing - General

(2) Terminology

Driveway	unless stated otherwise, the term driveway in this sub-section refers to the access between the road and the property boundary; ie. on council-controlled land. This sub-section does not provide advice on the vehicular movement area within the private property.
Crossover	the part of a driveway that is located crossing the kerb and channel.

Local Road	a road under the control of a Local Government.
Property owner	entity, applicant, developer or owner/s who is responsible for the driveway at the time.
Queuing area	the area of a circulation roadway between the property boundary and the vehicle control point, available for the queuing of vehicles.
Regulated parking	parking controlled by traffic signs or line marking.
Rural area	an area where the urban criteria are not met as specified in the Townsville City Plan.
Road corridor permit	a permit issued by the Department of Transport and Main Roads authorising works on a State-controlled Road.
Road works permit	a permit issued by council authorising works within the road reserve on a Local Road; the area of land under the council's control, dedicated, notified or declared to be a road for public use.
Sight stopping distance	means the distance to enable a normally alert driver, travelling at the design speed on wet pavement, to perceive, react and brake to a stop before reaching a hazard on the road ahead. Refer to the *Austroads Guide to Road Design Part 3 – Geometric Design*.
State-controlled road	means a road under the control of the Department of Transport and Main Roads, including national highways.
Urban area	an area where the urban criteria are met in accordance with SC6.4.3.13.

Note—types of driveways include:
New driveways - must comply with the requirements of council's standard drawings. Works are at the property owner's cost and to the satisfaction of council.

Non-conforming driveways - existing driveways which do not meet council requirements that must be reassessed in the event of a redevelopment of the site. Works are at the property owner's cost and to the satisfaction of council.

Redundant driveways – existing driveways that are no longer in use and must be removed. Works are at the property owner's cost and to the satisfaction of council.

Unapproved driveways - driveways that have not been approved by council. Council may require these driveways to be removed or modified. Such works are at the property owner's cost and to the satisfaction of council.

Modified driveways - modifications to existing driveways must comply with the requirements of council's standard drawings. Works are at the property owner's cost and to the satisfaction of council.

Temporary driveways - Temporary property access during construction. Works are at the property owner's cost and to the satisfaction of council.

SC6.4.3.17.2 Responsibility

(1) The driveway is the responsibility of the property owner to construct and maintain. A Road Works Permit is required for all works within the road reserve under council control.

(2) Costs

The property owner is responsible for the cost to:

(a) prepare and obtain the appropriate permit(s);

(b) design and construct the driveway and associated works; and

(c) maintain the driveway.

SC6.4.3.17.3 Location

The location and layout of a driveway must consider the type of frontage road, land use of the property, and the type and volume of vehicles likely to use the access. It must be located to avoid being a hazard to any pedestrian and cyclist, through movement of traffic, and to minimise damage to the verge and vegetation/ landscaping. A separate, clearly distinguishable access for pedestrians and cyclists is to be provided.

The property owner must ensure that there are no impacts on stormwater, upstream or downstream, due to the driveway (refer to SC6.4.3.8 Stormwater) being constructed.

Rural driveway location and layout must also consider the through traffic volume, turning volume, vehicle type,speed environment, road layout, land use and general topography. It may be necessary to widen the shoulder or provide a turning lane to enhance safety for turning vehicle and through traffic.

(1) For all driveways, the location of the driveway should be:

(a) as far as practical from intersections to minimise points of conflict and confusion, and to improve safety. Driveways should not be situated within the functional area of at-grade intersections;

(b) to a road of a lower hierarchy where reasonable access can be provided;

(c) at least 6m from the tangent point, or where no tangent point exists, at least 12m from the intersection of two street property boundaries; and

(d) positioned to achieve adequate sight distance for all traffic movements associated with property accesses. Desirably, a driver has at least stopping sight distance available to react to a potential conflict and come to a stop.

Editor's note—refer to *AS2890.1 Off street car parking.*

(2) All driveways should avoid being located:

(a) opposite the terminating road of a T-junction on non-residential streets;

(b) within the signalised area (defined by extension of the signal stop lines to the road boundaries), within 25m of a signalised intersection, and not adjacent to auxiliary lanes, depending on the property frontage width. Access may be permitted if it can be demonstrated to council that the location of the driveway will be safe;

(c) within a roundabout area, nor desirably within 25m of the roundabout entrances or exits. Access may be permitted if it can be demonstrated to council that the location of the driveway will be safe;

(d) opposite or within 6m of a median opening in a major road; and

(e) within the bus stop boarding area and on the downstream side of the bus stop.

Note—on-site parking bays must be located clear of queuing areas. This allows vehicles to drive completely onto the property without having to stop for other vehicles to complete on-site parking manoeuvres.

(3) Driveways must be constructed at a right angle to the kerb line/road centreline unless demonstrated that it is not safe to have the driveway at a right angle.

(4) Driver visibility at the property line to pedestrians, cyclists and other vehicles must be clear of obstruction (e.g. fencing and landscaping), and should account for changes in grades or curves in road alignment.

Note—if sight distance is not adequate then a mirror, or other approved device, will be required to be installed at the property owner's cost.

SC6.4.3.17.4 Amenity

(1) The driveway should not adversely affect, impede or cause a nuisance to neighbouring properties.

(2) The driveway crossover of one property should not encroach onto the frontage of any adjacent property, except where it is required to achieve the desired outcome and has received approval from council.

(3) The driveway should minimise the vehicle headlight impact on the adjacent neighbourhood.

SC6.4.3.17.5 Materials

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

SC6.4.3.17.6 Clearances

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

SC6.4.3.17.7 Gradient

The driveway must be constructed in accordance with SC6.4.4.8 Standard drawings.

Note—this may not be practicable in some particularly hilly residential locations. Driveways with higher gradients can be constructed by using the expertise of a professionally qualified engineer and with the approval of council.

SC6.4.3.17.8 Number of driveways

(1) The number of driveways will be one per lot.

(2) Two may be permitted where:

(a) there will be more than ten metres or less than four metres between the driveways; and/or

(b) the property has two street frontages; and

(c) an analysis of on-street parking demonstrates that on-street parking will continue to be adequate even if a second driveway is constructed.

Where parking bays are marked on the street including service bays and bus stops and alteration to these bays is required to accommodate the second driveway, there is to be no loss of use. Displaced bays can be included in the off street parking component of a commercial development where considered appropriate. The applicant is responsible for the alterations to the line marking and signage.

(3) Commercial and industrial properties with separate entry and exit points or two or more entry levels or multiple ramps can have more than two driveways. Where two or more access driveways are permitted for industrial or commercial sites, the two access driveways must be separated by a minimum spacing of ten metres from the edge of the driveway at the kerb and channel.

SC6.4.3.17.9 Stormwater

(1) The property owner must ensure that there are no impacts upstream or downstream as a result of the works.

(2) In rural areas in particular, the driveway must not block or significantly impede stormwater flow along the road table drain.

(3) Where a box culvert is installed under the access, the minimum clearance below the level at the property boundary or the edge of the bitumen roadway (whichever is the lower) to the top of the access is provided in accordance withSC6.4.4.8 Standard drawings. This clearance must be achieved to allow water flowing in the drain to surcharge over the access before entering onto the roadway or the adjacent property.

SC6.4.3.18 Geotechnical investigations

SC6.4.3.18.1 Introduction

(1) Purpose

This policy sub-section provides advice and guidance and assist applications

(a) on the preparation and assessment of geotechnical investigation reports;

(b) on the expected level of geotechnical investigation required for development based on the level risk or hazard identified; and

(c) information council may request for a development application.

(2) Background

Development on steep lands presents a unique set of design and engineering challenges, often requiring a greater degree of detail in the design and approval of allotments, earthworks, roads, services and built form.

There is a growing awareness of the risks, environmental values, and ongoing costs associated with development on steep slopes, which has resulted in an expectation of an improved standard of design in these environmentally and geologically sensitive areas. This is supplemented by an increased mindfulness of the risks and financial cost to construct and maintain the servicing in these areas and the need to consider these factors in the assessment of applications involving a landslide hazard.

Editor's note—certain existing steep land or hillside developments have demonstrated how inappropriate forms of land use and servicing can permanently damage local environmental features and diminish valued natural assets, particularly scenic qualities. In addition, it has been noted how the costs to maintain associated infrastructure can become a burden on the wider community due to the specialist nature of this infrastructure and the generally lower density in these areas. Whilst these areas do contribute to the diversity of housing choice, the pricing of lot and housing prices usually exceed the ability for the local economy to include these as affordable housing options.

(3) Application

This sub-section applies to development affected by the Landslide hazard overlay maps OM-07.1 and OM-07.2.

(4) Reference and source documents

Australian Geomechanics Society (AGS), *Australian Geomechanics*, Volume 42 No 1 March 2007.

Fell, R., Hungr, O., Leroueil, S. Riemer, W., 2000: *Keynote Lecture – Geotechnical engineering of the stability of natural slopes*, *and cuts and fills in soil*, GeoEng2000, 1, 21-120. Invited Papers, Technomic Publishing, Lancaster, ISBN: 1-58716-067-7, November 2000.

SC6.4.3.18.2 Geotechnical investigations

(1) Requirement of a site-specific geotechnical investigation report.

(a) Where development is subject to assessment against Part 8.2.7 Landslide hazard overlay code, an applicant will be required to undertake a geotechnical investigation of the likely impacts of the proposed development and to determine the measures to avoid or mitigate unacceptable risk and other adverse impacts.

(b) Table SC6.4.3.18.1 Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories specifies the level of investigation required for the particular hazard level affecting the subject land. Where the subject land has more than one hazard level mapped, the assessment technique shall be for the higher hazard level mapped. Table SC6.4.3.18.2 Applicability of site investigation methods to slope classes should be considered in conjunction with Table SC6.4.3.18.1.

(c) The planning and design of future development should consider the level of professional geotechnical input commensurate to the landslide hazard category which the development is subject to. In general, it is appropriate that geotechnical input for development be carried out in accordance with the reporting standards proposed by the AGS, 2007c Landslide Risk Management (Reference 8). This requires the

practitioner to consider not only the issues surrounding the landslide hazard (if one exists) but also the consequences if a landslide were to occur (i.e. the assessment need to be couched in a risk assessment context).

(d) The extent and detail of the investigation will vary dependent upon the level of hazard identified on the Landslide hazard overlay maps OM-07.1 and OM-07.2 and the nature of the development being proposed. Council will require each report to demonstrate a scope and depth of investigation appropriate to the level of hazard identified, for the specific site characteristics and the proposed development and works.

(e) Geotechnical reporting needs to clearly indicate whether the risk assessment is based on existing slope conditions or with risk treatment measures implemented (or both).

(2) Preparation of a site-specific geotechnical investigation report

(a) A geotechnical investigation report must document the following:

(i) introduction to the proposal including a description of the subject land, locality and proposed development;

(ii) description and investigation of existing conditions of the development site, including assessment of land stability and geotechnical constraints to development (see SC6.4.3.18.2(3) Investigation information requirements);

(iii) assessment of the suitability of the site for the development. This should include an assessment of the likely effects and impacts of the development upon slope stability or landslide hazard (see SC6.4.3.18.2(3) Investigation information requirements);

Editor's note— assessments should be undertaken and give sufficient consideration of the final intended development outcomes for the subject site, including staging of development and associated works.

(iv) measures recommended to mitigate impacts including siting, design, engineering, and any other necessary mitigation measures; and

(v) conclusion and recommendations (see SC6.4.3.18.2(3) Investigation information requirements).

(b) Geotechnical investigation reports are to reference Australian Geomechanics Society (AGS) Volume 42 No 1 March 2007, or any later guideline of the AGS as agreed by council.

(c) Geotechnical investigations are to be undertaken and certified by an appropriately qualified and experienced engineering geologist, geotechnical engineer or registered professional engineer appropriately experienced in slope stability investigations in accordance with Australian Geomechanics Society Volume 42 No 1 March 2007.

(d) The findings, recommendations and specific works of the geotechnical investigation report must be implemented and complied with to ensure that the risk level for the development will be no more than "low". If the engineer's assessment report finds that the site will be "low risk" after development without the need for specific works to achieve this, certification need not be required.

(e) Laboratory testing is required to be undertaken by a National Association of Testing Authority (NATA) certificated laboratory. All investigations, testing and design should be undertaken in accordance with industry practice and the provisions of relevant Australian Standards.

(3) Investigation information requirements

(a) Geotechnical investigations should cover the matters set out below, and may include, but need not be limited to:

(i) review of existing data sources including regional geology, topographic maps and geotechnical reports;

Editor's note— applicants may also refer to SC6.4.3.7 Steep land development design guidelines for further information.

Note—where a geotechnical investigation has been previously undertaken and the report provided as supporting documentation to council for a previous application over the subject land, these documents must be clearly referenced in the report prepared for the subsequent application. Such supporting documentation must be made available to council and be current and specifically relevant to the proposed development.

(ii) stereoscopic viewing of vertical air photo pairs to facilitate terrain mapping;

(iii) preparation of site plan showing results of geomorphic and engineering geological mapping (to scale);

(iv) subsurface investigations including drill holes, auger holes, shafts and test pits with locations shown on to scale site plan;

(v) results of laboratory testing of samples recovered from the subsurface investigation;

Note—the results of all laboratory tests must be included in the geotechnical report, including the location and level (including datum).

(vi) groundwater and surface water studies including recording of groundwater conditions in sub surface investigation and mapping of surface seepages;

(vii) preparation of cross section(s) showing interpreted geotechnical and groundwater conditions with cross section location identified on site plan;

(viii) evidence of past slope stability performance;

(ix) evidence of history of slope instability with assessed trigger events, including in relation to adjoining land;

(x) identification of landslides, shown in plan and on section, and discussed in terms of the site geomorphology and slope forming process;

(xi) assessment of consequences to property and life for each landslide and or type of landslide with basis therefore;

(xii) assessment of risk for each landslide and or type of landslide;

(xiii) assessment of landslide frequency (probability) and or type of landslide;

(xiv) risk assessment in relation to tolerable risk criteria (e.g. published criteria where appropriate); and

(xv) risk mitigation measures and options, including revised risk assessment following implementation.

(4) Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories
Table SC6.4.3.18.1 has been prepared for the standard geotechnical techniques identified in AGS, 2007c which are applicable for the assessment of landslide risk. The various investigation techniques have different levels of applicability for the different hazard categories shown on the Development constraints overlay map – Landslide hazard OM-07.1 and OM-07.2. Table SC6.4.3.18.1 should therefore be considered as a guideline as to the applicability of professional geotechnical input for any hazard category.

Table SC6.4.3.18.1 Guidelines for applicability of geotechnical assessment techniques in landslide hazard categories

Investigation techniques	Landslide hazard				
	Landslide hazard Map OM-07.1				OM-07.2
	Very Low	Low	Medium	High	>23degrees
1. Review of existing data sources including regional geology, topographic maps and geotechnical reports	B	A	A	A	A
2. Stereoscopic viewing of vertical air photo pairs to facilitate terrain mapping	B	B	A	A	A
3. Preparation of site plan showing results of geomorphic and engineering geological mapping (to scale)	B	B	A	A	A
4. Subsurface investigations including drill holes, auger holes, shafts and test pits with locations shown on site plan.	C	B	A	A	A
5. Results of laboratory testing of samples recovered from the subsurface investigation	D	C	B	A	A
6. Groundwater and surface water studies including recording of groundwater conditions in sub surface investigation and mapping of surface seepages	C	B	B	A	A
7. Preparation of cross section (s) showing interpreted geotechnical and groundwater conditions with cross section location identified on site plan.	C	B	B	A	A
8. Evidence of past slope stability performance.	B	B	B	A	A
9. Evidence of history of slope instability with assessed trigger events, including in relation to adjoining land	B	B	B	A	A
10. Identification of landslides, shown in plan and on section, and discussed in terms of the site geomorphology and slope forming process	C	B	B	A	A
11. Assessment of landslide frequency (probability) and or type of landslide.	C	B	B	A	A
12. Assessment of consequences to property and life for each landslide and or type of landslide with basis therefore	C	B	B	A	A
13. Assessment of risk for each landslide and or type of landslide	C	B	B	A	A
14. Risk assessment in relation to tolerable risk criteria (e.g. published criteria where appropriate).	D	C	C	B	A
15. Risk mitigation measures and options, including revised risk assessment following implementation	C	B	B	A	A

Note— A – Strongly Applicable B – Applicable C – May be applicable D – Seldom applicable

(5) Applicability of site investigation methods to slope classes
Table SC6.4.3.18.2 summarises the applicability of various site investigation techniques for natural and constructed slopes of various scales. The requirements for site investigations shown in Table SC6.4.3.18.1 should be considered in the context of the hazard categories given in Table SC6.4.3.18.2.

Note—
1. A – Strongly applicable, B – Applicable, C – May be applicable, D – Seldom applicable.
2. In similar areas.
3. SPT, CPT, CPTU.
4. Permeability.
5. During construction.

Table SC6.4.3.18.2 Applicability of site investigation methods to slope classes

Site investigation method	Natural slopes				Constructed slopes			
	Small/ shallow	Medium	Large	Existing cut	New fill	New cut	New fill	Soft clay
Topographic mapping and survey	A	A	A	A	A	A	A	A
Regional geology	A	A	A	A	A	A	A	A
Geological mapping of project								
Area	B	B	A	A	B	A	B	C
Geomorphological mapping	A	A	A	B	B	B	B	D
Satellite imagery interpretation	D	D	C	D	D	D	D	D
Air photograph interpretation	A	B	A	C	C	C	C	C
Historic record	A	B	B	A	B	B (2)	B (2)	B (2)
Dating past movements	B	C	B	D	D	D	D	D
Geological methods	C	C	B	C	C	C	D	C
Trenches and pits	B	A	B	B	B	B	B	C
Drilling/boring	C	A	A	C	B	B	B	A
Downhole inspection	C	B	B	C	D	C	D	D
Shafts and tunnels	D	C	B	D	D	D	D	D
In situ testing of strength								
Permeability	C (3)	C (3)	C (4)	D	B (3)	C	C	A (3)
Strength and permeability								
monitoring pore pressures,								
rainfall, etc.	C	A	A	A	A	C	C	A (5)
Monitoring of displacements	C	B	A	B	B	B (5)	C (5)	A (5)
Laboratory testing	C	A	B	B	B	B	C	A
Back analysis of stability	C	B	A	C	B	B (2)	C (2)	C (2)

Source: (Fell, Hungr, Leroueil and Reimer, 2000)

SC6.4.3.19 Road and street naming

SC6.4.3.19.1 Introduction

(1) Objectives

The objectives of this sub-section are to:

(a) provide a consistent procedure and setting of standards for road and street naming within the Townsville City Council Local Government Area to contribute towards a legible road and street network;

(b) ensure urban and rural addressing are simple as possible, unique and clearly identifiable;

(c) identify the information council may request for a development application or as a condition of approved; and

(d) provide guidance or advice about satisfying an assessment criteria.

(2) Terminology

Estate	an Estate is a group of homes and other buildings built together as a single development (e.g. housing development).
Roadway	is considered to be any public or private land- based thoroughfare or course navigable by vehicle or foot that can be used for assigning addresses or allowing access between points or to a feature. Examples of roadways include alleyways, roads, streets, highways, laneways, fire tracks, bike paths and walking tracks.
Roads	are generally through routes for the movement of vehicular traffic.
Streets	are generally for providing property access, pedestrian and cycle movement with more localised vehicular traffic.

(3) Reference and source documents

(a) Australian standards
AS/NZS 4819 – *Rural and urban addressing*

(b) SC6.4.4.8 Standard drawings
SD065 Street Name Sign and Installation Details
SC6.4.6.2 Minor concrete works
SC6.4.6.24 Signposting

SC6.4.3.19.2 Information requirements

(1) In order for council to consider a name for a new road or street, the following information is required, in support of the request:

Note—an application for road/street name approval must be submitted to and approved by council prior to the submission of any operational works application.

Editor's note— fees are to be paid in accordance with the *Planning and Development Schedule of Fees and Charges* for formal applications for road and street naming approval. *Planning and Development Schedule of Fees and Charges* – Schedule 1 can be found on council's website.

(a) for new developments not associated with an Estate, three proposed names for each proposed road/street;

(b) for a new Estate, a list of proposed names to be used within the Estate; and

(c) the origin of each name should be clearly stated on the submitted proposal for consideration. Requests

for roads/streets to be named after significant individuals are to be accompanied by a summarised autobiography of each individual to be recognised. For groups of names with similar origins, a bulk explanation is acceptable if the theme generated is from the same source.

Editor's note - For roads/streets that are existing gazetted roads, whether constructed or not, names must be submitted to council for approval

Editor's note - The approved road/street names as well as the road/street type must be shown on the engineering drawings submitted for subsequent operational works approval.

SC6.4.3.19.3 Criteria for the naming of roads and streets

The following criteria will be used in assessing requests for road and street naming:

(1) Australian standard (AS/NZS 4819 – *Rural and urban addressing*)

This sub-section adopts the parts of AS/NZS 4819 – *Rural and urban addressing* identified below, for use in the naming of roads and streets:

(a) **Section 1** – Scope and General;

(b) **Section 4** – Road definition and naming; and

(c) **Appendix A** – Road types – Australia.

Where this sub-section is silent on a matter, Sections 1, 4 and Appendix A of AS/NZS 4819 shall apply and, further, they will prevail to the extent of any inconsistency with this sub-subsection.

(2) Name duplication

Name duplication (both existing names and approved names) within the Townsville City Council Local Government Area will not be approved. This requirement is to ensure consistency and to avoid confusion and misunderstanding in the delivery of goods or services or in the dispatch of emergency vehicles.

(3) Sources

(a) The preferred sources for road and street names include:

(i) indigenous names of significance to the area, subject to prior approval of the relevant local Aboriginal or Torres Strait Islander Land Council via council's Aboriginal and Torres Strait Islander Advisory Committee;

Note—the relevant local Aboriginal or Torres Strait Islander Land Council should be consulted via council's Aboriginal and Torres Strait Islander Advisory Committee when choosing Aboriginal or Torres Strait Islander names, unless council already has an agreed list of appropriate names.

(ii) flora and fauna, generally using the common name and excluding lengthy or complex scientific names;

(iii) names of founding mothers and fathers, prominent citizens or identities, excluding living persons;

(iv) war casualty lists;

(v) local heritage values; and

(vi) existing road/street naming themes in the suburb or area.

(b) Names should be appropriate to the physical, historical or cultural character of the area concerned.

(c) The origin of each name should be clearly stated on the submitted proposal for consideration. Requests for roads/streets to be named after significant individuals are to be accompanied by a summarised autobiography of each individual to be recognised. For groups of names with similar origins, a bulk explanation is acceptable if the theme generated is from the same source.

(d) A variation to these sources will be considered on the individual merits of the proposal.

Note—all proposed names will be considered on their individual merit.

(4) Communication

(a) Names should be reasonably short, easy to read, spell and pronounce in order to assist service providers, emergency services and the travelling public. Proposed names should not be similar in spelling or sound to existing names.

(b) Names must not be offensive or discriminatory.

(c) Unduly long names and names composed of two or more words should be avoided:

(i) a given name should only be included with a family name where it is essential to identify an individual or where it is necessary to avoid ambiguity, e.g. Angus Smith Drive, John Melton Black Drive, Sir Leslie Thiess Drive etc. The use of given names should generally be avoided; and

(ii) whilst street and cul-de-sac names should have only one word it is recognised that some roads require a two word name because of their geographic relationship e.g. Old Common Road, Ross River Road etc.

(5) Spelling

(a) Where it is intended that a road/street have the same name as a place or feature with an approved geographical name, then particular care should be taken to ensure that the correct spelling is adopted.

(b) Where names have been changed or corrupted by long established local usage, it is not usually advisable to attempt to restore the original form; that spelling which is sanctioned by general usage should be adopted.

(c) Generally, road/street names proposed or approved should not contain abbreviations. For example, the "Creek" in "Wallaby Creek Road" must not be abbreviated. There is, however, one exception: "ST" should always be used in place of Saint.

(6) Form

(a) "The" must not be used in place of a name followed by a road type for example, "The Boulevard".

(b) Prepositions in road names should not be used, for example, "Hampton on Boulevard".

(c) No directional indicators are to be used, for example, "Gold Road West" and "Gold Road East".

(d) Prefixes such as "Upper", "New", "North" or "South" must not be used unless the name has been specifically derived from a name that includes these.

(e) The apostrophe mark must be omitted in the possessive case, e.g. ‘Smith’s Road’ should be "Smiths Road".

(f) Hyphens are not to be used.

(g) Full stops are not to be used.

(h) No symbols, diacritical marks or special characters are to be used. The exception is macrons for Maori names.

(i) Numerals are not to be used. Any numbers in a name must be written in full. Only standard A to Z alphabet characters may be used.

(7) Road types

(a) Particular attention should be paid to the use of street, road, court, crescent, drive etc., to ensure that the road type is representative of the road being described. Road/Street types are to be in accordance with AS 4819 Appendix A and read in conjunction with section 4.3 of AS 4819.

(b) The road/street type/s is required to be submitted to council as part of the application for consideration of road/street names. The road/street type/s is to be submitted for checking by council on plans associated with operational works approval. The road/street type must be appropriate for the road layout.

(8) Holding of approved names

Approved names remain valid for the following periods:

(a) 5 years for developments not associated with Estates; and

(b) for Estates, the applicant is to advise council at the time of the request for approval of names, the proposed, estimated time period for the completion of the Estate. Approved names will be held for this time period.

SC6.4.3.19.4 Street name signs

The street name signage must be in accordance with standard drawing SD065 Street Name Sign and Installation Details and installed and constructed in accordance with SC6.4.6.28 Minor concrete works and SC6.4.6.24 Signposting.

SC6.4.3.20 Public lighting and utility services

SC6.4.3.20.1 Introduction

(1) Purpose

The purpose of the Public lighting and utility services sub-section is to provide standards, advice and guidelines for the design, installation and construction of public lighting and utility services.

(a) Public lighting is provided to:

(i) allow for the use of and safe movement in public spaces;

(ii) provide improved safety and security for the community at night; and

(iii) enhance the public amenity.

Council encourages the design and use of efficient lighting systems that support council's commitment to sustainability and meet the requirements of AS/NZS 1158 *Lighting for roads and public spaces*.

(b) Utility services

A purpose of a road reserve is to provide a corridor for the delivery of utility services such as water supply, sewerage, gas, telecommunications (including future telecommunications) and electricity to all properties fronting the road, street or rear lane. The verge or footpath area between the road reserve boundary and the edge of the roadway provides the space for these service corridors and these guidelines are designed to achieve the following aims:

(i) provide a convenient location for the installation and safe access to all utility services for maintenance and retrofitting purposes;

(ii) provide a corridor for street furniture including road lighting poles;

(iii) minimise possible conflict with other underground services; and

(iv) provide an opportunity for street landscaping.

Council standard drawings (SC6.4.4.8 Standard drawings) for service corridors provide details of utility alignments within the footpath/verge and should be read in conjunction with SC6.4.4.1 Geometric road design

(2) Scope

(a) Public lighting includes:

(i) road lighting (urban and rural);

(ii) lighting for footpaths and cycle paths;

(iii) lighting for parks;

(iv) lighting for sports grounds and sports complexes;

(v) lighting for public buildings;

(vi) lighting for off-street car parks; and

(vii) feature lighting which may include bollards and in ground lighting.

(b) Utility services include (but are not limited to):

(i) reticulated water supply;

(ii) reticulated sewerage supply;

(iii) reticulated gas supply and its supporting infrastructure;

(iv) reticulated telecommunications network, including future services (fibre optic);

(v) reticulated electricity, both underground and overhead supply; and

(vi) lighting networks, including road, open space, community facilities and off-street parking.

(3) Consultation

Developers and sporting groups are encouraged to consult with council and the relevant servicing authority and determine any requirements these authorities may have before undertaking any detailed design.

Developers should obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

If there is an expectation that an application may have higher servicing demands, details of these additional demands should be provided to council and the servicing authority.

(4) Reference and source documents

(a) Council specifications and drawings
SC6.4 Development manual planning scheme policy - all specifications and drawings for design and construction.

(b) Australian Standards, in particular
AS/NZS 1158 - *Lighting for roads and public spaces*
AS/NZS 1596 - *The storage and handling of LP gas*

(c) Other
Australian Government, *Disability Standards for Accessible Public Transport 2002*
Electricity Act 1994
Electrical Safety Act 2002
Energy Queensland, *Developer's Tool Kit* (web-based)

Editor's note—the *Developer's Tool Kit* can be found on the Energy Queensland website.

SC6.4.3.20.2 Public lighting (urban and rural)

(1) Public lighting general
There are a number of types of public lighting infrastructure which meet a range of different needs. Infrastructure associated with public lighting generally consists of poles, outreach arms, lamps, luminaires, photoelectric cells, switch gear, footings and connections to a supply. The size and type of lighting infrastructure will be determined by the size and type of the use, the intensity of lighting required, remoteness from supply and the time of operation.

All lighting designs must be prepared and certified by an appropriately qualified Registered Professional Engineer of Queensland prior to submission to council with a development application.

Road and public space lighting must be designed in accordance with AS/NZS 1158 and Energy Queensland's requirements.

(2) Road lighting general
Lighting infrastructure must be chosen from the list of products supported by Energy Queensland, unless specifically otherwise agreed by council. Road lighting chosen from the list of products supported by Energy Queensland will become infrastructure owned by Energy Queensland, on a Rate 2 Tariff.

All Category P lighting in new residential areas must be LED lights as approved by Ergon Energy.

If other road lighting infrastructure is preferred by a developer for aesthetic or other reasons including for environmental protection, which the developer expects to hand to council for ongoing maintenance, justification must be provided on how this will fit into any lighting master plans for the area. Without approval council gives no guarantee that this infrastructure will be adopted by council, and if it is adopted, that it will be maintained in that form. Any "non standard" road lighting would be on a Rate 3 Tariff.

Editor's note—council does not support shading of lights on the basis that it would be a penalty to road users, particularly cyclists and pedestrians.

(a) Road lighting in rural residential areas
Flag lighting is to be provided at:

(i) all intersections on roads;

(ii) on curves where the advisory speed through the curve is 15 km/h lower than the gazetted speed limit of the road; and

(iii) at the ends of cul-de-sacs.

A maximum 150W luminaire should be used at a mounting height of 10.5m.

Lighting on roads under the control of the Department of Transport and Main Roads must be designed to meet their requirements.

(b) Road lighting in urban areas
Lighting must be provided in accordance with the relevant sections of AS 1158 and the following:

(i) Category V3 Lighting on arterial and sub-arterial roads;.

(ii) Category V5 Lighting on major collector streets;

(iii) Category P4 Lighting on, access Streets, access Places, industrial streets, and commercial precincts unless otherwise determined by council, e.g. higher lighting levels to assist with CCTV surveillance; and

(iv) lighting in public transport infrastructure (compliance to the *Disability Standards for Accessible Public Transport 2002*).

(c) Lighting for bicycle, pedestrian and shared paths
Lighting Category P1 – P4 for bicycle, pedestrian and shared paths as advised by council after consideration of location, hours of use and risk to the public.

(d) Lighting for parks
Lighting requirements for parks will be determined by council based on where the park fits into the hierarchical structure. A point of supply is required to most parks and where required, the precise location of the supply will be advised by council. This lighting may have a sub-metered supply.

(e) Lighting for sports grounds and sports complexes
Lighting requirements for sports grounds and sports complexes will be determined by council based on where the park fits into the hierarchical structure.

A point of supply is required to most parks and where required, the precise location of the supply will be advised by council.

(f) Lighting for public buildings and spaces
Lighting requirements for public buildings and spaces will be determined based on a risk assessment considering location, time of use, number of people, relevant building codes and AS/NZS 1158.

(g) Lighting for off-street car parks.
Lighting must be provided in accordance with the relevant sections of AS 1158. A point of supply is required to most off-street car parks. Lighting shall be provided in accordance with the lighting master plan for the area, unless otherwise approved by council. This lighting must have its own separate metered point of supply.

(3) New subdivision marketing banners on light poles

It is common practice for developers to place marketing banners on light poles along local roads within the boundary of the new subdivision. Banners are lightweight and made of a non-rigid material.

The developer must obtain approval from Ergon Energy to erect marketing banners on light poles and comply with all Ergon Energy conditions. Banners on light poles must not be a driver distraction on the road or at an intersection. Banners must not interfere with an official traffic sign, distract a drivers attention at a critical time, obscure the drivers view of a road hazard, give instructions to stop, imitate an official traffic sign, nor be an obstruction to the road or a hazard to all other road users. A high level of safety for road users must be maintained.

At the time of on maintenance council may accept the marketing banners on light poles, but the developer must indemnify council for all matters arising from the banners erected on light poles. The banners may remain on the light poles for twelve (12) months. If banners are required beyond this time then the developer must

submit a request to council for a twelve (12) month extension of time. Council may request the developer to remove any marketing banner on any light poles at any time.

Editor's note – there may be additional related requirements in Subordinate Local Law No. 1.4 (Installation of Advertising Devices) 2011.

Council will not give consent for advertising banners to be placed on street lights that are owned and maintained by council.

SC6.4.3.20.3 Utility services

(1) All utility services are to be underground.
All services to new developments must be constructed underground unless otherwise approved by council.
Layout plans for all service installations must be submitted to council as part of the developmentapplication.

(2) Alterations to existing services
Care should be taken during the design to avoid other existing underground services, and where this is unavoidable it will be the developer's responsibility to undertake the necessary alterations to the satisfaction of the asset owner at the developer's cost.

Where it is necessary to install conduits under existing roads, this installation must be undertaken by boring unless otherwise approved by council.

Telecommunication cabinets and electricity supply pillars
The proposed location of on street telecommunication cabinets and electricity supply pillars must be shown on plans and be located clear of access driveways to properties, and clear of any water and gas services in accordance with any requirements of the relevant authority.

(4) Electricity supply general
An overhead supply approved by the relevant energy authority where in the rural residential zone, special purpose zone or high impact industry zone or where on a lot of less than 2,500 m^2 within an area where the existing supply is overhead is acceptable.

In exceptional circumstances, remote access properties in the rural zone may be permitted provide an electricity supply that is not connected to the grid. It shall be demonstrated by the applicant that an adequate and reliable supply that maintains standards for safety, environmental, health and amenity is achievable. Acceptable alternatives may include solar or other similar self-generating system.

Electricity and/or telecommunications services must be designed in accordance with the relevant utility provider's guidelines. Electricity design plans submitted to council with an RPEQ certification are only accepted by council to permit the utility provider (e.g. Energy Queensland) to formally approve the design.

In the construction phase only conduits for both electricity and telecommunications utilities are installed, with the relevant utility provider installing the actual service after the works are complete.

(5) Gas supply
Where it is proposed to provide a reticulated gas supply to a development, the gas service pipe must be installed in the verge or footpath on the alignment shown on SC6.4.4.8 Standard drawings.

If a storage cylinder is proposed as part of the development, the cylinder must be installed and maintained on a separate freehold parcel of land in accordance with all safety regulations contained in the AS/NZS 1596 *The storage and handling of LP gas*. Details for servicing the gas cylinder must be provided to council as part of the development application.

SC6.4.3.21 Townsville Water planning and design guidelines

SC6.4.3.21.1 Introduction

(1) General

This sub-section has been developed by the Programs and Technical Support (PATS) department within Townsville Water and Waste, to document the procedures undertaken during the delivery of their services.

(2) Intent of the sub-section

This sub-section has been developed to detail relevant information pertaining to planning and design projects and to collate Townsville Water and Waste practices not documented elsewhere. Its intended use is as a reference manual for:

(a) internal Townsville City Council staff including Townsville Water and Waste and Planning and Development (Infrastructure Planning Unit and Development Assessment);

(b) external consultants engaged to perform specific commissions; and

(c) developments that include water and wastewater infrastructure.

(3) Application

These guidelines shall apply to sewerage and water supply distribution, collection, pumping and treatment and effluent reuse in the areas of:

(a) planning;

(b) design;

(c) technical specifications for approval;

(d) preparation of technical contract documentation; and

(e) collection and submission of as-constructed details.

It excludes: information on the presentation of drawings.

(4) Purpose

The purpose of these guidelines is to ensure that:

(a) all water supply, sewerage and effluent reuse works are designed and constructed to common standards throughout Townsville city, and comply with codes and standards established by the relevant government authorities;

(b) the reticulation and pumping systems provided are hydraulically adequate for the demands from the currently planned stage of development within any particular Water Supply/Sewerage Scheme at any point in time;

(c) the total system of reticulation pumping and treatment is progressively developed with adequate capacity to meet the ultimate requirements of the particular Water Supply/Sewerage Scheme; and

(d) the quality of water supplied and the quality of effluent disposed by Townsville Water and Waste meets acceptable minimum standards established by the relevant government authorities.

(5) Triple bottom line

Any new works undertaken by Townsville Water and Waste and development must meet the requirements of a triple bottom line approach to sustainable development, and be economically, environmentally and socially viable.

(6) Acceptance of designs and documentation

The design of infrastructure shall comply with the requirements that are detailed in Townsville Water and Waste's Total Management Plans where relevant.

Externally produced designs and documentation including drawings shall be certified by a Registered Professional Engineer of Queensland (RPEQ).

SC6.4.3.21.2 Water supply design

(1) Introduction

(a) Scope

The work to be carried out under SC6.4.3.21.2 includes the design of a water supply system either as a stand-alone project or as part of a development.

(i) Inclusions

SC6.4.3.21.2 covers the design of:

(A) pump stations;

(B) storage reservoirs;

(C) water mains – including trunk and reticulation mains; and

(D) property connections.

(ii) Exclusions

SC6.4.3.21.2 does not cover requirements for:

(A) bulk water storage – dams etc.; and

(B) water treatment plant design considerations.

Bulk water supply infrastructure will be planned and designed by council in conjunction with experienced specialist consultants.

(b) Documents

(i) Reference and source documents

SC6.4.3.21.2 is to be read in conjunction with the current version of the following documents.
Australian Drinking Water Guidelines (National Health and Medical Research Council)
Planning Guidelines for Water Supply and Sewerage, Department of Energy and Water Supply (*DEWS Guidelines*)
(WSA 03) Water Supply Code of Australia
Workplace Health and Safety Queensland, *Safe Design of Structures – Code of Practice*

(ii) Document precedence

The order of precedence (highest to lowest) of documents shall be:

(A) SC6.4.4.8 Standard drawings;

(B) this sub-section;

(C) WSA 03; and

(D) DEWS Guidelines.

(c) Standard drawings

SC6.4.4.8 Standard drawings shall be read in conjunction with this sub-section. Standard drawings other than water and sewerage (such as road crossings) also contain information on water and sewerage infrastructure and shall also be referred to.

(i) Amendments to WSA 03

The design of water supply systems shall comply with *WSA 03 Water Supply Code of Australia* unless otherwise specified herein, and shall be constructed in accordance with *WSA 03 Water Code of Australia Construction Specification.* Amendments required by Townsville Water and Waste to WSA 03:2011 are included in Table SC6.4.3.21.1. Any conflicting information in later codes shall be referred to Townsville Water and Waste for clarification.

Table SC6.4.3.21.1 Amendments to WSA 03:2011 – Water Supply Code of Australia

WSA 03 Section	Amendments to WSA 03 – Water Supply Code of Australia:
2.3	Demand parameters are set in SC6.4.3.21.2(2). Variations from these parameters are to be approved by Townsville Water and Waste.
Figures 2.1(a) and 2.1(b)	Dead end mains are not permitted.
2.4	Minimum mains sizing – DN100 (with fire service provision) on one side of the street, in conjunction with DN63 (rider main) to the other side.
2.5.3	Minimum service pressure shall be 22 m at the service connection under peak flow conditions, with a minimum service flow rate of 30 L/minute.
2.9	Storage reservoirs shall be sized to not empty under 7 consecutive days of 95% peak day demands.
3.1.5	Water supply systems shall be designed for fire fighting capability in accordance with parameters set out in Table SC6.4.3.21.3.
3.3 and 3.8	Minimum Class of pipe shall be PN16.
4.7	GRP pipe is not permitted.
5.6	Shared Trenching is not permitted without prior written approval.
5.10	Dead end mains are not permitted.
5.11 and 15.8	Property Service and Water Meters shall only be installed by Townsville Water and Waste upon application.
9.2.2	Longitudinal section drawings shall be provided for water mains DN200 and above.
14.2, 16.0	Pipe embedment and support: For flexible pipes refer to AS2566.2, Tables G1, G2 and G3 for suitable material types.
15.20.1	An access hatch is required on the steel main to reinstate cement mortar lining.

(2) Water supply planning

(a) Scope

Water supply system planning covers the requirements of the water distribution and reticulation system from the bulk supply system to the service connections. This includes pump stations, storage reservoirs, trunk water mains, and reticulation mains.

(b) Hydraulic loading assessment

(i) General

Hydraulic loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

(A) designated value of EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of Townsville City Plan;

(B) the location of various zone types as specified in Townsville City Plan;

(C) an assessment of the ultimate population, including the expected peak occupancy rates and the quantity of undeveloped land for each zone type listed in Townsville City Plan; and

(D) estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by an analysis of historic consumption and consultation with the institution regarding future development.

Editor's note - Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Townsville City Council Growth Model which is available from Planning and Development (Infrastructure Planning Unit). This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU), Office of Economic and Statistical Research within the Queensland Government, Department of Treasury and Trade.

(iii) Design flows

Peak demands are to be calculated from Table SC6.4.3.21.2.

Table SC6.4.3.21.2 Water supply unit demand parameters

Parameter	Unit Demand	Peaking Factor
Average Day (AD)	600 L/day/EP	
Mean Day Max Month (MDMM)	900 L/day/EP	1.5 AD
Peak Day (PD)	1125 L/day/EP	1.25 MDMM
Peak Hour (PH)	0.033 L/s/EP	2.56 PD

In addition to the residential demand, the AD irrigation demand is 60L/EP.

(iv) Design criteria

Water supply systems shall be sized in accordance with the requirements of:

- *Planning Guidelines for Water Supply and Sewerage.*

The design criteria for water supply infrastructure are summarised in Table SC6.4.3.21.3.

Table SC6.4.3.21.3 Water supply infrastructure design criteria

Design Criteria	Value
System Pressure NB: measured immediately upstream of the customer's water meter not downstream of water meter. Max Head loss through a water meter is 25kPa i.e. 2.5 m (AS3565.1)	
Minimum Operating Pressure	22 m to the meter
Maximum Operating Pressure	80 m to the meter
Fire Fighting Requirements	
System Pressure	12 m minimum at the property boundary and any point within the system
Fire Flow	Rural Residential (Zone 1 or 2) – 7.5L/s Residential – 15 L/s Commercial and industrial – 30 L/s
Background Demand	PH > 3,000 person communities 2/3 PH < 2,000 person communities Linear interpolation between 2/3PH and PH for 2000 and 3000 persons communities
Reservoir level	Mid-water level
Reservoir Storage	
Ground Level Storage	7 days of 95% PD Demand; Cases where inflow is MDMM Demand this equates to:- 7*(0.95*1.2*MDMM-MDMM) = 1.31 MDMM
Elevated Storages	6*(PH-1/12 MDMM) + Fire fighting reserve (150 kL)
Pumping Capacity	
Duty Pump Capacity	Sized for MDMM flows with 20 hours operation
Pumps serving Elevated reservoirs	(6*PH-Operating Volume)/(6*3600)
Standby pump capacity	To match the capacity of the largest pump in the station

Design Criteria	Value
Pipeline Design	
Pipe Capacity - Distribution Mains	Sized for MDMM flows.
Pipe Capacity - Reticulation	Based on peak instantaneous demands; of PH and Fire Flow.
Fire Services Pumps	TWW preference is for pumped fire services to be connected downstream of a fire tank. If fire pump is directly connected to the water reticulation main applicant must provide evidence that the selected pumps will not have adverse impact on the surrounding network.

Friction factors to be adopted for the pipe network modelling are detailed in Table SC6.4.3.21.4.

Table SC6.4.3.21.4 Hazen Williams pipe friction coefficients

Mains	Diameter (mm)	Adopted "C" Values	
		Cement Lined Pipe	Plastic Pipe
Distribution	< 300 300-600 > 600	110 120 125	130 140 150
Reticulation	<= 150 225 – 300 > 300	100 110 120	120 130 140

(c) Network planning

(i) Purpose

The purpose of network planning is to determine the most effective means of providing a service to an area through analysis of both infrastructure and non-infrastructure based solutions. The determination of the most effective solution should be made through analysis of whole of life costs and consideration of non-financial aspects such as operations, maintenance, and environmental obligations.

Section SC 6.4.3.21.2(2)(c) details the circumstances under which a network plan should be prepared.

When preparing planning reports for both water and sewerage assets, the author shall refer to Section 6 of the DEWS *Planning Guidelines for Water and Sewerage.*

(ii) Network modelling

A water network model is required for all code or impact assessable material change of use (MCU) and reconfiguring a lot (RoL) applications where:

(A) new trunk and/or reticulation mains are to be constructed as part of a development;

(B) the development requires trunk infrastructure identified in council's Plans for Trunk Infrastructure to be constructed ahead of its planned date, or out of sequence identified in master planning;

(C) the proposed land use results in an increase in demand greater than what is presently allowed for Townsville City Plan; or

(D) water mains are required to be relocated or reconfigured as part of the proposed works, and these works are expected to change the hydraulics of the existing supply.

TCC also requires the development of a network model for:

- the preparation of Infrastructure Master Plans; and
- the preparation of Priority Infrastructure Plans (and Plans for Trunk Infrastructure).

Network modelling shall be undertaken in accordance with SC6.4.3.23 Water and sewerage network modelling guidelines.

(iii) Levels of assessment

Depending on the type of works in question, simplified or detailed modelling may be required to demonstrate compliance with these guidelines. Simplified or detailed assessments are defined below:

(A) "Simplified Assessment" – an assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

(B) "Detailed Assessment" – an assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

SC6.4.3.23 Water and sewerage network modelling guidelines outline the process to be followed to obtain council advice as to what level of assessment is required.

(iv) Timeframes

Master planning shall be undertaken over a 30 year timeframe. The capacity of the existing network to service ultimate demand should be assessed and any system augmentations to service ultimate requirements identified. The staging of infrastructure works is an essential consideration and should be incorporated into the planning and design process. Staging of infrastructure works should be also considered at no greater than 10 year intervals until the ultimate horizon.

For developments being completed in less than a 5 year timeframe, network modelling shall be undertaken for existing case, and full development.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.

Net present value cost analysis should be undertaken using a range of interest rates (typically 3%, 5% and 7%), as well as the rate for weighted annual cost of capital (WACC) which can be sourced from council. Timeframes of 10, 20, and 30 years shall be applied.

Longer timeframes will enable assessment of the impacts of major replacement and upgrade works on the viability of the system. Council may require longer timeframes for analysis.

Cost assessments should only consider an engineering cost assessment, with loan interest and depreciation considered separately by council when considering a business case for a particular project. The following on-cost allowances should be made:

Establishment	2%
Project management/engineering design/council management costs	15%
Contingency	30%

(3) Bulk water storage and water treatment

(a) General

New bulk water storages and storage upgrades, new water treatment process design and upgrades are complex and site specific, and are typically undertaken as one-off projects and performed by experienced designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of specialist consultants suitable to carry out the project.

(b) Re-chlorination

At locations within the distribution system it may be necessary to re-chlorinate the water supply to maintain the free chlorine residual within the target range of 0.5 – 1.5 mg/L.

Re-chlorination stations should be located either at pump stations or at reservoir sites.

For safety, re-chlorination stations are to be fitted with appropriate signage and alarms to comply with

work, health and safety codes and requirements.

(4) Pump stations

(a) General

This section covers the design of:

(i) bulk water supply pump stations to service reservoirs; and

(ii) smaller booster pump stations to boost pressure in the distribution system. Booster pump stations should be avoided wherever practical by appropriate reticulation design, and will only be permitted with written approval by Townsville Water and Waste.

(b) Capacity and pump sizing

(i) Pump station capacity

Pump stations shall be sized to meet the system requirements for the planning horizon. Multiple pump units can be used to achieve the required pump duty.

(ii) Booster pump stations

Pump stations acting as reticulation boosters will supply the range of flow and head duties from Minimum Flow to Peak Hour conditions.

(iii) Hydraulic analysis

Hydraulic analysis is to be used to determine the flow and head requirements for the pump station.

(iv) Pump and rising main sizing

Pump size in combination with the delivery main size is to be designed to minimise whole of life costs covering capital, operating and maintenance costs.

(v) System resistance curves

System Resistance Curves covering all expected duties of the pumps, including maximum and minimum head cases shall be prepared. A net positive suction head available (NPSHA) curve shall also be prepared.

(vi) Pump selection

Pump selection shall achieve all expected duties as per the system resistance curves.

Redundant (standby) pump capacity shall be provided. Standby pump capacity shall be at least equal to the capacity of the largest pump unit.

(c) Building structure and general arrangement issues

(i) Materials

Pump stations shall be contained in above ground structures, constructed from reinforced masonry block and/or reinforced concrete walls with concrete or metal (Colourbond) roofs.

In undeveloped areas metal clad buildings may be acceptable subject to suitable compliance with noise emission requirements and adequate site security/vandalism restraint, and with approval from Townsville Water and Waste (See SC6.4.3.21 Attachment C).

(ii) Buildings general

(A) Permits – a development permit is required for building work (IDAS Form 2) for permanent pump station buildings.

(B) Location - pump station location and visual appearance shall be approved by Townsville Water and Waste, and shall generally complement the amenity of the local area. Pump stations in built-up areas should have appropriate external appearance to match the surrounds.

(C) Security – pump station shall be secure, and protected against vandalism, vermin and birds. Buildings shall be designed for Importance Level 3 (minimum) in accordance with the *Building Code of Australia* Table B1.2a as well as with designs shown in SC6.4.3.21 Attachment C.

(D) Level – pump station floor to be located a minimum of 300 mm above 1% AEP flood level,

be subject to a flood risk assessment, and shall be approved by Townsville Water and Waste.

(E) Noise management – pump stations shall be designed to comply with the relevant noise emission legislation, regulations and policies.

(F) Ventilation – ventilation or air-conditioning where required shall be provided as necessary to control heat from equipment within the building. Independent ventilation of chlorinator rooms shall be provided to meet work, health and safety requirements.

(G) Internal drainage – provision shall be made to drain leakage/flows from pumps/pipework away from the building without flooding of switchboards and electrical components.

(H) Safety – Pump station structures shall be designed in accordance with Safe Design of Structures – Code of Practice.

(iii) Structure sizing
Pump stations structures shall be sized to:

(A) provide adequate access around all pumps and associated pipework, generally 1 m minimum clearance and for maintenance access to pumps, pipework, valves etc.;

(B) house the pump station electrical switchboard and telemetry;

(C) house necessary cranage (see also (v);

(D) house chlorination systems (where required) – a separate room is generally required for chlorination systems, independently ventilated; and

(E) wherever practical the pump station structure shall be sized to accommodate the pumps and equipment necessary to achieve the proposed ultimate pump station capacity.

(iv) Site access
All weather sealed access for maintenance vehicles shall be provided, including:

(A) sealed asphalt access road, minimum pavement width 4 m;

(B) provide access during a minimum 1% AEP flood event; and subject to a flood risk assessment;

(C) on-site turn-around for maintenance vehicle; and

(D) road geometry suitable for use by light vehicles and single axle trucks.

(v) Lifting requirements
Design of the building shall enable the use of mobile cranes for lifting of pump units, motors and other equipment.

Where this is not possible, permanent cranage is to be provided within pump stations to allow maintenance of equipment, consisting of a minimum of a monorail crane accessing the pumps and motors. Set-down areas shall be provided:

(A) within the pump station adjacent to large maintenance doors where the area can be accessed externally by a crane truck; or

(B) externally by extending the monorail outside the building to allow loading onto the back of flat bed vehicle (bed height 1.2 m).

(d) Pipework

(i) Each pump shall be provided with suction and discharge isolation valves and a non-slam non-return valve on the pump discharge.

(ii) At least one easily removable piece of pipework is required on each pump to enable efficient removal and replacement.

(iii) Steps and walkways in accordance with AS1657 Fixed platforms, walkways, stairways and ladders - Design, construction and installation shall be provided over pipework such that access is readily available to both sides of each pump.

(e) Disinfection system

(i) Chlorine residual booster stations shall be provided when required.

(ii) Chlorine dosing will be by the use of sodium hypochlorite solution or chlorine gas. Dosing control (either flow paced, fixed rate or other) is to be approved by Townsville Water and Waste.

(iii) Sodium hypochlorite or chlorine gas storage and dosing equipment shall be housed in a separate room, independently ventilated. The chemical unloading, storage and dosing facility should comply with the handling and safety requirements for the chemical.

(iv) Chlorine dosing should be into the pump station discharge pipework.

(v) A safety shower and eyewash facility and appropriate signage is to be provided to meet work, health and safety requirements.

(f) Power supply and telemetry/instrumentation

(i) Power supply for the site shall be provided in accordance with the requirements of SC6.4.3.21.4.

(ii) Backup power is not normally provided within water pump stations. Where deemed necessary emergency power shall be provided in accordance with SC6.4.3.21.4.

(iii) Telemetry/instrumentation - All pump stations shall be provided with telemetry monitoring. Reticulation system booster pump stations typically are controlled to maintain a constant pressure at the pump station discharge. Pump stations are normally monitored but not controlled by the Telemetry system. Control of the pumps is performed locally.

(g) Land tenure

The required land tenure for a pump station site is council-owned freehold title.
The land tenure for access to the pump station in order of suitability is:

(i) public road; or

(ii) council-owned freehold land; or

(iii) water supply easement in the name of Townsville City Council.

(5) Storage reservoirs

(a) Scope

This section covers the design of water supply reservoirs, including the requirements for on-ground storages and elevated tanks on steel tank stands.

Refer to SC6.4.3.21.2(5)(c) for structural design of reservoirs.

Editor's note–Townsville Water's Program and Technical Support maintains a set of internally used Standard Drawings for Reservoirs, which can be made available on request.

(b) Site

(i) Location selection

Selection of reservoir site shall be approved by Townsville Water and Waste and shall consider the following:

(A) proximity to the area(s) to be served and length of mains necessary to supply into the reservoir and distribute to the service area;

(B) elevation of land to achieve required top water level (TWL) and bottom water level (BWL), and minimum operation level for the reservoir;

(C) environmental impacts, including visual impact;

(D) access to site;

(E) ability to achieve required land tenure;

(F) geotechnical issues;

(G) impacts on other services and infrastructure;

(H) landscaping of the site should be provided where necessary to minimise the visual impact of the facility; and

(I) where the reservoir is not readily accessible from a public road, particular attention to the

following criteria is required:

- vehicle access and site manoeuvrability;
- access road cross section and drainage; and
- width of land required for access road.

(ii) Visual appearance

The location and visual appearance shall complement the amenity of the local area.

If deemed necessary, a landscape architect shall be engaged to design fast growth plantings to provide a visual screen.

(c) Reservoir tank design

(i) Size and design life

The reservoir and associated inlet and outlet pipes shall be sized in accordance with the planning requirements of this section.

The reservoir design life shall be 80 years minimum.

(ii) General arrangement

Reservoirs shall be circular where possible to provide the most economic construction.

Foundations – the entire tank structure shall be founded on undisturbed parent material. Founding on fill material is not permitted.

The reservoir shall include, but not be limited to:

(A) steel floor, walls and roof support columns:

- a zincalume (or Colourbond Ultra) double sided coated roof on zincalume coated steel purlins (with down-turned lip on bottom flange) and beams;
- inlet and outlet pipework with valves;
- scour pipework with valve;
- overflow pipe;
- lockable access ladders (external only);
- fall arrest system for safe roof access in form of a permanent static line from roof access hatch platform to centre of reservoir;
- davit arm provision for vacuum cleaning by divers;
- telemetry control and monitoring;
- flow meter;
- level sensor;
- natural vermin proof roof ventilation; and
- telemetry control on inlet valve.

(B) all reservoirs shall be roofed and made vermin and bird proof. Drainage from the roof shall not enter the tank; and

(C) personnel access – access shall be provided into the reservoir:

- external access consisting of a galvanised steel ladder to AS 1657;
- lockable roof access opening minimum dimensions 1 m x 1 m;
- minimum one wall access hatches with sampling tap; and
- external accesses shall incorporate features to prevent use by unauthorised persons.

(iii) Materials

The following applies:

(A) the reservoir shall be constructed from plate steel;

(B) steel reservoirs shall be cathodically protected; and

(C) painting – the interior and exterior of the reservoir shall be painted with an approved epoxy paint system, approved for immersion in potable water supply. Colours will be advised by Townsville Water and Waste.

(iv) Pipework

The following applies:

(A) reservoirs shall be provided with separate inlet and outlet pipes, on opposite sides of the reservoir tank to achieve circulation. the inlet shall have a bend to facilitate circulation;

(B) a control valve shall be provided on the inlet pipework where specified by Townsville Water and Waste;

(C) a non-return valve shall be provided on the outlet pipework only where specified by Townsville Water and Waste;

(D) scours shall be sized to enable the reservoir to be completely drained from full within 24 hours. Scours are to be specified to stormwater; and

(E) an overflow capable of carrying the ultimate design inflow shall be provided, with connection to scour pipework.

(d) Geotechnical

Geotechnical investigations shall be undertaken for reservoir sites to ascertain sub-surface conditions for the tank design and for stability of batter slopes. Founding must be on undisturbed ground. Construction on fill is not permitted. The following must be taken into consideration:

(i) slope stability for the reservoir site;

(ii) site excavation;

(iii) stability of excavation batters; and

(iv) design parameters for the access road pavement.

(e) Security

Fencing is required around reservoir sides. Refer to SC6.4.3.21.5(4) for details.

(f) Telemetry/instrumentation

Minimum telemetry monitoring requirements for reservoirs should be reservoir level by submersible pressure transducer.

(g) Land tenure

The required land tenure for reservoir sites is council-owned freehold title.

The land tenure for access to the reservoir site in order of suitability is:

(i) public road; or

(ii) council-owned freehold land; or

(iii) reserve for water supply purposes; or

(iv) water supply easement in the name of Townsville City Council.

(6) Water mains

(a) General

(i) Scope

This section covers the design of distribution and water supply reticulation mains:

(A) distribution mains – provide for the transfer of bulk water between treatment and storages infrastructure within the water supply network; and

(B) reticulation mains – provided for supply from the bulk water system to consumers through the reticulation network.

(ii) Extent

Mains shall be provided to service all properties within the development and where relevant also include bulk mains to service the declared water service area.

(b) Water main sizing

(i) Demands

Mains shall be sized to meet demands (including fire flows).

(ii) Network modelling and whole of life costs

Where specified by Townsville Water and Waste, appropriate network modelling shall be

undertaken to determine mains sizes within the development.
Where distribution mains are pumped, the main size is to be determined in conjunction with the pump size to minimise whole of life costs for the system including capital, operating and maintenance costs.

(c) Mains layouts and general arrangements

(i) Configuration

(A) Distribution mains shall comply with the following:

- configuration and extent of the main is to be determined to suit the requirements of the ultimate development to the approval of Townsville Water and Waste; and
- connections to reticulation mains network and consumers are not permitted, unless required under the project and approved by Townsville Water and Waste.

(B) Water reticulation mains layout shall comply with the following requirements:

- water mains are required down both sides of roads where service connections are provided. Cross-road service connections are not permitted, except in the Rural residential zone where a main on one side of the roadway is acceptable;
- Low density residential zone and Character residential zone streets shall have a minimum of DN 100 (with fire hydrants) on one side of the street and a minimum of DN 63 PE service main on the other;
- water mains (DN100 minimum with fire hydrants) are to be provided on both sides of the road in the cases of divided carriageways, centre, industrial, and medium or high density residential zones. In centre, industrial or high-rise building areas, one of the mains in the street shall be DN150 minimum; and
- permanent dead end mains are not permitted.

(ii) Temporary dead ends are not permitted for more than 12 month defect liability period, temporary loops are to be installed prior to end of defect liability period. Temporary ends/loops are to be design to allow for future connection without shutdown to existing residents, which may include in-line thrust block, valve and FH.

The location for water mains in order of preference is in:

(A) council controlled roads; or

(B) main roads controlled by State or Federal Governments; or

(C) reserves and unallocated state land; or

(D) council owned freehold land; or

(E) easements in privately owned freehold land.

Distribution mains alignment shall be as follows:

- the alignment of distribution mains is to be resolved with the appropriate control authority for the road, land or easement, and approved by Townsville Water and Waste.

Reticulation mains alignment shall be as follows:

- the alignment within a road reserve shall be in accordance with SC6.4.4.8 Standard drawings SD-015 Verge Service Corridors, General Type, Sections.

(iii) Cover requirements

Cover requirements shall comply with WSA 03 (Section 5.4.2) plus:

(A) distribution mains – minimum cover is to provide for the structural integrity of the pipe, meet the requirements of the appropriate control authority for the road, land or easement; and

(B) reticulation mains:

- minimum pipeline cover requirements for water mains shall be in accordance with standard drawing SD-325 Embedment and Trench Fill, Typical Arrangement; and
- maximum cover for maintenance purposes – 1.5 m.

(iv) Services and alignments

Consideration is to be given to other services in the area when selecting alignments.

Refer to WSA 03 Table 5.5 and SC6.4.4.8 for minimum clearance requirements from other services.

Minimum clearance requirements and/or conditions may be imposed by the service owner. Specific conditions apply to construction near services including:

(A) fibre optic cables;

(B) high pressure gas or oil mains;

(C) underground power; and

(D) overhead power - consider overhead power when selecting pipeline alignments for:

- safety and clearance issues with construction under or near overhead power lines; and
- the designer should avoid locating continuously welded steel pipelines in parallel to high voltage power lines (WSA 03, Section 5.4.12).

(v) Shared trenches

Shared trenching of water mains with other services will not be permitted without approval from Townsville Water and Waste.

(vi) Easements

Easements shall be taken over water mains constructed in private property.

The easement width shall be a minimum 3 m. For >DN375 mains, easement width shall be approved by Townsville Water and Waste.

Easement corridor widths shall be suitable to accommodate all water mains for the ultimate development, and approved by Townsville Water and Waste.

(d) Pipe

(i) Materials

Allowable pipe materials include:

(A) PVC-U, PVC-O, PVC-M (OD compatible with DICL fittings);

(B) ductile iron cement lined (DICL);

(C) mild steel cement lined (MSCL);

(D) ABS;

(E) polyethylene (PE);

(F) copper; and

(G) stainless steel.

Pipeline materials shall be in accordance with WSA 03.
Pipe shall be minimum pressure class of PN16 for all pipe sizes.

(ii) Pipe design

Pipeline material structural design shall be undertaken in accordance with WSA 03 for all internal and external loads applied to the pipeline.
The “PN” rating shall be selected to suit the pipeline design pressures.

In selecting the PN rating for plastic pipes, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer to WSA 03*).*

(iii) Pipe jointing

Pipelines should generally be rubber ring jointed. Mild steel cement lined pipes will normally be rubber ring jointed unless there are specific reasons for installation of continuously welded pipe segments. PE pipe shall be connected by butt thermal fusion or by electrofusion couplings. Up to 50 mm ID PE pipe may use compression fitting connections.

The following applies for flanged Joints:

(A) Flanged pipework shall be used where necessary at connections, to transfer thrust, or provide beam action for the pipeline to span;

(B) Flange classes shall be selected to suit the pipeline design pressures; and

(C) Flange classes shall be to AS/NZS 4087 *Metallic flanges for waterworks purposes* except where connecting to existing flanges from a different standard. Minimum flange classes shall be:

- Class 14 for Steel Cast Iron; and
- Class 16 for DICL.

(iv) Pipe anchorage

Water mains with unrestrained flexible joints shall be designed to resist the total unbalanced thrust and transmit all thrust loads to the adjacent native soil or rock.

Pipe anchorage and thrust blocks shall be provided in accordance with WSA 03.

Alternatively, TYTON-LOK joints or similar may be approved by Townsville Water and Waste in special circumstances. Marker tape shall be provided above the pipe to clearly show the extent of the restrained jointing.

(v) Concrete encasement

Concrete encasement of pressure mains is not permitted without written approval of Townsville Water and Waste.

(vi) Above ground water mains

Above ground construction is to be approved by Townsville Water and Waste.

Where a section of water main is to be laid above ground, the pipe materials, support and restraint for the pipes and fittings shall be in accordance with WSA 03, and the pipe manufacturer's recommendations.

(vii) Cathodic protection

Cathodic protection (CP) for steel mains laid through corrosive environments may be required if specified by Townsville Water and Waste.

CP shall be designed by an experienced specialist in accordance with WSA 03.

(viii) Pipe bedding

Pipe bedding for water mains shall be in accordance with WSA 03.

(ix) Restoration

Refer to WSA 03 for construction specification.
For restoration under roadways refer to standard drawing SD-055 Road Crossing and Footpath Reinstatement for Trench Laid Services.

(x) Geotechnical

Geotechnical matters shall be considered in accordance with WSA 03.

(xi) Trenchless construction

Where specified by other infrastructure owners or Townsville Water and Waste, trenchless construction methods may be required. Circumstances requiring trenchless construction methods may include:

(A) crossing of major roads;

(B) where the land controller specifies (e.g. rail and main roads); and

(C) crossing environmentally sensitive areas.

The designer is to provide the details of trenchless construction techniques proposed.
QR National requires compliance with their Specification: *MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services)*. Common forms of trenchless pipeline construction include:

- pipe jacking;
- horizontal direction drilling; and
- micro tunnelling.

The designer shall identify where trenchless construction techniques are necessary or economical during the design process.

(xii) Road and rail crossings of existing pipes

Road crossings for existing above ground pipes shall comply with the requirements of the standard road crossing drawing provided in SC6.4.3.21 Attachment B. Rail crossings will be designed on a case by case basis.

For existing underground pipes where road/rail upgrades or new roads/rails are proposed protection or relocation may be required. Concrete encasement may be approved on a case by case basis, preference however is for envelopers. This often is required at major road crossings, at rail crossings and sometimes at waterway crossings. Enveloper designs for road and rail crossings shall be undertaken in accordance with the Land Corridor controller's requirements. Where no specific requirements are provided refer to the standard drawings of WSA 03 and Townsville Water and Waste for further details.

The void between enveloper and carrier pipe shall be grouted at each end using low strength grout on completion of the pipe installation unless other arrangements are required by the Land Corridor controller.

(xiii) Disinfection

The designer shall specify the disinfection of all water mains after satisfactory testing in accordance with *WSA 03*.

(xiv) Pipeline drawings

Drawings shall include a Plan (1:500) for all mains, and Longitudinal Sections (1:1000 (H); 1:100(V)) for mains DN200 or greater.

(e) Pipeline appurtenances

(i) Hydrants

Hydrants shall be located such that:

(A) existing and future development lots are or will be within 40 m of the nearest hydrant;

(B) the spacing between hydrants does not exceed 80 m;

(C) hydrants are also provided at all high and low points of distribution mains and at (temporary) dead ends; and

(D) hydrants shall be located in accordance with SC6.4.4.8 Standard drawings SD-305 Street Positioning of Mains, Valves, Hydrants and Domestic Water Service connections and SD-355 Typical Valve and Hydrant Installation – Hydrants and Air relief Valves.

Hydrants may not be located within 10m of pole/pad mounted transformer.

Hydrants located within mixed commercial/residential zones must be installed on a tee with a valve to allow maintenance of hydrant without shutdown of the water main.

(ii) Stop valves

The following applies:

(A) stop valves for reticulation shall be provided in accordance with the requirements of WSA 03;

(B) stop valves shall be provided so that a maximum of ten dwellings are isolated for maintenance purposes, and a maximum of four valves to be closed to isolate any section of reticulation main (maximum of one block to be shutdown within the ten dwellings);

(C) valves shall be located to avoid conflicts with driveways, telephone house service pits, and underground electrical boxes;

(D) stop valves shall be anti-clockwise closing;

(E) maximum of 200m between valves; and

(F) stop valves are to be located on either side of a road crossing.

(iii) Valve and hydrant installation

Valve and hydrant installation shall be in accordance with the following standard drawings:

(A) SD-305 Street Positioning of Mains, Valves, Hydrants and Domestic Service Connections;

(B) SD-345 Valve and Hydrant Identification – Identification Markers and Marker Posts;

(C) SD-350 Typical Valve and Hydrant Installation – Valve Arrangement; and

(D) SD-355 Typical Valve and Hydrant Installation – Hydrants and Air Relief Valves.

(iv) Air valves

Air valves are to be provided at high points in distribution water mains. It is not normal practice to provide air valves in reticulation mains as air can be exhausted through hydrants and property connections.

Air valves shall be designed in accordance with WSA 03 and SC6.4.4.8 Standard drawings SD-355 Typical Valve and Hydrant Installation – Hydrants and Air Relief Valves.

(v) Scours

Scours shall be provided at low points in distribution mains and larger reticulation mains for maintenance purposes.

Scours are not normally provided in smaller reticulation systems. This function is performed using hydrants.

Scour design will be in accordance with WSA 03 and SC6.4.4.8 Standard drawings SD-360 Typical Appurtenance Installation – Scour Arrangement.

(vi) Pressure and flow control devices

The detailed design of a water reticulation system shall identify the need for pressure and flow control devices.

The designer shall specify, for ease of valve maintenance, fittings located within concrete valve chambers. Valve types shall be selected such that, wherever possible, servicing of the valve can be effected without its removal.

Pressure and flow control valve design shall be in accordance with WSA 03.

The designer is to refer to WSA 03 for detailing requirements for valves chambers.

(vii) Envelopers

Enveloper pipes shall be used where necessary, and as required by Townsville Water and Waste.

Enveloper designs for road and rail crossing shall be performed in accordance with the land corridor controller's requirements. Where no specific requirements are provided, refer to the standard drawings of WSA 03.

QR National requires compliance with their Specification: *MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services)*.
Suitable casing spacers/insulators shall be fitted to the pipe to ensure adequate spacing from the enveloper. The void at each end between enveloper and carrier pipe shall be grouted on completion of the pipe installation in accordance with SC6.4.4.8 Standard drawings SD-376 Buried crossings, Bored and jacked encasing detail.

(7) Property connections

(a) General

In most circumstances property service connections are not provided by the developer as part of the development, but are installed by Townsville Water and Waste on application from the property owner. Where small and/or narrow lots are created, and there is only one option for service connection location; or council has agreed to service connections within the road reserve or under concrete footpaths or driveways, they must be provided by the developer and located within a valve box to protect the service and to provide easy access.

(b) Property service mains

The following applies:

(i) distribution mains – Property connections from distribution mains are not permitted; and

(ii) reticulation mains – Property connections not permitted from reticulation mains > DN225. A smaller service main shall be provided for property service connections where necessary.

(c) Sub-metering

Sub-metering shall be in accordance with WSA 10 and subject to Townsville Water and Waste approval.

Point of supply for properties with sub-meters will be the master meter. Any equipment between the master and sub-meters is the responsibility of the property owner.

SC6.4.3.21.3 Sewerage system design

(1) Introduction

(a) Scope

The work to be undertaken in SC6.4.3.21.3 includes the design of a sewerage system either as a stand-alone project of as part of a development.

(i) Inclusions

SC6.4.3.21.3 covers the design of:

(A) property connections;

(B) gravity sewers;

(C) sewage pump stations;

(D) pressure mains; and

(E) reuse systems.

(ii) Exclusions

SC6.4.3.21.3 does not cover requirements for sewage treatment plant design considerations. Bulk sewerage infrastructure will be planned and designed by Townsville Water and Waste in conjunction with experienced specialist consultants.

(b) Documents

(i) Reference and source documents

This section is to be read in conjunction with the current version of the following documents.
Department of Energy and Water Supply *Planning Guidelines for Water Supply and Sewerage (*DEWS Guidelines*)*
Department of Energy and Water Supply, *Water Quality Guidelines for Recycled Water Schemes,* November 2008
National Water Quality Management Strategy, *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1),* 2006
National Water Quality Management Strategy, *Australian Guidelines for Water Recycling: Treated sewage and stormwater to augment drinking water (Phase 2)* 2008
Public Health Regulation 2005
Workplace Health and Safety Queensland, *Safe Design of Structures – Code of Practice*
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Supply Code of Australia* (as referenced by WSA 02)
WSA 04 *Sewerage Pumping Station Code of Australia*
WSA 07 *Pressure Sewerage Code of Australia*

(ii) Document precedence

The order of precedence of documents shall be:

(A) SC6.4.4.8 Standard drawings;

(B) this sub-section;

(C) All WSA codes; and

(D) DEWS Guidelines.

(c) Standard drawings

SC6.4.4.8 Standard drawings shall be read in conjunction with this sub-section. Standard drawings other than water and sewerage (such as road crossings) also contain information on water and sewerage infrastructure shall also be referred to.

(i) Amendments to WSA 02

The design of sewerage systems shall comply with *WSA 02 Sewerage Code of Australia* unless otherwise specified herein, and shall be constructed in accordance with *WSA 02 Sewerage Code of Australia Construction Specification*.

Amendments required by Townsville Water and Waste to WSA 02:2014 are included in Table SC6.4.3.21.5. Any conflicting information in later codes shall be referred to Townsville Water and Waste for clarification.

Table SC6.4.3.21.5 Amendments to WSA 02:2014 Sewerage Code of Australia and WSA 04:2005 Sewage Pump Station Code

WSA 02 Section	**Amendments to WSA 02 – Sewerage Code of Australia:**
2.3	A sewerage Master Plan is to be submitted by the Developer for approval at the discretion of Townsville Water and Waste.
2.4.2	Townsville Water and Waste requirement is ADWF of 230 L/EP/day.
5.2.8	Easements over gravity sewers are not required in Queensland. Easements over pressure sewers may be required in certain situations. Refer to Townsville Water and Waste.
Table 7.6.5	Maximum of four internal drops into a manhole.
7.0	Maintenance Structures (Manholes (MH), maintenance holes, maintenance chambers) required at a maximum spacing of 90 m (industrial zones 40m). Maintenance Shafts (MS and TMS), are not permitted except those approved by Townsville Water and Waste.
6.4.2	Multiple property connections (i.e. combine house drains) are not lawful in Queensland
7.6.9	Ladders, step irons and landings are not permitted.
8.2	Water seals are not permitted.
8.6	Inverted Siphons are not permitted.
8.9	Wet weather storage is not required, as it is impractical in tropical conditions. However, it may be considered upon written application to Townsville Water and Waste.
4.6.2	PVC Sewer Pipe – minimum SN10 for DN100 and SN8 for other sizes is required.
Construction Section	*Internal Epoxy Coating of Manholes – normally only required at Pressure Main receiving manholes.*
Construction Section	*Pipe embedment and support – For flexible pipes refer to AS2566.2 Tables G1, G2 and G3 for suitable material types.*
Appendix B	*Estimation of EP Flows – Townsville Water and Waste's alternative method is to apply EP densities from Townsville City Council Headworks Policy (* EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of the Townsville City Plan)
Appendix C	*Refer to comments above.*
General	Townsville Water and Waste's preference is to convey sewage by gravity systems only. Therefore, Townsville Water and Waste's written approval is required for a Pumping Station proposal, and its particular requirements including current electrical and telemetry standards, overflow and emergency arrangements, and compliance with Townsville Water and Waste's current Licence conditions.
WSA 04 Section	**Amendments to WSA 04-2005, Sewage Pump Station Code**
9.1.2	Minimum size of discharge pipework is DN100.
10.5.4	In selecting the PN rating, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer WSA 03 Planning and Design).
WSA Drawing	**Comments/Amendments to WSA Drawings**
All	These drawings shall be read in conjunction with SC6.4.4.8 Standard drawings: Where there is a conflict, the standard drawings take precedence.

(2) Sewage collection system planning

(a) Scope

Sewage collection system planning covers the requirements of the sewage collection system from service connection to treatment facility. This includes collection sewers, trunk sewers, pump stations and pressure mains.

(b) Hydraulic loading assessment

(i) General

Hydraulic loading shall be determined for all catchments being assessed. Loadings shall be determined in terms of equivalent persons (EP) and developed into flows using the unit loading factors and peaking factors detailed in the following sections.

(ii) Equivalent population estimations

The ultimate equivalent population (EP) used to determine design flows shall be determined from the following:

(A) designated value of EP per hectare for each zone type provided in Section 4.2.11 of Part 4 of Townsville City Plan;

(B) the location of various zone types as specified in Townsville City Plan;

(C) an assessment of the ultimate population, including the expected peak occupancy rates and the quantity of undeveloped land for each zone type listed in Townsville City Plan; and

(D) estimation of contributing loads for “Special Purpose” zonings (university, refineries, hospitals, etc.) shall be determined by analysis of historic consumption and consultation with the institution regarding future development.

Where staging of the works is necessary, the planner is to consider the expected growth rate for the area to develop loadings for intermediate planning horizons. This shall be based on the Townsville City Council Growth Model which is available from the Infrastructure Planning Unit. This model is based on population projection information available from the Planning Information Forecasting Unit (PIFU), Office of Economic and Statistical Research within the Queensland Government, Department of Treasury and Trade.

(iii) Design flows

The flow in a sewer comprises domestic sewage, industrial wastes, groundwater infiltration, stormwater inflows and rainfall dependent infiltration.
Design sewage flow shall be calculated in accordance with WSA 02 with the following amendments:

Design Flow(PWWF)	=5 * ADWF
	PDWF = C2 x ADWF
Where	ADWF = Average Dry Weather Flow = 230L/EP/day; PDWF = Peak Dry Weather Flow
	$C2=4.7 \times (EP)^{-0.105}$

(iv) Sewage pump station design flows

Design flows for sewage pumps stations shall be determined in accordance with SC6.4.3.23 Water and sewer network modelling guidelines.

(c) Network planning

(i) Purpose

The purpose of network planning is to determine the most effective means of providing a service to an area through analysis of both infrastructure and non-infrastructure based solutions. The determination of the most effective solution should be made through analysis of whole of life costs and consideration of non-financial aspects such as operations, maintenance, and environmental obligations.

Section 6.4.3.21.3 (2)(c)(ii) Network modelling details the circumstances under which a network plan should be prepared.

When preparing planning reports for both water and sewerage assets, the author shall refer to Section 6 of the DEWS *Planning Guidelines for Water and Sewerage.*

(ii) Network modelling

A sewer network model is required for code and impact assessable material change of use (MCU) and reconfiguring a lot (RoL) applications where:

(A) the proposed land use results in an increase in load greater than what is presently allowed for in the planning scheme; or

(B) the development requires trunk infrastructure identified in council's Plans for Trunk Infrastructure to be constructed ahead of its planned date, or out of sequence identified in master planning;or

(C) the development requires the construction of new trunk infrastructure not already identified on council's Plans for Trunk Infrastructure; or

(D) existing sewer infrastructure is required to be relocated as part of the development, and such relocation may impact the hydraulics or operational functionality of the system. End of line works are excluded from this requirement.

TCC also requires the development of a network model for:

- the preparation of Infrastructure Master Plans; and
- the preparation of Priority Infrastructure Plans (and Plans for Trunk Infrastructure).

Network modelling shall be undertaken in accordance with SC6.4.3.23 Water and sewer network modelling guidelines.

(iii) Levels of assessment

Depending on the type of works in question, simplified or detailed modelling may be required to demonstrate compliance with these guidelines. Simplified or Detailed assessments are defined below:

(A) "Simplified assessment" – an assessment that demonstrates network capacity through manual calculations, or through the use of simplified network models (schematic style models); and

(B) "Detailed assessment" – an assessment involving the preparation of detailed network models based on proposed design and/or development layouts.

SC6.4.3.23 Water and sewer network modelling guidelines outline the process to be followed to obtain council advice as to what level of assessment is required.

(iv) Timeframes

Master Planning shall be undertaken over a 30 year timeframe. The capacity of the existing network to service ultimate demand should be assessed and any system augmentations to service ultimate requirements identified. The staging of infrastructure works is an essential consideration and should be incorporated into the planning and design process. Staging of infrastructure works should be also considered at no greater than 10 year intervals until the ultimate horizon.

Council may request that master planning consider provision to adjacent developments to enable an efficient trunk network.
For developments being completed over a shorter timeframe, network modelling shall be undertaken for existing case, full development.

Net present value cost analysis should be undertaken using a range of interest rates (typically 3%, 5% and 7%), as well as the rate for weighted annual cost of capital (WACC) which can be sourced from council. Timeframes of 10, 20, and 30 years shall be applied. Longer timeframes will enable assessment of the impacts of major replacement and upgrade works on the viability of the system.

Council may require longer timeframes for analysis.

Cost assessments should only consider an engineering cost assessment, with loan interest and depreciation considered separately by council when considering a business case for a particular project. The following on-cost allowances should be made:

Establishment	2%
Project Management/Engineering Design/Council Management Costs	15%
Contingency	30%

(d) Sewerage systems

(i) General

Where possible the sewer system shall be designed to use gravity to convey the sewage.

Proposals for systems including pumping stations and rising mains require Townsville Water and Waste's written approval, including particular requirements for current electrical and telemetry standards, overflow and emergency arrangements, and compliance with Townsville Water and Waste's current Licence conditions. Undulating terrain or other economic considerations may preclude the viability of a purely gravitational system.

As such, Townsville Water and Waste may opt for sewage pumping stations and pressure mains to transport wastewater into an adjacent catchment or direct to the WWTP and will be at the approval of Townsville Water and Waste.

(ii) Alternative sewer systems

Alternative sewer systems (e.g. common effluent drains, vacuum sewerage, pressure sewer systems, etc.) will only be considered with an analysis showing the benefits of such systems using a triple bottom line approach, and require Townsville Water and Waste's written approval.

(iii) Sewers

Sewer layouts, pipe sizing and grading shall be determined in accordance with WSA 02, unless detailed elsewhere in this guideline.

(iv) Sewage pump stations and pressure mains

Sewage pump stations are to be provided where gravity systems cannot be utilised or sewers become uneconomically deep (usually > 5m).
Sewage pump stations are to be provided where approved in writing by Townsville Water and Waste.

Pump stations shall be planned and designed to optimise construction, operation and maintenance costs for the total-life cycle of the infrastructure and equipment. This shall include the pump station along with the discharge pressure main.

Pump station and pressure main planning shall be undertaken in accordance with WSA 02 and WSA 04 and as amended by this guideline. Unless detailed elsewhere in this guideline.

(3) Property connections

(a) Scope

SC6.4.3.21.3(3) covers the design of property connection sewers (PCS).

(b) Location

Location of property connection points shall generally be in accordance with WSA 02 and the following constraints:

(i) to connect directly to maintenance holes where possible Industrial/Commercial properties connections must be to maintenance holes;

(ii) the property connection jump-up must be 1.5 m from the property boundary, unless council has agreed to the service connection being located within the road reserve, in which case the jump up must be located within a valve box that is easily identifiable and located for access and maintenance;

(iii) combined sanitary (house) drains are not permitted; and

(iv) dual connections to a single jump-up are not permitted permitted and no property connections are allowed to trunk mains.

(c) Maximum depth

The depth at the property connection shall not exceed 1.5 m.
Property connections shall not be made into sewers >3 m deep. In cases of deep sewers private connections must be
MHs or construct a shallow sewer.

(d) Type

Property connections shall be buried interface method in accordance with WSA 02 (Type 2 and 4 Appendix H).
Water Seals on property connections are not permitted.

(e) Size

Minimum size shall be DN100.

(residential) or DN150
(commercial/industrial).

(f) Length

The maximum length of property connection sewers shall be:

(i) DN100 – 10 m

(4) Gravity sewer design

(a) Scope

SC6.4.3.21(4) covers the design of gravity sewers.

(b) Sewer layout

(i) Extent

Sewer layouts shall be prepared to demonstrate drainage of the specified catchment, including the "most disadvantaged lot".

The sewer configuration is to be developed to minimise the overall length of sewers.

Sewers are to be designed to control the whole of the area of each allotment being sewered, except in industrial areas where a lesser area of control can apply if approved by Townsville Water and Waste.

Sewers are to be extended to the boundaries of the site to serve existing lots and potential upstream development sites where specified by Townsville Water and Waste.

(ii) Configuration

The sewers shall comply with the following additional requirements:

(A) be a minimum of DN150 (except property connections);

(B) located at the rear of allotments, except

- in areas where safe work area for staff and equipment, including access from the road frontage to the infrastructure (in particular the maintenance structures) cannot be achieved, sewers may be located in the front clearance area of the lot.
- in small and narrow lots where the alignment is within the road reserve at an alignment agreed to by council and in accordance with the considerations in WSA02
- in industrial and commercial developments where the alignment is within the property 1.5 m back from street frontage; and

(C) alignment is 1.5 m from property boundary. Environmental considerations are must be taken into account when selecting sewer alignments.

The designer must refer to WSA 02 for additional considerations such as alignment with road reserves and pathways. Sewers in road reserves are only permitted when:

- environmental considerations preclude alignments within the properties; and
- approved by Townsville Water and Waste.

(c) Sewers

(i) Sewer loading

Sewer loading shall be determined in accordance with this sub-section.

(ii) Sizing and grading

Sewers shall be sized to carry the design flow with the depth of flow no greater than 70% of internal diameter for initial and any future conditions (WSA 02).

The design flow shall be calculated by the method nominated in this sub-section.

Refer to WSA 02 for minimum sewer sizes and grades to meet required pipe capacities.

(iii) Minimum cover and services clearance requirements

Refer to WSA 02 for minimum cover requirements over sewer mains and requirements for minimum clearance from other services.

(iv) Above ground sewers

The following applies:

(A) above ground sewers are to be avoided where possible;

(B) above ground sewers are to be constructed from DICL or MSCL pipe unless otherwise approved by Townsville Water and Waste; and

(C) the designer of an above ground sewer shall take into account the considerations listed in WSA 02.

(v) Pipe material

The following applies:

(A) pipeline materials shall be in accordance with WSA 02;

(B) PVC pipe shall be a minimum of SN10 for DN100 and SN8 for other sizes;

(C) DICL and MSCL sewers shall be Cement Mortar Lined

(D) FRC and concrete pipes are not permitted; and

(vi) Pipe jointing

Pipelines shall be rubber ring jointed or butt welded in the case of PE pipe.
If flanged pipe is required, minimum flange classes shall be AS4087 Class 14 for Steel pipes and Class 16 for DICL.

(vii) Concrete encasement

Concrete encasement of sewers is not permitted except with the approval of Townsville Water and Waste.

(d) Maintenance structures

(i) Maintenance holes

The design and location of maintenance structures shall be in accordance with *WSA 02.*
Requirements include:

(A) maximum spacing between MHs is 90 m;

(B) a MH is required at the end of all sewers (except PCS see *WSA 02*);

(C) MHs are to be provided at all sewer changes of directions or grade;

(D) MHs on sewers within industrial subdivisions are to be either at 40 m maximum centres or on every second property;

(E) MH may have up to 4 internal drops;

(F) the top of a standard MH must be 150 mm higher than the finished surface level or known flood level (100 year ARI);

(G) MHs may be constructed from pre-cast concrete or cast in-situ concrete;

(H) full depth cylindrical MHs shall be used in lieu of a taper tops;

(I) step irons, ladders or landings are not permitted within MHs for safety considerations; and

(J) internal epoxy coating of MHs is not normally required (except at pressure main receiving MHs).

(ii) Maintenance chamber

(A) Maintenance chamber will only be permitted with the approval of Townsville Water and Waste.

(B) The use of terminal maintenance chamber will not be approved. Maintenance Shafts (as per WSA02-2014) will not be permitted.

(iii) Pressure main discharge maintenance hole

(A) Pressure main discharge MHs shall be in accordance with SC6.4.4.8 Standard drawings SD440A Pressure Main Discharge to Manhole.

(B) Discharge MHs shall be internally epoxy coated.

(C) Discharge MHs shall be vented in accordance with SC6.4.4.8 Standard drawings SD-450 Vents at Sewerage Rising Main Receiving Inspection Chambers and Pump Stations.

(e) Pipe bedding

Pipe bedding for sewers shall be in accordance with WSA 02.
For flexible pipes refer to AS 2566.2 *Buried flexible pipelines - Installation*, Table G1, G2 and G3 for suitable material types.

(f) Restoration

Refer to WSA 02 for construction specification.
For restoration under roadways refer to SC6.4.4.8 Standard drawings SD-055. For state controlled road restoration should be design and constructed in accordance with their standards and requirements.

(g) Geotechnical

For geotechnical matters that should be considered refer to WSA 02.

(h) Envelopers

Enveloper pipes shall be used where necessary at major road crossings, at rail crossing and at major waterway crossings.

Enveloper designs for road and rail crossing are to be undertaken in accordance with the requirements of the Land Corridor controller's requirements. Where no specific requirements are provided refer to the standard drawings of WSA 02.

QR National requires compliance with their specification: MCE-SR-16 Requirements for Services under the Railway Corridor (Non-QR Services).

Suitable casing spacers/insulators shall be fitted to the pipe to ensure adequate spacing from the enveloper. At each end of the void between enveloper and carrier pipe is to be grouted on completion of the pipe installation.

(i) Land tenure

Easements are not required over gravity sewers.

(j) Emergency relief structures

All pumped catchments shall be provided with an "Emergency Relief Structure" in accordance with SC6.4.4.8 Standard drawing SD-445 Overflow Maintenance Hole Arrangement.

(k) Inverted syphons or water seals

Inverted syphons or water seals are not permitted.

(l) Colour coding pipes

Where sewer pipes are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipe the designer shall provide for the pipes to be colour coded (in accordance with WSA02 Table 4.1) and shown on the drawings accordingly.

(5) Sewage pump station design

(a) Scope

This section covers the design of sewage pump stations within the sewerage collection system, and also incorporates the requirements for the sizing of sewage pressure mains.

(b) Pump station design

(i) Pump station types

(A) Type 1 - Low lift pump stations
Low lift pump stations are characterised by short pressure mains with the ability of sewage to overflow into the downstream sewer;

(B) Type 2 - Small submersible pump stations (up to 30 L/s)
Small submersible pump stations consist of a single circular 1.8 - 2.3 m diameter wet well containing two submersible pump units;

(C) Type 3 – Medium size submersible pump stations (30 L/s to 200 L/s)
Medium size pump stations consist of a submersible type pump station with total pumping capacity of up to 200 L/s. They may consist of one single large diameter pump well housing multiple pumps or multiple smaller diameter wells housing individual or multiple pumps; and

(D) Type 4 – Large pump stations (>200 L/s)
Large pump stations are the major pump stations often delivering to the sewage treatment works. These stations may be wet well or wet/dry well configuration.

(ii) Design guidance

The *WSA 04 Sewerage Pump Station Code* and DEWS Guidelines shall be consulted in conjunction with this sub-section for Pump Stations Types 1, 2 and 3. These guidelines are based on twin pump submersible configurations in a duty/stand-by arrangement.

Type 4 pump stations require specialist input and shall be designed by experienced pump station design engineers.

Pump stations shall be designed to comply with the Code of Environmental Compliance, ERA 63(3) - Sewage Treatment (EHP) as applicable.

However refer to Townsville Water and Waste for the latest agreement with EHP for this guideline as some sections are not regarded as appropriate.

(iii) Importance level

Buildings shall be designed for Importance Level 3 (minimum) in accordance with the *Building Code of Australia* Table B1.2a.

(c) Pump system design

(i) General

The design of the pressure main and pump station should be considered together.

Pump system design requires the consideration of the interaction of the pump station and pressure main. The design principle is to determine the whole-of-life least cost solution for the pump station and pressure main considering both initial construction costs and on-going operating costs.

The sewage pressure main system within Townsville City consists of two general configurations:

(A) pressure mains that discharge into gravity systems or other sewerage pump stations; and

(B) pressure mains that connect into combined pressure main systems from a collection of pump stations.

The major sewage transport systems within Townsville City are characterised by combined pressure mains. The combined pressure main systems tend to consist of a major trunk pressure main with individual pump stations mains delivering to the trunk main through separate pressure mains up to several kilometres in length.

These combined systems can result in very significant variations in the operating head requirements of the pump depending upon the instantaneous flows from other stations within the combined system.

To service the wide variation in pressure head requirements for the differing conditions it may be

necessary to have several different capacity pumps to cover all conditions.

(ii) Design loading

Design loading for the pump station shall be determined in accordance with this sub-section.

(iii) Design flow

The design flow for the pump station shall be determined for both dry weather and wet weather (peak flow) conditions.

Dry weather flow:

(A) peak dry weather flow (PDWF) shall be based on 2*ADWF unless better information is available.

Wet weather flow:

(B) the peak wet weather flow factor (PWWFF) is defined by:

Peak wet weather flow (PWWF) = PWWFF * ADWF.

The PWWFF shall be determined based on an analysis of the existing pump station flows but in no case should PWWFF be less than 5.

(iv) Pump and pressure main sizing

Pump units shall be sized for the full range of operating conditions that the pump delivery system will be exposed to. This includes initial and long term operational conditions.

Pump units and pressure main sizing shall be:

- optimised for normal ADWF conditions; and
- be capable of performing under PWWF conditions.

For Type 2, 3 and 4 pump stations it may be necessary to provide for each duty.

Pump and pressure main sizing shall be performed in accordance with WSA 04 with the following additional conditions:

(A) a minimum of two pumps shall be provided in a duty/standby arrangement;

(B) pump stations may utilise all pumps within the station to achieve PWWF;

(C) if different size pump units are provided within the station, an environmental assessment shall be performed on the consequences of overflow to determine if a redundant (standby) unit is required for the large pump, and is subject to written approval from Townsville Water and Waste. If the consequences are acceptable Type 2 and 3 pump stations may use a single pump unit for PDWF and a single pump unit for PWWF conditions; and

(D) pumps are able to operate within their safe operating range under all conditions. VSD, high speed and grinder types may be considered, subject to written approval from Townsville Water and Waste.

Pump size in combination with the delivery main size is to be designed to minimise whole of life costs covering capital, operating and maintenance costs.

(v) System resistance

System resistance curves shall be developed for the pump station covering the full range of pump operating conditions. System curves shall be developed in accordance with WSA 04 with the following additional requirements:

(A) separate system curve bounds are to be developed for PDWF conditions and PWWF conditions;

(B) upper and lower bound curves shall be prepared for each case;

(C) upper bound curves are to be based on:

- minimum Hazen “C” value;
- well at pump stop level; and
- in the case of a combined rising main, with all contributing pumps operating; and

(D) lower bound curves are to be based on:

- maximum Hazen “C” value;
- well at pump start level; and

- in the case of a combined rising main, with no other contributing pumps operating.

For Hazen "C" values actual figures shall be derived from calibration data where possible. Where data is not available the values in Table SC6.4.3.21.6 may be used.

Table SC6.4.3.21.6 Range of Hazen C Values

Material	Min C	Max C
Cement Lined and FRC	100	150
Plastic pipes	110	160

Complex pressure main systems will require pipe network analysis packages to assist with the development of the curves.

A net positive suction head available (NPSHA) curve shall also be prepared.

(vi) Pressure mains

Pressure mains shall be sized in conjunction with the pump stations to optimise overall whole-of-life costs.

(vii) Pressure main velocity

The minimum velocity for pressure mains should comply with the requirements of *DEWS Guidelines*. The target velocity at the duty point of the pump is 1.0 m/s with a range of 0.75 m/s to 1.5 m/s.

The minimum velocity in pressure mains is to be 0.75 m/s. Where a small and large pump combination is proposed, 0.5 m/s for the smaller pump may be permissible if the larger pump flushes the main regular intervals of no greater than weekly. Acceptance by Townsville Water and Waste will be based on the individual merits of the design. Pump operation is described in TCC24, Standard Specification for Electrical Switchboards, clause 18.2.

The maximum velocity in pressure mains shall not exceed 1.5 m/s (single) and 2.5 m/s (all pumps).

(viii) Pressure main hydraulic models

Wherever possible pump and pressure main system hydraulics shall be performed using calibrated hydraulic models.
Townsville Water and Waste has a number of network models for the complex pressure main system. These hydraulic models have been developed in SewerGEMS modelling software.

These models shall be used for the analysis of pumping system that is part of the pressure main network system in conjunction with Townsville Water and Waste.

(d) Pump well sizing

Pump well sizing shall be performed in accordance with WSA 04.

The required pump operating volume shall be calculated as follows:
$V = 900 \times Q^P/S$
where:
V = cut-in/cut-out volume (L);
Q^P = pump capacity (L/s); and
S = allowable number of starts per hour.

The maximum number of starts per hour shall be:

(i) Motors <= 50 kW: 12 Starts per hr; and

(ii) Motors > 50 kW: 5 Starts per hr.

For fixed speed pumps, the pump capacity shall be based on the capacity of the largest pump unit within the well.

For variable speed pumps, the pump capacity should be based on the flow rate associated with the minimum velocity requirements of the pressure main.

Operating and control levels within the well shall be in accordance with WSA 04.

(e) Overflow management

(i) General

Systems shall be designed to minimise overflow of sewage to the environment.

All pumped catchments shall be provided with an emergency relief structure accordance with SC6.4.4.8 Standard drawing SD-445. Refer to other sections of this sub-section and ERA 63(3), Code of Environmental Compliance, on requirements for pump station failure or overload management.

An environmental assessment shall be performed to determine the most appropriate overflow location.

The system shall provide, as a minimum, 6 hours of ADWF flow as emergency storage. For remote sites this may need to be increased dependent upon emergency response times.

Methods for limiting the risk of sewage overflows include:

(A) emergency storage;

(B) provision of emergency power at the site; and

(C) inter-catchment overflows.

Pump stations shall be fitted with telemetry monitoring to communicate alarms of system failures to emergency operations personnel.

(ii) Level and location of relief structures

The level of relief structures shall be designed to prevent sewage from exiting through disconnector gullies or maintenance hole lids. Relief structures shall be located as close as practical to pump station.

(iii) Emergency storage

Emergency storages shall be provided in accordance with the requirements of WSA 04.

(iv) Emergency power

Stand-by generators are required at all Type 2, 3 and 4 pump stations.

Sufficient fuel shall be stored to operate the pump station at full capacity for 24 hours.

The electrical system shall be equipped with an automatic change-over switch and start system for the stand-by generator in the event of mains power failure.

(f) General arrangement and site infrastructure

(i) Location and layout

Issues to be considered when sighting a pump station are discussed in WSA 04.

(ii) Standard drawings

Type 2 pump stations shall be in accordance with standard drawing SD-420 Small Sewerage Pump Stations Typical Plans, Sections and Details

(iii) Flood level

Pump stations are to be constructed 300 mm above 1% AEP flood level (refer WSA–04).

(iv) Site fencing

Security fencing is not normally required.
In urban areas where site fencing is deemed to be necessary, fencing shall be in accordance with SC6.4.3.21.5(4).

(v) Landscaping

Sites shall be landscaped to minimise visual impact whilst not compromising access to the pump station and equipment. For landscaping requirements refer to WSA 04.

(vi) Water supply

Water supply shall be provided to all pump stations for wash-down purposes and general amenity. Backflow prevention is required on the water supply service.

Water services shall be provided in accordance with WSA 04.

(vii) Power supply

The power supply connection to the pump station site shall be underground.

Refer to other sections of this guideline for the provision of power for the site.

(viii) Site buildings

If specified by Townsville Water and Waste, site buildings shall be provided for pump stations to house large switchboards and other associated equipment.

Buildings shall be architecturally designed.

A Development Permit is required for buildings.

(ix) Lifting requirments

Permanent cranage or davits are not normally required. Exceptions to this are where equipment is located within buildings and require removal on a basis of more than once every 10 years.

If specified by Townsville Water and Waste, permanent cranage or davits shall be incorporated into the design of the pump station or building. The design shall be approved by Townsville Water and Waste.

Set-down points of the cranage equipment shall be:

(A) in an area able to be reached by a crane truck where the mass and reach are within the crane truck capacity;

(B) paved access is provided for the crane truck to reach the necessary position;

(C) on back of flat bed vehicle (bed height 1.2 m) elsewhere; and

(D) if these requirements are impractical, other lifting arrangements may be considered such as removable roof or local lifting equipment with provision for trolleying to a suitable crane pick-up point.

(x) Valve pits

Valve non-return and isolation pits shall be provided and be in accordance with the general concepts detailed in *WSA 04:2005.*

(xi) Ventilation pole

Ventilation poles are required.

(g) Vehicular access

(i) Access road

Sealed access road shall be provided to pump stations to enable all-weather access for maintenance vehicles. Access requirements shall be in accordance with WSA 04 with the following additional requirements:

(A) sealed asphalt access road;

(B) provide access during 1% AEP flood event;

(C) minimum road width of 4 m;

(D) on-site turn-around for maintenance vehicle; and

(E) parking area provided adjacent to all equipment to be lifted for a crane truck maintenance vehicle. Parking is only required for a single vehicle.

Design of access is to be approved by Townsville Water and Waste.

(ii) Maintenance vehicle reconfiguration

Allowance shall be made for maintenance vehicles that are 10 t (8.8 m long) crane-trucks Medium Rigid Vehicles (AS 2890.2 *Parking facilities - Off-street commercial vehicle facilities*) with

mounted crane positioned centrally on the rear end of the vehicle.

(h) Odour control and septicity control

(i) General

If directed by Townsville Water and Waste, odour and septicity control shall be incorporated into the design of the pump station, and the design shall be approved by Townsville Water and Waste.

The generation and release of hydrogen sulphides can result in odours as well as increasing the corrosiveness of the environment within and around the pump station.

The extent of hydrogen sulphide generation is related to the age and retention time of the sewage, and the turbulence generated when discharged from pressure mains.

For further readings on the generation and management of odours, refer to:

(A) WSA 04*;*

(B) *Hydrogen Sulphide Control Manual;* Volumes 1 and 2, Technological Standing Committee on Hydrogen Sulphide Corrosion in Sewerage Works (1989); and

(C) DEWS Guidelines.

(ii) Management

On-site odour management shall be designed. Options management in order of preference include:

(A) passive control of odour release from sewage (by appropriate pump station design);

(B) odour scrubbing with activated carbon; and

(C) chemical masking.

Air and oxygen injection are not preferred.

(i) Durability

(i) General

The following applies:

(A) pump station structures and equipment shall be designed for the design lives set out in accordance to other sections of this sub-section;

(B) all metalwork within the wells shall be grade 316 stainless steel. Connections to concrete shall be by stainless steel chemical anchors;

(C) all pipework within the wells shall be coated with a fusion bonded coating or high build epoxy coating system that provides long term protection;

(D) submersible pumps shall be provided with stainless steel lifting chains;

(E) guide rails shall be in accordance within other sections of this sub-section; and

(F) covers for wells and pits shall be fabricated from aluminium.

(ii) Well type

Refer to SC6.4.3.21.5(3)(g) Pump stations and wet well materials

(j) Safety

The following applies:

(i) ladders shall not be provided into confined spaces. This includes the pump well and valve pits;

(ii) pits and wells shall be designed for confined space entry access of a person lowered from a tripod system;

(iii) forced ventilation shall be provided for all pump station dry wells;

(iv) the designer shall make provision for temporary fencing around well openings, and permanent grates for times when the covers are open; and

(v) signage shall be provided in accordance with the work, health and safety regulations identifying confined space areas and appropriate actions for entry.

(k) Flotation

Structures shall be designed to resist flotation in accordance with AS/NZS 1170 *Structural design*

actions.

(l) Instrumentation requirements

Control level probes shall be provided in accordance with other sections of this sub section.

Type 3 and 4 pump stations shall be provided with electromagnetic flow meters to measure the entire pump station outflow. Selected Type 2 pump stations may require electromagnetic flow meters – consult with TWW.

(m) Land tenure

The land tenure for the pump station and any associated infrastructure including valve pits, vent poles, etc., is in order of preference:

(i) council owned freehold land; or

(ii) council controlled road or reserve; or

(iii) easement over freehold land.

(n) Documentation

All new pump stations, and any modification works to existing pump stations, require a comprehensive documentation suite including: design and as constructed drawings, equipment operation and maintenance manuals and initial procurement and logistics data.

(o) Operations and Maintenance Manual (O&M Manual)

TheOperationsandMaintenanceManualcomprisesallrelevantdocumentsforthepumpstation. The document structure for the O&M manual shall be adhered to and not altered unless approved by TWW.

Where modifications are being undertaken to an existing pump station, TWW shall provide any existing available O&M manual or relevant documentation to the designer for update.

(p) Document Requirements Schedule (DRS)

The DRS is a control document summarising all documents required in the O&M manual, quantities of each document to be provided at completion of commissioning (Practical Completion, or date of “On Maintenance”).

The DRS lists up to 4 hold points during the design and construction process where TWW require review of documentation. Some elements of documentation may be deleted from the DRS/O&M Manual at the discretion of TWW. The DRS, including necessary documentation and hold points shall be discussed and agreed with TWW prior to commencing detailed design. Hold points shall be adhered to through the design and construction process.

The baseline DRS schedule to be used as a starting point for development of sewage pump station documentation can be made available on request.

(q) Process and Instrumentation Diagram (P&ID)

A Plant and Instrument Diagram (P&ID) is to be delivered with each new pump station and existing P&ID are to be revised by any project modifying or upgrading a pump station.

The P&ID provides the standard symbols and naming/tagging conventions for all equipment delivered. This includes piping, Instrumentation and Mechanical process equipment.

The TWW Process and Instrumentation Sheet includes relevant symbols to be applied to P&IDs. This information can be provided on request.

Unique Tag numbers developed in accordance with the Tagging conventions are to be allocated to each equipment item delivered and included on the P&ID. The tag numbers are to be used as the reference for each document delivered for that specific equipment item. Tag numbers should be used to refer to equipment in Inspection and Test Plans (ITP’s) and as much design documentation as is practical.

(r) TWW Sewage Pump Station Equipment Schedule (TWW SPS Equip Schedule)

An equipment schedule is to be prepared for each new pump station and existing equipment schedules are to be revised for any project modifying or upgrading a pump station. The document is referenced by Tag number and lists, in summary, critical design and performance data for mechanical, electrical, radio and telemetry, and instrumentation and control equipment. The schedule is a required document in all O&M manuals.

The schedule is the cross reference document between the tag number and the actual equipment item delivered. The schedule is a useful tool when selecting equipment as it contains relevant process parameters for each equipment item. The sample Equipment Schedule to be used and can be provided on request.

(6) Pressure main design

(a) Scope

SC6.4.3.21.3(6) covers the design of sewage pressure mains.

(b) Pressure main sizing

Pressure mains shall be sized in association with the pump stations. Refer to SC6.4.3.21.3(5)(c) for guidance on sizing.

(c) Alignment

(i) Location

The location for pressure mains in order of preference is in:

(A) council controlled road; or

(B) council owned freehold land; or

(C) easement in privately owned freehold land.

The alignment within the Road shall be in accordance with SC6.4.4.8 Standard drawings SD 015.

(ii) Service allocations

The designer is referred to the sub-section SC6.4.3.2 Building over or adjacent to services in selecting alignments in other areas:

(iii) Minimum cover

Minimum pipeline cover is 600 mm in accordance with SC6.4.4.8 Standard drawings SD-325 and WSA codes.

(iv) Services and alignments

Refer to WSA 04 for minimum clearance requirements from other services.

Minimum clearance requirements and conditions imposed by other services owners shall be complied with. Minimum clearance requirements may be imposed by the service owner. Specific conditions apply to construction near:

(A) fibre optic cables;

(B) high pressure gas mains; and

(C) underground power.

Refer to the service owner for conditions on clearances.

Consider overhead power when selecting pipeline alignments. Construction with excavation equipment under or near overhead power lines has difficulties with monitoring and clearance requirements.

(d) Pipe

(i) Materials

Allowable pipe materials are:

(A) PVC-U, PVC-O, PVC-M

(B) DICL;

(C) mild steel cement lined; and

(D) polyethylene.

Pipeline materials shall be in accordance with WSA.

Pressure mains shall be a minimum of PN12.

In selecting the PN rating for plastic pipes, pressure de-rating for transient loads (water hammer) and temperature shall be taken into account (refer to WSA 03).

(ii) Pipeline material structural design shall be carried out in accordance with WSA 03.

(iii) Pipe jointing

Pipelines shall be rubber ring jointed or butt welded in the case of polythene pipe.

Flange classes shall be selected to suit the pipeline design pressures. Flange classes should be AS/NZS 4087 *Metallic flanges for waterworks purposes* except where connecting to existing flanges from a different standard.

Minimum flange classes shall be Class 14 for Steel and Cast Iron and Class 16 for DICL.

(iv) Concrete encasement

Concrete encasement of pressure mains are not permitted, unless approved by Townsville Water and Waste.

(v) Above ground pressure mains

The design of above ground pressure mains will be in accordance with WSA 03.

(e) Appurtenances

(i) Air releases

Air releases shall be provided on all high points along the pipeline, unless specifically omitted by Townville Water.

Air release shall be avoided wherever possible by maintaining a continuous rising grade away from the pump station.

Manual air releases shall be used where the release is located in developed residential areas where odours will be noticed. Automatic air valves can be used at other locations. Automatic air valves shall be suitable for use with sewage.

(ii) Scours

To the greatest reasonable extent, a designer shall avoid the occurrences of low points within a pressure system to prevent the use of scours. If a low point is unavoidable, a scour shall be used to assist with clearing of accumulated solids.

Scours shall be directed back into the pump station or adjacent sewer where possible. Where not possible, the scour shall be directed into a manhole designed to allow pump-out into a tanker.

(iii) Isolation valving

Isolation valves shall be provided at the following locations:

(A) outside of pump station;

(B) on the branch of any tees;

(C) at 500 m maximum spacing;

(D) either side of significant waterways; and

(E) either side of major road crossings.

(f) Colour coding of pipes

Where pressure mains are to be located in close proximity to other services pipes or where there is the likelihood of the pipes not being recognised as sewerage pipe the designer shall provide for the pipes to be colour coded to Australian Standard and shown on the drawings accordingly.

(g) Pipe bedding

Pipe bedding for pressure mains shall be in accordance with:

(i) WSA 02 for sewers; and

(ii) WSA 04 for pressure mains.

For flexible pipes refer to AS/NZS 2566.2 *Buried flexible pipelines - Installation*, Table G1, G2 and G3 for suitable material types.

(h) Restoration

Refer to WSA 02 for construction specification.

For restoration under roadways refer to SC6.4.4.8 Standard drawings SD-055.

(i) Geotechnical

Refer to the following for geotechnical matters:

(i) WSA 02, Section 8.6 for sewers; and

(ii) WSA 03, Section 5 for pressure mains.

(j) Marker tape

Detectable marker tape is required on non-metallic pressure mains(refer to SC6.4.4.8 Standard drawings SD325) and shall be in accordance with WSA PS-3.18 Marking Tape, Detectable.

(7) Scope

Wastewater treatment process design is complex and site specific.

New plants and plant upgrades are typically undertaken as one-off projects and performed by experienced wastewater treatment plant designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of suitable specialist consultants to undertake the project.

(8) Recycled water systems

(a) General

(i) Scope

SC6.4.3.21.3(8) covers the design of recycled water distribution infrastructure.

(ii) Design citeria

Design of a recycled water scheme shall comply with the requirements of the documents referenced in SC6.4.3.21.3(1)(b).

The design of a proposed recycled water project shall address, as a minimum, the following issues:

(A) be consistent with council's latest practices

(B) quality of treated water appropriate to proposed usage;

(C) maintenance of treated water quality standards within the storage and distribution system; and

(D) distribution system infrastructure including, storage, pumping and mains distribution network and irrigation networks.

Details of the proposed design are to be submitted to Townsville Water and Waste for review and approval.

(b) Infrastructure

(i) Sizing

The methodologies used for the sizing of water supply infrastructure of mains, pump stations and reservoirs can be applied to recycled water.

Reservoirs, pump stations, and mains are required to be sized to maintain the desired flow and minimum pressure at the property connection.

Refer to SC6.4.3.21.2 Water supply design for design requirements, and SC6.4.3.21.3(2) Sewage collection system planning for guidance on sizing requirements.

(ii) Colour coding

All recycled mains and connections and outlets shall be colour coded to AS 2700 *Colour standards for general purposes* to differentiate from other infrastructure.

Mains, taps and meters shall be coloured Lilac P23.

(c) Reticulation mains layout

(i) Extent

Mains shall be provided to service intended connections within the area being serviced.

(ii) Mains

Mains shall be designed with isolating valves, pressure and control regulating valves (as required), air valves and scours to *WSA 03*.

(iii) Scours

Scours from recycled water mains shall be directed into sewers where possible.

(iv) Meters

Water meters are to be provided on all service connections. Left-hand threads shall be used on all fittings to prevent accidental cross connection to potable water.

SC6.4.3.21.4 Electrical and mechanical

(1) Introduction

(a) Scope

SC6.4.3.21.4 addresses the electrical and mechanical design considerations applicable generally to water and sewerage pump stations but can extend to treatment plants.

(b) Treatment plants

New treatment plants and plant upgrades are typically undertaken as one-off projects and performed by experienced treatment plant designers/consultants with the necessary qualifications, specialist skills and experience to carry out the planning, assessment, design and delivery processes for the project.

Generally, Townsville Water and Waste will prepare a detailed design brief and requirements for the engagement of specialist consultants suitable to carry out the electrical aspects of the project including issues of supply, transformers, HV, plant and motor control and monitoring.

(c) Legislative requirements

Electrical designs and works shall consider relevant legislative requirements including:

(i) *Electrical Safety Act 2002* including associated regulations and Codes of Practice;

(ii) *Electricity Act 1994* and associated regulations;

(iii) *Electricity National Scheme (Queensland) Act 1997;*

(iv) *Building Act 1975* and associated regulations; and

(v) *National Electricity Rules.*

(d) Reference and source documents

The following documents shall be referred to.
TCC – 24 *Townsville City Council Standard Specification for Electrical Switchboards*
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Code of Australia*
WSA 04 *Sewerage Pump Station Code of Australia*
Townsville City Council Standard Specification for Standby Generators

(e) Standards

In general the following standards, codes and manuals are applicable to the design and documentation of typical pumping stations.

Workmanship and design:

Standard	Name
Australian Standards	All relevant Australian Standards
IEC and British Standards	Relevant International Electrotechnical Commission (IEC) and British Standards where no Australian Standard exist.
BCA	Building Code of Australia
NER	National Electricity Rules
ECMM	Queensland Electrical Connection and Metering Manual

Preparation of electrical drawings:

Standard	Name
AS1100	Technical Drawings
AS1102	Graphical Symbols for Electro-technology
AS3702	Item Designation in Electro-technology
TCC24	Townsville City Council Standard Specification for Electrical Switchboards

(2) Electrical supply requirements

(a) General

(i) Provision of power supply

Energy Queensland is the electrical distribution entity responsible for the connection of power supplies to all Townsville Water and Waste infrastructure assets.

The designer shall where possible, commence discussions with the electrical distribution entity at an early stage as part of the overall planning process for the proposed construction of new water and sewerage infrastructure or for the augmentation of existing water and sewerage infrastructure. Early involvement of the distribution entity shall be sought in order to resolve network considerations and availability to meet the anticipated electrical loads. Budget costs where possible shall be obtained from the distribution entity for any required upgrading of the existing power supply network, and provided to Townsville Water and Waste for inclusion in project budgets. The current distribution entity policy is that no cost estimates are provided unless the full application process is completed with a detailed design. This shall be considered in the design program.

The designer shall obtain plans of existing infrastructure in the vicinity from the Dial Before You Dig service of the existing and proposed electricity supply network in the vicinity of the proposed infrastructure. The location of the existing network will have a bearing on the proposed locations of the infrastructure, and electrical “point of supply”. The optimum location for the electrical “point of supply” should be as near as practicable to either the largest electrical loads or the proposed location of the electrical main switchboard and/or motor control centre.

The designer shall seek advice from suitably experienced people where information from the distribution entity is not forthcoming as to potential electrical supply issues.

Electrical power supply connections shall comply with the requirements of the *Queensland Electrical Connection and Metering Manual* available from their web site.

(ii) Energy retailer

The energy retailer may not necessarily be the energy supplier to the infrastructure asset. As the Queensland electricity market is a contestable market, Townsville Water and Waste may decide to obtain electrical energy from another Energy Retailer. The designer shall consult with Townsville Water and Waste to determine current Townsville Water and Waste commercial agreements in regard to energy retailer contracts to be applied to the new infrastructure.

(iii) Clearances

The location of water and sewerage structures such as treatment plant and pump station buildings shall be such that minimum clearances are maintained from overhead and underground electrical cables. These clearance distances are contained within the *Electrical Safety Act 2002* and AS/NZS 3000 *Electrical installations (Australian and New Zealand Wiring Rules)* and are dependent upon variables including the voltage of the overhead power lines. Guidance shall be sought from the distribution entity regarding the voltages of overhead power lines to ensure adequate clearance distances are maintained. The supply authority normally prohibits the construction of structures beneath overhead power lines. The designer shall also consider clearance distances for cranage during construction maintenance and demolition of these structures.

(iv) Ownership of HV infrastructure

Townsville Water and Waste's preference is for ownership and on-going maintenance of high voltage transformers and switchgear to remain with the distribution entity.

Where the designer seeks to have Townsville Water and Waste retains ownership and on-going maintenance of the high voltage supply assets, a detailed financial breakdown of the cost of ownership including initial capital cost and on-going maintenance costs shall be undertaken.

(v) Connection of power supply

It is Townsville Water and Waste's practice that costs associated with the connection of the required power supply to each location (including the distribution entity capital contribution) is normally included in the contract price by the Contractor performing the works. Tender documentation shall state this requirement.

All forms required to be submitted for the connection of the power supply shall be completed by the Contractor and forwarded to Townsville Water and Waste for signature. Submission of the forms shall be by the Contractor. However, circumstances may arise where the arrangements for power connection may be excluded from the contract and undertaken by Townsville Water and Waste directly with the distribution entity, including:

(A) requirements for a capital contribution by the distribution entity; and

(B) extended application timeframes within Energy Queensland and design program requirements where costs may not be known at the time of tendering the works.

(b) Submission of application to distribution entity

The designer shall be responsible for the calculation of the electrical loads for the proposed infrastructure or the additional electrical loads where existing infrastructure is proposed for augmentation. These shall be submitted with the application in the format required by the distribution entity.

(c) Fault levels

In order to determine the applicable fault level for the installation, particularly for HV connections, advice will be required from the distribution entity as to the applicable fault levels at the site connection. This information can then be used during the design process to calculate the fault levels throughout the site and to enable equipment selection.

In practice, this information, particularly for LV connections, is generally not forth coming from the distribution entity within typical project design time frames. To enable design progression, suitable experienced designers shall by site inspection determine as far as possible the existing LV networks configuration and based on anticipated works determine the most likely fault level for the site.

Suitable allowance for future augmentation of the proposed infrastructure shall be taken into account when calculating the prospective fault levels. The designer shall seek advice from Townsville Water and Waste to determine any proposed future upgrading at the facility.

(d) Retail energy metering

All retailer energy metering shall be designed, installed and connected in accordance with the relevant retailer requirements.

Metering locations shall be accessible to the retailer's meter reading personnel during normal working hours. Typically for new installations, the metering panel is not located within a building or locked compound. Where old facilities are being refurbished, the designer shall relocate the meters to an accessible location.

Phone line connections etc. should be provided at each metering location in accordance with the requirements of the distribution entity. Where the installation of GSM modems for remote downloading of energy readings is required, the location of the meter panel shall be such that adequate mobile telephone coverage is achieved.

(e) Energy tariff

(i) Tariff selection

Should it be determined that the site will be connected as a regulated energy tariff connection

rather than as a contestable site then:

(A) the designer shall provide a detailed analysis of energy consumption at the site, taking account of equipment run times and hours of operation. The analysis shall provide indicative comparison; and

(B) submit details of the energy consumption along with monthly metering charges and all other additional costs payable to Townsville Water and Waste, and seek their approval prior to the installation and connection of energy meeting.

(ii) Energy cost minimisation

The electrical design shall encompass all energy cost savings applicable due to off-peak electrical consumption. Where pumps and other large electric motors are installed, control systems shall be configured to only operate pumps within high energy cost periods to maintain minimum levels in reservoirs and pump stations where possible. Major pumping shall occur during periods of off-peak low energy costs. These tariff control measures shall be provided with manual override facilities both locally and as part of any SCADA based control system.

Other constraints particularly in the sewerage network (e.g. pump station storage, or peak flows into sewerage treatment plants) may prevent the use of “off-peak”, for example the storage then delivery of large quantities of raw sewerage to biological treatment plant processes.

Retailer energy charges are in Queensland presently based on real energy measurement with regulated limits on the amount of reactive power that may be produced or consumed at each site.

Some other states in Australia also charge for reactive power consumption, the rate for reactive power is generally higher than real power providing ability to determine a return on investment for power factor correction devices (other than by simple regulatory compliance).

Given potential for Queensland to alter present charging strategies in regard to reactive power design consideration should be given to provision of space for future ability to retrofit power factor correction equipment to the site. This provision may include space, switchgear, and busbar extension, and so on as required.

(3) Emergency power supply

(a) General

(i) Generator requirements

Each water and sewerage site shall have provision for either the permanent connection of a standby diesel generating set, or as a minimum be provided with facilities for the connection of a portable generating set as required by TCC24.

A formal risk assessment of the criticality of a particular infrastructure asset shall be made by the Designer in order to assess whether the standby generating set shall be permanently located and connected or provision made for connection of a portable generating set.

For sewerage pump stations the following general guidelines apply for the provision of standby generating sets:

(A) where a sewerage pump station has inter-area overflow capabilities, the installation of a manual transfer switching arrangement and plug-in type connection socket as a minimum is required; and

(B) where the sewerage pump station does not have inter-area overflow capability, a permanently connected standby generating set with automatic changeover facilities mounted within the electrical switchboard is required.

For water pump stations, it is not normal practice to provide permanent standby generators as water is normally continued to be supplied by gravity from reservoirs during power failures. The exception is where supply to consumers will fail during power outages. In such cases permanent generators are required.

Standby generating sets shall be sized to ensure that the largest pump load combination required at the site can be successfully started and run. Manual transfer switching arrangements shall also be sized for the largest electrical pump load combination required at the site.

Generators shall be fitted with protective circuit breakers on the supply cables.

Technical requirements for the generator are provided in the council's *Standard Specification for Standby Generators*.

(ii) Site location

The generator set shall be located on the site to allow for easy and safe access for servicing and maintenance (including removal from the site where necessary). This may require a suitable hardstand area.

Access shall allow all panels on the generating set to be easily opened without hindering access to the electrical switchboard or pump station.
Vandal proofing shall be to TCC24 minimum requirements.

(iii) Fuel storage requirements and alarms

The generator set shall have a fuel capacity for a minimum of 24 hours operation based on 100% of the rated load of the generating set.

The designer shall also take into account the reliability of fuel supplies to specific locations after severe storm and cyclone events which may prevent access to the sites for re-fuelling. Where the designer determines unacceptable risk to the supply of fuel to a critical site, additional fuel storage shall be provided to Townsville Water and Waste's satisfaction.

Remote locations (e.g. Magnetic Island, rural areas) shall be considered as special cases and the availability of fuel supplies at the site after severe weather events shall be a consideration in resolving the quantity of fuel stored on-site.

A low fuel alarm from fuel storage tanks shall be connected to the telemetry and SCADA systems. The alarm shall operate when the fuel level in the tank has fallen to a level which only provides two hours of remaining operation of the standby generating set at full load.

(iv) Environmental considerations – generating sets

Fuel containment - The generating set shall be located within a bunded area which provides drainage to a low point. A lockable draw-off valve shall be provided for discharge of liquid from the bunded area. Alternatively, suitable fuel containment and drip trays shall be provided within the emergency generator set base frame.

Noise - The generator shall be fitted with sound attenuation systems to meet the environmental requirements for allowable noise emissions.

(v) Battery charging

Each generating set shall have a battery charger powered from a dedicated circuit from the main sites switchboard or distribution board.

(b) Indoor standby generating sets

Where the electrical main switchboard and/or motor control centre are contained within a building structure, the standby generating set shall also be located within the same building structure.

The generating set shall be contained within a fire rated sound attenuated room that provides adequate airflow for cooling purposes. Airflow requirements shall be based upon the individual generating set manufacturer's recommendations.

Bulk fuel storage shall be located externally to the building. The bulk fuel storage shall have a lockable fuel cap.

A smaller day storage tank may be provided within the room. Automatic transfer of fuel between the

external bulk fuel storage tank and the smaller day tank shall be provided.

The location of the refuelling point and ability to access safely shall be considered for each site such that it allows accessibility for the delivery of fuel by the selected method.

(c) External standby generating sets

Where the electrical switchboard is either plinth or pole mounted externally, the generating set shall also be located externally provided requirements such as noise attenuation can be met.

Permanently connected standby diesel generating sets shall be fully enclosed and sound attenuated. Generating set enclosures shall offer easy access to all maintainable parts for maintenance personnel.

Externally installed generator installations shall be vandal resistant. No glass or plastic panels are to be provided on the generator exterior housing. All covers (including radiator and fuel caps) are to be pad-lockable. No controls (eg emergency stop) are to be external or accessible without opening a locked door or cover.

There should be no exposed “hot” parts, such as exhausts. It should not be possible to drop items down the exhaust pipe.

Surface treatment of the generator and acoustic enclosure and other exposed parts shall be selected for the environment at the site, and to provide a 15 year minimum design life.

(4) Determining electrical site loads

(a) General

The designer shall determine the site loading in accordance with AS/NZS 3000 *Electrical installations* requirements, and with consideration of the proposed pump/equipment operation combinations and sequencing. Load calculations shall be approved by Townsville Water and Waste prior to being forwarded to the electrical distribution entity.

The designer shall be responsible for the early submission of electrical load calculations to the electrical distribution entity to minimise delays with electrical connection works.

The designer shall ensure that the calculated motor drive sizing can be achieved by a recognised pump manufacturer selected from Townsville Water and Waste’s preferred equipment lists.

The electrical load calculations shall take into account Townsville Water and Waste’s planned future augmentation of the infrastructure. Where no future augmentation is planned, the electrical loads shall be calculated on the anticipated connected loads plus 25% extra.

(b) Pump stations

Electrical load calculations shall be based on the method of operation of the pumps to be supplied and installed e.g. Duty-Duty, Duty-Standby, Duty1-Duty2-Standby etc. The proposed method of operation shall also be discussed with the distribution entity to determine any potential network issues with the proposed arrangements. The design for motor starting shall meet the requirements of the distribution entity and TCC24.

(5) Electricity point of supply

The preferred method for the connection to the point of supply shall be by underground cabling.

The final location for the point of supply shall be agreed between the distribution entity and Townsville Water and Waste and shall be compatible with access to the site. Parts of the overall area serviced by Townsville Water and Waste are prone to flooding. All electrical infrastructure susceptible to flood damage shall be located above the design inundation levels adopted for the proposed site. Flood inundation level information is available from Townsville Water and Waste to assist in the location of electrical infrastructure above predicted inundation levels.

The point of supply within residential locations shall be via a galvanised steel property pole or underground URD

pillar. Where galvanised steel property poles are used, the pole location shall be such that the final consumer's mains cabling length is kept to a minimum. No aerial cables are permitted to cross over infrastructure or vehicle working areas.

All connectivity at points of supply shall be accessible for maintenance purposes.

(6) Cabling

(a) Consumer's mains cabling

The consumer's mains cabling shall be sized by the designer in accordance with the calculated electrical load at the particular site and the requirements of AS/NZS 3000 *Electrical Installations*.

Cabling shall generally be Cu PVC/PVC/XLPE installed underground in HD uPVC conduits run between the nominated point of supply and the site electrical Main Switchboard.

Where external cabling enters a building, the cabling may be installed on cable ladder or cable tray with mechanical protection as required under AS/NZS3000.

Where underground HD uPVC electrical conduits are installed, the designer shall provide for spare conduits, generally in the ratio of one spare conduit of the same diameter of the conduit installed for each conduit containing electrical cables.

(b) Sub-mains cabling

Sub-mains cabling shall be sized by the designer in accordance with the calculated electrical load at the particular location and the requirements of AS/NZS 3000.

Cabling shall consist of single or multi-core copper PVC/PVC or PVC/XLPE conductors generally installed underground where run external of structures in suitably sized cable ducts or within cable trays where run internally of building structures.

(c) Power and control cables

Power and control cables shall be circular type cabling to facilitate ease of waterproofing cable entries. Consideration shall be given to use of flexible type cabling to pumps to facilitate ease of removal and installation.

Power cables shall be a minimum of 2.5 mm². Control cables shall be a minimum of 1.5 mm². A minimum of two spare cores shall be provided for all control cables following installation. Only one control voltage shall be contained within any control cable.

Where the designer has deemed a higher risk of further mechanical damage, Steel Wired Armoured (SWA) cabling or other protection method shall be provided.

(d) Variable frequency drive cables

Cables run to motors driven by VFDs shall be flexible type cabling to facilitate ease of termination and removal from pumping equipment. Cabling type, length and installation method shall be selected to meet the applicable Electromagnetic Compliance (EMC) requirements. Typically a screened cable would be used with screen continuous from the motor terminal box to the VFD terminals.

(e) Instrumentation cables

Instrumentation wiring and cabling required to carry signals to the PLC or process instrumentation shall be selected to suit the intended application.
Generally, overall screened cables shall be used for digital signal while overall and individually screened pairs shall be used for analogue signals. Analogue and digital signals shall not be provided within the same cable.

Cables shall generally be Dekoron or approved equivalent of minimum conductor size of 0.75 mm². Adequate separation shall be provided between instrumentation cables and other cabling to ensure non-interference from AC power and control cables. As a minimum, cable trays shall have adequate partitions and instrumentation cabling not in trays shall be run in separate conduits.

Provision of surge suppressing transient barriers shall be provided for all instrumentation cabling run external of buildings.

(f) Control systems networks

Control system networks shall be designed to suit specific application by a control system specialist.

(g) Pump power cable connection

Power cable termination for pump units shall be determined in consultation with Townsville Water and Waste. The following applies:

(i) typical all electrical equipment shall be hardwired; and

(ii) remote sites or high maintenance sites shall be connected by decontactor style plug and socket connections.

Where plug-in connections are used, the designer shall ensure that cableways from the plug to the motor are sized to permit plugs to be withdrawn with all other cables in place.

(h) Lighting and power sub-circuits

Cabling for lighting and power circuits shall be sized in accordance with the requirements of AS/NZS 3000 *Electrical installations.*
Generally, sub-circuit cabling shall be circular multiple stranded 0.6/1kV Copper PVC/PVC insulated and sheathed conductors where not enclosed in ducting and single insulated where enclosed by ducting.

The following minimum cable cross sectional areas shall apply:

Lighting sub circuit cabling	1.5 mm²
Power sub circuit cabling	2.5 mm²

(i) Cable identification

All cables shall have an identification number engraved on a non-corrodible metallic tag secured by a non-corrodible metallic tie. Tags shall be fitted to both ends of every cable.

(7) Wiring enclosures

(a) General

Cables shall be installed within wiring enclosures to provide the required degree of mechanical protection in accordance with AS/NZS 3013 *Electrical installations - Classification of the fire and mechanical performance of wiring system elements*. The wiring enclosures shall typically consist of cable ladder or conduits.

Wiring System Classification (AS3013)	Conduit Type
WSX1	Light Duty uPVC or equivalent
WSX2	Heavy Duty uPVC or equivalent
WSX3	Metallic Rigid Conduit or equivalent

(b) Cable ladder

Cable ladders shall typically be a heavy-duty aluminium type conforming to NEMA20B. In wet or corrosive areas stainless steel ladder may be required. Cable ladder shall be the primary method of support for surface run cables. Ladder support systems shall be designed such that loadings on ladders shall not cause deflection in excess of 1:200 of span length. Typically supports for horizontal ladders shall not exceed 3000 mm spacing and for vertical ladders, 1500 mm. In no case shall manufactures guidelines be exceeded. Ladders installed external to buildings shall be fitted with covers – horizontal ladders shall have peaked covers; vertical ladders shall have flat covers. Cables on ladders shall not be exposed to direct sunlight. It may be necessary to fit covers to the underside of some ladders. Bends, Tees and other fittings shall be of the same manufacture as the cable ladder. All fixings shall be stainless steel. Cables shall be secured in ladders utilising ties or clamps. Where external to a building, the ties/clamps shall be a non-corrodible metallic type.

(c) Conduit

Conduits shall have a minimum diameter of 20 mm and shall be run as directly as practical with a minimum number of bends or sets. Surface run conduits are to be as inconspicuous as possible and shall be run parallel to walls, floors and ceilings where ever practical. Conduit fittings shall be of the same manufacture and be compatible with the conduit. Elbows and Tee type fittings shall not be used. Long radius bends/sets or suitably sized junction boxes shall be used. Metallic conduits installed in wet or

corrosive environments shall be stainless steel or aluminium. Corrugated PVC conduit shall not be acceptable.

Underground conduits shall typically be installed to a Category A system as classified in AS 3000. The depth of burial shall be selected to suit the site environment. Sand shall be used as a bedding material – the type and grade selected to provide the required thermal properties for the installation.

Underground cable systems shall use cable pits at each change of direction and every 50 m on straight runs. The pits, lids and method of installation shall be suitable for the maximum wheel loads that may occur in the area in which they are installed. Typically “plastic” pits shall never be used where they might be subject to vehicle traffic. The pits shall be sized to suit the number of conduit entries and size/type of cables to be installed. Ensure that cable manufacturer’s minimum bending radius is never compromised. All conduit entries shall be bell-mouthed.

Underground cable routes shall be identified at each end, each change of direction, each pit entry and every 30 m along straight runs by a non-corrodible metallic plate with direction arrow, set in a concrete block.

(d) Flexible conduit

Flexible conduit shall be used to make the final connection to an item of plant. The flexible conduit shall typically be a PVC sheathed metallic liquid tight type, though in certain environments other materials may be more suitable, e.g. in wet, chemical or hazardous area environments. The flexible conduit shall be terminated with correct fittings from the same manufacturer as the conduit. The length of flexible conduit shall be kept to the minimum required to make a final termination to an item of plant. Corrugated PVC conduit shall not be acceptable.

(8) Switchboard design guidelines

(a) General

The following applies:

(i) electrical switchboards including motor control centres, distribution boards etc. shall be constructed in accordance with the requirements of the TCC specification TCC24 and accompanying standard drawings;

(ii) these typical drawings shall be adapted to suit the application and the proposed switchboard general arrangement;

(iii) the switchboard main switch shall be rated for 125% of the current rating of the consumer mains cabling;

(iv) generator control and/or connectivity shall be included;

(v) switchboard design shall include shrouding of live terminals to prevent inadvertent contact;

(vi) sections of switchboards required to be accessed by non-electrical personnel shall be physically segregated from other sections of the switchboard and be supplied by extra low voltage 24VDC power supplies. Where this requirement is not achievable, lockable hinged escutcheons shall be provided to prevent access to electrical equipment by unauthorised persons;

(vii) where the electrical energy metering is included in the overall switchboard design, a separate compartment with pad-lockable access door shall be provided in where required by the energy retailer;

(viii) switchboards located adjacent to sewerage pump stations shall be mounted on a concrete plinth to the side of the well;

(ix) sufficient concrete hardstand area shall be provided for maintenance personnel servicing the switchboard. Switchboards shall be located such that the access doors do not open towards an access road or the actual pump well; and

(x) galvanised steel bollards filled with concrete shall be erected in the vicinity of external electrical switchboards to minimise accidental vehicular damage to the switchboard and to protect maintenance personnel.

(b) Design documentation

The following list contains the minimum design documentation required for switchboard and electrical design to be submitted to Townsville Water and Waste for approval:

(i) Detailed electrical drawings including but not limited to the following:

(A) power single line diagrams;

(B) control circuit drawings;

(C) PLC control and network drawings;

(D) switchboard general arrangement drawings; and

(E) layout drawings.

(ii) Detailed electrical calculations including but not limited to the following:

(A) electrical maximum demand calculations;

(B) fault level calculations;

(C) cable calculations; and

(D) earth fault loop impedance.

(iii) Detailed electrical schedules including but not limited to the following:

(A) cable schedules;

(B) I/O schedules;

(C) single line diagrams;

(D) electrical equipment lists; and

(E) technical data sheets.

(c) Switchboard construction

Switchboard construction and equipment shall be in accordance with TCC24 specification, including:

(i) construction from 316 grade brushed stainless steel (the use of zinc anneal switchboard enclosures may be considered in internal locations with air-conditioned switch room);

(ii) all switchboard hardware, including, but not limited to, hinges, locking devices etc. shall also be manufactured from 316 grade stainless steel;

(iii) padlockable, vandal resistant swing handle type locking mechanisms are preferred for enclosures to suit the standard keying system. The overall number of lockable compartments shall be kept to a minimum; and

(iv) ventilation/cooling requirements to ensure internal temperatures do not exceed manufacturer's recommendations for any equipment contained in the switchboard.

External switchboards shall be painted colours that provide reflection of direct sunlight to minimise heat build-up within the switchboards, and shall be orientated to minimise risks of direct sunlight affecting internal electronic components.

Externally mounted switchboards and control panels shall be provided with sunhoods to minimise heat build-up within the control panels and to provide cover to maintenance personnel when working on the switchboards in rain.

- separate compartments to locate electronic soft starters > 22kW;
- separate compartments for PLC and telemetry hardware, with associated cabling terminated on suitably rated terminal strips; and
- VFD equipment in external boards may require suitable mechanical refrigeration/cooling systems to extend equipment life.

Motor starters, motor protection, and switchboard instrumentation shall be in accordance with the requirements of TCC specification TCC 24.

Major main switchboards and distribution boards shall include arc detection and VESDA protection.

(d) Electrical switchrooms

Dedicated electrical switchrooms shall be provided for large scale pump stations, treatment plants or where required to suit equipment types or the application.

Switchrooms shall conform to the requirements of AS/NZS 3000, the Building Code of Australia (BCA), and Townsville Water and Waste's operational requirements. Emergency lighting and fire extinguishers shall be provided at each Main Switchboard located within a dedicated switchroom as a minimum.

(e) Lightning and surge protection measures

Transient and surge projection devices shall be provided as recommended by the relevant Australian Standards including:

(i) AS 1768 *Lightning protection*; and

(ii) AS 4070 *Recommended practices for protection of low-voltage electrical installations and equipment in MEN systems from transient over-voltages*.

(9) Monitoring/control guidelines

(a) Design outputs

Control loop and P and ID drawings shall be provided for all major infrastructure including treatment plants and large pump stations.

Functional specifications shall be produced for proposed PLC and SCADA based control systems. Integration works are to be approved by Townsville Water and Waste.

For design and construct works, control loop and P and ID drawings shall be provided as part of the evaluation phase.

(b) Monitoring/control methodology - pump stations

Pump stations shall generally be controlled as per TCC-24 including local automatic / local manual and system control mechanisms.
All pump stations are to be remotely monitored by the telemetry and SCADA system.

(c) Monitoring methodology - reservoirs

Reservoir level monitoring shall be performed using submersible pressure transducers or external differential pressure transmitters.
Where flow to the reservoir is controlled by a pump or control valves, the pressure transducer shall be used for pump and/or valve control.

(d) Monitoring/control methodology - treatment plants

Treatment plants shall be controlled by PLC and SCADA based control systems, utilising optical fibre communication cabling.

Systems shall be to Townsville Water and Waste's current requirements, and systems for plant augmentations shall be compatible with existing systems. SCADA system shall be Citect or ClearSCADA (Townsville Water and Waste to confirm). PLC equipment shall be Siemens S7 series.

A functional specification for the monitoring/control of treatment plant systems including design and redundancy is to be included in the detailed design brief for each project.

(e) Float switches

Encapsulated float switches are to be provided in sewerage pump stations to indicate high level alarms. The installation of float switches must allow for the float to be accessed from the top of the pump well without the need to enter the well.

(10) Field equipment installation, wiring and terminations

(a) General

Field equipment installation, wiring and terminations shall generally encompass all electrical works external to the switchboards and motor control centres including but not limited to the installation of field cabling and cable support systems, local control stations, marshalling boxes, motor and equipment isolation and field instrumentation.
Important considerations include:

(i) preferred method of support and environmental conditions - includes consideration of flood levels, UV and damage by insects or vermin;

(ii) segregation of cabling - separation of differing cable types;

(iii) cable carrier capacity - capacity for present and planned expansion;

(iv) cable bend limitations;

(v) cable labelling requirements; and

(vi) cable mechanical protection.

(b) Field instrumentation and installation

(i) General

Field instrumentation shall be supplied and installed in accordance with the process requirements and the manufacturers' recommendations. The location and height of each instrument shall be shown on the relevant "Layout" drawings.

Field instruments shall be located as close to their primary connection to ensure instrument accessibility while still facilitating ease of access for operation, inspection and maintenance.

An optimum working and/or viewing height for each instrument shall be 1500 mm above grade or finished surface level.

No LCD screens for instrumentation or other plastic components that may be susceptible to damage from UV radiation shall be exposed to direct sunlight and potential vandalism shall be considered when locating equipment.

Where process instrumentation is installed on process pipework, suitable isolation devices shall be provided to allow for instrument removal.

All power supplies to instrumentation shall be surge protected and filtered.

(ii) Installation

Instrument enclosures suitable for the prevailing environment and any potential hazardous area classification of the area shall be provided for all field instrumentation and shall be installed in safe accessible locations.

Transmitters shall be enclosed in their own weatherproof enclosure and in addition, those mounted outdoors shall be shaded by 316 stainless steel covers with sides, drip hood and back as a minimum. All brackets and mounting bolts etc. for sensors and transmitters shall be 316 grade stainless steel.

Instrumentation shall not be supported from handrails or from steel work or plant which may be subject to vibration. All brackets and supports shall be constructed of 316 grade stainless steel and be constructed so that vibration from wind, operation of surrounding equipment, etc. is negligible.

(iii) Specific instrument requirements

Pressure transmitters where installed shall be fitted with valve manifold blocks.

Hydrostatic type level sensors shall be installed such that they are not affected by turbulence by the use of either stainless steel weighted cables or stilling tubes.

Impulse lines shall be fitted with valves and strainers. Lines shall be constructed of either copper or stainless steel and be provided with draining facilities for cleaning and maintenance. Cables shall be identified by an engraved metallic tag with SS fixings.

(c) Labelling of equipment

Equipment labels in the form of "traffolyte" labels shall be provided at each field mounted instrument to identify the instrument and at each local isolator or stop/start station to identify the item of plant that the isolator or control stations controls. Labels shall be fixed to equipment with stainless steel screws.

(11) Radio telemetry and SCADA system

(a) General

Townsville Water and Waste operates a telemetry system to monitor and/or control sewage pump stations, water supply pump stations and reservoirs. The system is based on Schneider Scadapack Hardware Controls (previously Serck/Hunter Watertech) PDS and Enet hardware connected by narrow band analogue and digital UHF radio networks. Human machine interface is provided by various SCADA software.

Automated and manual alarm dial outs are provided from SCADA alarms.

(b) New facilities

All new sewerage pump stations, water supply pump stations and reservoirs are required to be connected to the Telemetry system for the purposes of monitoring and control as required in TCC 24.

Functional system requirements such as network and repeater interfaces for the site and frequency details shall be determined during the design in consultation with council's electrical systems engineer.

(12) Mechanical services

(a) Pump design - general guidlines

(i) Pump selection

Pump selection shall be based on the following criteria:

(A) Townsville Water and Waste preferred equipment lists;

(B) system resistance curves (refer SC6.4.3.21.2 Water supply design; and SC6.4.3.21.3 Sewerage system design [SC6.4.3.21.3(5) Sewage pump station design]). Pump selection shall achieve all expected duties as per the system resistance curves;

(C) redundant (standby) pump capacity shall always be provided. Standby pump capacity should be at least equal to the capacity of the largest pump unit;

(D) availability of local product support for maintenance purposes; and

(E) whole of life costs.

For all pumps supplied as part of contracted works, the NPV shall be based on a 15-year design life and 8% real discount rate.

(ii) Motors

All pump motors shall be afforded a minimum of IP56 and be tropic proofed.

(iii) Water void protection

Water void protection shall be provided for all water pumping applications. Water void protection on large installations shall typically consist of limit switches mounted on an extended shaft of the non-return valve.
On smaller applications, flow switches may be used for water void protection.

(iv) Document requirments

The following documentation shall be provided as a minimum by the Contractor and/or pump supplier:

(A) details of all recommended spare parts and servicing tools including a priced list of the costs for each individual item;

(B) operations and maintenance manuals which adequately detail servicing intervals and requirements, dismantling instructions, itemised parts lists;

(C) pump performance – pump/motor factory test curves;

(D) the results of specific pump/motor performance testing to AS2417, showing flow rate, pressure, current, efficiency, and NPSH as a minimum; and

(E) pump/motor specification plates – shall be fixed to the pump and motor. Two additional sets of specification plates shall be supplied, one for inclusion into the switchboard.

(b) Pumping applications

Types of pumps for typical applications shall generally be as follows:

(i) sewage pump stations shall be provided with wet well submersible centrifugal pumps for all new

locations. Existing pump stations that are planned for upgrades shall be converted to dry well mounted submersible centrifugal type pumps. Grinder style pumps may also be offered where conditions exist that may prevent an 80 mm sphere being passed through the pump and discharge pipework;

(ii) water pumping stations shall generally be centrifugal pumps, with the number of pump stages to suit the duty point required;

(iii) RAS and WAS pumps at Sewage Treatment Plants shall generally be centrifugal submersible type controlled by VVVF Drives; and

(iv) positive displacement type pumps shall generally be installed for sludge handling applications.

Where sand infiltration causes excessive abrasion at pump stations, wear rings with increased hardness shall be fitted to the pumps and consideration given to ceramic coatings on the wearing surfaces.

Where pumps are provided with a double mechanical seal, a barrier fluid conductivity probe shall also be provided. This type of system shall be capable of producing an alarm which will be registered in the pump's switchboard and possibly the telemetry system when a change in conductivity is sensed. It is assumed that this will alarm due to a mechanical seal fault.

(c) Chemical dosing pumps

Dosing pumps shall generally be small diaphragm type pumps with either electronic or manual stroke adjustment depending on the application. Pump type and material is to be suitable for the chemical to be dosed.

Critical dosing pumps may require installation with automatic alarm considerations and feedback signals to the telemetry or PLC. These dosing pumps will generally be installed with means of electronically recording/confirming the flow in the dosing line and a means by which the flow in the dosing lines can be diverted back to the dosed fluid reservoir.

Dosing pumps may be required to be flow paced. Flow pace settings shall be manually adjustable.

Larger dosing pumps for dosing rates of between 5 and 50 L/hr shall generally consist of centrifugal pumps with magnetic drive. In this instance fluid void protection is to be provided.

Mass balance dosing systems are not desirable.

Generally Sodium Hypochlorite tank levels shall only be monitored in treatment plant applications.

Townsville Water and Waste's standard P and ID control and pipework drawing shall be used for all dosing pump installations.

(d) Pumping equipment

(i) Motor cable
The designer is to consider the future application of the pump, including if future conversion to VVVFD operation is required. Pumps with present or future VVVF Drive requirements shall be fitted with screened flexible cable.

(ii) Guide rails
Guide rails for removal of submersible pumps shall generally be stainless steel pipe, SCH 40 or better and shall be a minimum of 40 mm diameter.

(iii) Lifting chains
Lifting chains shall be provided at each submersible sewage pump station. Lifting chains shall be selected to be suitable tensile strength to lift the attached pump and shall be manufactured from coated or galvanised steel.

(iv) Pressure gauges
Pumps for water pumping applications shall be supplied with suction and discharge pressure gauges.

(e) Vibration monitoring

Pumps shall generally be provided with the following vibration monitoring devices in three axis locations.

Motor Size	Vibration Monitoring Requirements
10 kW and under	No requirement for vibration monitoring devices
Over 10 kW and up to 99 kW	Vibration monitoring pads
100 kW and above	Inbuilt vibration monitoring devices

Inbuilt vibration monitoring devices shall have all alarms connected to the telemetry and/or SCADA-based monitoring system.

(f) Pump work testing

Works testing of pumps shall be performed for units rated at 5 kW and above. All other pumps shall be provided with a Type Test Certification from the pump manufacturer.

Works testing shall be performed to AS 2417 *Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1 and 2:*

(i) Class 1 for water supply pumps greater than 20 kW; and

(ii) Class 2 otherwise.

The pump supplier shall provide copies of all test certification prior to the pump being dispatched from the manufacturer's factory.

Works testing will normally negate the requirement for a draw-down test to be conducted at each individual site. Where specified draw-down tests may be used to judge the performance of the pumps installed.

(g) Mixers

Mixers shall be either of the submerged type or stool mixers.

(h) Manual valves

Pressure reducing valves shall generally be Derot 300 series (or approved equivalent) with throttling plugs. Vee Port valves shall only be used with the permission of Townsville Water and Waste.

(i) Actuated valves

Actuated valves shall generally be installed with AUMA or Rotork electric actuators (or approved equivalent), in accordance with Townsville Water and Waste's preferred equipment lists.

Electrically actuated valves shall be three phase 415 V rated.

Pneumatically actuated valves shall generally be installed with Tyco Keystone pneumatic actuators, limit switches and/or positioners. In general, "spring close" is required for this type of installation.

All actuated control valves shall have analogue 4-20 mA signal position feedback into PLC and SCADA based monitoring and control systems. Where the actuated valve is not a control valve, limit switches may suffice for positioning.

(j) Air supply blowers

Air supply blowers for treatment plant applications shall generally be lobe type or roots blowers. Townsville Water and Waste's preference is for Robuschi manufactured blowers (or approved equivalent) of the positive displacement rotary type.

Blowers shall be provided with sound attenuation devices to limit the operating noise to levels that are within the limits that provide a safe working environment without the need for ear protection and are in accordance with the relevant local laws and environmental requirements.

(13) Equipment manuals

When purchasing equipment the designer shall specify that, detailed operations and maintenance manuals are to be provided.

As a minimum operation and maintenance manuals shall contain details of:

(a) general description of systems and equipment;

(b) operation and maintenance of systems and equipment instructions which adequately detail servicing

intervals and requirements, dismantling instructions, itemised parts lists Maintenance of Systems and Equipment Instructions;

(c) equipment schedules;

(d) manufacturer's literature;

(e) as-constructed equipment drawings; and

(f) commissioning and test data.

The following copies of the manual shall be provided:

- three hard copies of the manuals; and
- one PDF copy of all documentation.

Specific requirements for sewerage Pump Stations shall refer to SC6.4.3.21.3(5)(n).

SC6.4.3.21.5 Structural and civil design

(1) Introduction

(a) General

SC6.4.3.21.5 sets out the minimum requirements for:

(i) the design of new steel and reinforced concrete structures;

(ii) modifications to existing Townsville Water and Waste steel and reinforced concrete structures; and

(iii) design of civil works including fencing and security, roads and access, site works and landscaping for Townsville Water and Waste infrastructure.

(b) Reference and source documents

SC6.4.3.21.5 is to be read in conjunction with the following documents.
WSA 02 *Sewerage Code of Australia*
WSA 03 *Water Supply Code of Australia*
WSA 04 *Sewerage Pumping Station Code of Australia*
Workplace Health and Safety Queensland – *Safe Design of Structures – Code of Practise*

(c) Codes and standards

All designs and materials shall conform to these guidelines, the relevant current versions of the following general codes and standards in Table SC6.4.3.21.7, and also to the standards referred to within following Sections (2) to (6).

Table SC6.4.3.21.7 Townsville Water and Waste general codes and standards

Code/Standard	Description:
General	
Building Code of Australia (BCA)	Structures shall be designed for a minimum Importance Level of 3 according to the Building Code of Australia Table B1.2a
AS/NZS 1170.0	Structural design actions; Part 0: General principles
AS/NZS 1170.1	Structural design actions; Part 1: Permanent, imposed and other actions
AS/NZS 1170.2	Structural design actions; Part 2: Wind actions
AS/NZS 1170.4	Minimum design loads on structures; Part 4: Earthquake loads
AS 1657	Fixed platforms, walkways, stairways and ladders – design, construction and installation
AS 1418.1	Cranes (including hoists and winches); Part 1: General requirements
Structural Steelwork	
AS 1210	Pressure vessels
AS 4100	Steel structures
AS 4600	Cold formed steel structures
AS 1163	Structural steel hollow sections
AS/NZS 1594	Hot-rolled steel flat products
AS/NZS 3678	Structural steel – hot-rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural steel – Part 1: Hot-rolled bars and sections
AS/NZS 3679.2	Structural steel – Part 2: Welded I sections
AS 3828	Guidelines for the erection of building steelwork

Code/Standard	Description:
AS/NZS 1554.1	Welding of steel structures
AS/NZS 1554.5	Welding of steel structures subject to high levels of fatigue loading
AS/NZS 2312	Guide to the protection of iron and steel against exterior atmospheric corrosion
AS 1627	Metal finishing – Preparation and pretreatment of surfaces; Part 0 to Part 9
AS/NZS 2311	Guide to the painting of buildings
AS 4020	Products for use in contact with Drinking Water
AS/NZS 4680	Hot-Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS/NZS 4791	Hot-Dip Galvanised (Zinc) Coatings on Ferrous Open Sections, Applied by an In Line Process
AS/NZS 4792	Hot-Dip Galvanized (Zinc) Coatings on Ferrous Hollow Sections Applied by a Continuous or Specialised Process
AS 2832.4	Cathodic Protection of Metals – Internal Surfaces
AS 3774	Loads on Bulk Solids Containers
Australian Institute of Steel Construction.	Structural Design of Steel Bins for Bulk Solids
API 650	Welded steel tanks for liquid storage
AWWA D100	Welded carbon steel tanks for water storage
Concrete Design	
AS 2870	Residential slabs and footings
AS 3600	Concrete structures
AS 3610	Formwork for concrete
AS 3700	Masonry structures
AS 3735	Concrete structures retaining liquids
AS 2159	Piling design and installation
AS 5100	Bridge design
AS/NZS 4671	Steel reinforcing materials
AS 1379	The specification and manufacture of concrete
AS 1478	Chemical admixtures for concrete
AS 1012	Methods of testing concrete

Where a discrepancy exists between this sub-section and the documents referenced herein, this sub-section shall take precedence.

(d) Certification

All designs shall be certified by a Registered Professional Engineer of Queensland (RPEQ).

Designs shall require a structural design certificate signed by an RPEQ prior to acceptance by Townsville Water and Waste. Acceptance of the design by Townsville Water and Waste does not relieve the designer of their legal or contractual obligations.

(2) Structural steelwork design

(a) General

(i) Scope

This section sets out the minimum requirements for the design of new steel structures and modifications to existing Townsville Water and Waste steel structures.
Typical Townsville Water and Waste steel structures include:

(A) reservoir tanks;

(B) monorails

(C) walkways / platforms and ladders; and

(D) buildings and sheds.

These guidelines do not apply to the design of other types of structures or the following materials:

- aluminium structures (except aluminium walkways/platforms and ladders);
- stainless steel; and
- composite structures.

Design incorporating these materials or relating to other structures shall be performed by suitably

experienced and competent persons.

(ii) Design and materials

All steelwork designs and materials shall conform to these guidelines, the relevant current versions of the standards listed in Table SC6.4.3.21.7 and the standards referred to within them.

(iii) Connections

The following applies:

(A) minimum design actions for connections shall be as per the relevant loading codes;

(B) generally bolted connections shall be designed to be a minimum of 2 x M20 8.8S bolts through 10mm thick cleats. Generally weld sizing shall be designed by using GP welds using E48XX welding electrodes;

(C) seal plates, where required, shall be a minimum of 6 mm thick;

(D) cast in bolts for structural purposes shall be galvanised and at least M12 diameter. Structural fixings to insitu concrete or masonry shall be a minimum of 2 x M12 bolts; and

(E) base plates shall be a minimum of 10 mm thick and grout shall be a minimum of 35 mm thick.

(iv) Protective coating systems

The following applies:

(A) generally, the protective coating system of the steelwork shall conform with current version of AS/NZS 2312 and Standards and documents referred to therein;

(B) painting where adopted shall conform with the current version of AS 1627 and AS/NZS 2311, and standards and documents referred to therein;

(C) all painting on the internal surface of water storage structures shall conform with the requirements of AS 4020 *Products for use in contact with Drinking Water;*

(D) galvanising, where required, shall conform with the current version of AS/NZS 4680, AS/NZS 4791, AS/NZS 4792, and standards and documents referred to therein;

(E) the design and detailing of members to be hot dipped galvanised shall take into account the recommendations of the Galvanizers Association of Australia;

(F) protection of steelwork by a protective wrap shall be in accordance with the manufacturer's recommendations and specifications and to the satisfaction of the designer; and

(G) protection of internal surfaces of water storage tanks by cathodic protection shall be in accordance with the current version of AS 2832.4 and standards and documents referred to therein.

(b) Reservoirs

Reservoir structures shall be designed for a minimum importance level of 3 according to the *Building Code of Australia* Table B1.2a.

Townsville Water and Waste has a preference for circular steel reservoirs, with a steel floor and roof structure. Typical "standard" reservoir details can be made available by Townsville Water and Waste, on request.

"Non-standard" reservoirs shall be designed using the principles outlined in AS 3774 *Loads on Bulk Solids Containers and Structural Design of Steel Bins for Bulk Solids* published by the Australian Institute of Steel Construction.

Reservoir Design criteria shall incorporate:

(i) bird and vermin proofing;

(ii) the roof shall ensure adequate ventilation and sufficient fall to ensure adequate drainage for the adopted roof sheeting;

(iii) steel purlins shall have downturned lips to the bottom flange and be oriented to prevent ponding of moisture;

(iv) roof falls shall allow for rafter and purlin deflections. The exposure of the site will determine the roof

sheeting finish and type;

(v) a lockable access cover shall be provided through the roof to allow access for internal cleaning. No permanent access to the interior of the reservoir shall be provided. Access shall be via temporary means only;

(vi) the design of the reservoir shall incorporate an access ladder or stairway from ground level to roof level, with lockable cage to restrict unauthorised access;

(vii) the roof design shall incorporate sufficient fall arrest restraints or hand railing around the perimeter;

(viii) the design of the floor shall consider cleaning and maintenance required in the future; and

(ix) the foundations of the entire tank structure shall be founded on undisturbed parent material. Founding on fill material is not permitted.

(c) Monorails

The following applies:

(i) monorail beams and supports shall be designed in accordance with AS 4100 and AS 1418.1;

(ii) the safe working load (SWL) shall be clearly and permanently marked (not painted) on all monorails beams;

(iii) the minimum SWL shall be determined by the functional requirements of the monorail, but shall not be less than a minimum lift weight of 1000 kg;

(iv) unless known otherwise, monorail beams shall be designed based on the assumption that the centre of bearing of the trolley wheels is on the edge of the beam flange;

(v) deflections of monorails beams and supports shall not impair the functioning of the monorail but in no instances shall exceed the span/500;

(vi) the number of load cycles shall be calculated for each individual monorail based on a minimum design life of 50 years;

(vii) all monorail beams shall be load tested after erection; and

(viii) the design of the monorail beam shall consider future maintenance requirements.

(d) Walkways/Platforms and Ladders

The following applies:

(i) walkways, platforms and ladders shall be designed in accordance with AS 1657;

(ii) generic products conforming with the above Standard may be utilised;

(iii) all ladders greater than 2.5 m high shall be provided with a cage complying with AS 1657;

(iv) walkways, platforms and ladders may be galvanised, stainless steel or aluminium;

(v) where possible riser and going dimensions on stairs shall conform with both AS 1657 and the BCA; and

(vi) no ladders or stairs shall be designed for access to confined spaces as defined by workplace health and safety unless approved by council.

(e) Sheds

Typically, design of sheds will be outsourced to suitably experienced and competent persons.

(3) Concrete design

(a) General

(i) Scope

This section sets out the minimum structural requirements for the design of reinforced and plain concrete members, and reinforced concrete masonry block work for Townsville Water and Waste. Specifically, this section provides guidelines for the design of the following types of structures:

(A) thrust blocks, valve and fittings pits associated with pipelines;

(B) bored piers;

(C) slabs on ground;

(D) concrete pavements

(E) manholes;

(F) pump stations and wet walls; and

(G) retaining walls.

These guidelines do not apply to the design of post tensioned concrete. Design incorporating post tensioned concrete or relating to other structures shall be performed by suitably experienced and competent persons.

(ii) Design and materials

All concrete and false work designs and materials shall conform to these guidelines, the current relevant versions of the standards listed in Table SC6.4.3.21.8 and standards referred to within them.

All reinforcement and concrete materials shall be sourced from a quality assured manufacturer of such products.

Splicing and lapping of reinforcement shall be as per the requirements of AS 3600. All exposed corners shall be designed for a 25 x 25 chamfer.

The use of low ductility mesh as reinforcement in suspended concrete should be avoided.

(iii) Minimum concrete requirements

Concrete grades and cover for reinforcement shall be in accordance with the appropriate exposure classification in AS 3600 and AS 3735 with minimum values as set out in Table SC6.4.3.21.8.

Table SC6.4.3.21.8 Minimum concrete strengths

Construction Element	Minimum Concrete Strength
Access cover (sewer and stormwater)	N32
Thrust blocks	N20
Concrete surrounds for sewerage house connection branches	N20
Bored pier footings	N25
Pump stations and wet wells	N40
General concrete works (sign post bases, bases for post and rail fences etc.)	N20

Minimum reinforcement in reinforced concrete members shall conform with the requirements of AS 3600, AS 3735, AS 5100 or AS 2159.

(b) Thrust blocks and valve pits

Thrust blocks shall be sized in accordance with SC6.4.4.8 Standard drawings SD-371 Thrust Block Details – Concrete Blocks.

Valve pits shall be sized to provide adequate clearance around valves, pipes and fittings to allow for operations, maintenance and repair of the equipment. Pits required to provide in-line thrust shall be designed accordingly, taking into account the allowing bearing capacity of the soils. Pits shall be provided with lockable aluminium lids; and the designer is to refer to WSA-03 for detailing requirements for valve chambers.

(c) Bored piers

Bored pier design shall take into account the design loads and soil parameters. Soil parameters for the design of piers may be assessed visually by suitably experienced and competent persons if deemed suitable for the application.

Typically bored piers for building applications shall be a minimum size of 450 mm diameter by 900 mm deep in undisturbed ground. When steelwork is cast into piers the top surface of the concrete pier shall be worked to provide a positive fall away from the steelwork to the outside of the pier.

(d) Slab on ground

Slabs and footings for habitable buildings shall be generally designed and constructed in accordance with AS 2870. Assessment of site reactivity shall be in accordance with requirements of AS 2870. Beam

layouts and depths shall be as per AS 2870 except that all footings shall be continuous at re-entrant corners.

Non habitable buildings shall be designed using the guidelines in *Guide to Industrial Floors and Pavements* published by the Cement, Concrete and Aggregates Australia. The possible future uses of the building should be considered in determining the appropriate design for the slab and footings.

Minimum slab thickness shall be 100 mm and minimum reinforcement shall be SL72. Slab thicknesses and reinforcement shall be sufficient to support any loads from plant and maintenance equipment and sufficient to provide adequate cover to any slab fixings.

(e) Concrete pavement

Concrete pavement shall only be designed by suitably experienced and competent persons. Concrete pavement shall be designed in accordance with sub-section SC6.4.4.2 Pavement design and all standards and documents referred to in them.

(f) Access covers

Access covers shall be circular, and sized in accordance with the current version of the following standard drawings:

(i) SD-510 Maintenance Holes; Typical Manhole Cover Arrangements;

(ii) SD-205 Stormwater Manhole Details;

(iii) SD-210 Precast Stormwater Manhole Slab Top Details; and

(iv) SD-475 Typical MH Cover Arrangements.

(g) Pump stations and wet well materials

Pump station buildings shall be constructed from reinforced concrete and/or reinforced masonry block. Wet wells shall be constructed from reinforced concrete. Drainage of below ground structures shall be considered in the design.

Other materials (e.g. GRP) are subject to approval from council.

The structure shall be sized to allow for adequate clearances for maintenance and replacement work, with appropriate clearances for different valves and fittings. No permanent access ways shall be constructed within pump stations or wet wells. The size of the structure shall be the most cost effective combination allowing for concrete, reinforcement and formwork costs.

(4) Fencing and security

Townsville Water and Waste assets will generally require an assessment of fencing and security issues, some security designs are shown in Attachment C: General facility security.

(a) Reference and source documents

The following references shall be consulted.
Disaster Management Act 2003
AS/NZS 4360 *Standard for Risk Management*
Emergency Management Australia - *Critical Infrastructure Emergency Risk Management and Assurance* handbook to support AS/NZS 4360
Queensland Government - *Securing Queensland's Critical Infrastructure: Guideline for Owners/Operators*
LGAQ - *Local Government Counter Terrorism Risk Management Kit*
The National Security Australia web site www.nationalsecurity.gov.au

(b) Minimum fencing requirements

The minimum requirement shall be a 2.8 m high chain mesh fence with 4 barb extensions with top and bottom rails, with double access gates 6 m minimum width determined by site requirements as per SC6.4.3.21 Attachment C.

All gates shall be provided with the standard Townsville Water and Waste padlock.

Some installations may require additional interlocked padlocks for access by other services.

(5) Roads and access

(a) General

This section sets out the minimum requirements for the design of roads and accesses to Townsville Water and Waste facilities.

The facilities typically encountered include pump stations, storage reservoirs and roads, access and parking at treatment plants.

(b) Design standards

All roads, accesses and carparks shall be designed in accordance with the following sub-sections:

(i) SC6.4.4.1 Geometric road design; and

(ii) SC6.4.4.2 Pavement design.

(c) Minimum requirements

All weather sealed access for maintenance vehicles shall be provided including:

(i) sealed asphalt access road, minimum pavement width 4 m (spray sealed access roads may be considered for longer accesses or lower longitudinal grades in areas where vehicles do not manoeuvre);

(ii) special surface treatments e.g. pavers may be required for aesthetic reasons or usage/transport of chemicals at some facilities;

(iii) provide access during a 1% AEP flood event;

(iv) road geometry suitable for use by light vehicles and single axle trucks, including vertical alignment check to ensure vehicle clearance. All turning movements shall be analysed with turning path software. Three point turns are allowed for access at pump stations;

(v) bunding of tanker unloading areas will be necessary as well as associated storage and pump-out facilities; and

(vi) all accesses shall be provided with suitable signage and line marking.

(6) Stormwater drainage

(a) General

This section sets out the minimum requirements for stormwater drainage at Townsville Water and Waste facilities.

(b) Design standards

All stormwater drainage shall be designed in accordance with SC6.4.4.4 Stormwater drainage design.

(c) Minimum design requirements

The following are minimum requirements for consideration during stormwater design:

(i) all Townsville Water and Waste facilities shall be above the 1% AEP flood level plus 300 mm freeboard and above the 0.2% AEP storm surge level;

(ii) all accesses shall be above the 1% AEP flood level, where possible;

(iii) the design shall allow for both primary and secondary drainage paths;

(iv) the issue of contaminated water shall be addressed and pollution traps may be necessary; and

(v) erosion and sediment control plans shall be prepared for all projects.

(7) Site regrading

(a) General

This section sets out the minimum requirements for site regrading at Townsville Water and Waste facilities.

(b) Design standards

(c) All site regrading shall be designed in accordance with SC6.4.4.5 Earthworks. Minimum design requirements.

The following are minimum requirements for consideration during site regrading design:

(i) a geotechnical investigation may be necessary by a suitably qualified consultant;

(ii) excavation may expose acid sulfate soils and this must be addressed in accordance with

legislation;

(iii) excavation may expose hazardous substances and this is to be addressed in accordance with workplace health and safety legislation; and

(iv) if blasting is necessary suitably qualified personnel are to be consulted and all safety approvals and public consultation requirements are to be addressed.

Note—SC6.4.3.24 Geotechnical investigations, specifies requirements for undertaking geotechnical investigation works. Part 9.3.2 Healthy Waters Code of Townsville City Plan has requirements regarding ASS/PASS and accords to State requirements.

(8) Landscaping

Where specified, some Townsville Water installations will require landscaping. Refer to requirements in SC6.4.3.6 Landscaping policy.

(9) Blasting activities

All purposed blasting activities must be designed and certified by an RPEQ and specifically state that there will be no structural impact on council infrastructure. Refer to SC6.4.5 Construction management and SC6.4.6.10.4 Blasting general, for use of explosives during construction.

(10) Drafting deliverables

All drafting shall be to current Australian Standards.

All drawings submitted for approval shall be provided in A3 size paper format or digital PDF format as determined by the Townsville Water and Waste project officer.

Final drawing submission shall comprise the following:

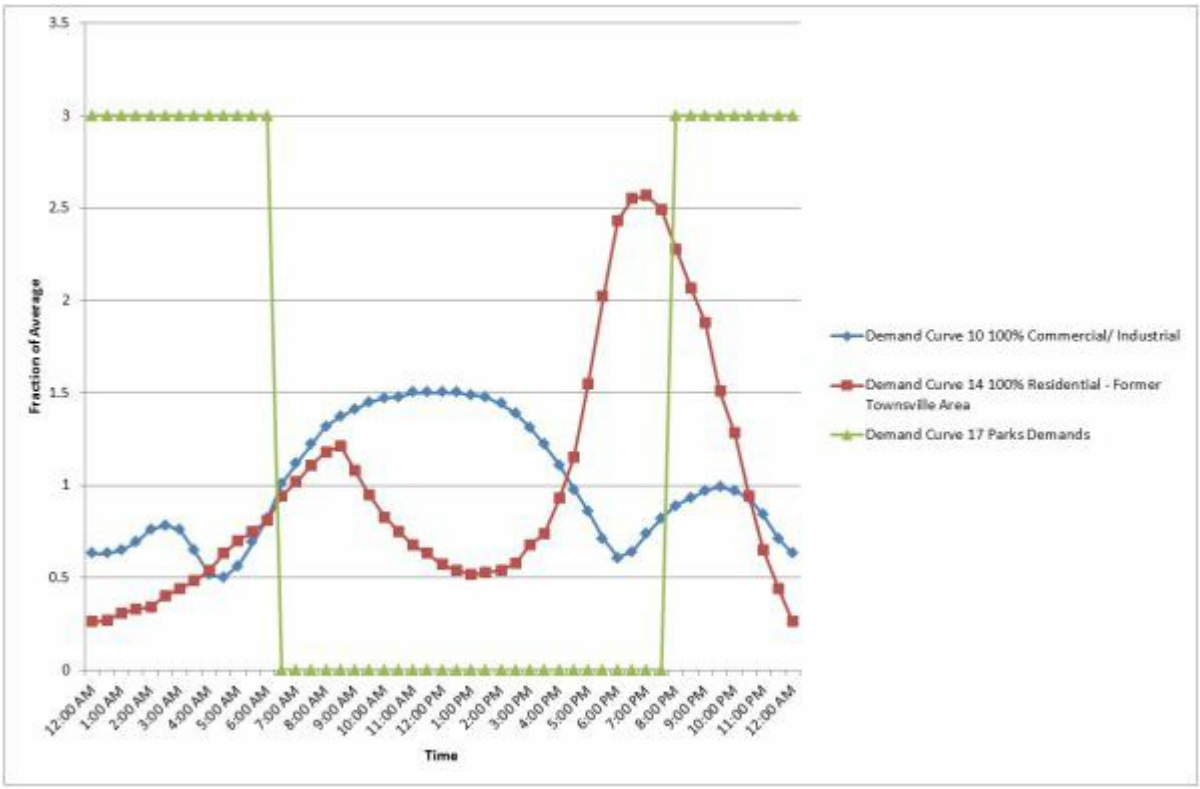
(a) digital DWG file in AutoCAD 2008 format on CD;

(b) digital PDF file on CD; and

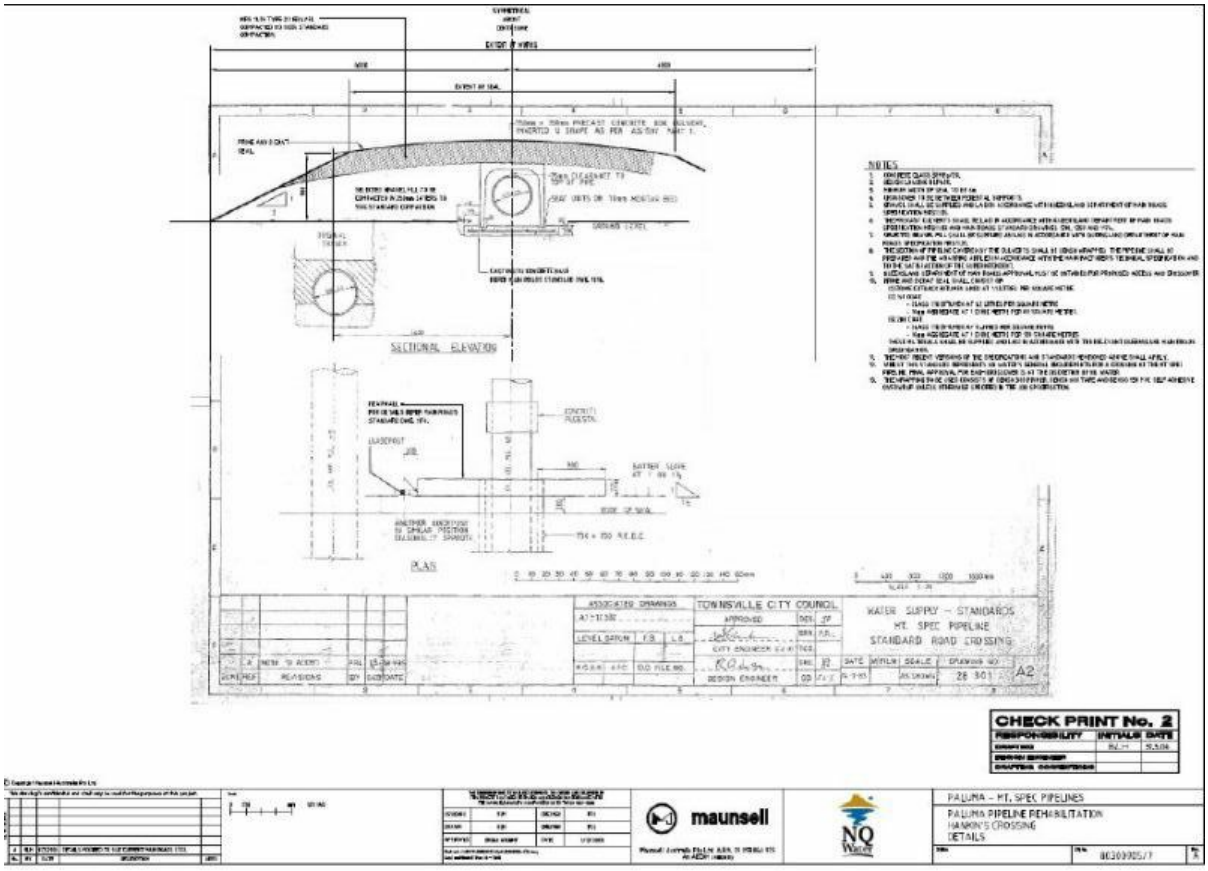
(c) one x A3 size paper copy.

SC6.4.3.21 Attachment A – Water supply diurnal patterns

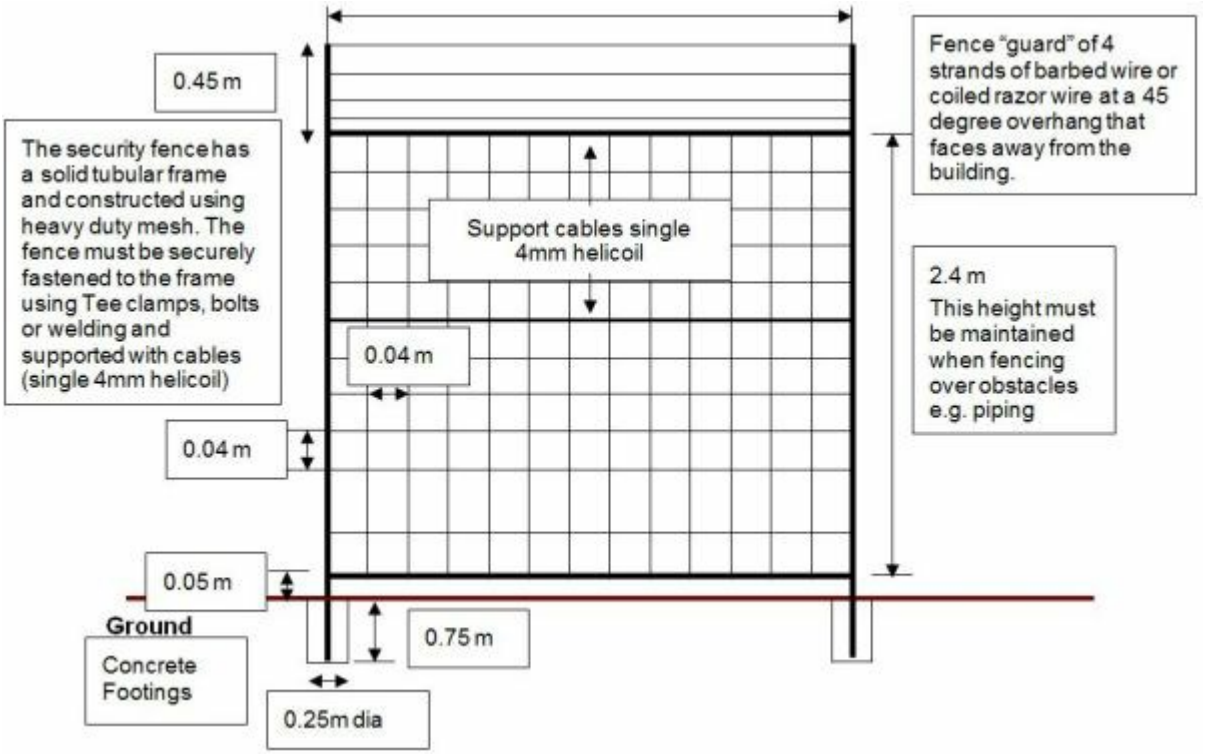
TIME	Demand Curve 10	Demand Curve 14	Demand Curve 17
	100% Commercial/ Industrial	100% Residential - Former Townsville Area	Parks Demands
12:00 AM	0.63	0.26	3
12:30 AM	0.63	0.27	3
1:00 AM	0.65	0.31	3
1:30 AM	0.69	0.33	3
2:00 AM	0.76	0.34	3
2:30 AM	0.78	0.40	3
3:00 AM	0.76	0.44	3
3:30 AM	0.65	0.48	3
4:00 AM	0.52	0.54	3
4:30 AM	0.50	0.63	3
5:00 AM	0.56	0.70	3
5:30 AM	0.69	0.75	3
6:00 AM	0.82	0.81	0
6:30 AM	1.01	0.94	0
7:00 AM	1.12	1.02	0
7:30 AM	1.22	1.11	0
8:00 AM	1.32	1.18	0
8:30 AM	1.37	1.21	0
9:00 AM	1.41	1.08	0
9:30 AM	1.45	0.95	0
10:00 AM	1.47	0.83	0
10:30 AM	1.48	0.75	0
11:00 AM	1.50	0.68	0
11:30 AM	1.50	0.63	0
12:00 PM	1.50	0.57	0
12:30 PM	1.50	0.54	0
1:00 PM	1.49	0.52	0
1:30 PM	1.48	0.53	0
2:00 PM	1.44	0.54	0
2:30 PM	1.39	0.58	0
3:00 PM	1.31	0.68	0
3:30 PM	1.22	0.74	0
4:00 PM	1.11	0.93	0
4:30 PM	0.98	1.15	0
5:00 PM	0.86	1.55	0
5:30 PM	0.71	2.02	0
6:00 PM	0.61	2.43	0
6:30 PM	0.64	2.55	0
7:00 PM	0.74	2.57	0
7:30 PM	0.82	2.49	0
8:00 PM	0.89	2.28	3
8:30 PM	0.93	2.07	3
9:00 PM	0.97	1.88	3
9:30 PM	0.99	1.51	3
10:00 PM	0.97	1.28	3
10:30 PM	0.93	0.94	3
11:00 PM	0.84	0.65	3
11:30 PM	0.71	0.44	3
12:00 AM	0.63	0.26	3



TCC Daily Diurnal Variations

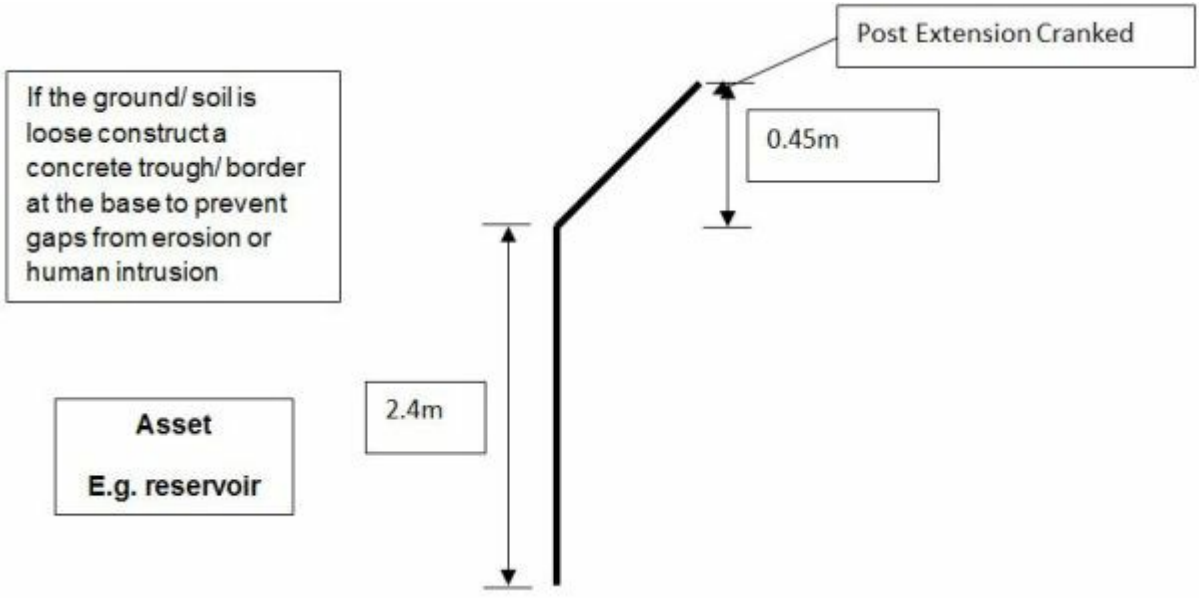


SC6.4.3.21 Attachment B – Standard road crossing



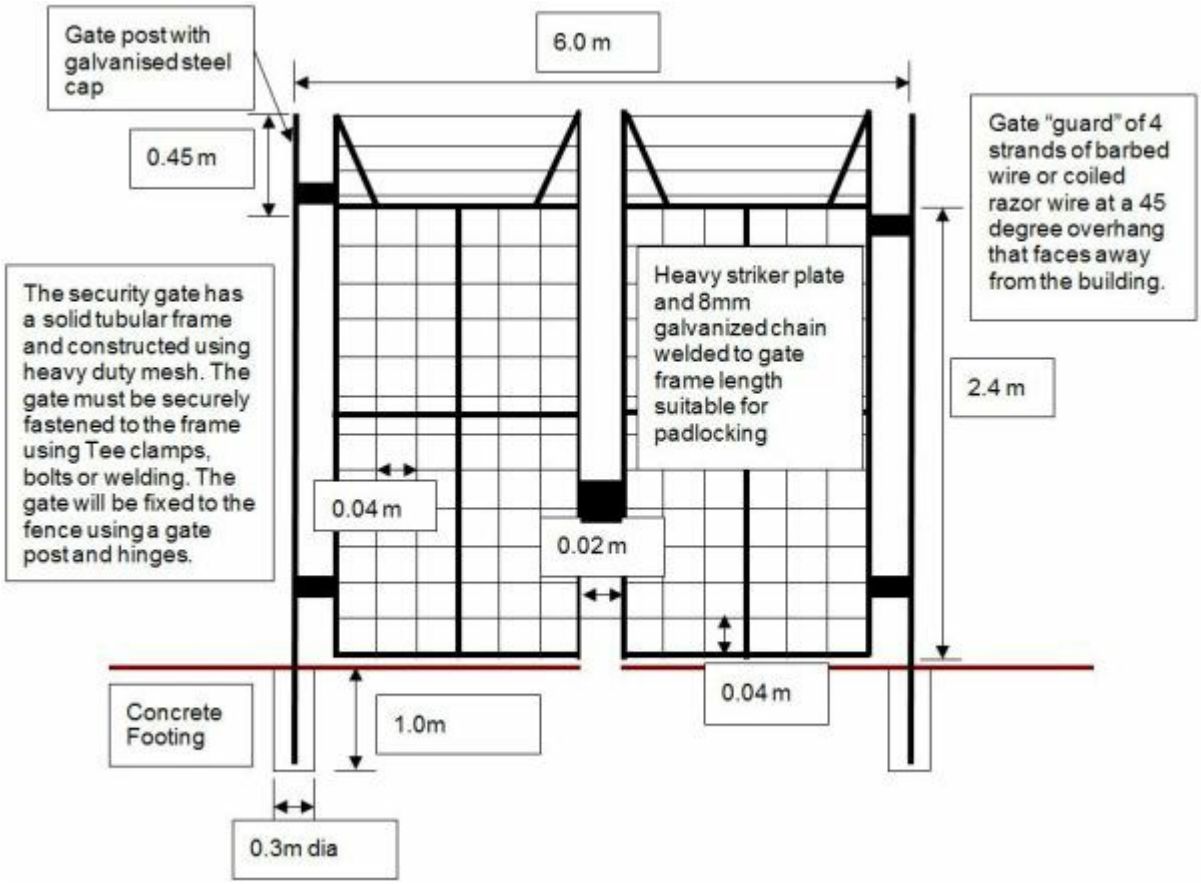
Security Fence Design Specifications
Figure SC6.4.3.21.1 Front view

SC6.4.3.21 Attachment C – General facility security



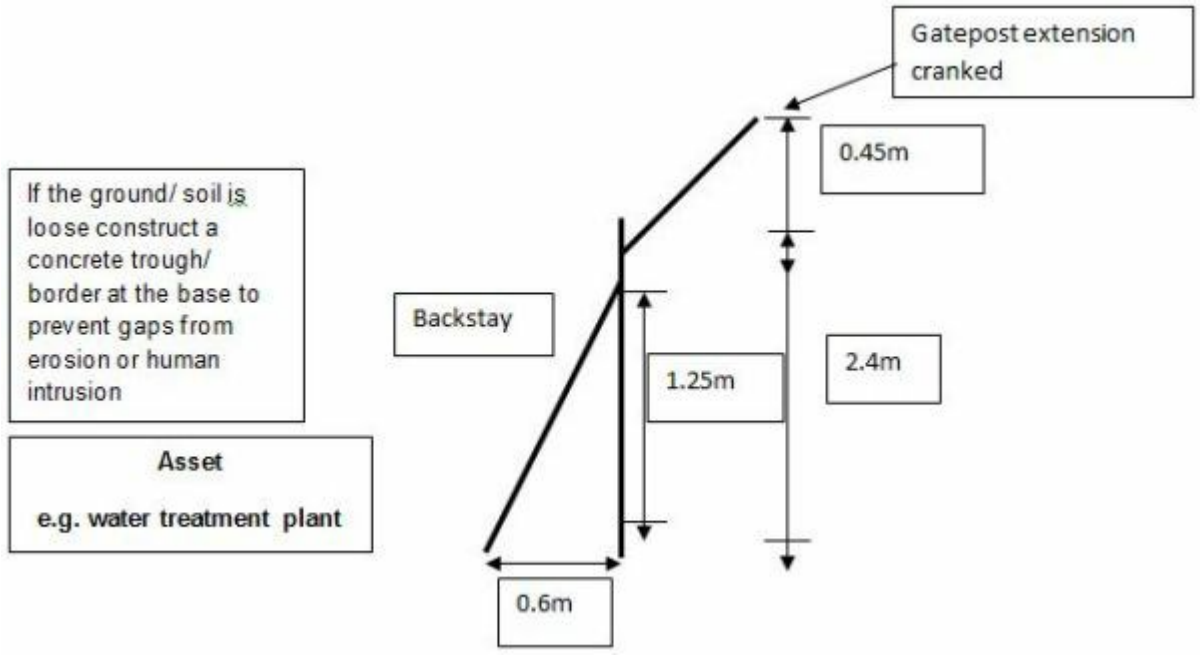
Security Fence Design Specifications
Figure SC6.4.3.21.2 Side view

SC6.4.3.21 Attachment C – General facility security



Security Gate Design Specifications
Figure SC6.4.3.21.3 Front View

SC6.4.3.21 Attachment C – General facility security



Security Gate Design Specifications
Figure SC6.4.3.21.4 Side View

SC6.4.3.21 Attachment C – General facility security

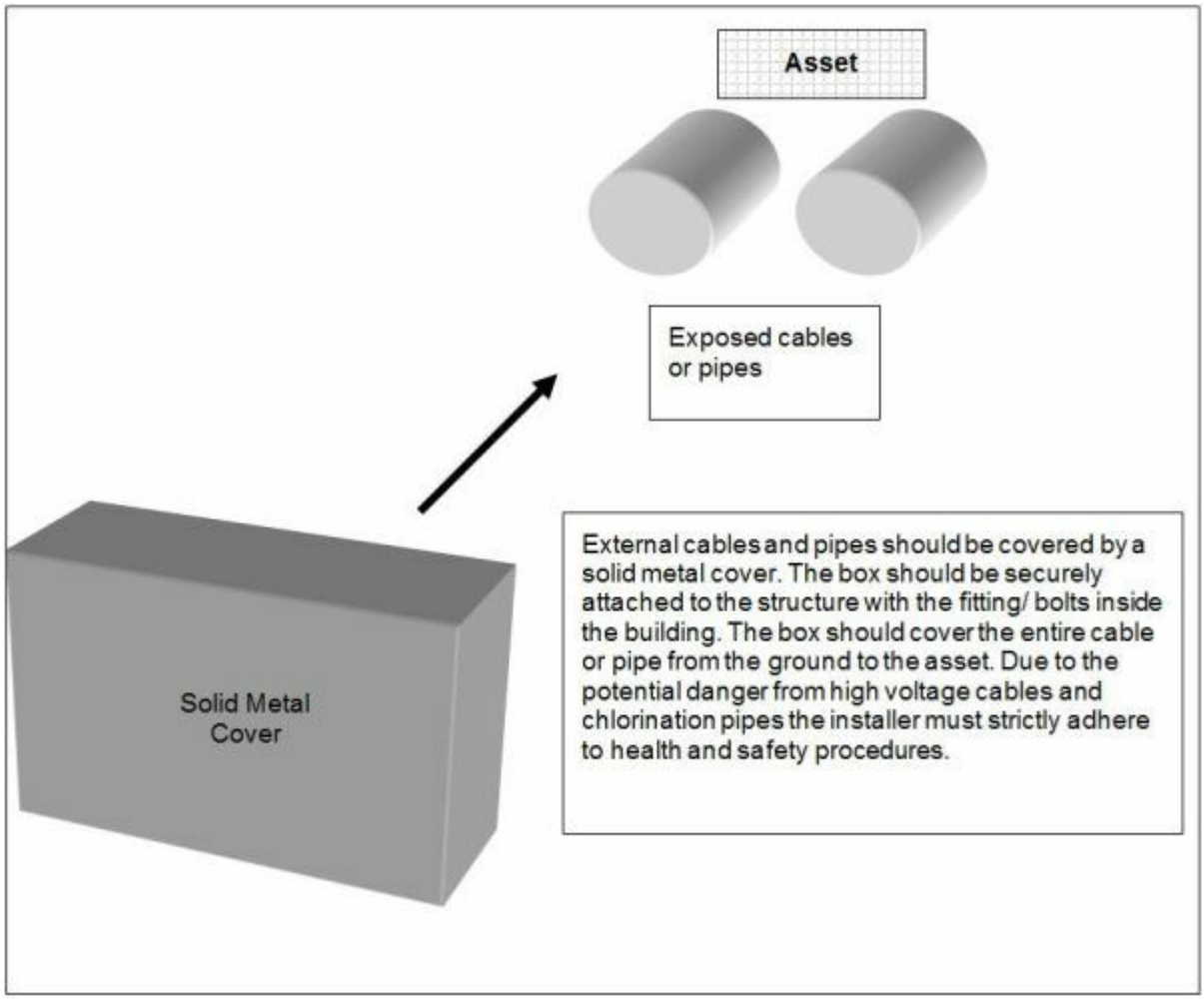


Figure SC6.4.3.21.5 External Cable and Pipe Cover Design Specifications:

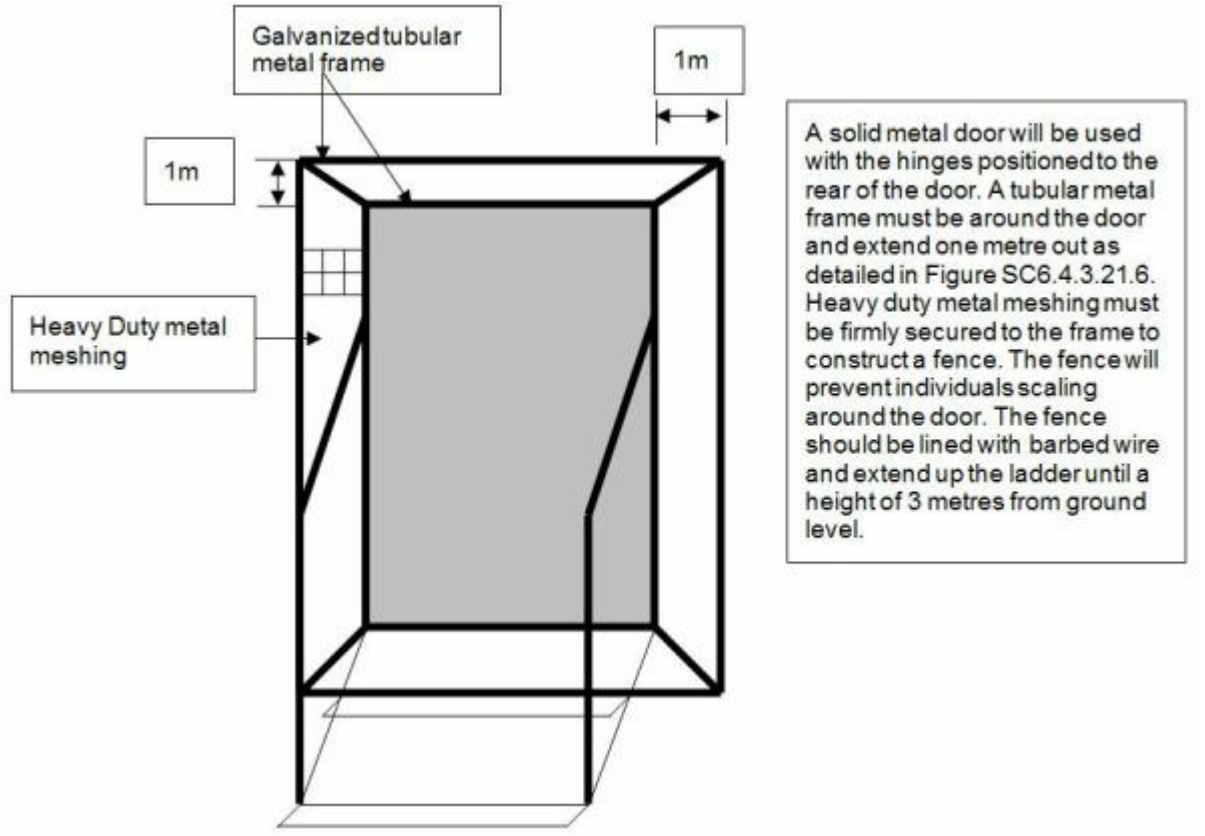


Figure SC6.4.3.21.6 Front View

Stairs or Bridge Gate Design Specifications:

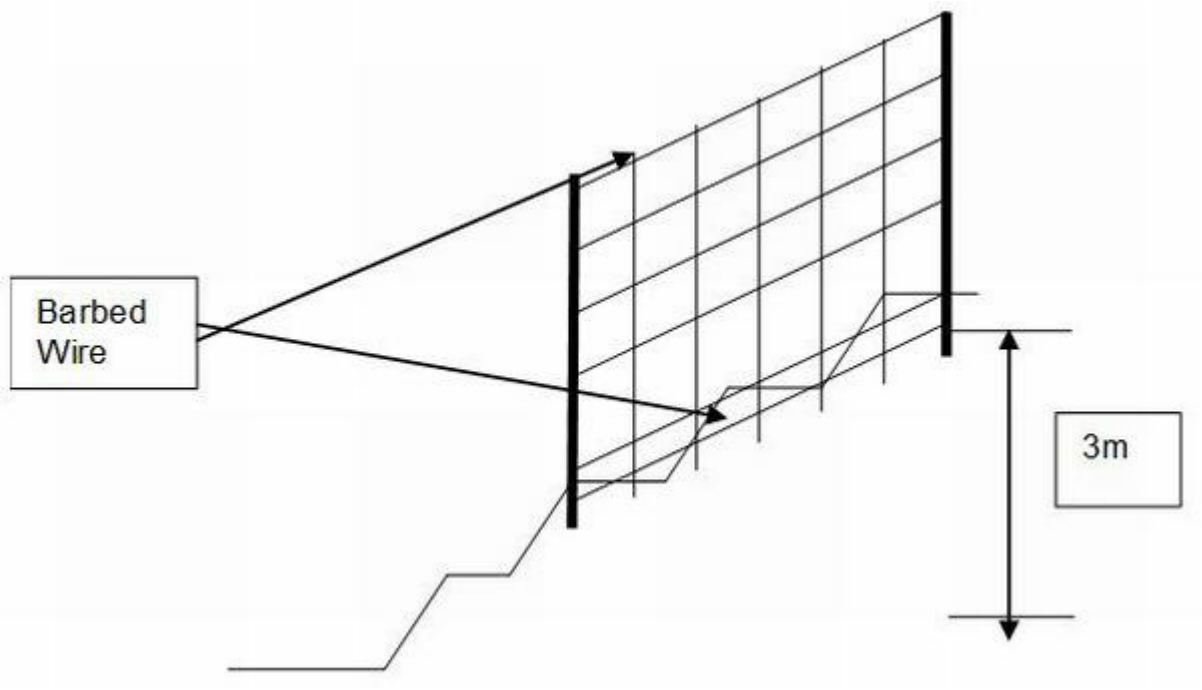


Figure SC6.4.3.21.7 Side View

Stairs or Bridge Gate Design Specifications:

SC6.4.3.22 Waste management guidelines

SC6.4.3.22.1 Introduction

(1) Purpose

The purpose of the Waste management guidelines is to:

(a) ensure development provides for the functional management of waste in a manner which is environmentally acceptable, safe and efficient and that does not have adverse amenity impacts on external properties or internal development;

(b) provide general guidelines and advice about achieving waste management outcomes of Townsville City Plan and satisfying any assessment criteria which identifies this planning scheme policy sub-section as providing that guidance or advice;

(c) state standards for waste management, storage and servicing identified in assessment criteria and which identifies this planning scheme policy sub-section as providing the standards; and

(d) provide guidelines about the preparation of a waste management plan.

(2) Reference and source documents

Reference and source documents and other policy sub-sections listed below shall be used, applied and read in conjunction with this planning scheme policy sub-section.

(a) Development manual planning scheme policy sub-sections that are to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscaping
SC6.4.3.17 Driveways
SC6.4.4.1 Geometric Road Design

(b) Legislation
Environmental Protection Regulation 2008
Environment Protection (Water) Policy 2009
Environmental Protection (Waste Management) Regulation 2000

(c) Townsville City Council
Townsville Waste Services Requirements for Waste Chute Guidelines, 2012
Liquid Trade Waste Policy, 2009

(d) Australian Standards
AS/NZS 3816 - *Management of clinical and related waste*
AS/NZS 2890 - *Parking facilities*
AS 4123 – *Mobile waste containers*

SC6.4.3.22.2 Waste management plans

Where proposed developments are likely to generate unusual or large amounts of waste, a waste management plan (WMP) may be required in demonstration of providing appropriate waste storage and waste servicing.

(1) Council may require submission of a waste management plan for development involving the following development thresholds:

(a) a residential use with more than 10 dwellings;

(b) a business/commercial/industrial use with a gross floor area greater than 500m² or any use likely to generate large or unusual amounts of waste, including educational establishment, rooming accommodation, hotel major sport, recreation and entertainment facility;

(c) an environmentally relevant activity (as defined by Schedule 1 of the *Environmental Protection Regulation 2008)* and/or development involving the use of a hazardous materials or chemicals;

(d) operational works involving substantial waste materials resulting from removal and construction of new infrastructure or demolition and major earthworks; and

(e) another use or activity where identified as having significant waste management requirements.

(2) Where WMPs are required to support a development application, it should be tailored to the needs of the proposal.

(3) Short-term activities or small-scale, uncomplicated developments require relatively simple and short WMPs.

(4) Larger proposals will require detailed plans covering the different stages of the development, operations or works program.

(5) A WMP should be submitted detailing how the proposal will meet the requirements of the Townsville City Plan and consider the following issues:

(a) Residential applications:

(i) types and amounts of waste that may be generated based on number of dwellings;

(ii) how the waste will be disposed including number of mobile storage bins or nomination of a suitable size bulk bin;

Note—all residential waste must be removed by council.

(iii) access and egress for council waste collection vehicles;

Editor's note—applicants should refer to sub-sections SC6.4.3.5 Car parking and public transport facilities guidelines and SC6.4.3.17 Driveways for additional information on design and access requirements.

(iv) screening of waste facilities by landscaping or other suitable means and where required, nomination of separation distances to property boundary or other residential buildings;

Editor's note—applicants should refer to sub-section SC6.4.3.6 Landscaping for additional information regarding landscape treatments.

(v) design of facility incorporating requirements from SC6.4.3.22.3 Waste management for development and Table SC6.4.3.22.1 General requirements;

(vi) sensitivity of the receiving environment and neighbouring residents (adequate setbacks of waste areas from adjoining property boundaries so as to prevent odour, dust or noise nuisance);

(vii) nomination of collection times where bulk refuse containers are required to protect nearby and on-site sensitive land use; and

(viii) designated bin wash down facilities to be identified for the contained cleaning of waste bins.

Note—bin washing water is not to be disposed of into stormwater facilities.

(b) Commercial and industrial applications:

(i) types and amounts of waste that may be generated by the authorised activities;

(ii) how the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with;

(iii) procedures for identifying and implementing opportunities to minimise the amount of waste generated, promote efficiency in the use of resources, and otherwise improve the waste management practices employed, including recycling;

(iv) access and egress for those disposing waste and waste collection vehicles;

Editor's note—applicants should refer to SC6.4.3.5 Car parking and public transport facilities guidelines and SC6.4.3.17 Driveways for additional information on design and access requirements.

Note—if the waste is stored in a secured underground shelter, then the waste must be taken out and presented to Townsville Waste Services on collection day.

(v) noise management for collection (collection methods and times);

(vi) screening of waste facilities by landscaping when used in combination with other suitable means and where required, nomination of separation distances to property boundary or other sensitive land uses;

Editor's note—applicants should refer to sub-section SC6.4.3.6 Landscaping for additional information regarding landscape treatments.

(vii) details of any accredited management system employed, or planned to be employed, to deal with the waste;

(viii) how often the performance of the waste management practices will be assessed;

(ix) the indicators or other criteria on which the performance of the waste management practices will be assessed;

(x) staff training on matters relevant to waste management;

(xi) details of the responsible person for implementing the WMP;

(xii) procedures for dealing with accidents, spills and other incidents;

(xiii) sensitivity of the receiving environment, and neighbouring residents (adequate setbacks of waste areas from adjoining property boundaries so as to prevent odour, dust or noise nuisance);

(xiv) management of odour;

(xv) extent and life of the proposed activities;

(xvi) details of bunding arrangements to contain waste where appropriate; and

(xvii) designated bin wash down facilities to be identified for the contained cleaning of waste bins.

Note—bin washing water is not to be disposed of into stormwater facilities.

(6) Council may request other reasonable management strategies in relation to individual developments.

(7) The WMP must be implemented during construction and at commencement of the use or the signing of the survey plan.

(8) WPMs should take into account any staging of a development.

(9) Consideration of screening treatments will include ensuring structural safety, durability to minimise whole of life costs, and where practical, integration into the building design and constructed from similar materials used in the building design (integration). Screening must be to a minimum of the height of the bins used and should ensure screening addresses adjoining uses and public spaces.

(10) Any amendments to a WMP must not be implemented until approval from council is received.

SC6.4.3.22.3 Waste management for development

(1) The waste management standards for development are identified in the following section and in Table SC6.4.3.22.1 General requirements.

(2) In addition to the requirements of Table SC6.4.3.22.1 General requirements, the following standards shall be considered for development:

(a) access for a refuse collection vehicle to an on-site or kerbside bin or a compactor is maintained at all times; or

(b) "No Standing Any Time" signs are to be installed in designated refuse truck turning areas including residential developments, cul-de-sacs and other locations to enable safe access for waste refuse vehicles; or

(c) a development application is to indicate the days and times that a refuse removal service is to operate. If evidence from a refuse collection contractor indicates that collection will occur outside normal service/delivery or business times, it may be permissible to allow a refuse collection vehicle to utilise

service bays or parking spaces on the site for access; or

(d) where applicable, development is to provide the vertical and horizontal clearances for the service to safely and efficiently operate. Unless otherwise stated in Table SC6.4.22.1 General requirements, the minimum vertical clearance required for movement of a refuse collection vehicle is 6.5m. Larger operational clearance dimensions may be required depending on site specific requirements; or

(e) where applicable, a development that proposes to utilise a waste collection system requiring clearances less than 6.5m for vehicle movement is to include a written confirmation from the proposed waste collection provider giving full details of the proposed system, bin sizes, number of bins, frequency of collection and the refuse collection vehicle size; or

(f) all refuse collection for residential development is to be collected by council, whilst office refuse may be collected by the council or a private operator and retail, shop or industrial refuse collection is to be collected by a private operator; or

(g) whether domestic refuse collection is from a bulk storage area or bins located throughout a unit development, all circulation and access roads utilised by a refuse vehicle are to be a minimum of 6.5m wide; or

(h) where a development has access onto a road, all refuse collection is from within the site. For access to a road the refuse truck is required to enter and leave the site in a forward direction; or

Editors note - Applicants should refer to SC6.4.3.13 Townsville road hierarchy for additional information.

(i) industrial development is to indicate the location of the refuse collection area in the development application and provide an indication of the proposed method of disposal of refuse and waste, including trade waste. Where disposal of industrial or commercial liquid waste by discharge to a road tanker application is necessary, the road tanker is able to stand totally on-site and comply with all other relevant regulations; or

(j) the owner/occupier must keep the bins clean, in good repair and securely covered.

(k) the property must be designed to store the bin/s at ground-level, and generally located towards the rear of the premises or, if not, out of sight of the general public, except when put out for collection (one day maximum); or

(l) where required, the property must be designed to facilitate the placing of the bin/s out (on the specified collection day) as follows:

  (i) on, or as close as possible to, the kerb adjacent to the premises, with the bin axle away from the road;

  (ii) with no structure or obstacle preventing the waste/ recycling crew from picking the bin up; and

  (iii) with at least 500mm spacing between the bins; or

(m) particular serviced premises may be required to keep the bin on an elevated platform or an imperviously paved area, enclosed and/or with drainage; or

(n) council may also instruct certain residential premises to dispose of their waste by an approved environmental licensed authority.

(3) Applications must ensure that adequate unhindered access for waste collection vehicles is possible, ensuring that not only the road reserve widths accommodate a waste collection vehicle, but that vehicles can safely and efficient collect kerb side waste.

(4) Waste collection from properties in cul-de-sac heads or hammer heads may require kerb side concrete hardstand areas to be constructed to ensure that kerb side collection remains possible. SC6.4.3.22.5 Concrete hardstand design for wheelie bins provides the design specification for kerb site domestic wheelie bins.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(5) Waste collection from a laneway is only permitted when the laneway has through access, sufficient width to accommodate the waste collection vehicle and the identification of wheelie bin collection points. Overhead

services also need to be clear of the waste collection area.

(6) Private access handles where multiple lots may be serviced from are not accessible by a waste collection vehicle. In such instances, a safe designated kerb side collection point is to be nominated. SC6.4.3.22.5 Concrete hardstand design for wheelie bins provides the design specification for kerb side domestic wheelie bins.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(7) Where waste collection points are nominated away from the property being serviced (cul-de-sacs, laneways, access handles), nominated collection points are not permitted adjacent to a park and are not to compromise the safe use or access to pedestrian or other utility service.

Editor's note—applicants may be asked to submit a plan demonstrating the location of waste collection points.

(8) Where staged residential estates result in temporary no through connection roads (for example, until subsequent stage construction is complete), compacted gravel (or equivalent) is required to be created at the end of a constructed road within a public tenure (i.e. road reserve).

Editor's note—waste collection vehicles will not be permitted to use privately owned land to turnaround.

(9) In instances where roads terminate to adjoining land and adjoining land is in separate/different ownership or not subject to the development application, applicants will need to provide a turnaround area within the development site until future through connection can be established. In this instance, the turnaround area will need to be constructed of durable material.

(10) If a rear lot, the frontage is to include an additional truncated area to provide sufficient space for the servicing of mobile waste containers. These truncated collection points are to avoid obstructing any driveway or encroachment onto neighbouring frontages.

(11) If there are two or more rear lots, no more than two adjoining truncated areas are provided for the servicing of mobile waste containers.

(12) Collection points are not located:

(a) near intersections;
(b) near roundabouts or traffic calming devices (or other traffic management devices);
(c) on arterial road frontages;
(d) in narrow lanes (where refuse collection vehicle access is difficult or impossible); and
(e) near bus stops.

(13) Where on-street (kerbside) waste collection is proposed for standard domestic waste containers sufficient kerbside space is provided adjacent to the frontage of the premises for the required number of bins and such space is:

(a) clearly separated from car parking bays, loading bays and other similar no-standing areas;
(b) clear of overhanging branches, awnings and other such hindrances to servicing by a lifter arm;
(c) clear of footpaths and pedestrian access connections to the road;
(d) not in front of shop entrances or private residential premises;
(e) not blocking the vision of vehicles using the roadway or entering and exiting the property;
(f) capable of being serviced safely without the collection vehicle impeding traffic flow during servicing; and
(g) capable of being serviced while the collection vehicle travels forward (i.e. without the vehicle needing to

reverse).

SC6.4.3.22.4 Regulated waste guidelines

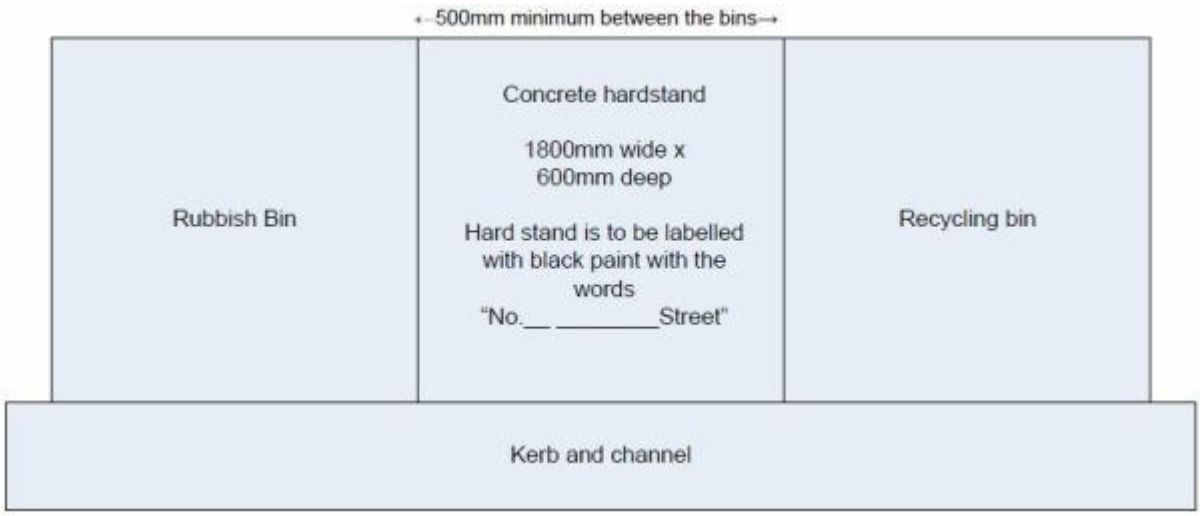
(1) Regulated waste is administered by the Department of Environment and Heritage Protection.

(2) Transport, storage, recycling or disposal of regulated wastes are environmentally relevant activities.

(3) Environmentally relevant activities that are prescribed activities are generally industrial activities but can also include some agricultural activities. A full list of all of the prescribed ERAs can be found in Schedule 2 of the *Environmental Protection Regulation 2008.*

SC6.4.3.22.5 Concrete hardstand design for wheelie bins

Where waste collection vehicles are unable to collect wheelie bins directly in front of a property due to access restrictions, owner/occupiers must take the bin/s to a designated collection point. The diagram below demonstrates the dimensions required for a hardstand for these bins at the designated collection point.



SC6.4.3.22.6 Examples of bin storage area

Figure SC6.4.3.22.1 Concrete hardstand for mobile waste containers or a bulk bin

A: Courtside entrance: The height of the roof is 1m in the middle receding downwards.
B: Interior: The height is 2.5m to the top of the pillar/ gutter level.
C: Exterior entrance: The gate is 1.9m of the total 4m depth and is accessed by a key.
D: Kerbside view.

Figure SC6.4.3.22.2 Enclosed concrete hardstand for bulk waste and recycling mobile waste containers

SC6.4.3.22.7 Bulk bin specifications

Note—refer to AS 4123 for the standard sizing of bulk bins. Bulk bins must be ordered well in advance to ensure availability.

Table SC6.4.3.22.2 Bin dimensions in litres (L) and cubic metres (m^3)

Recycling and Waste bins available for units, multi-dwelling units and commercial units
240 L plastic
360 L plastic (recycling)
Bulk Recycling and Waste bins available for multi-dwelling units and commercial units
660 L plastic/metal
1100 L metal
Bulk Waste bins available for multi-dwelling units and commercial units
0.75 m^3 metal
1 m^3 metal
1.5 m^3 metal
3.0 m^3 metal
Bulk Waste bins available for commercial units
4.0 m^3 metal

Table SC6.4.3.22.3 Weekly bin collections in relation to bulk bin size

Number of units (dwellings)	Bulk bin Size	Collection frequency (per week)
6	0.75 m^3	Twice
6	1 m^3	Twice
6	1.5 m^3	Once
12	1.5 m^3	Twice
12	3 m^3	Once
24	3 m^3	Twice

Table SC6.4.3.22.1 General requirements

	General details	Access and collection	Locality of storage areas/design of facility
Residential (dwelling house dual occupancies)	Mobile waste containers (240 L) are used for both waste collection and recycling. Owner/occupiers may also choose to pay a small additional charge for a 360 L recycling bin.	Where sloping areas exist (≥15%), an adequate level hard stand area with sufficient space to accommodate all bins for collection is to be made available along the street frontage for the collection of mobile waste and recycling containers collected fortnightly. Refer to SC6.4.3.22.5 for an auto court concrete hardstand design for wheelie bins. Other arrangements may be negotiated.	Mobile waste containers must be stored at a location within the property boundary that avoids nuisance to neighbouring properties.

Residential (including multiple dwelling, residential care facility retirement facility and the like)	Developments containing a maximum of 10 dwellings will be issued with new mobile waste containers unless there is insufficient footpath to place the waste and recycling bins for collection. Where on-street access for collection of mobile garbage (wheelie) bins is not available, or multiple dwellings contain more than 10 dwelling (or similar) the developer must provide bulk refuse facilities. Refer to SC6.4.3.22.7 for more information on bulk bin collections. Recycling bins will be allocated at the rate of: 1-4 dwellings 1 bin per dwelling 5-10 dwellings 5 bins More than 10 dwellings 1 bin per 2 dwellings If constructing waste chutes, refer to council's Waste Chute guidelines.	Access roads must be designed and constructed to accept vehicle loadings of not less that G.V.M. 33 tonnes. If the road system is incapable of allowing waste vehicle access, tailored solutions will be negotiated with the developer in association with the Waste Services Division. Vehicles must be capable of exiting the site in a forward gear. A turning circle of 25m is required. Waste collection facilities are to be located within the curtilage of the premises in an accessible location to receive the service. Facilities should be sited in front of any entry gates to the building. Where security gates cross the driveway restricting vehicular access to the site, bin storage areas are to be located within property boundaries on the street side of the gate. A minimum overhead clearance of 6.5m is required (with an additional 2m if located near power lines). This must be unobstructed by anything overhead such as trees, wires, sails, awnings, fascia or other structures. Where sloping areas (≥15%) such as steep road reserves exist, an adequate level hard stand area with sufficient space to accommodate all bins for collection is to be made available along the street frontage for the collection of mobile waste containers (collected weekly), and recycling mobile waste containers (collected fortnightly).	For multiple dwellings where there is sufficient room for each dwelling to store their mobile waste containers; the resident of each dwelling is responsible for the storage of their bins (including recycling bins). Where there is insufficient space for individuals to accommodate their bins, a common waste storage area must be provided of a sufficient size to accommodate all bins (including recycling bins). Storage areas must provide convenient access for owners, tenants and collection vehicles. Refer to SC6.4.3.22.6 for examples of bin storage areas. Facilities must provide a suitable level enclosure with a concrete slab floor, graded and drained through an approved sediment/silt trap to a legal sewer connection. A hose cock and hose must be fitted in close proximity to the enclosure. Enclosure dimensions for bulk bins must exceed the size of the nominated bin size by at least 300mm at the rear and both sides and 600mm at the front; and be oriented to allow convenient access for collection. Where mobile waste containers are in use, an adequate storage area must be provided. Facilities must be enclosed/screened such that they are not visible from any street frontage.

Commercial and business industrial	The proprietor is to arrange for the removal of waste from the premises by a suitably licensed waste transport contractor. Putrescible waste arising from activities undertaken on this development must be collected and removed at periods not exceeding seven days. (a) The collection of waste is to be undertaken to minimise, so far as reasonably practicable, excessive noise to neighbouring occupants. The collection method must ensure that waste is adequately managed to prevent escape or contamination. (b) Where the development has the potential to generate or handle clinical and regulated waste material; clinical and medical related waste is to be handled in accordance with AS/NZS 3816; and the *Environmental Protection (Waste Management) Regulation 2000*. (c) Where practicable, all loading and unloading shall take place within the containment area (storage area). This area is to be constructed in such a way that any spills from loading or unloading are not permitted to escape to areas exposed to storm water. No clinical and related wastes shall be disposed of via the storm water drainage system. (d) Trade Waste is to be managed in accordance with council's Liquid Trade Waste Management Plan 2009.	Access roads and driveways must be designed and constructed to accept vehicle loadings of not less that G.V.M. 33 tonnes. Vehicles must be capable of exiting the site in a forward direction. A turning circle of 25m is required. A minimum overhead clearance of 6.5m is required (with an additional 2m if located near power lines). This must be unobstructed by anything overhead such as trees, wires, sails, awnings, fascia or other structures.	Facilities are to be located within the curtilage of the premises in an accessible location to receive the service. Facilities should be sited in front of any entry gates to the building. Where security gates cross the driveway restricting vehicular access to the site, bin storage areas are to be located within property boundaries on the street side of the gate. Adequate provision must be made for the collection of the waste storage containers within the premises. Storage of waste must not cause odour, dust or noise related nuisance to neighbouring properties. Facilities must provide a suitable level enclosure with a concrete slab floor, graded and drained through an approved sediment/silt trap to a legal sewer connection. A hose cock and hose must be fitted in close proximity to the enclosure. Bulk bin enclosure dimensions must exceed the size of the nominated bin size by at least 300mm at the rear and both sides and 600mm at the front; and be oriented to allow convenient access by the collection vehicle. Where mobile waste containers are in use, an adequate storage area must be provided. Facilities must be enclosed/screened such that they are not visible from any street frontage.

SC6.4.3.23 Water and sewer network modelling guidelines

SC6.4.3.23.1 Introduction

(1) General

Water and sewerage network models are important engineering technical tools that are used to inform both forward infrastructure planning and network design. Where used appropriately as part of the planning and design process, models can assist to achieve the following outcomes:

(a) value for money infrastructure delivery;

(b) utilisation of existing infrastructure to its full capacity; and

(c) provision of accurate information for future infrastructure planning decisions.

(2) Purpose

The purpose of these guidelines is:

(a) to outline an approach to the development of new models to enable a consistent approach to modelling to be followed by both council, external service providers and developers;

(b) to provide guidance regarding modelling approaches to demonstrate compliance of designs with SC6.4.3.21 Townsville Water planning and design guidelines; and

(c) to provide details on reporting requirements to be submitted as part of design reports and planning reports.

(3) Scope

SC6.4.3.23 Water and sewer network modelling guidelines are to be used in conjunction with:

(a) SC6.4.3.21 Townsville Water planning and design guidelines;

(b) Townsville City Plan; and

(c) *Planning Guidelines for Water and Sewerage*, Department of Environment and Water Supply (Latest version).

Editor's note - These guidelines are not intended for use in building hydraulic services or irrigation design.

(4) Terminology

AD	Average Day Demand
ADWF	Average Dry Weather Flow
CSS	Customer Service Standards
DAU	Development Assessment Unit Within TCC
DSS	Design Service Standards
EP	Equivalent Population
FF	Fire Flow Demand
GWI	Groundwater Infiltration
HGL	Hydraulic Grade Line
IP	Infrastructure Planning Unit Within TCC
MDMM	Mean Day Maximum Month
PD	Peak Day Demand
PDWF	Peak Dry Weather Flow
PIA	Priority Infrastructure Area
PIP	Priority Infrastructure Plan
PFTI	Plans For Trunk Infrastructure
PH	Peak Hour Demand
PWWF	Peak Wet Weather Flow
RPEQ	Registered Professional Engineer of Queensland
TCC	Townsville City Council
TWW	Townsville Water and Waste (The Water Service Provider)

SC6.4.3.23.2 Determining when to complete a network modelling analysis

The circumstances under which a network model is required is listed under clauses SC6.4.3.21.2 Water supply design and SC6.4.3.21.3 Sewerage system design of SC6.4.3.21 Townsville Water planning and design guidelines. The process flow chart in SC6.4.3.23 Attachment A demonstrates the decision process that is to be followed when considering the requirement for a network analysis.

(1) Available information

Planning demand and loading rates for water and sewerage infrastructure design are listed in Part 4 Priority infrastructure plan of the Townsville City Plan.

Council has established a number of sewer network models covering service catchments across the city. A map showing sewer catchments, modelling status and latest planning report information can be requested from the Development Assessment Unit (DAU) of council.

A city wide water network model is also available for use.

Editor's note—Access to council's city wide water network model is available to appropriately qualified users approved by the Infrastructure Planning Unit of TCC. Refer to SC6.4.3.23.3 (2).

Plans for Trunk Infrastructure (PFTI) are available and detail trunk infrastructure that is planned for by council to service the Priority Infrastructure Area (PIA). These should also be referred to in order to determine if your development may affect or should take into consideration planned infrastructure in its vicinity.

(2) Preparing a preliminary needs analysis

An applicant for a development must complete a “Preliminary Needs Analysis” form (SC6.4.3.23 Attachment B) for their development which enables identification of any potential impacts on the water and sewer network. Where an impact is anticipated, it is likely that an analysis will be required to demonstrate compliance with design standards. The level of modelling assessment required is dependent on the impact expected.

Editor's note - If your preliminary analysis results in a modelling assessment being required, you should contact the DAU of council to confirm the level of modelling necessary. It is encouraged that this assessment be completed prior to application lodgement to ensure an efficient approval process.

The completed "SC6.4.3.23 - Attachment B - Form M1 - Network model needs analysis form" is required to be included with your analysis and application to justify the level o analysis undertaken.

Editor's note—The "Preliminary Needs Analysis" will determine if:

(a) a network analysis is not required; or

(b) you are required to do a simplified network analysis; or

(c) you are required to do a detailed network analysis, involving establishment of a new model, or use an existing model; or

(d) you need to incorporate a network modification in your application, with details specified by council.

If a network analysis is required, it must be done in accordance with these guidelines

SC6.4.3.23.3 Provision of the TCC Network Model Data

(1) Requesting information to inform your analysis

Modellers may request boundary condition information from council, and/or access to council's network models by submitting a “Request for Network Modelling Information” form included in SC6.4.3.23 Attachment C - Form M2 - Request for network modelling information.

Editor's note—"SC6.4.3.23 Attachment C - Form M2 - Request for network modelling information" is an electronic form.

In most cases it is desired that boundary condition information is sufficient to enable a modeller to prepare their own network model. However, depending on the size or impact of the development being considered, it may be necessary for the modeller to utilise council’s network models to demonstrate:

(a) in the case of the sewer network:

(i) receiving network capacity is sufficient; and

(ii) modified or realigned infrastructure as a result of the development has not adversely affected existing or planned for system hydraulics; and

(b) in the case of the water network:

(i) network supply capacity is sufficient; and

(ii) existing network hydraulic capacity is not adversely affected by any changes to the supply network as a result of the proposed development.

Generally, where trunk infrastructure may be affected by the proposed works, council's network models must be used to verify the impact and identify required mitigation/augmentation options.

(2) Access to council models

Access to council's network model/s is available to appropriately qualified users approved by the Infrastructure Planning Unit of TCC.

Editor's note—For information on the approval process applicants should contact the Infrastructure Planning Unit of TCC.

Council will make available at their offices a computer to enable analysis of a development or for viewing existing network model information. The applicant must apply for access to council's network model/s by submiiting the "SC6.4.3.23 - Attachment C - Form M2 - Request for network modelling information" form. The modeller will need to agree to council's terms of use on this form.

SC6.4.3.23.4 General requirements for network models

(1) Scale and spatial reference

"Simplified Models" may be developed as representative schematics of the proposed network. Manual calculations without the use of network modelling software may be permitted.

"Detailed Models" shall be constructed based on proposed design and/or development layouts. The layouts may be schematic but should remain representative of the proposed development layout. In order to enable import of models into council's existing network models, they shall be developed to the GDA1994 MGA Zone 55 coordinate system unless otherwise notified.

(2) Modelling timeframes

Timeframes for modelling shall be as per clauses SC6.4.3.21.2(2) and SC6.4.3.21.3(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

(3) Model calibration

Where possible, calibrated models shall be used to verify system capacity.

(4) Modeller experience and qualifications

Network modelling must be carried out by professionals suitably experienced and qualified in the undertaking of network modelling analysis and design. Models, associated reports and designs must be certified by the appropriately qualified and experienced RPEQ.

SC6.4.3.23.5 Water network modelling

(1) Scope

A water network model is required where listed under the requirements of SC6.4.3.21.2(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

(2) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations or simplified network models to demonstrate compliance with design standards. A simplified assessment must include:

(a) assessment of design demands in accordance with SC6.4.3.23.5 (3)(d) of this sub-section;

(b) where necessary, hydraulic calculations based on fixed boundary conditions for both peak hour and fire-fighting demand;

(c) calculations can be undertaken manually, using spread sheets or using network modelling software. Where modelling software is used, the model files shall be provided to council as part of the submission;

and

(d) a brief report covering the requirements of SC6.4.3.23.5 (3)(f) of this sub-section. Sketches of results are to be provided where they make it easier to interpret results.

(3) Model requirements – detailed assessment

(a) Format

Bentley WaterGEMS must be used for the development of new water network models. Models shall be set up such that all scenarios and options considered for the study are incorporated into a single model file. The model file(s) shall be provided to council as part of the submission.

(b) Scenario planning

A scenario plan must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A “parent” scenario should be applied for each design horizon or stage, and ultimate development. The following model structure provides an example of a model scenario structure.

---Scenario 1000- Existing Peak Day Demand (Extended Period Analysis)
----------Scenario 1100- Existing Peak Hour Demand (Steady State Analysis)
----------e.g. Scenario 1110 - Existing Peak Hour with Infrastructure Option 1
----------e.g.Scenario 1120- Existing Peak Hour with Infrastructure Option 2 (Preferred)
----------Scenario 1121- Existing Fire Fighting Assessment (Steady State analysis, automated)
---Scenario 2000- Ultimate Peak Day Demand (Extended Period Analysis)
----------Scenario 2100- Ultimate Peak Hour Demand (Steady State Analysis)
----------e.g.Scenario 2110- Ultimate Peak Hour with Infrastructure Option 3 (Preferred)
----------Scenario 2111- Ultimate Fire Fighting Assessment (Steady State analysis, automated)

As shown the scenario structure naming should be clear and transparent as to which design case it represents and the preferred option applied for the design should be marked.

(c) Technical specification

(i) Hydraulic method

Modelling must be undertaken using the Hazen Williams hydraulic calculation method, with pipe friction coefficients as listed in Table SC6.4.3.21.4 of SC6.4.3.21 Townsville Water planning and design guidelines.

(ii) Losses across valves

Where control valves are required in the system, the valve should be modelled with appropriate loss factors/curves. The modeller must ensure that loss factors applied for design of a system can be achieved in reality by available products, and where possible apply the loss factor or curve for a design valve.

(iii) Pump curves

A design duty (single point pump curve) may be used initially when designing a pumping system however the modeller is to ensure that the pump duty proposed can be achieved by readily available pumps. Where possible an actual pump curve for a design pump shall be applied for modelling purposes.

(iv) Pump controls

Pumps shall be modelled with simple controls where possible. The modeller must consult with council when applying pump controls to ensure it meets the requirements of Townsville Water operators.

(v) Reticulation

Master Planning Models shall model trunk infrastructure only. Refer to Part 4.7 Definitions of the Townsville City Plan for the definition of trunk infrastructure.

Design Models shall model reticulation down to a DN63 pipe.

(d) Demands

(i) General

Design demands are to be calculated in accordance with SC6.4.3.21.2(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

Demands must be applied as Peak Day demand in litres per second (L/s), with the appropriate diurnal pattern applied for the particular land use.

Demands should be applied at the nearest network node, and within 40 m of the property boundary.

Where a node represents demands generated from different land uses, separate demand entries should be applied to the node to enable quick identification of the source of the demand.

(ii) Use of unit demand factors

WaterGEMS enables unit demand factors to be applied, such that the resultant demand from the unit load, loading rate and peaking factors are calculated as part of the modelling process. The use of this feature is required for master planning models, enabling tracking of design EPs modelled.

(iii) Diurnal patterns

Diurnal patterns represent fluctuations in demand load across a day. Patterns for various land uses are included in SC6.4.3.21 Attachment A of the Townsville Water planning and design guidelines.

(e) Scenarios

(i) Extended period analysis

Extended period analysis is used to demonstrate compliance with SC6.4.3.21 Townsville Water planning and design guidelines. Extended period analysis must be utilised when considering networks that incorporate reservoirs, pump stations or other hydraulic controls.

Extended period analysis enables assessment of the bulk water transportation capacity of the network to ensure that:

(A) reservoirs never empty;

(B) reservoir minimum contingency storage levels are maintained;

(C) the reservoir supply system has a net delivery capacity equal to or greater than Peak Day;

(D) pumping systems are designed within operational limits; and

(E) system pressures are achieved across a day.

(ii) Council requires two scenarios of extended period analysis to be modelled:

3 day extended period analysis

Boundary conditions:

- reservoirs commencing water level 90% capacity;
- pump stations – all pumps in station initially off; and
- demand applied: Peak Day demand.

7 day extended period analysis

Boundary conditions:

- reservoirs commencing water level 90% capacity;
- pump stations – all pumps in station initially OFF; and
- demand applied: 95% of Peak Day demand.

(iii) Steady state analysis

Peak hour

Where a peak day analysis is required for a model, a separate steady state analysis to demonstrate compliance with design standards for Peak Hour is not necessary. Rather, the results at Peak Hour on the Peak Day may be reported at that specific time step.

Peak hour analysis is used to assess network pressures at Peak Hour to ensure the design requirements of SC6.4.3.21 Townsville water planning and design guidelines are met.

Boundary conditions:

(A) demands may be applied directly as Peak Hour demand, or at Peak Day demand with peaking factor to represent Peak Hour.

Fire-fighting analysis

Fire fighting analysis is used to assess network capacity of the network water mains with respect to the design requirements listed the SC6.4.3.21 Townsville water planning and design guidelines.

Use of automated analysis, where fire-fighting conditions are tested at each node/hydrant within the network, should be employed.

Boundary conditions:

(A) reservoirs commencing at mid water level; and

(B) demand applied: Peak Hour unless otherwise advised by council.

(f) Reporting requirements

A water network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction:

(A) development locality, lot/plan description, application number (if applicable);

(B) objectives of study – design/master plan; and

(C) brief methodology – describe level of modelling undertaken (simplified/detailed), software used, reference to model overview in appendix.

(ii) Population and demand assessment:

(A) population assessment based on land use categories, site plan showing layout and land use;

(B) demand assessment showing demand calculation and peaking factors applied;

(C) summary table showing total demand, with breakdown for each land use category, Average Day (kL/d), Peak Day demand (kL/d or L/s); and

(D) summary table showing demand breakdown for each service catchment, where applicable.

(iii) Modelling assessment:

(A) modelling method – simplified or detailed assessment;

(B) scenarios analysed, including description or reference to design standards applied;

(C) modelling assumptions;

(D) existing network description, including proposed connection points; and

(E) modelling assessment:

- existing system capacity;
- existing system + ultimate development; and
- augmentations, new infrastructure options analysis including assessment of options at interim stages - 10y/20y/ultimate horizons.

(iv) Options analysis:

(A) triple bottom line analysis; and

(B) net present value assessment.

(v) Summary:

(A) preferred option, justification, capital works program.

(vi) RPEQ Certification statement as detailed in SC6.4.2.

(vii) Appendix:

(A) for detailed models, model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);

(B) model map showing model layout (nodes, pipes, labels and any relevant boundary conditions, e.g. reservoirs or head points applied); and

(C) tabulated data and results – to be provided at peak hour analysis and fire fighting analysis:

Nodes	• Element ID • Node Elevation • Peak Hour Demand • Calculated Hydraulic Grade (m) • Calculated Pressure (m) For fire-fighting analysis • Available fire-fighting flow • Available pressure at fire fighting demand
Pipes	• Element ID • Pipe diameter • Material and class • Length • Start node • Stop node • Hazen Williams C value • Flow rate • Velocity • Headloss gradient
Pump Stations	• Element ID • Pump type (fixed, variable speed) • Pump configuration (duty/standby etc.) • Pump curve, if selected
Reservoirs	• Element ID • Reservoir Capacity • Top Water Level • Bottom Water Level

(D) pump stations - system resistance curve with pump curve overlaid. Pump curve may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (i.e. it needs to be physically achievable).

SC6.4.3.23.6 Sewer network modelling

(1) Scope

A sewer network model is required where listed under the requirements of clause SC6.4.3.21.3 of SC6.4.3.21 Townsville water planning and design guidelines.

(2) Model requirements – simplified assessment

A simplified assessment involves the use of manual calculations to demonstrate compliance with design standards. A simplified assessment must include:

(a) assessment of design loads in accordance with SC6.4.23.6(3)(d) of this sub-section;

(b) where necessary, hydraulic calculations based on fixed boundary conditions for Peak Wet Weather Flow loading;

(c) calculations can be undertaken manually, using spreadsheets or using network modelling software. Where modelling software is used, the model files shall be provided to council as part of the submission; and

(d) a brief report covering the requirements of SC6.4.23.6(3)(f) of this sub-section. Sketches of results are to

be provided where they make it easier to interpret results.

(3) Model requirements – detailed assessment

(a) Format

Bentley SewerGEMS sanitary must be used to undertake detailed assessments of sewer networks. This will enable models to be incorporated into council's existing network models.

Models shall be set up such that all scenarios and options considered for the study are incorporated into a single model file.

(b) Scenario planning

A scenario must be developed by the modeller prior to commencing modelling such that each scenario required for analysis is identified and that differences between scenarios are clearly understood.

The modeller must utilise parent and child scenarios and alternatives such that common information for each scenario is inherited to child scenarios, and that unique changes are clearly identifiable. A "parent" scenario should be applied for each design horizon or stage and ultimate development. The following provides an example of a model scenario structure.

---Scenario 1000- Existing Average Dry Weather Flow
----------Scenario 1100- Existing ADWF Overflow Storage Assessment
----------Scenario 1200- Existing Peak Wet Weather Flow
---Scenario 2000- Ultimate Average Dry Weather Flow
----------Scenario 1100- Ultimate ADWF Overflow Storage Assessment
----------Scenario 1200- Ultimate Peak Wet Weather Flow
----------Scenario 1210- Ultimate PWWF Infrastructure Option 1
----------Scenario 1220- Ultimate PWWF Infrastructure Option 2 (Preferred)

(c) Technical specification

Hydraulic method

Mannings formula must be used for calculation of gravity network hydraulics, in accordance with the requirements of the *Sewerage Code of Australia* (WSA 02-2002).

Hazen-Williams method must be applied for pressure pipe systems in accordance with SC6.4.3.21 Townsville Water planning and design guidelines.

Inflow/Infiltration

Inflow/Infiltration shall be modelled intrinsically as a part of the calculated design loads, in accordance with SC6.4.3.21 Townsville Water planning and design guidelines.

Pump curves

A design duty (single point pump curve) may be used initially when designing a pumping system however the modeller is to ensure that the pump duty proposed can be achieved by readily available pumps. Where possible an actual pump curve for a design pump shall be applied for modelling purposes.

Pump controls

Pumps must be modelled with simple controls where possible. The modeller must consult with council when applying pump controls to ensure it meets the requirements of Townsville Water operators.

(d) Sewage flow calculation

Design loads are to be calculated in accordance with SC6.4.3.21.3(2) of SC6.4.3.21 Townsville Water planning and design guidelines.

Loads must be applied to the model as an Average Dry Weather Flow (ADWF) base demand. A peaking factor multiplier applied as a fixed pattern on the load must be used to generate Peak Wet Weather Flow (PWWF).

Where a manhole represents demands generated from different land uses, separate demand entries must be applied to the node to enable quick identification of the source of the demand.

(e) Scenarios

(i) Static vs. dynamic modelling

Sewer network models should be run dynamically (i.e. over an extended period) to enable:

(A) assessment of system storage prior to overflow;

(B) ensure model stability when system is fully loaded; and

(C) ensure the interaction of pumps on a common system are assessed.

A minimum 24 hr simulation period is therefore recommended. The user should report results at the appropriate timestep (i.e. maximum conditions in system).

(ii) ADWF analysis

ADWF analysis is used to assess basic system performance under dry weather flow conditions. This analysis is also used to assess the amount of system storage available before an overflow is activated within the catchment (being inter-area or environmental).

(iii) PWWF analysis

PWWF analysis is used to assess network performance in respect to the design requirements listed in SC6.4.3.21 Townsville Water planning and design guidelines.

(f) Reporting requirements

A sewer network modelling report must be prepared to document the process, assumptions and analysis employed through modelling to develop the infrastructure design and/or master plan.

The following provides details of sections to be incorporated into the modelling report. The modeller may provide further information as needed to justify decisions made through the modelling and design process.

(i) Introduction:

(A) development locality, lot/plan description, application number (if applicable);

(B) objectives of study – design/master plan; and

(C) brief methodology – describe level of modelling undertaken (simplified/detailed), software used, reference to model overview in appendix.

(ii) Sewage flow/loading assessment:

(A) population assessment based on land use categories, site plan showing layout and land use;

(B) load assessment showing calculation of ADWF and PWWF flows; and

(C) summary table showing total load, with breakdown for each pump station catchment or network subcatchment, average dry weather flow (L/s), (kL/d), peak wet weather flow (L/s), (kL/d).

Where an existing council model is being updated, a table comparing previous catchment loads to updated catchment loads must be provided.

(iii) Modelling assessment

(A) scenarios analysed, including description or reference to design standards applied;

(B) modelling assumptions;

(C) existing network description, including proposed connection points; and

(D) modelling assessment:

- existing system capacity;
- existing system + ultimate development;
- augmentations, new infrastructure options analysis including; and
- assessment of options at interim stages - 10y/20y/ultimate horizons.

(iv) Options analysis:

(A) triple bottom line analysis; and

(B) net present value assessment.

(v) Summary:

(A) Preferred option, justification, capital works program.

(vi) RPEQ Certification statement in accordance with SC6.4.2.

(vii) Appendix:

(A) model overview to be included in appendix (covering scenario structure, options and clearly outlining which scenario represents the design solution);

(B) tabulated results of the manhole, gravity and pressure main outputs:

Manholes	• Element ID • Node Elevation • Design Load
Pipes - gravity and pressure mains	• Element ID • Pipe diameter/material and class • Grade • Upstream manhole • Downstream manhole • Pipe flow depth as percentage of diameter PWWF (gravity mains) • Flow velocity at PWWF (pressure mains) • Flow velocity under single pump operation (pressure mains)
Pump Stations	• Element ID

(viii) pump stations - system resistance curve with pump curve overlaid. Pump curve may be duty point however the designer shall consider the capability of pumps on the market to meet such a duty (i.e. it needs to be physically achievable).

SC6.4.3.23.7 Copyright and ownership of submitted models

When a technical report or study is submitted to council as part of a development application, this report/study, along with all components of the submission, can be made available to the public as part of the notification stage. The report can be provided to anyone seeking the report during this stage and following the approval. Use of the report for any third party use will be at the complete risk of the third party. It should be noted that only the approved report including any council requested amendments, will be referred to in future.

Once a development application is approved council is permitted to use the model for incorporation into its overall city water and sewer models to inform its infrastructure planning.

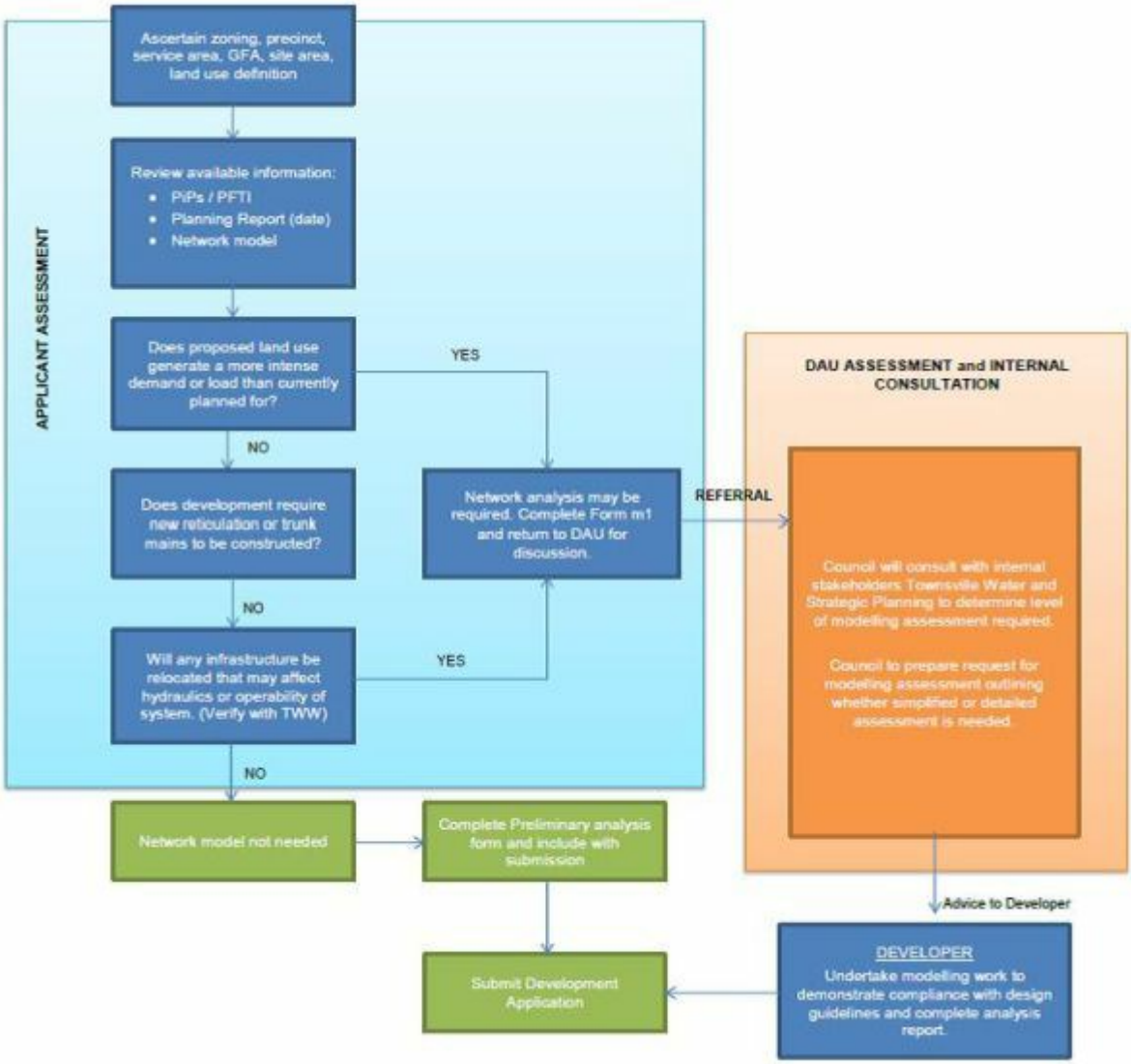


Figure SC6.4.3.23.1 Network model needs analysis, assessment and consultation process

Attachment B Preliminary needs analysis
Click here to obtain a copy of the following form.

Attachment C Form: Request for network modelling information
Click here to obtain a copy of the following form.

Attachment D Model setup summary
Click here to obtain a copy of the following form.

Attachment E Model submission checklist (water and sewer)
Click here to obtain a copy of the following form.

SC6.4.4 Design specification and standard drawings

SC6.4.4.1 Geometric road design

SC6.4.4.1.1 Introduction

(1) Purpose

(a) This sub-section sets out the specifications developed specifically for the design of roads using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.

(b) A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road.

(c) All relevant design principles must be integrated in the development of the road network, recognising the primary role of roads for transport function.

(d) The objective of road design is to recognise the carrying of through traffic.

(e) The objectives of street design are to recognise improving safety and security, increase vitality and interaction, reduce private motor vehicle dependence, improve development efficiency, provide valuable community space and retain economic activity in communities.

(2) Scope

(a) This specification must be read in conjunction with the IPWEAQ publication *Complete Streets: Guidelines for Urban Street Design*, with limited adoption in Townsville as follows:

(i) in areas with close nexus to CBD, and in areas where higher densities are encouraged and it can be demonstrated that there is high access and potential use of public transport, then a full adoption of *Complete Streets* while tying into existing road and street networks. For infill development and upgrades in these areas, development is to be in line with *Complete Streets* principles of pedestrian and cyclist friendly environments, encouraging developments that engage with active street frontages;

(ii) new, large, master planned developments are to adopt *Complete Streets*, although they will be required to recognise the particular role of public transport as an alternative to moving people between these sites and other areas of Townsville. Designs should emphasise pedestrian and cyclist movements, and allow for retrofitting of public transport options in the future, if and when they become viable;

(iii) other developments are to adopt updated cross-sections and road hierarchy, and apply priorities in line with *Complete Streets*, but layout is to be adapted to tie into existing road and street networks, recognising high car dependence, and lack of containment opportunities, where commercial centres, schools and retail facilities are not proposed within the development; and

(iv) curvilinear street designs are to be avoided wherever practical, with a focus on the grid structure in accordance with *Complete Streets and requirements of the Townsville City Plan.*

(3) Aims

A road system within a subdivision is to be designed so as to achieve the following aims:

(a) to provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists;

(b) to provide safe, logical and hierarchical transport linkages with existing street system, including consideration of crime prevention in streets, bikeways and pathways;

(c) to provide appropriate access for buses, emergency and service vehicles;

(d) to provide both a permeable and legible street network;

(e) to provide for a quality product that minimises maintenance costs;

(f) to allow for public utilities;

(g) to provide an opportunity for visual amenity, e.g. street landscaping;

(h) to provide convenient parking for visitors;

(i) to provide connecting streets and places through permeable networks without any corresponding increase in vehicle speeds or "rat-runs"; and

(j) to have appropriate regard for the climate, geology and topography of the area.

(4) Terminology

For the purpose of this sub-section the definition of terms used to define the components of the road reserve must be in accordance with these AS 1348 terms.

Carriageway	that portion of the road or bridge devoted particularly to the use of vehicles, inclusive of shoulders and auxiliary lanes.
Footpath	the paved section of a pathway (verge).
Pathway	a public way reserved for the movement of pedestrians and of manually propelled vehicles.
Pavement	that portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic.
Shoulder	the portion of the carriageway beyond the traffic lanes and contiguous and flush with the surface of the pavement.
Verge	that part of the road reserve between the carriageway and the road reserve boundary. It may accommodate public utilities, footpaths, stormwater flows, street lighting poles and plantings.

(5) Reference and source documents

(a) Council specifications and drawings:
SC6.4 Development manual planning scheme policy - all specifications and drawings for design and construction.
SC6.4.3.13 Townsville road hierarchy

(b) Australian Standards, in particular:
AS 1348 - *Road and traffic engineering – Glossary of terms, Road design and construction*.
AS 1428 - *Design for access and mobility.*
AS 1742 - *Manual of uniform traffic control devices*.
AS 2890 - *Parking facilities.*
AS/NZS 3845 - *Road safety barrier systems.*

(c) QLD State Authorities:
Department of Transport and Main Roads *Accessible Regional Bus Stops Guidelines, 2008*
Department of Local Government and Planning, *Queensland Residential Design Guidelines, 1998*
Department of Transport and Main Roads, *Queensland Manual of Uniform Traffic Control Devices*,
Department of Transport and Main Roads, *Road Planning and Design Manual*
Department of Transport and Main Roads, *Queensland Transport's Interest in Planning Schemes, 2008*
Queensland Health (2006) *Issue Guidelines for Natural and Built Determinants of Health*

(d) Austroads:
Road Design – *Guide to Road Design*
Design vehicles and turning path templates
Traffic management: *Guide to Traffic Management*

(e) Other
Queensland Government, *Active Healthy Communities*
Queensland Government, *Crime Prevention through Environmental Design,*
Institute of Public Works Engineering Australia, Qld Division, *Complete Streets: Guidelines for Urban Street Design, 2010*

Commonwealth Department of Housing and Regional Development, *Australian Model Code for Residential Development* (AMCORD): *A National Resource Document for Residential Development, 1995.*

SC6.4.4.1.2 Consultation and planning

(1) Consultation

(a) Designers are encouraged to consult with the council and other relevant authorities prior to and during the preparation of the design. Designers should, in addition to requirements of this sub-section, ascertain the specific requirements of these authorities as they relate to the designs in hand.

(b) The designer must obtain service plans from all relevant public utility authorities and organisations whose services may exist within the area of the proposed development. These services are to be plotted on the relevant drawings including the plan and cross-sectional views.

(2) Planning concepts

(a) In new areas (as distinct from established areas with a pre-existing road pattern) each class of route should reflect its role in the street and road hierarchy by its visual appearance and related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the required traffic speed, adjoining land-uses, and other factors. All higher order road networks under Townsville City Council jurisdiction must comply with SC6.4.3.13 Townsville road hierarchy.

(b) The road network for residential developments should have clear legibility for all road users, particularly pedestrians and cyclists.

(c) The road network should reinforce legibility by providing sufficient differentiation between the road functions.

(d) Distinct existing landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance their legibility.

(e) Whilst legibility can be enhanced by introduced physical features such as pavement and lighting details, the road network should by its inherent design and functional distinction provide the necessary legibility and place making.

(f) The road network should provide for shortest reasonable access from any lot to the major road system for all pedestrian cyclists and vehicles.

(g) Speed regulation should be built in to the street geometry, to create an environment where drivers are actively discouraged from driving above the legislated/design speed. Speed control devices, often known as Local Area Traffic Management (LATM), are considered unnecessary for appropriately designed new streets and should only be used where no other solution is viable, due both to their capital and maintenance costs and possible intrusive nature. Side friction may be considered to assist with speed regulation where appropriate.

(h) Provide convenient and safe access to all allotments for all road users including pedestrians, cyclists, public transport users, garbage trucks and motorists. Priority of consideration in streets should be as per *Complete Streets.*

(i) Include adequate network considerations in the placement and design of safe pedestrian crossing facilities especially across roads and high volume streets.

SC6.4.4.1.3 Urban design criteria

(1) Road and street hierarchy

(a) A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly. The design should convey to motorists the predominant function of the road.

(b) Transport routes are divided into two distinct levels (refer to SC6.4.4.8 Standard drawings):

(i) streets; and

(ii) roads

(c) The lowest order of transport route (streets) have as their primary function to facilitate public interaction

and movement through a place, village, town or city.

(i) Streets should be designed in accordance with the adjoining land uses.

(d) The highest order of transport route (Roads) should have as its main function the convenient and safe distribution of traffic and should be designed in accordance with the SC6.4.3.13 Townsville Road Hierarchy, Austroads and Department of Transport and Main Roads standards.

(2) Road network

(a) The design features of each type of road or street convey to the driver its primary functions and encourage appropriate driver behaviour.

(b) Traffic volumes and speeds on any road or street should be compatible with its adjoining land uses and function.

(c) The maximum length of a residential street should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, bicycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints.

(d) The distance required for pedestrians, cyclists and drivers to travel between two points within the development should be minimised.

(e) Where local streets form part of a pedestrian or bicycle network, access links should provide suitable connectivity with adjoining local streets or open space systems so as to ensure such pedestrian and bicycle network are functionally efficient and safe.

(f) The road network should ensure that no road intersects with another road which is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may intersect with others that are more than two levels apart with council approval, however, no local street should have direct connection to an access-controlled arterial road.

(g) The road and street layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan.

(h) The external road network should be designed and located to provide routes which are more convenient for potential through traffic within the network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate through network movements. The internal road system should not provide through routes that are more convenient than the external road network.

(i) The design of sub-arterial roads should achieve a context sensitive design by providing an acceptable balance between the level of service, safety, whole of life costs, flexibility for future upgrading or rehabilitation and environmental impact. Consequently, sub-arterial roads should provide a higher level of efficiency and safety with space for public transport, bicycle lanes and pedestrian facilities.

(j) Operations on sub-arterial roads must be in accordance with Austroads' *Guide to Road Design Part 2: Design Considerations,* taking into account:

(i) intersection spacing and control;

(ii) lane changing;

(iii) weaving;

(iv) merging;

(v) spacing of median openings;

(vi) reverse flow/tidal traffic control;

(vii) pedestrians;

(viii) cyclists;

(ix) parking (if permitted);

(x) transit lanes for buses and high occupancy vehicles (HOV);

(xi) provision for B-doubles and multi-combination vehicles;

(xii) provision for intelligent transport systems (ITS);

(xiii) bus stops;

(xiv) service roads;

(xv) driveway spacing and their distances from intersections (if permitted); and

(xvi) signage and line marking in accordance with Main Roads' *Manual of Uniform Traffic Control Devices* (MUTCD) and *Traffic and Road Use Management Manual* (TRUM).

(3) Design speed

(a) Design speed is generally used as the basic parameter in the specification of design standards, determining the minimum design value for other elements and is the 85th percentile maximum speed of traffic within the street. This is similar to the "Speed Environment" used in Austroads *Guide to Road Design*. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

(b) Adoption of a low design speed discourages speeding, however, where vertical or horizontal curves of low design speed are located in otherwise high speed sections (tangents) the result is a potentially dangerous section of road. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

(c) Design speed should allow for road characteristics such as:

(i) traffic volume;

(ii) width of carriageway;

(iii) grades; intersections;

(iv) the presence and spacing of consolidated property access;

(v) traffic characteristics; and

(vi) traffic composition (pedestrians, cyclists, public transport, passenger vehicles, heavy vehicles).

(d) The need for road safety barriers must be assessed and designed in accordance with SC6.4.6.25 Non-rigid road safety barrier system and AS/NZS 3845.

(4) Longitudinal gradient

(a) A general minimum gradient of 0.5 % should be adopted. In very flat conditions it may be reduced to 0.3% with council approval. Where underground drainage with gully pits or other special works are used it is preferable to allow near level grades rather than reverting to introduction of artificial undulations. Variable crossfall may be necessary to produce the required grade in the kerb and channel. The maximum longitudinal grade on any street should not exceed 12%, from consideration of pedestrian walking convenience.

(b) Grades over 8% must provide additional considerations for pedestrians, cyclists, public transport and heavy vehicles (e.g. garbage trucks, furniture vehicles) where appropriate. Exceptionally steep terrain may be allowed for very short lengths on steep streets of up to 16%. In these exceptional circumstances, the developer must demonstrate that alternate routes for pedestrians, bicycles and heavy vehicles are available.

(c) The longitudinal grade of the minor street on the approach to an intersection should not exceed 4% with sufficient length to accommodate a stationary single unit truck. Design of the road alignment and the grades used are interrelated. A steep grade on a minor side street is not acceptable if vehicles have to stand waiting for traffic in the major road.

(d) Turning circles in cul-de-sacs on steep grades should have grades less than 5%.

(5) Horizontal curves and tangent lengths

(a) The horizontal alignment of a road or street is normally in a series of tangents (straights) and curves which may be connected by transition curves. The choice of the horizontal alignment should be determined from the design speeds for a particular street, in particular the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road*

Design Part 3: Geometric Design. Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers of all vehicles can safely negotiate the curve. Curves which progressively tighten and sudden reverse curves must be avoided.

(b) While horizontal alignment is one means of limiting vehicle speed, the greater of the following requirements must be complied with:

(i) minimum curve radius for a street - 10 m; or

(ii) minimum curve radius for a road in accordance with DTMR design standards.

(c) Carriageway widening applies to all standard carriageway widths. Widening should be applied to the inside kerb line of the carriageway, in accordance with Austroads' *Guide to Road Design.*

(d) The minimum horizontal sight distance required at any point along the street is the general minimum sight distance for the spot speed relevant at that point. The sight distance is measure along the vehicle path, which may be assumed as the carriageway centreline for streets.

(6) Vertical curves

(a) The design of vertical alignment must reflect the expected operating speeds and constraints of the developments adjacent to the road in accordance with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(b) Vertical curves will be simple parabolas and should be used on all changes of grade exceeding 1%. The length of the crest vertical curve for stopping sight distance is based on speed and should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(c) In addition to the above general minimum sight distance, which is required to be provided at all points along the street, at locations where there may be channelisation or line marking, such as intersections or pedestrian crossings, the driver must be able to see such indications within the stopping distance, i.e. sight distance from 1.15m eye height to zero is not less than single-vehicle stopping distance.

(d) For adequate riding comfort, lengths of sag vertical curves should conform with Austroads' *Guide to Road Design Part 3: Geometric Design.*

(e) Junctions of roads should be located at a safe distance from a crest, determined by visibility from the side road. Location of a side road at a crest should only occur if there is no suitable alternative.

(f) Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) is suggested. To avoid water ponding in excessively flat sections of kerb and gutter, a minimum grade of 0.3% must be maintained in the kerb and channel.

(g) The three dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improved traffic safety and aesthetics. Economic considerations often require a compromise with aesthetic considerations. The following principles should be applied:

(i) the design speed of the road in both horizontal and vertical planes should be of the same order; and

(ii) combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.

(h) Horizontal curves should not be introduced at or near the crest of a vertical curve.

(7) Superelevation

(a) The use of superelevation in association with horizontal curves is an essential aspect of geometric design of roads with design speeds in excess of 60km/h. Streets which are designed for speeds of 40km/h or less and with curves of 60m radius or less generally have the pavement crowned on a curve instead of superelevation.

(b) The maximum superelevation for urban roads of higher design speeds should be 5%. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While all curves should be superelevated, negative crossfall should be limited to 3%.

(c) In general, curve radii larger than the minimum and superelevation rates less than the maximum should be used where possible. The minimum radius of curves is determined by the design speed, the minimum

superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve, and the maximum coefficient of side friction which allows safe lane changing. Refer to the *Road Planning and Design Manual* Table 11.1.

(d) Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation/crossfall are as per Austroads' *Guide to Road Design.*

(e) Plan transitions are required on superelevated curves for appearance and to provide a convenient length in which to apply the superelevation. On urban roads, superelevation may be conveniently applied to the road cross section by shifting the crown to 2m from the outer kerb. The axis of rotation of the cross section for urban roads will normally be the kerb grading on either side which best enables access to adjacent properties and intersections.

(f) Rate of Rotation for superelevation refer Austroads' *Guide to Road Design Part 3: Geometric Design* (Section 7.7).

(8) Road reserve characteristics

(a) The cross section of the road reserve must provide for all functions that the road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities and street scaping. Road reserve widths will depend on verge widths, service roads and pathway requirements, and sub-arterial and arterial roads must also allow for future upgrading.

(b) The carriageway width must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include trucks, emergency vehicles and, on some roads, buses. Excessive carriageway widths can be detrimental to safety, amenity, user convenience, capital expenditure and maintenance costs.

For example, for urban residential streets:

(i) narrower urban residential carriageways in accordance with Urban Type A of Standard Drawing SD-001 are allowable for shorter street lengths, with low parking demand, and serving standard residential allotments. This carriageway does not allow for any buses, bike lanes, or indented parking. Frequent staggered parking may occur on both sides of the street where there are less than 150 vehicles per day, otherwise on street parking should be infrequent or along one side of the street only. Generally leg lengths should be kept to a maximum length of 150m. These streets may not function as a through route, and must carry a low traffic volume;

(ii) standard urban residential carriageways in accordance with Urban Type B of Standard Drawing SD-001 are allowable where there is relatively frequent parking on both sides of the street with traffic volumes generally less than 750 vehicles per day;

(iii) wider urban residential carriageways in accordance with Urban Type C of Standard Drawing SD-001 are required where there is a higher density residential area with higher parking demand or higher volume of traffic (less than 3000 vehicles per day in accordance with SC6.4.3.13) and possible bus routes. Indented bus bays may be required, on advice from council;

(c) the safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width;

(d) the carriageway width should also provide for unobstructed access to individual allotments. Drivers should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway;

(e) the design of the carriageway should discourage drivers from travelling above the intended speed by reflecting the functions of the road in the network. In particular the width and horizontal and vertical alignment should not be conducive to excessive speeds;

(f) appropriate verge width should be provided to enable the safe location, construction and maintenance of required footpaths and public utility services (above or below ground), with acceptable clearances and to accommodate the desired level of streetscaping. Wherever possible, services should be located in common trenches;

(g) the verge when considered in conjunction with the horizontal alignment and permitted fence and property

frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements;

(h) stopping sight distances and junction or intersection sight distances, provided by the verge, should be based on the intended speeds for each road type;

(i) safe intersection stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout; and

(j) industrial roads and streets must be designed to allow access for larger vehicles including B-doubles and multi-combination vehicles into these areas, including safe turning manoeuvres at intersections and to and from allotments.

(9) Crossfall

(a) Roads should be crowned in the centre. Typical pavement crossfalls on straight roads are:

Pavement Type	**Crossfall**
Bituminous seal coat	3%
Bituminous concrete pavement	3%
Cement concrete pavement	3%

Source: Austroads, *Guide to Road Design*

(b) There are many factors affecting levels in urban areas which force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting one way crossfalls. Sustained crossfalls should not exceed 4%, although up to 6% may be used where unavoidable with council approval. The rate of change of crossfall should not exceed those adopted in SC6.4.4.1.3(7) Superelevation.

(c) The use of one way crossfalls should be limited taking into consideration overland drainage and the impact on open space, public footpaths and private properties.

(d) The crossfall on a higher order transport route should take precedence over the grade in minor side streets. Standard practice is to maintain the crossfall on the major road and adjust the minor side street levels to suit. The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street. A maximum change of grade of 2% in the kerb line of the side street relative to the centre line grading is acceptable.

(10) Verges and property access

(a) A suitable design for the verge will depend on utility services, the width of footpath, access to adjoining properties, likely pedestrian usage and preservation of trees. Low level footpaths may only be used if normal crossfalls are impracticable. Crossfalls in footpath paving should not exceed 2.5%, in accordance with Austroads' *Guide to Road Design - Part 6A: Pedestrian and Cyclist Paths*. Longitudinal grade usually parallels that of the road and this may be steeper than 5%.

(b) Differences in level across the road between road reserve boundaries may be accommodated by:

(i) cutting at the boundary on the high side and providing the verge at normal level and crossfall;

(ii) battering at the boundary over half the verge width with the other half against the kerb constructed at standard crossfall;

(iii) a uniform crossfall across the carriageway; and

(iv) the lower verge being depressed below the gutter level.

(c) The above measures can be used singularly or combined. The verge formation should extend with a 0.5m berm beyond the road reserve boundary.

(d) The designer must design a vehicular driveway centreline profile for the property access and check this design using critical car templates, to ensure that vehicles can use the driveway satisfactorily.

(e) Where commuter pedestrians and cyclist paths are proposed, appropriate shading and rain protection should be provided. An approved landscaping master plan must be provided for approval.

(11) Intersections

(a) The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on major collector streets.

(b) Intersection design for the junction of subdivision roads and streets with existing state rural or urban roads and national highways should generally be in accordance with the publication Austroads' *Guide to Road Design – Part 4, Intersections and Crossings.*

(c) Intersections with state roads or national highways are to be designed, approved and constructed in accordance with the requirements of the Queensland Department of Transport and Main Roads.

(d) Where major intersections are required to serve a development complete reconstruction of the existing road pavements may be necessary.

(e) Intersections should be generally located in such a way that:

(i) the streets intersect preferably at right-angles and not less than 70º;

(ii) the landform allows clear sight distance on each of the approach legs of the intersection;

(iii) the minor street intersects the convex side of the major street;

(iv) the vertical grade lines at the intersection do not impose undue driving difficulties;

(v) the vertical grade lines at the intersection will allow for any direct surface drainage;

(vi) two minor side streets intersecting a major street in a left-right staggered pattern must have a minimum centre-line spacing of 50m to provide for a possible right-turn auxiliary lane on the major street; and

(vii) a right-left manoeuvre between the staggered streets is preferable, avoiding the possibility of queuing in the major street, but only where staggered streets cannot be avoided.

(f) Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

(g) Appropriate provision should be made for vehicles to park safely, where required.

(h) Safe intersection sight distance - refer clause SC6.4.4.1.3(8)(i).

(i) The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross-section profile.

(j) All vehicle turning movements are accommodated utilising *Design Vehicles and Turning Templates*, as follows:

(i) for intersection turning movements involving low order roads, the "design semi-trailer" with turning path radius 15 m;

(ii) for intersection turning movements involving streets, the "design single unit" bus with turning path radius 13 m; and

(iii) for turning movements at the head of cul-de-sac local streets sufficient area is provided for the "design single unit" truck to make a three-point turn Driveway entrances are not to be used for turning movements. The minimum cul-de-sac head radius is 9m to kerb lip.

(k) Turning radii at intersections or driveways on major collector streets accommodate the intended movements without allowing desired speeds to be exceeded.

(l) On bus routes 3-centred curves with radii 15m, 10m, 30m are to be used at junctions and intersections.

(m) Un-signalised intersections on sub-arterial roads at grade should have a median width of at least five metres to allow for a two stage crossing from the side street.

(n) Design of traffic signals in sub-arterial roads must be in accordance with the Department of Transport and Main Roads' *Road Planning and Design Manual* (RPDM), Chapter 18. Council approval is required for use of equipment that is uniquely associated with traffic signals.

(o) Barrier kerb and channel must be used at intersection kerb turnouts extending to the tangent point. A one metre kerb transition must be used to connect barrier kerb and channel turnout with adjacent layback kerb and channel.

(12) Roundabouts

(a) Roundabouts are to be approved by council.

(b) Roundabouts should generally be designed in accordance with the requirements of *Austroads Guide to Road Design - Part 4B - Roundabouts.* Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

(i) safe provision for pedestrians, cyclists and public transport movements;

(ii) entry width to provide adequate capacity;

(iii) adequate circulation width, compatible with the entry widths and design vehicles e.g. buses, trucks, cars;

(iv) central islands of diameter sufficient only to give drivers guidance on the manoeuvres expected;

(v) deflection of the traffic to the left on entry to promote gyratory movement;

(vi) adequate deflection of crossing movements to ensure low traffic speeds;

(vii) a simple, clear and conspicuous layout; and

(viii) design to ensure that the speed of all vehicles approaching the intersection will be less than 40 km/h.

(13) Local area traffic management

(a) Local area traffic management (LATM) devices are unnecessary for appropriately designed new streets, but may be used to address speed and safety issues in existing streets, and must be approved by council.

(b) Calming devices such as thresholds, slow points, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the publication *Guide to Traffic Management Part 8: Local Area Traffic Management (LATM)* and the *Manual of Uniform Traffic Control Devices*. Device designs should generally comply with the following.

(i) Streetscape:

(A) reduce the linearity of the street by segmentation;

(B) avoid continuous long straight lines (e.g. kerb lines);

(C) short straights and short distances between intersections;

(D) enhance existing landscape character;

(E) maximise continuity between existing and new landscape areas;

(F) on-street parking; and

(G) mixed activity precincts.

(ii) Location of devices/changes:

(A) devices other than at intersections should be located to be consistent with streetscape requirements;

(B) existing street lighting, drainage pits, driveways, and services may decide the exact location of devices; and

(C) slowing devices are optimally located at spacings of 100-150m.

(iii) Design vehicles:

(A) emergency vehicles, garbage trucks and furniture vehicles must be able to reach all residences and properties;

(B) local streets with a “feeding” function between arterial roads and streets must be designed for an Austroads Design Single Unit Truck/Bus;

(C) where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers; and

(D) in newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be provided for.

(iv) Control of vehicle speeds:

(A) maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds;

(B) speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings); and

(C) speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by "segmenting" streets into relatively short lengths (less than 300 m), using appropriate devices, streetscapes, or street alignment to create short sight lines and by inducing in drivers a feeling of constriction through the introduction of side friction.

(v) Visibility requirements (sight distance):

(A) adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds;

(B) sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers; and

(C) night time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night time operation. Additional street lighting must be provided by the developer at proposed new speed control devices located away from existing street lighting.

(vi) Critical dimensions

Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

(A) pavement narrowings in accordance with *Guide to Traffic Management;*

(B) bicycle lanes (including adjacent to pavement narrowings) – 1.5m minimum, 1.2m absolute minimum with council approval (in accordance with *Guide to Traffic Management*, and *Guide to Road Design);*

(C) plateau or platform areas;

(D) 75 mm to 100 mm height maximum, with 1 in 15 ramp slope;

(E) width of clear sight path through slowing devices;

(F) The width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, (usually vegetation);

(G) dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates; and

(H) on bus routes, devices must allow the full-length of the bus to be contained between ramps.

(14) Road safety audits

(a) Road safety audits (RSA) should be carried out on sub-arterial road projects in accordance with *Guide to Road Safety Part 6: Road Safety Audit*. Confirmation from council is to be sought on which project stages require an RSA. The following stages of the project should be considered for an RSA, as appropriate:

(i) feasibility design;

(ii) completion of design development;

(iii) completion of final design;

(iv) during construction, where temporary traffic management measures are proposed;

(v) two weeks prior to opening to traffic; and

(vi) within one week of opening to traffic.

(15) Parking

(a) The parking requirements for normal levels of activity associated with any land use should be accommodated on-site.

(b) All on-site parking should be located and of dimensions that allow convenient and safe access and usage. All designs must account for a B99 (AS 2890) vehicle as the minimum requirement.

(c) Adequate parking should be provided within the road reserve for visitors, service vehicles and any excess resident parking since a particular use may generate a high demand for parking. Such parking is to be convenient to the use.

(d) The availability of parking should be adequate to minimise the possibility of driveway access being obstructed by cars parked on the opposite side of the street.

(e) On single lane local streets parking spaces should be provided within the verge. Such parking should be well defined and an all-weather surface provided. Such parking may not restrict the safe passage of vehicular and pedestrian traffic.

(f) Parking spaces provided on the verge or carriageway should be of adequate dimensions, convenient and safe to access.

(g) For non-residential land uses the opportunity for joint use of parking should be maximised by being shared by a number of complementing uses.

(h) On single lane carriageways a number of verge spaces are combined to provide for short term truck parking within 40m of any allotment.

(i) All verge spaces and indented parking areas are constructed of concrete, interlocking pavers, bitumen with crushed rock or other council approved base material and are designed to withstand the loads and manoeuvring stresses of vehicles expected to use those spaces.

(j) Right-angled kerbside parking is provided only on streets where posted speeds do not exceed 40 km/h.

(16) Bus routes

(a) It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 5% of residents should have to walk in excess of 5 minutes to catch a bus. Sub-section SC6.4.3.5 Car parking and public transport facilities guidelines details minimum criteria for bus route design, though local conditions, including climate and topography should be taken into consideration to demonstrate that bus routes are readily accessible to the majority of residents.

(b) Carriageway widths must comply with sub-sections SC6.4.4.8 Standard drawings, and SC6.4.3.13 Townsville road hierarchy. For indented bus bays on streets identified as bus routes, refer to SC6.4.4.8 Standard drawings. Shelters are subject to council's requirements.

SC6.4.4.1.4 Rural design criteria

(1) General

(a) In addition to the above, SC6.4.4.1.4 specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farms types of developments.

(b) Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in *Guide to Road Design.*

(c) Superelevation, widening and centreline shift and their associated transitions are to comply with Austroads Guides, where appropriate.

(d) Where the table drain is likely to scour, a stone pitched or suitably lined dish drain is to be constructed along the invert. For grades of less than 0.5%, the inverts of the drain are to be lined to prevent siltation. Drains with a minimum gradient of 0.25% are to be concrete lined.

(e) All rural subdivisions should be designed to restrict access to major roads.

(f) Access should be limited to one point on to street, major collector or arterial road networks.

(2) Sight distances

(a) Stopping sight distance should be provided at all points on the road.

(b) Stopping sight distance is the sum of the braking distance and the distance the vehicle travels during a reaction time of 2.5 seconds.

(3) Horizontal and vertical alignment

Horizontal and vertical curves are to be designed generally to the requirements of *Guide to Road Design*. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform with the terrain to achieve aesthetic quality and being in harmony with the landform.

(4) Intersections

(a) Intersections should generally be designed in accordance with the publication *Guide to Road Design Part 4: Intersections and Crossings and Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings.* The type of intersection required will depend on existing and planned connecting roads.

(b) Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location must be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

(i) ASD relates to the ability of drivers to observe the roadway layout at an anticipated approach speed.

(ii) ESD relates to the driver entering the intersection from a minor road and ability to observe the roadway layout and assess traffic gaps. SISD relates to an overall check that vehicles utilising the intersection have sufficient visibility to allow reaction and deceleration so as to provide adequate stopping distance in potential collision situations.

(iii) Tabulated speed/sight distance requirements together with detailed explanations for each of the sight distance criteria are given in the relevant sections of the *Austroads Guide to Road Design*. Repositioning of an intersection may be required to obtain conformance with the sight distance criteria.

(iv) Stopping distance envelopes must be provided to ensure sight distances are achieved in the street layout.

(c) Staggered-T arrangements proposed for rural cross-intersections should preferably be of the “right to left” type. This arrangement eliminates traffic queuing in the major road, the need for additional pavement for right turn lanes and greater stagger length associated with “left to right” T-intersections. Figures and discussion on staggered-T treatments are given in the *Austroads Guide to Road Design.*

(5) Carriageways

Carriageway widths for rural roads should generally be as per SC6.4.4.8 Standard drawings SD-010 Typical Road Cross Sections – Rural Roads.

(6) Superelevation

Use of maximum superelevation will be considered where the radius of the curve in approaching the minimum speed environment. Reference should be made to *Austroads Guide to Road Design* for superelevation calculation. At low and intermediate ranges of design speed (i.e. below 80 km/h) all curves should be superelevated to at least a value equal the normal crossfall of straights.

(7) Table drains

Table drains to rural roads must comply with *Guide to Road Design Part 3: Geometric Design*. Minimum longitudinal grade of table drains is 0.50%. Refer to *Guide to Road Design Part 6: Roadside Design, Safety and Barriers for capacity of drains.*

(8) Scour protection

Scour protection of roadside drainage and table drains is required. The level of protection will depend on the

nature of the soils, road gradients and volume of stormwater runoff. Protection works may involve concrete lined channels, turfing, rock pitching, grass seeding, individually or any combination of these. Geotechnical investigations should be carried out of determine the level and extent of any protection works prior to proceeding to final design stage.

SC6.4.4.2 Pavement design

SC6.4.4.2.1 Introduction

(1) Objectives

The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs to its design functions and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design. In areas with a history of salinity problems, subsurface drainage may be prescribed to keep the groundwater table lower in the strata so as to avoid progressive deterioration of the health of topsoil and upper layers due to salinity levels increased by rising and/or fluctuating groundwater tables.

(2) Scope

(a) This sub-section covers the design guidelines for road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface, and the design of the subsurface drainage system for the road pavement and/or subgrade.

The sub-section contains guidance in the design of the following forms of surfaced road pavement construction types:

(i) flexible pavements consisting of unbound granular materials;

(ii) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;

(iii) rigid pavements (i.e. cement concrete pavements); and

(iv) concrete or clay segmental pavements.

(b) This sub-section generally sets out procedures in determining the following design criteria:

(i) design traffic;

(ii) design CBR of pavement subgrade (including method of sampling and testing);

(iii) determination of required subgrade treatments;

(iv) design methods for rigid and flexible pavement (pavement thickness);

(v) subsoil and foundation drains;

(vi) sub-pavement drains; and

(vii) drainage mats, including Type A and Type B mats.

(3) Terminology

Foundation drains	are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.
Sub-pavement drains	are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade.
Subsoil drains	are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings and fill areas.
Type A drainage mats	are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type B drainage mats are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

(4) Reference and source documents

(a) Development manual planning scheme policy sub-section to be read and applied in conjunction with this sub-section are as follows:

SC6.4.4.1 - Geometric road design
SC6.4.6.8 - Drainage mats
SC6.4.6.12 - Flexible pavements
SC6.4.6.13 - Asphaltic concrete
SC6.4.6.14 - Mass concrete sub base
SC6.4.6.15 - Plain and reinforced concrete base
SC6.4.6.16 - Sprayed bituminous surfacing
SC6.4.6.17 - Bituminous microsurfacing
SC6.4.6.18 - Segmental paving
SC6.4.6.20 - Subsoil, foundation and pavement drains
SC6.4.6.21 - Subsurface drainage

(b) Australian Standards

AS 1289 – *Methods of testing soils for engineering purposes*
AS 1289.4.2.1 - *Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method*
AS 2439.1 - *Perforated drainage pipe and associated fittings.*
AS/NZS 1477 - *PVC pipes and fittings for pressure applications.*

(c) Department of Transport and Main Roads

Pavement Design Manual – Supplemental to 'Part 2: Pavement Structural Design' of the *Austroads Guide to Pavement Technology.*
MRTS05 - Unbound Pavements
MRTS11 - Sprayed Bituminous Surfacing (Excluding Emulsion)
MRTS12 - Sprayed Bituminous Emulsion Surfacing
MRTS31 - Heavy Duty Asphalt
MRTS08 – Plant-Mixed Stabilised Pavements using Cement or Cementitious Blends
MRTS13 – Bituminous Slurry Surfacing
MRTS17 - Bitumen
MRTS18 – Polymer Modified Binder
MRTS20 – Cutback Bitumen
MRTS21 – Bituminous Emulsion
MRTS30 – Asphalt Pavements
MRTS35 – Recycled Materials for Pavements
MRTS38 – Pavement Drains
MRTS39 – Lean Mix Concrete sub-base for Pavements
MRTS40 – Concrete Base in Pavements Jointed Unreinforced, Jointed Reinforced, Continuously Reinforced and Steel Fibre Reinforced Pavements

(d) Other

Austroads, *Guide to Pavement Technology (all parts).*
Austroads, *Guide to Road Design – Geotechnical Investigation and Design.*
Concrete Masonry Association of Australia:

CMAA – MA57 - Concrete Segmental and Flag Pavements – Guide to Specifying, 2010
CMAA - T45 - Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads
CMAA - T46 - Concrete Segmental Pavements - Detailing Guide.

Clay Brick and Paver Institute, *Design Manual 1 - Clay Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic.*

SC6.4.4.2.2 Pavement design criteria

(1) The design traffic loading must be calculated based on the following minimum design lives of pavement:

Table SC6.4.4.2.1 Design ESAs

Road or street type	Minimum design life
Urban streets and roads	20 years
Rural streets and roads	20 years
Rigid (concrete)	40 years
Segmental block	25 years

Design traffic loading for urban areas must be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity.

For new subdivisions, the design traffic loading must take account of the construction traffic associated with the subdivision development, and the in-service traffic for the subdivision and any future developments linked to that subdivision.

When designing staged developments, the number of vehicle trips must take into consideration the ultimate development that will eventually access each segment of the road under consideration with appropriate allowances for bus, garbage, construction and in-service traffic.

For interlocking concrete segmental pavements, the simplification of replacing ESAs with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA-T45 is acceptable up to a design traffic of 10^6ESAs. Beyond this, ESAs should be calculated.

The pavement design must include all traffic data and/or assumptions made in the calculation of the design traffic. The estimated design traffic must generally be made in accordance with G*uide to Pavement Technology* – in particular *Part 2 Pavement Structural Design* for the calculation of design traffic volumes up to and exceeding 10^6ESAs.

In the absence of other traffic data, the following traffic values (in ESAs) may be taken as a guide to the minimum design traffic, but are subject to variation depending on the circumstances for the particular development.

Table 6.4.4.2.2 Design ESAs

Street Type	Design ESAs - 20 year design life (minimum)
Urban Residential	
- Type A	2×10^4
- Type B	1×10^5
- Type C	1×10^6
Major Collector	2×10^6
Commercial and Industrial	5×10^6
Rural Roads	1×10^6

Traffic volume and annual growth rate can be obtained upon request to council as guidance in determining the design traffic loading to be used for pavement design. For roads, the design traffic loading must be determined using a design life as per SC6.4.4.2.2.(1), however, a practical design strategy to allow extensions of the pavement life to 35 years (minimum) must also be submitted.

For new residential developments where traffic data is not readily and accurately available, the design may consider the following data to determine the design traffic loading:

(a) traffic generation – 10 vehicles per day/allotment plus 20 ESAs per equivalent allotment for consideration of construction traffic;

(b) traffic growth rates – 0.5% – 2% for streets. Annual traffic growth rates for roads are subject to

confirmation by council and will be based on available traffic data;

(c) commercial vehicles – 3%-7% for streets. Commercial vehicle percentages for roads are subject to confirmation by council and will be based on available traffic data;

(d) ESA per heavy vehicle (ESA/HVAG) - Urban 0.7, Rural 0.9; and

(e) axle group per heavy vehicle (NHVAG) – Urban 2.5, Rural 2.8.

(2) The calculation of design traffic loading for rural area must adopt a similar approach to the urban areas while the design for industrial roads will require a detailed assessment addressing the following factors and must be designed using a mechanistic approach:

(a) traffic generation, including peak hour traffic volumes and truck volumes;

(b) details of the types of heavy vehicles that are expected to utilise the road; and

(c) predicted route patterns (heavy vehicles).

(3) The calculation of design traffic loading for industrial development must include the following factors:

(a) traffic generation of the proposed industrial development (including peak hour traffic volumes). Refer to *Guide to Pavement Technology Part 2* for the method of calculating load factors for each type of heavy vehicles;

(b) to Austroads Guide to Pavement Technology Part 2 for the method of calculating load factors for each type of heavy vehicles;

(c) details of types of trucks that will utilise the proposed road network with consideration to the proportion of heavy vehicles that will have full load; and

(d) predicted truck usage patterns with consideration to expected land use.

SC6.4.4.2.3 Geotechnical evaluation

(1) General

The designer must arrange a detailed geotechnical investigation of the naturally occurring material along the alignment of the proposed roads. The extent of any areas of filling and cutting must be determined including the strength of the underlying materials and considered in the overall pavement design.

The geotechnical investigation, including both field and laboratory testing must be undertaken in accordance with all relevant Australian Standards (e.g. AS 1289) and *Guide to Road Design* in particular *Part 7 Geotechnical Investigation and Design.*

(2) Subgrade testing

(a) Except where a mechanistic design approach is employed using Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*, the measure of subgrade support must be the California Bearing Ratio (CBR). Where a mechanistic design approach using linear elastic theory is employed for flexible pavements, the measure of subgrade support must be in terms of the elastic parameters (modulus, Poisson's ratio), e.g. for use in CIRCLY computerised pavement design methods.
In conducting subgrade tests, the following approach must be adopted for new roads:

(i) test pits/holes along the alignment of the road must have a spacing between 60m and 120m as appropriate for each urban residential and industrial street or a minimum of three test locations per street in a stage, whichever is greater;

(ii) test pits/holes along the alignment of a rural area must have a spacing of up to 300m or a minimum of 3 test locations per road whichever is greater;

(iii) test holes must be excavated to a minimum depth of 1 m and must extend a minimum 500mm below the proposed subgrade level;

(iv) if the depth of fill material over the natural subgrade is more than 500mm, then the fill material is considered to be the new subgrade and it must be assessed; and

(v) if the depth of fill is less than 500mm, investigation must assess the natural ground conditions and also the properties of the proposed fill material.

(b) The following factors must be considered in determining the design strength/stiffness of the subgrade:

(i) sequence of earthworks construction;

(ii) the compaction moisture content and field density specified for construction;

(iii) moisture changes during service life;

(iv) subgrade variability; and

(v) the presence or otherwise of weak layers below the design subgrade level.

(3) California Bearing Ratio (CBR)

(a) Notwithstanding the requirements of AS1289.6.1.1, this document specifies additional or differing requirements, including:

(i) CBR tests must be carried out with a maximum of 4.5kg surcharge; and

(ii) maximum correction allowable to the applied force is 0.5mm along the horizontal axis of the penetration curve.

(b) The calculation of the Design CBR must be based on either soaked or unsoaked conditions as appropriate.

(i) For boxed in pavements soaked conditions must be adopted for the calculation of Design CBR and must be based on a minimum of three 4-day soaked CBR laboratory samples for each subgrade area compacted to 97% of maximum dry density, standard compaction at optimum moisture content (OMC).

(ii) If it can be demonstrated that the subgrade is well drained and not less than 300mm above natural surface or table drain, e.g. Rural formation, in free draining material and not influenced by spring/seepage conditions then the unsoaked condition will be considered for design by council. When unsoaked conditions are to be adopted the calculation of Design CBR must be based on a minimum of three laboratory samples for each subgrade area compacted to 97% maximum dry density standard compaction at OMC and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone and soil type if appropriate (as per the guidelines in Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*) to give an estimate of equilibrium in-situ CBR.

(iii) The Design CBR for each subgrade area is computed by using the appropriate formula as follows:

Design CBR = Least of estimated CBRs, for less than five results

or

Design CBR = 10th percentile of all estimated CBRs, for five or more results

Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades.

The pavement design must include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

(4) Environment

The environmental factors which significantly affect pavement performance are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

(a) rainfall/evaporation pattern;

(b) permeability of wearing surface;

(c) depth of water table and salinity problems;

(d) relative permeability of pavement layers;

(e) whether shoulders are sealed or not; and

(f) pavement type (boxed or full width).

The effect of changes in moisture content on the strength/stiffness of the subgrade must be taken into account by evaluating the design subgrade strength parameters (i.e. CBR or modulus) at the highest moisture content likely to occur during the design life, i.e. the design moisture content. The provision of subsurface drainage may, under certain circumstances, allow a lower design moisture content, and hence generally higher design CBR.

The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of changes in temperature environment should also be considered for bound or concrete layers.

The pavement design must include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

(5) Expansive soils

Highly expansive materials are classified as highly reactive with high plasticity. Refer to the classification in Table SC6.4.4.2.1 Guide to classification of expansive soils, with prominence give to classification based on the CBR swell. Expansive soilds have the potential to exhibit significant volume changes with the variation in moisture content leading to possible loss of pavement shape and longitudinal cracking in the future pavement. For this reason, if test results indicate highly expansive materials (classified as "High" or "Very High"), the design CBR must be 3% or less. Materials having a measured CBR swell ≥2.5% must incorporate a low permeability treatment layer to minimise significant moisture changes in the underlying subgrade.

Table SC6.4.4.2.3 Guide to classification of highly expansive soils

Expansive Nature	Liquid Limit (%)	Plastic Index	PI x % <0.425mm	Potential Swell (%)*
Very High	>70	>45	>3200	>5.0
High	>70	>45	2200-3200	2.5-5.0
Moderate	50-70	25-45	1200-2200	0.5-2.5
Low	<50	<25	<1200	<0.5

*Swell OMC and 97% MDD using Standard compactive effort; 4 day soak based on 4.5kg surcharge.
(Source: Guide to Pavement Technology – Part 2).

SC6.4.4.2.4 Subgrade treatment

(1) General

Subgrade treatment may be required subject to ground conditions defined in Table SC6.4.4.2.4 Ground conditions for subgrade treatment.

Table SC6.4.4.2.4 Ground conditions for subgrade treatment

Category	Condition	Definition	Treatment Type
A	Excessively wet subgrade anticipated prior to construction and/or excessively wet subgrade encountered once construction commences	“Wet” subgrade	Working Platform
B	Low Design Subgrade Strength *	Soaked CBR ≤ 3%	Capping Layer
C	Highly or very highly expansive subgrade soil #	Swell ≥ 2.5%	Pavement Cover
D	Ground beneath pavement will be exposed to water (due to the effect of capillary rise and/or positive head)	“Water Exposure”	Drainage Layer

* CBR swell at OMC and 97% MDD using Standard Compactive effort; 4 day soak based on 4.5kg surcharge. (Source: Austroads Guide to Pavement Technology – Part 2)

Swell measured in CBR test described in SC6.4.4.2.3 (5)

Design subgrade CBR = 3% must be adopted into the pavement design if the subgrade soaked CBR is > 3% but with CBR swell of ≥ 2.5% (classified as highly or very highly expansive).

This specification does not provide direct criteria for determining the required depth of subgrade treatment in highly or very highly expansive soils (Category C). However, as Category C subgrade will need to be designed with CBR of ≤ 3%, the subgrade treatment of Category B (low design subgrade strength) will ensure that the total "Pavement Cover" is adequate to meet the cover requirements for an expansive subgrade soil. It is noted that the type of subgrade treatment that is acceptable will be depend on the expansive nature of the soil. A subgrade with CBR swell of ≥ 2.5% will require capping material to include a low permeability layer.

Subgrade Treatment selection is outlined in flowchart Figure SC6.4.4.2.1 Guide to determine subgrade treatment. Details for subgrade "Treatment Layer" is described in Table SC6.4.4.2.5 Selection of subgrade treatment type. Subgrade treatment may comprise one or a combination of the alternatives listed.

(2) Subgrade treatment types

(a) In-situ lime stabilisation of the subgrade;

(b) Plant mixed cement stabilised gravel;

(c) Unbound gravel;

(d) Select fill;

(e) Rock fill (geofabric wrapped) + min. 150mm select fill;

(f) Drainage layer material + min. 150mm select fill; and

(g) Geofabric separation layer.

The acceptable types and combinations of treatment are as outlined in SC6.4.4.2.4 (3).

(3) Selection criteria for subgrade treatment type

Figure SC6.4.4.2.1 Guide to determine subgrade treatment outlines subgrade treatment layers, denoted as Treatment L1 to L11. Table SC6.4.4.2.5 Selection of subgrade treatment type details which subgrade treatment options are acceptable for each condition.

Table SC6.4.4.2.6 Thickness of treatment layer outlines procedure for determination of the required thickness of the treatment layer under the pavement. Note that no prescription is given to the required thickness of Working Platform, as this will depend on the specific conditions encountered and the treatment layer selected.

(4) Required thickness of treatment layer

Table SC6.4.4.2.6 Thickness of treatment layer outlines procedure for determination of the required thickness of the treatment layer under the pavement. Note that no prescription is given to the required thickness of Working Platform, as this will depend on the specific conditions encountered and the treatment layer selected.

(5) Working platform

A working platform could comprise of any of the treatment type *(a)* to *(g)* as defined in Table SC6.4.4.2.5 Selection of subgrade treatment type.

(a) Except for treatment type (g) – geofabric separation layer, the working platform is required to meet the following minimum standards necessary for it to function when it becomes part of the subgrade for the operating service life of the pavement structure:

(i) at least 150mm compacted thickness, and as thick as necessary to provide support required;

(ii) have a surface maintained with a geometric tolerance of ± 10mm of the specified height and a maximum deviation from a 3m straight edge of 8mm at all points on the surface; and

(iii) where a treatment type (b) – plant mixed cement stabilised gravel is used, gravel must be of a standard no less than Type 2.3 with a minimum UCS of 0.8 MPa and a maximum UCS of 3.5 MPa at 28 days.

(b) The working platform must be designed by the Contractor to meet the particular requirements of the project including, but not limited to, the following considerations:

(i) the characteristics of the underlying subgrade materials;

(ii) the Contractor's construction traffic and equipment the Contractor intends to use to construct the

pavements and other works;

(iii) the full operating life of the working platform including, but not limited to:

- actual period during which the working platform will be required to provide access for construction traffic;
- actual periods during which the working platform will be required to provide a platform for construction traffic and equipment, including for construction of the pavement layers; and
- actual periods during which it is not in use prior to the construction of the overlying pavement;

(iv) provide protection to the underlying layers, including protection from water and stress;

(v) provide a platform for the construction of the overlying pavement;

(vi) suitability for the Contractor's construction program; and

(vii) be sufficiently stiff to enable the placement and compaction of the overlying pavement layers in accordance with their specified requirements.

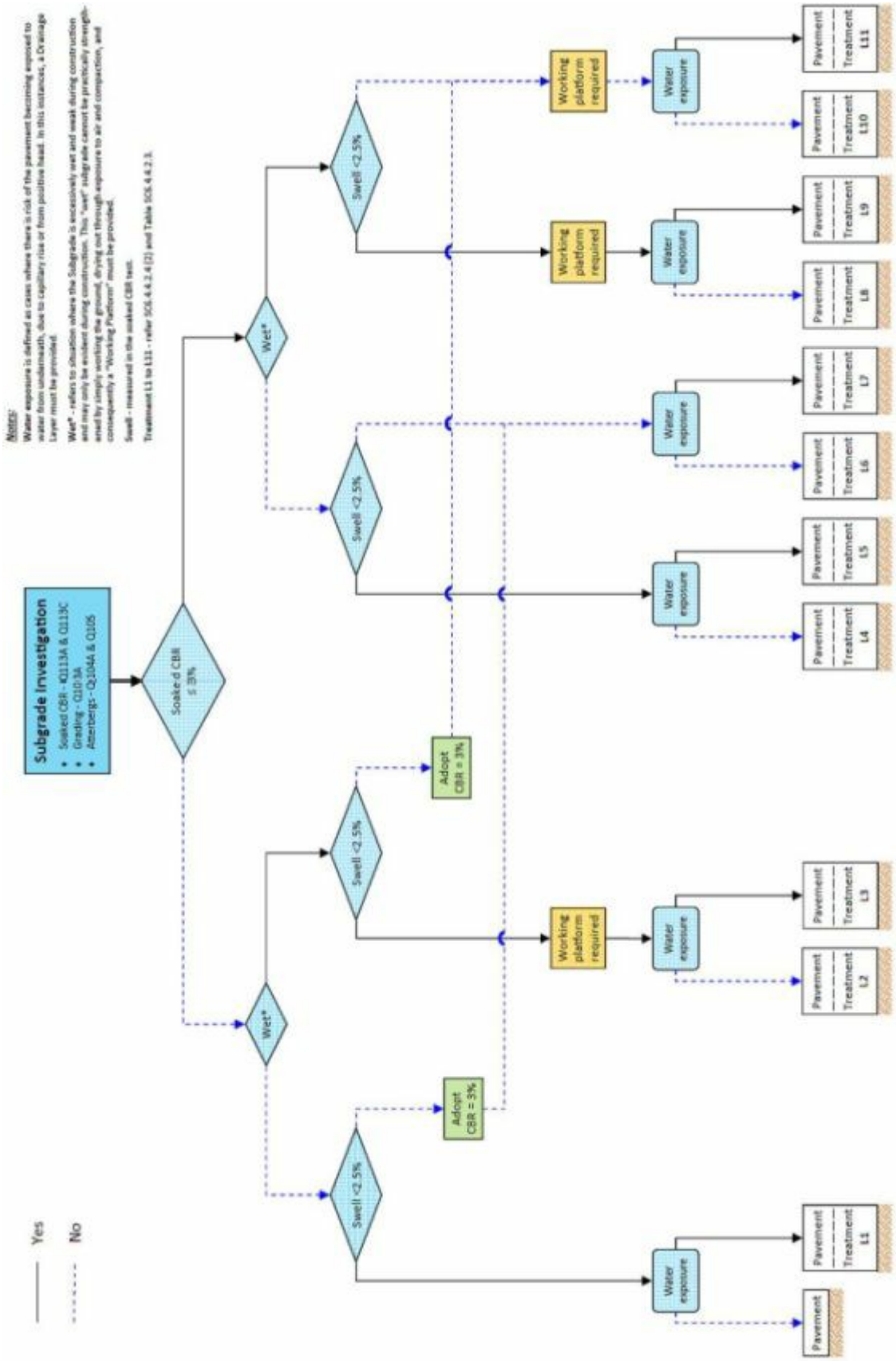


Figure SC6.4.4.2.1 Guide to determine subgrade treatment

Table SC6.4.4.2.5 Selection of subgrade treatment type

Treatment	Soaked CBR ≤ 3%	Wet at construction	Swell < 2.5%	Water Exposure	Acceptable Treatment Types	Treatment Name
-	X	X	✓	X	No treatment required	-
L1	X	X	✓	✓	(e) or *(f)*	Drainage layer
L2	X	✓	✓	X	If "Wet" layer entirely removed & replaced: (b) to (e) & (g)*. If not: (a), (b), (e) or *(g)**.	Working platform
L3	X	✓	✓	✓	(e)	Drainage layer & working platform
L4	✓	X	✓	X	(a) to (d)	Capping layer
L5	✓	X	✓	✓	(e) or (f)	Capping layer & drainage layer
L6	✓	X	X	X	(a), (b) or (d)	Capping layer & pavement cover
L7	✓	X	X	✓	(e) or (f)	Capping layer, pavement cover & drainage layer
L8	✓	✓	✓	X	If "Wet" layer entirely removed and replaced: (b) to (e). If not: (a), (b) or (e)	Capping layer & working platform
L9	✓	✓	✓	✓	(e)	Capping layer, drainage layer & working platform
L10	✓	✓	X	X	(a), (b) or (e)	Capping layer, pavement cover & working platform
L11	✓	✓	X	✓	(e)	Capping layer, pavement cover, drainage layer & working platform

* (g) – geofabric layer may or may not provide adequate as a working platform upon which pavement construction can proceed. This can only be determined by trial and error. If it proves insufficient support, other acceptable treatments will be required.

(6) Capping layer

Capping layer must be provided where the in-situ untreated subgrade has a design CBR ≤ 3%. Treatment types that are suitable for use as a capping layer and a reference to the quality requirements are as follows:

(a) in-situ lime stabilisation of the subgrade – refer SC6.4.4.2.4 (8);

(b) plant mixed cement stabilised gravel – refer SC6.4.6.12 Flexible pavements;

(c) unbound gravel – refer SC6.4.6.12 Flexible pavements;

(d) select fill – refer SC6.4.4.2.4 (7);

(e) rock fill (geofabric wrapped) + min. 150mm *(b)* or *(d)* – refer SC6.4.4.2.4 (9); and

(f) drainage layer material + min. 150mm *(b)* or *(d)* – refer SC6.4.4.2.4 (10).

(7) Select fill

Select fill can be used as part of a subgrade treatment solution when a "capping layer" and/or "pavement cover" is required, and could also be used as a "working platform" to replace a wet layer. Select fill may comprise a naturally occurring material from on site or imported to site, or may comprise a natural material that has its properties improved by addition of cement or lime. The natural material or improved product must meet the minimum requirements in Table SC6.4.4.2.7 Material properties for select fill.

Table SC6.4.4.2.6 Determining thickness of treatment layer

Treatment	Thickness of treatment	Treatment name
L1	Refer SC6.4.6.8 Drainage mats	Drainage layer
L2	Excluding *(g)* "geofabric layer", thickness is as required to successfully achieve compaction on top of the working platform, min. 150mm	Working platform
L3	Refer SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Drainage layer & working platform
L4	Refer SC6.4.4.2.7 (1) and (2)	Capping layer
L5	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Capping layer & drainage layer
L6	Refer SC6.4.4.2.7 (1) and (2)	Capping layer & pavement cover
L7	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer	Capping layer, pavement cover & drainage layer
L8	Refer SC6.4.4.2.7 (1) and (2). Greater thickness may be required to achieve an adequate working platform	Capping layer & working platform
L9	Refer SC6.4.4.2.7 (1) and (2) and SC6.4.6.8 Drainage mats. A minimum 150mm thick layer of type *(d)* must be provided on top of the drainage layer. Greater thickness may be required to achieve an adequate working platform	Capping layer, drainage layer & working platform
L10	Refer SC6.4.4.2.7 (1) and (2). Only types *(a), (b)* or a combination of a minimum 150mm of *(d)* on top of *(e)*, are acceptable due to expansive subgrade. Greater thickness may be required to achieve an adequate working platform	Capping layer, pavement cover & working platform
L11	150mm of *(d)* is required on *(e).* Thickness of *(e)* determined from SC6.4.6.8 Drainage mats. Combined thickness must also satisfy SC6.4.4.2.7 (1) and (2). Greater thickness may be required to achieve an adequate working platform	Capping layer, pavement cover, drainage layer & working platform

Table SC6.4.4.2.7 Material properties for select fill and treated material

Property	**Depth below Working Platform** [1]	
	≤ 150 mm	**> 150 mm**
Laboratory CBR (%) [1]	≥ 10	≥ 10
Maximum aggregate size (mm)	75	75
Plasticity index	≥7	≥7
Weighted plasticity index (WPI)	< 1200	< 2200
Swell (%) [2]	≤ 0.5	≤ 2.5
% passing 0.075 mm	15–30 inclusive	4–30 inclusive

Note—

(1) material may be chosen with a minimum CBR greater than specified above, ift his is considered to provide a better overall design solution. However, for design purposes, the layer may not be modelled with CBR of greater than1 5%. CBR to be tested in accordance with Q113C (97.0% MDD, OMC, standard compactive effort), 4.5kg surcharge and soaked for a period of four days.

(2) swell determined from CBR test described above.

(8) In-situ lime stabilised subgrade

In-situ lime stabilisation of the subgrade soil is the preferred means of satisfying "Capping Layer" and "Pavement Cover" requirements when the subgrade comprises plastic clay soils.

In-situ treatment of clay subgrades using lime involves mixing lime, which has been either previously hydrated or hydrated on site by adding water (slaking), into a subgrade to increase subgrade strengths. This may be done to modify the subgrade (i.e. usually achieve a temporary strength gain) or it may be added to stabilise it (i.e. achieve a permanent increase in strength). In the case of the latter sufficient lime must be added to ensure that these strength gains are permanent. It is essential that the purpose of the treatment is clearly identified and clear to all concerned.

No design benefit can be adopted if stabilisation is only for the purpose of "modifying" the subgrade soil properties. To qualify for use as a "Capping Layer" and/or "Pavement Cover", full stabilisation as outlined below is required.
Subgrade soil not suitable for lime stabilisation must include:

(a) unbound material with:
  (i) a plasticity index less than 10%; or
  (ii) less than 25% passing the 0.425 mm sieve; or
  (iii) Soluble sulphate > 0.2%

(b) any patch which may include:
  (i) concrete; or
  (ii) cement treated material; or
  (iii) asphalt.

Lime stabilisation of subgrade material must be carried out as a 2 day operation to a minimum depth of 250mm, except for natural subgrades with a representative strength of CBR 0.5% where stabilisation depth must be a minimum of 300mm. The required process is detailed in SC6.4.6.12 Flexible pavements.

(9) Rock fill (geofabric wrapped) + min. 150mm of *(b)* or *(d)*
Rock fill (geofabric wrapped) can be utilised in combination with treatment types *(b)* or *(d)* for application within a capping layer, a working platform and a Drainage Layer.

Rock fill must meet the quality requirements for rock Fill in TMR Specification MRTS04 and the Geofabric must be selected in accordance with TMR Specification MRTS27.

The minimum rock fill layer thickness must be twice the maximum particle size, but not less than 300mm. If a working platform is also required, the thickness must be sufficient to bridge the natural subgrade and provide solid support for the *(b)* or *(d)* overlying layer.

(10) Drainage layer + min. 150mm of *(b)* or *(d)*

A drainage layer must be provided where water exposure occurs, or is likely to occur, from beneath the pavement (due to the effect of capillary rise and/or positive head). The drainage layer must be a minimum 300mm thick (refer SC6.4.6.8 Drainage mats) and covered by a minimum 150mm of type *(b)* or *(d)*.

Treatment type *(f)* must not be used for situation where a working platform is also required due to the insitu material being wet and of low strength (which can be assessed by in situ dynamic cone penetrometer testing), and only treatment type *(e)* is acceptable.

(11) Equivalent subgrade CBR for design
Section SC6.4.4.2.4 (1) to (10) outlines the requirements of subgrade treatment and treatment type options acceptable by Council. Once subgrade treatment has been identified, the equivalent subgrade CBR value for pavement design calculation or modelling must be adopted as per Table SC6.4.4.2.8 Equivalent subgrade CBR.

As a capping layer is compulsory for treatment L4 to L11, there are two design conditions to determine the thickness requirement and equivalent subgrade CBR strength for the capping layer.

(a) Capping layer comprises in-situ lime stabilised subgrade or plant mixed cement stabilised gravel
The pavement above an in-situ lime stabilised subgrade or plant mixed cement stabilised gravel must be designed for an equivalent CBR derived from the natural subgrade CBR and the design traffic load (ESA's) as shown in Figure SC6.4.4.2.2 Design chart: Subgrade CBR equivalent to lime stabilised layer + natural subgrade (M. Matheson).

The capping layer depth required must be 250mm for natural subgrade CBR of > 0.5%, otherwise depth must be 300mm.

(b) Capping layer comprises unbound material

As detailed in section SC6.4.4.2.4 (6), unbound material that are acceptable to be used as capping layer include:

- unbound gravel;
- select fill;
- rock fill (geofabric wrapped) + min. 150mm select fill; and
- drainage layer material + min. 150mm select fill.

The required capping thickness is given in Table SC6.4.4.2.9 Capping thickness for unbound materials. However, for natural subgrade CBR ≤ 1.0%, a specific assessment is required.

Table SC6.4.4.2.8 Equivalent subgrade CBR

Treatment	Natural ground subgrade CBR (%)	Treatment type	Equivalent subgrade CBR
-	> 3	Nil	Use natural ground subgrade CBR
L1	> 3	*(e)* or *(f)*	CBR = 10%
L2	> 3	*(b), (c), (d), (e)* or *(g)**	If wet layer is removed and replaced: Use natural ground subgrade CBR
		(b), (e) or *(g)**	If wet layer remains: CBR = 3%
L3	> 3	*(e)*	CBR = 3%
L4	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(c) or *(d)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L5	≤ 3	*(e)* or *(f)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L6	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(d)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L7	≤ 3	*(e)* or *(f)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L8	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(e)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L9	≤ 3	*(e)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L10	≤ 3	*(a)* or *(b)*	Refer SC6.4.4.2.4 (11A)
		(e)	CBR = 3%. Refer SC6.4.4.2.4 (11B)
L11	≤ 3	*(e)*	CBR = 3%. Refer SC6.4.4.2.4 (11B)

* (g) – geofabric layer may or may not provide adequate as a working platform upon which pavement construction can proceed. This can only be determined by trial and error. If it proves insufficient support, other acceptable treatments will be required.

Table SC6.4.4.2.9 Capping thickness for unbound material

Natural subgrade CBR	Minimum capping layer thickness (mm)
≥ 2.5% to ≤ 3.0%	150
≥ 2.0% to < 2.5%	200
≥ 1.5% to < 2.0%	300
≥ 1.0% to < 1.5%	400

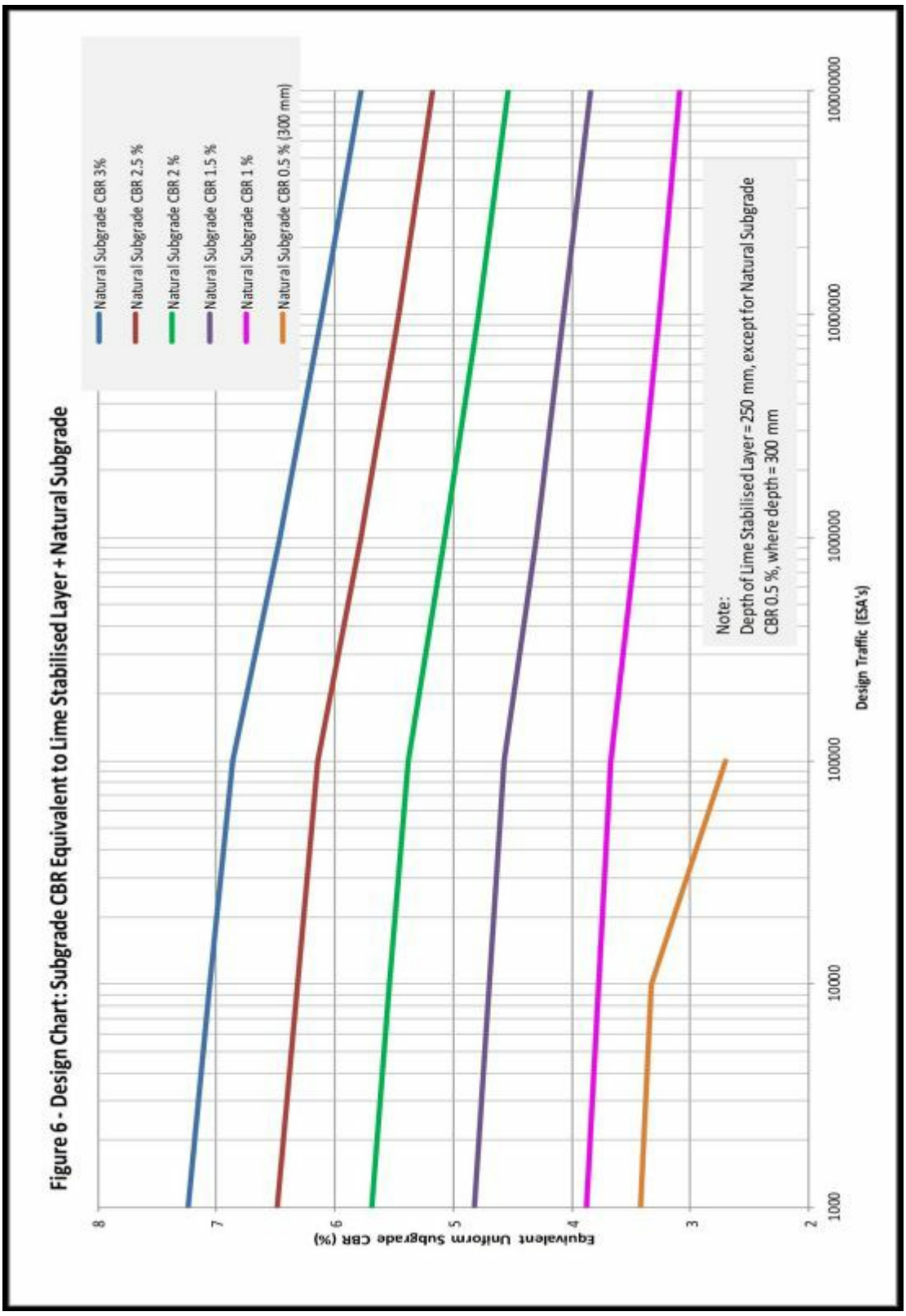


Figure SC6.4.4.2.2 Design chart: subgrade CBR equivalent to lime stabilised layer + natural subgrade (M. Matheson)

SC6.4.4.2.5 Pavement and surfacing materials

(1) Pavement materials can be classified into the following categories according to their fundamental behaviour under the effects of applied loadings:

- unbound granular materials;
- cement modified granular materials, also known as cement modified (0.8 MPa < UCS < 1.5 MPa);
- bound (cemented) granular materials, also known as cement treated (UCS >1.5MPa);
- asphaltic concrete;
- cement concrete; and
- heavy duty asphalt (deep lift asphalt).

(2) Surfacing materials can also be classified into essentially five categories or types:

- sprayed bituminous seals (flush seals);
- asphaltic concrete;
- cement concrete;
- concrete segmental pavers; and
- clay segmental pavers.

(3) Unbound granular materials, including modified granular materials, must satisfy the requirements of SC6.4.6.12 Flexible pavements.

(4) Bound (cemented) granular materials must satisfy the requirements of SC6.4.6.12 Flexible Pavements.

(5) Asphaltic concrete must satisfy the requirements of SC6.4.6.13 Asphaltic concrete.

(6) Cement concrete must satisfy the requirements of SC6.4.6.14 Mass concrete subbase, SC6.4.6.15 Plain and reinforced concrete base, as appropriate.

(7) Sprayed bituminous seals must satisfy the requirements of SC6.4.6.16 Sprayed bitumen surfacing.

(8) Concrete and clay segmental pavers must satisfy the requirements of SC6.4.6.18 Segmental paving.

(9) Heavy duty asphalt pavements must satisfy the requirements of MRTS31.

SC6.4.4.2.6 Construction and maintenance considerations

The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:

(1) extent and type of drainage;

(2) use of boxed or full width construction;

(3) available equipment of the Contractor;

(4) use of stabilisation;

(5) aesthetic, environmental and safety requirements;

(6) social considerations;

(7) construction under traffic;

(8) use of staged construction; and

(9) ongoing and long-term maintenance costs

These factors are further discussed in Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

SC6.4.4.2.7 Pavement design

Pavement design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design* unless otherwise stated in this document.

(1) Pavement Thickness

Notwithstanding subgrade testing and subsequent pavement thickness design, the minimum pavement thickness on local streets must not be less than 250 mm. This is necessary to ensure that council has sufficient thickness for future insitu stabilisation of pavements (without the risk of mixing the subgrade into the pavement during the process). Additionally, individual compacted layer thickness must be chosen to suit construction process and must be no less than 125 mm nor greater than 250 mm for optimal compaction and to avoid lamination of layers.

(2) Design subgrade CBR

The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.

Design CBR of untreated subgrade must be no greater than 3% unless otherwise approved by council who reserves the rights to carryout independent 3rd party geotechnical investigations to confirm adopted design CBR's and respective pavement designs.

Warrants for the provision of subsurface drainage are given in SC6.4.6.21 Subsurface drainage. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a design moisture content above the optimum moisture content (OMC).

Subgrade treatment must be carried out in accordance with this document on all natural subgrade CBRs ≤ 3% (97% maximum dry density standard compaction at OMC). The equivalent design subgrade CBR of the treated subgrade must be determined in accordance with this document. Pavement design over treated subgrades may adopt the equivalent CBR determined in accordance with this document.

(3) Pavement structure - general

Unbound granular materials used must comply with the requirements of MRTS05. Bound layers must comply with the requirements under MRTS08.

The subbase layer must extend a minimum of 150 mm behind the rear face of any kerbing and/or guttering. The base and surfacing must extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer must also extend a minimum of 150 mm behind the rear face of the kerbing and/or guttering.

For unkerbed roads, the subbase and base layers must extend for the full width of the formation.

The pavement designer must make specific allowance for traffic load concentrations within car park areas (e.g. entrances/exits).

The pavement designer must make provision for pavement layer drainage on the assumption that during the service life of the pavement ingress of water will occur. Compaction of the subbase, including 150mm behind the rear face of the kerb and channel, must be carried out before trenching of the subsoil behind the kerb.

(4) Unbound granular flexible pavements (bituminous surfaced)

Unbound granular flexible pavements with thin bituminous surfacings, including those with cement or lime modified granular materials, with design traffic up to 1 x 10^6 ESAs must be designed in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*.

Residential streets and rural roads with non-fixed level construction (future overlay possible) must be designed in accordance with Austroads Guide to Pavement Technology Part 2: Pavement Structural Design.

For design traffic above 1 x 10^6 ESAs, the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

An unsealed gravel pavement may be acceptable for assigned traffic volumes of less than 100vpd on lightly trafficked roads in rural areas. Where the connecting road to a reconfiguration is also unsealed, it must be upgraded to at least the gravel pavement standard, and, if the assigned traffic volume equals or exceeds 100vpd, it must be fully sealed, from its connection with an existing sealed road to a threshold point where the assigned traffic volume on the connecting road falls below 100vpd. Where an existing rural road is specified as upgraded to gravel pavement standard, the minimum pavement thickness is 100mm.

(5) Flexible pavements containing bound layers (bituminous surfaced)

Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than non-structural asphalt surfacings, must be designed in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(6) Rigid pavements

Rigid (concrete) pavements, with design traffic up to 1 x 10^6 ESAs must be designed in accordance with either CACA -T51 or Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

Rigid (concrete) pavements for design traffic above 1 x 10^6 ESAs, the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design.*

(7) Concrete segmental pavements

Concrete segmental pavements with design traffic up to 1 x 10^6 estimated commercial vehicles exceeding 3T gross must be designed in accordance with CMAA T45.

For design traffic above 1 x 10^6 ERAs estimated commercial vehicles exceeding 3T gross the design must be in accordance with Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design*, with the calculation of design traffic in terms of ESAs.

(8) Clay segmental pavements

Clay segmental pavements with design traffic up to 1 x 10^6 ESAs must be designed in accordance withAustroads *Design Manual 1 - Clay Segmental Pavements.*

For design traffic above 1 x 10^6 ESAs and up to 1 x 10^7 ESAs the design must involve consideration of both *Design Manual 1 - Clay Segmental Pavements* and Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design,* with the thicker and more conservative design of each of the two methods adopted.

For design traffic above 1 x 10^7 ESAs, the pavement must be designed in accordance with *Guide to Pavement Technology Part 2: Pavement Structural Design.*

SC6.4.4.2.8 Surfacing design

(1) Choice of surface type

Except where the pavement is designed for concrete or segmental paver surfacing, the wearing surface must be a bituminous wearing surface as follows:

(a) urban residential streets – urban Type A, B and C, major collector, sub-arterial and arterial roads—prime, plus one coat flush seal, plus asphalt;

(b) rural residential streets—access roads, collector roads, sub-arterial and arterial roads—prime, plus two coats flush seal; and

(c) commercial and industrial streets—prime and one coat flush seal plus asphalt;

In cases where it is required for the road to be opened to traffic upon completion of work, primerseal may be used with prior approval from council.

At intersection approaches and cul-de-sac turning circles on residential streets with flush seals, asphalt surfacing must be provided within the vehicle braking and turning zones.

Variations to these requirements may be approved by council in special circumstances.

(2) Sprayed bituminous seals (flush seals)

The design of sprayed bituminous (flush) seals, including primer seals, must be in accordance with the *Guide to Pavement Technology Part 3: Pavement Surfacings.*

7mm primer seals or prime and seals must be indicated on the Drawings below all flush seals, and asphalt surfacings. Where a 7 mm primer seal is impractical, a 10mm primer seal must be indicated in lieu.

Two-coat flush seals must be double-double seals, comprising a minimum of two coats of binder and two coats of aggregate. The preferred seal types are:

(a) 1st coat 14 mm; and

(b) 2nd coat 10 mm.

Single coat flush seals may be allowable if asphaltic concrete is to be applied as the finished surface. The preferred seal type is either 14mm or 10mm.

(3) Asphaltic concrete

In urban residential roads, medium to heavily trafficked commercial streets and in all industrial roads, the asphalt mix design must be a dense graded mix in accordance with the MRTS 30 06/09.

Asphaltic concrete surfacings must be designed to provide a nominal compacted layer thickness of not less than 30 mm (AC10) on light to medium trafficked residential streets, and 50 mm (AC14) minimum on medium to heavily trafficked residential, commercial roads and on all industrial and classified roads including all roundabouts and all cul-de-sac heads.

As a minimum, a 10mm primer seal or prime and seal must be indicated on the Drawings below the asphalt surfacing. Tack coat is to be used where the asphalt is used as an overlay.

Polymer Modified Bitumen in accordance with MRTS18 must be used in the asphalt in areas of heavy traffic where braking, turning, acceleration is to be experienced.

(4) Segmental pavers

Pavements must be sealed with a minimum of 10 mm primerseal prior to laying segmental pavers. Concrete segmental pavers must be 80mm thick, shape Type A, and designed to be paved in a herringbone pattern.

Clay segmental pavers must be 65mm thick, Class 4, and designed to be paved in a herringbone pattern. The edges of all paving must be designed to be constrained by either kerbing and/or guttering, or by concrete edge strips.

SC6.4.4.2.9 Documentation – pavement design criteria and calculations

All considerations, assumptions, subgrade test results, and calculations and other documentation required under this design specification must be submitted with the pavement design for approval by council.

The Drawings must clearly indicate the structure, material types and layer thicknesses of the proposed pavement and surfacing.

Pavement design criteria must be shown on the pavement drawings and include the ESA, CBR and expected design life.

SC6.4.4.2.10 Subsurface drainage design

(1) Subsoil and sub-pavement drains

(a) Warrants for use

(i) Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings and fill areas.

(ii) Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade.

(iii) Subsoil or sub-pavement drains must be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to

allow for likely variations in subgrade and pavement moisture contents:

(A) cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level;

(B) locations of known hillside seepage, high water table, isolated springs or salt affected areas;

(C) irrigated, flood-prone or other poorly drained areas;

(D) highly moisture susceptible subgrades, i.e. commonly displaying high plasticity or low soaked CBRs;

(E) use of moisture susceptible pavement materials;

(F) existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture; and

(G) at cut to fill transitions.

Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

(iv) The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation. The Design Drawings must be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

(2) Layout, alignment and grade

Typical cross sections of subsoil drains are shown in SC6.4.4.8 Standard drawing SD-080 – Subsoil Drain. In kerbed roads, the only acceptable location for the line of the trench is directly behind the kerbline. Pavement layers must extend to at least the line of the rear of the trench.

In unkerbed roads, subsoil and sub-pavement drains must be located within the shoulder, preferably at the edge of the pavement layers.

The minimum desirable longitudinal design grade is 1.0%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

Trench widths must be a minimum of 300 mm for a 100mm diameter slotted pipe or a minimum of 100mm for strip drains, Outlets must be spaced at maximum intervals of 150m into gully pits or outlet headwalls. As a salinity prevention measure and where practical, discharge must be on the downhill side of the embankment or in the cut-fill area to reduce the risk of recharge to the subsurface water table. Unless otherwise authorised, where subsurface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run must be specified. A small precast concrete headwall must be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

Cleanouts must be provided at the commencement of each run of drain, and at intervals not exceeding 80m. Cleanouts must generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

In salinity affected areas, the Designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation. Saline subsurface drainage should not be routinely discharged directly into natural watercourses. Reference to water quality targets for downstream watercourses is essential and the Designer must provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource or environmental protection authority.

SC6.4.4.2.11 Foundation drains

(1) Warrants for use

Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location must be shown on the Drawings. However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

Where the road formation traverses known swampy, flood-prone, salt affected areas or watercharged strata, the Drawings must be suitably annotated for the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

(2) Layout, alignment and grade

Typical cross-sections of foundation drains are shown below in Figure SC6.4.4.2.3.

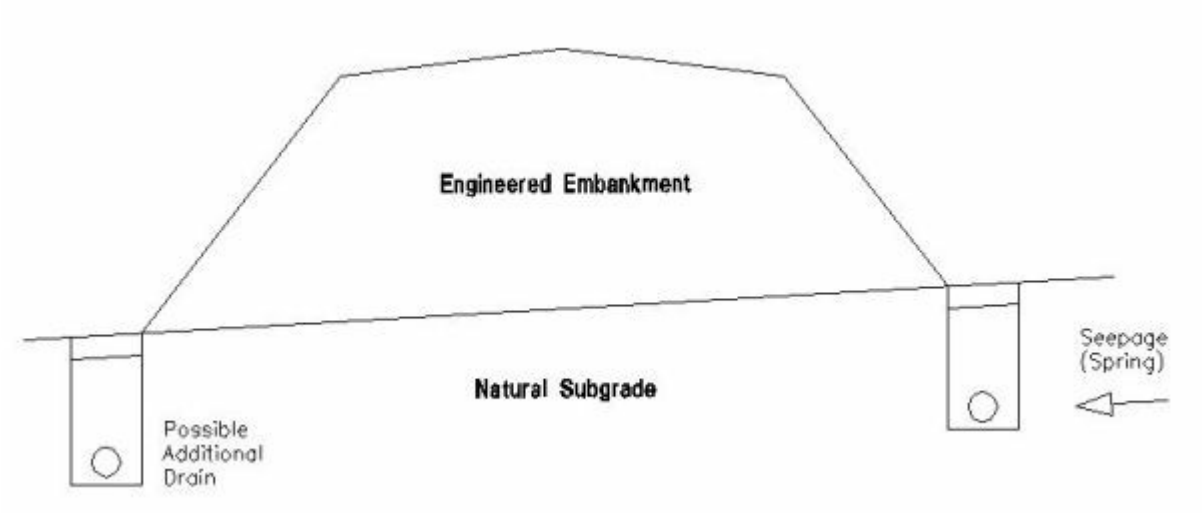


Figure SC6.4.4.2.3 Foundation drains

The minimum desirable design grade is 1%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Foundation drains must have a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

Outlets must be spaced at maximum intervals of 150m.

Where practicable, cleanouts must be provided at the commencement of each run of foundation drain and at intervals not exceeding 60 m. Where not practicable to provide intermediate cleanouts, outlets must be spaced at maximum intervals of 100m.

SC6.4.4.2.12 Drainage mats (blankets)

(1) Warrants for use

Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings. Type B drainage mats must be constructed after completion of the subgrade construction and before construction of the pavement.

The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

SC6.4.4.2.13 Materials

(1) Subsoil and sub-pavement drain pipe

Pipes designated for subsoil, foundation and sub-pavement drains must be 100mm dia. slotted pipe.

Corrugated plastic pipe must conform with the requirements of AS 2439.1. The appropriate class of pipe must be selected on the basis of expected live loading at the surface. Joints, couplings, elbows, tees and caps must also comply with AS 2439.1.

Slotted rigid UPVC pipe must be of a type and class approved by council.

All pipe must be slotted, and fitted with a suitable geotextile filter tube, except for cleanouts and outlets through fill batters which must be unslotted pipe.

(2) Intra pavement drain pipe

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses neither less than 150mm nor more than 200mm must be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses exceeding 200 mm must be slotted pipe of a type and class approved by council.

Pipes for use in Type B drainage mats must be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

(3) Filter material

The types of filter material covered by this sub-section must include:

(a) Type A filter material for use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats;

(b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains;

(c) Type C filter material comprising crushed rock for use in Type A drainage mats; and

(d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

Material requirements and gradings for each type of filter material are included in the construction sub-section SC6.4.6.21 Subsurface drainage.

The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) depends on the permeability of the pavement layers and/or subgrade and the expected flow rate. Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels. Further guidance to the selection of appropriate filter material is contained in *Guide to Pavement Technology.*

(4) Geotextile

To provide separation (i.e. prevent infiltration of fines) between the filter material in the trench and the subgrade or pavement material, geotextile must be designated to encapsulate the filter material. The geotextile must comply with the requirements included in sub-section SC6.4.6.21 Subsurface drainage.

Geotextile must also be designated for both Type A and Type B Drainage Mats.

SC6.4.4.2.14 Documentation – subsurface drainage drawings and calculations

The proposed location of all subsurface drains must be clearly indicated on the Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement. The location of outlets and cleanouts must also be indicated on the Drawings.

SC6.4.4.3 Bridges and other structures

SC6.4.4.3.1 Introduction

(1) Objective

This sub-section sets out design considerations to be adopted in the design of structural engineering elements associated with

(a) road traffic bridges;

(b) pedestrian/cyclist bridges;

(c) any structure designed to carry a road or a path over a waterway, depression or obstacle; and

(d) temporary works.

(2) Design considerations

Such structures may be primarily constructed of concrete, timber, steel or other materials appropriate to the application. The design should always have a primary emphasis on safety and whole of life cycle costs. The structure/s should comply with current Safety in Design principles and guidelines.

The design is to be certified that the proposed structure will not become unfit for use during its intended design life. This assessment will have measured regard to all associated issues with the proposed structure including:

(a) consideration of any future infrastructure planning;

(b) economic constraints;

(c) physical or structural constraints;

(d) aesthetic considerations;

(e) flooding or hydraulic capacities (if applicable);

(f) safety in design;

(g) maintenance and repair constraints;

(h) constructability; and

(i) fit for purpose.

(3) Basis of design

(a) The basis of the proposed bridge design is to principally conform to Austroads' road design standards, and AS 5100 as appropriate. The design must be based on sound engineering principles, and certified by a suitably qualified engineer (RPEQ).

(b) The safety and service performance of a structure will depend on the quality control exercised in fabrication, supervision of the site, control of unavoidable imperfections and the experience and skill of the personnel involved. Specific attention must therefore be given to these particular factors.

(c) All design criteria for bridges in the Townsville City Council local government area must be approved by council prior to the design being carried out. The Designer must make reference and address all issues outlined in Appendix A of AS 5100.1.

(d) Adequate management control and supervision by experienced engineers (RPEQ) is required at all stages of the design and construction to prevent the occurrence of any unapproved non-conformances with the plans and specifications.

(e) Specifications must be notated on the Drawings with sufficient details to ensure that the above described strategies are able to be effectively implemented throughout the construction stage.

(4) Reference and source documents

(a) Development manual planning scheme sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.4.1 - Geometric road design

SC6.4.4.2 - Pavement design

SC6.4.4.4 - Stormwater drainage design

SC6.4.4.7 - Bicycle, pedestrian and shared path design

(b) Australian Standards

AS 1158	*Lighting for roads and public spaces*
AS/NZS 3845	*Road safety barrier systems*
AS 5100	*Bridge Design*
AS1428	Design for access and mobility

(c)

AS1170	Minimum design loads on structure (SAA Loading Code)
AS1684	National timber framing code
AS3600	Concrete structures
AS3700	Masonry in buildings (SAA Masonry Code)
AS4100	Steel structures

Other codes and guidelines referred to in the Australian Standards, as relevant.

(d) Department of Transport and Main Roads Technical Specifications

MRS70	*Concrete (10/11)*
MRS71	*Reinforcing Steel (06/09)*
MRS72	*Manufacture of Pre-cast Concrete Elements (08/13)*

Other

Austroads, *Guide to Bridge Technology Part 4 - Design Procurement and Concept Design, 2009*
Queensland Department of Transport and Main Roads, *Road Planning and Design Manual, 2006*
Queensland Department of Main Roads, *Road Traffic Noise Management: Code of Practice, 2000*
Queensland Department of Energy and Water Supply, *Queensland Urban Drainage Manual*

SC6.4.4.3.2 Road traffic and pedestrian bridges

(1) Bridge design must only be carried out by properly qualified persons who are Registered Professional Engineers of Queensland (RPEQ) and experienced in structures design. If requested, such designers must submit evidence of these qualifications and experience to council prior to approval of any bridge design.

(2) The *Bridge Design Code* (AS 5100) must be used for all bridge design.

(3) Bridges must have low maintenance finishes. Adequate precautions must be taken for protection of the materials used in the bridge design; for example, timber and steel require special consideration. Heavy debris and bed loads may be characteristic of some streams so that large spans with slender piers are encouraged. If floodwater overtopping is to occur, pedestrian safety rails and road safety barriers could be omitted to reduce debris collection on the roadway. Flood depth indicators and appropriate signposting will be provided in such cases.

(4) Preventative maintenance is a key issue affecting the design life of the structure. The Drawings must specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design must also be shown on the Drawings.

(5) Hydraulic design of bridge/s must be in accordance with the requirements for major structures in SC6.4.4.4 Stormwater drainage design.

(6) Where structures are designed to be inundated, the effect of the backwater gradient on upstream property must be identified on the Drawings. Detailed consideration of alternate evacuation routes are also to be considered in the event that the bridge structure is to be inundated.

(7) Where no inundation is permitted, appropriate afflux must be adopted together with a 500mm freeboard to the underside of the bridge deck. All road structures with a 1% annual exceedance probability (AEP) designed waterway which is in excess of 5sqm must be modelled using current hydrological modelling practices (software) to determine the upstream impacts over the full range of storm events up to and including the 1% AEP. Impacts of the PMF are also to be assessed on the structure.

(8) The designer is to enquire with the appropriate authority on any current or likely provisions for public utilities or services on bridges. These should be concealed for aesthetic reasons. Consultation with the appropriate utility authority is to be undertaken during the course of the structural design, particularly in regard to the location and placement of existing and future public utilities.

SC6.4.4.3.3 Provision for pedestrians and cyclists on road bridges

(1) Provision for pedestrians and cyclists on bridges is required in rural residential as well as urban areas. The

minimum provision is a 1.5m footpath with a 150mm high kerb at the traffic lane edge. The design is to consider pedestrian on the bridge. A safety railing is to be provided between pedestrians and the trafficable lane together with 1.5m (min) wide shoulder to accommodate on-road cyclists.

(2) Council may require the provision of a combined cycleway and pedestrian footway should the risk to on-road cyclists be too high.

(3) Disability access across the proposed bridge is to be DDA compliant and generally in accordance with AS 1428.

(4) Urban bridge approaches should be lit in accordance with AS 1158.

SC6.4.4.3.4 Structures other than bridges, associated with roads

Public utility structures, major culverts, major sign support structures, retaining walls, and the like will be designed by a competent, practicing engineer (RPEQ certified) who is accredited in the design of such structures. The design must be in accordance with the SC6.4 Development manual planning scheme policy, relevant Austroads codes, all relevant Australian Standards, and the requirements of any utility owners that may be applicable.

SC6.4.4.3.5 Structures used for public safety

(1) Since the requirement of road safety barriers and pedestrian safety rails on bridges are different, the design engineer must consider whether separate traffic and pedestrian barriers can be detailed to satisfy the major functional requirements.

(2) The *Bridge Design Code* (AS 5100.1 Sections 10 - 12) and AS/NZS 3845 are recommended references in this regard.

(3) It is essential that all safety barriers and rails have been fully tested and accredited for the intended use under quality assurance provisions.

(4) Bridge crossings in urban and rural residential areas must be provided with street lighting in accordance with AS 1158. Such requirements will be noted accordingly on the drawings.

SC6.4.4.3.6 Temporary works

Structures which are proposed for the temporary support of roads, services and the like must be designed by a qualified Engineer (RPEQ certified) experienced and accredited in the design of such structures and designed in accordance with the *Bridge Design Code* (AS 5100). A construction programme, indicating the sequence of events leading to the implementation and removal of the temporary structures must be specified on the drawings. The design of such temporary structures is to mandate the safe constructability and use of these structures throughout the term of the construction works.

SC6.4.4.4 Stormwater drainage design

SC6.4.4.4.1 Introduction

(1) Objectives

(a) The objectives of SC6.4.4.4 Stormwater drainage design are as follows:

(i) to ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits;

(ii) to provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits; and

(iii) retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.

(b) In pursuit of these objectives, the following principles apply:

(i) new developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in QUDM (Third Edition 2013 – provisional or as amended); that is, the "major" system shall provide safe, well-defined overland flow paths for infrequent storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events; and

(ii) redevelopment - where the proposed development replaces an existing development, stormwater must be managed in a way that does not exacerbate flooding, and /or adversely impact on neighbouring land or road. The level of drainage provided must be consistent with new development.

(2) Scope

The work to be executed under this sub-section consists of the design of stormwater drainage systems for urban and rural areas.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with its sub-section are as follows:

SC6.4.6.4 Stormwater Drainage
SC6.4.6.5 Drainage Structures
SC6.4.6.6 Pipe Drainage
SC6.4.6.7 Precast Box Culverts
SC6.4.6.9 Open Drains

(b) Australian Standards

AS/NZS 1254	*PVC-U pipes and fittings for stormwater and surface water applications.*
AS/NZS 2032	*Installation of PVC pipe systems.*
AS/NZS 2566.1	*Buried flexible pipelines, structural design.*
ASNZS 3725	*Design for installation of buried concrete pipes.*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure).*
AS 4139	*Fibre reinforced concrete pipes and fittings.*

(c) The State of Queensland Department of Energy and Water Supply, *Queensland Urban Drainage Manual – Third Edition 2013 provisional, 2013*.

(d) Department of Transport and Main Roads*, Road Drainage Manual, 2015*

(e) *Other*

Argue, John, Australian Road Research Board, Special Report 34, Stormwater drainage design in small urban catchments: a handbook for Australian practice.

Australian National Conference On Large Dams, Leederville WA, ANCOLD 1986, Guidelines on Design Floods for Dams.

Australian Road Research Board, Research Report ARR368, The collection and discharge of stormwater from the road infrastructure, Allan Alderson, 2006.
Austroads, Guide to Bridge Technology.
Austroads 2013, Guide to Road Design Part 5: Drainage – General and Hydrology Considerations 2013, Austroads Ltd, Sydney NSW.
Chanson, H, Hydraulic Design of Stepped Cascades, Weirs and Spillways, Pergamon, Oxford 1994 .
Chanson, H, Hydraulics of Nappe Flow Regime Above Stepped Chutes and Spillways, Australian Civil Engineering Transactions, IEAust Volume 1 CE36 No. 1, January 1994.
Chow, Ven Te, Open Channel Hydraulics, 1959.
Concrete Pipe Association of Australia, Concrete Pipe Guide, charts for the selection of concrete pipes to suit varying conditions.
Hare CM., Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems, Transactions, Inst. of Eng. Aust., Feb. 1983.
Henderson, FM., Open Channel Flow, 1966.
Insearch Ltd, NSW Institute of Technology (NSWIT), Energy Losses in Pipe Systems, C.M. Hare in Advances in Urban Drainage Design, 1981.
Institute of Engineers, Australian Rainfall and Runoff (AR&R). A guide to flood estimation, Aug 1998.
Institute of Public Works Engineering Australia, Qld Division, Standard Drawings, 2000.
Main Roads Department, Urban Road Design Manual (URDM), Volume 2., Queensland. First Edition 1975 as subsequently amended.

(e) *Sangster, WM., Wood, HW., Smerdon, ET., and Bossy, HG, Pressure Changes at Storm Drain Junction, Engineering Series, Bulletin No. 41, Eng. Experiment Station, Univ. of Missouri 1958.*
SC6.7 Flood hazard planning scheme policy.

Townsville City Council SC6.4.4.8 Standard drawings
SD-015 Footpath service allocation new streets
SD-020 Concrete kerbing
SD-080 Subsoil drains
SD-085 Drainage connections
SD-200 Precast grated kerb inlet system and cast insitu stormwater manhole SD-205 Stormwater manhole details
SD-210 Manhole slab top details
SD-215 Raised grate field inlet manhole

SC6.4.4.4.2 Major and minor system design AEPs

(1) The Annual Exceedence Probability(AeP) is the probability of exceedence of a given rainfall intensity or discharge within a period of one year.

(2) The major system design AEP is the Defined Flood Event, being the 1% AEP, unless altered by Table 8.2.6.3(b) of the Flood hazard overlay code.

(3) The Minor system design AEPs must be in accordance with Table SC6.4.4.4.1.

Table SC6.4.4.4.1 Minor System Design AEP and ARI

Development Category	ARI (yrs)	AEP
Residential	2	39%
Commercial - Lower order (district centre and below)	2	39%
Commercial - Other (excluding Lower order commercial and Principal centre)	5	18%
Industrial	5	18%
Principal Centre (CBD)	10	10%
Rural Residential	20	5%
Parks and recreation areas (excluding community facilities)	1	1EY

(4) The Minor system design AEP for streets is as per the adjacent development category listed in Table SC6.4.4.4.1.

SC6.4.4.4.2 Hydrology

(1) Design rainfall data can be obtained from one of the following methods:

(a) Design intensity-frequency-duration (IFD) rainfall - IFD relationships shall be derived in accordance with Volume 1, Book II, of AR&R, 1998 for the particular catchment under consideration;

(b) The nine basic parameters read from Maps 1-9 in Volume 2 of AR&R shall be shown in the calculations submitted to council, except where the Bureau of Meteorology provides a polynomial relationship for the catchment; or

(c) Design IFD rainfalls can be obtained from the Bureau of Meteorology website for specific locations and these are to be submitted to council.

(2) Catchment area

(a) The area of land contributing stormwater runoff to the point under consideration. Consideration must be given to likely changes to individual catchment areas and catchment parameters caused by the full development of the catchment in accordance with the zonings in the Townsville City Plan.

(b) Where no detailed survey of the catchment is available, contour maps produced from council's GIS are to be used to determine the catchments and to measure areas. A suitable scale shall be chosen.

(c) Catchment area land use shall be based on current available zoning information or proposed future zonings, where applicable.

(3) Rational method

(a) Rational method calculations to determine peak flows shall be carried out in accordance with QUDM (Third Edition 2013 – provisional).

(b) All calculations shall be carried out or supervised by a qualified engineer (RPEQ certified) who is experienced in hydrologic and hydraulic design.

(c) Coefficients of discharge shall be calculated as per QUDM (Third Edition 2013 – provisional or as amended) and full details of coefficients utilised shall be provided.

(d) Details of percentage impervious for individual zonings are given in SC6.4.4.4 Attachment A.

(e) The time of concentration of a catchment is defined as the time required for storm run off to flow from the most remote point on the catchment to the outlet of the catchment. Most catchments will have multiple lengths of flow paths and gradients. The longest length flow path may not always govern the critical flow path. The hydrologic design should analyse several paths to assess any sensitivity to the catchment's time of concentration.

(f) Where the flow path is through areas having different flow characteristics or includes property and roadway, then the flow time of each portion of the flow path shall be calculated separately.

(g) The minimum time of concentration shall be taken as 5 minutes urban and 10 minutes rural.

(h) Flow paths to pits must be designed to accommodate the flows from the fully developed catchment and provide for anticipated obstructions such as fences, building pads, buildings and other likely obstructions. Any proposed changes to flow paths must be undertaken on a catchment wide basis to ensure flow paths are not diverted onto other land parcels which may result in damage or loss of enjoyment of the adjoining lands.

(i) Surface retardance "n*" shall generally be derived from information in Volume 1, Book 8 Section 1.5.4 of AR&R 1998. Values applicable to specific zoning types and overland flow path types are given below:

Flow across parks 0.35
Flow across rural residential land (sparse vegetation) 0.30
Flow across park residential (short prairie grass) 0.150
Flow across residential low density 0.21
Flow across residential high density flow across industrial 0.06
Flow across commercial 0.04
Flow across paved areas 0.01
Flow across asphalt roads 0.02

Flow across gravel areas 0.02.

(j) The design and analysis of stormwater drainage is to be based on the peak runoff flows from sub-catchments and from accumulated catchments. Designers are to show, by the assessment of partial catchment areas, that the peak flows have been identified.

(k) The rational method is not appropriate for use in catchments with floodplain storage, timing effects due to multiple flow paths, and detention basins.

(4) Hydrological models

(a) Council has carried out flood modelling for most area across Townsville. Hydrological information from these models such as peak flows should be obtained to assist with the design of the stormwater system.

(b) Other hydrological models may be used as long as the requirements of AR&R are met, summaries of calculations are provided and details are given of all program input and output.

Details on the modelling requirements should be obtained from SC6.7 Flood hazard planning scheme policy.
A sample of a summary sheet for hydrological calculations is given in SC6.4.4.4 Attachment B.

(c) Where computer analysis programs are used, copies of the final data files shall be provided on submission of the design to council and with the final drawings after approval by council.

SC6.4.4.4.3 Hydraulics

(1) Hydraulic grade line

(a) Hydraulic calculations shall generally be carried out in accordance with AR&R and shall be undertaken by a qualified person experienced in hydrologic and hydraulic design. The calculations shall substantiate the hydraulic grade line adopted for design of the system and shown on the drawings. Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output.

(b) The "major" system shall provide a safe, well-defined overland flow path for larger storm events up to the maximum defined flood event. The "minor" system shall be capable of carrying and design flows from the lesser nominated flood events based on the land zoning of the area.

(c) Downstream water surface level are to be obtained from council's current existing flood studies. If flood study information is not available, the most appropriate of the below is to be used:

(i) known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event;

(ii) where the downstream starting point is a pit and the hydraulic grade line is unknown, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line;

(iii) where the outlet is an open channel and the design storm is the minor event, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line. The top of the outlet pipe or the hydraulic grade line, or mean high water springs shall be the downstream control, whichever is higher;

(iv) where the outlet is an open channel, the design storm is the major event and downstream flood levels are not known, details of the downstream system shall be obtained and further analysis performed to determine the hydraulic grade line. The top of the outlet pipe or the hydraulic grade line shall be the downstream control whichever is the higher;

(v) where the outlet is an open channel, the design storm is the major event and downstream flood levels are known, the downstream control shall be the highest of all duration events for the defined flood event;

(vi) mean high water springs (MHWS) where discharges are to river or creek systems within the intertidal zone:
In some instances, the downstream water surface level may need to be determined with the

development of a flood study. Details on the flood study requirements should be obtained from SC6.7 Flood hazard planning scheme policy; and

(vii) the downstream water surface level used in the calculations should be provided to council.

(2) Major/minor system

Design of the drainage system should be in accordance with the major/minor flood management concept which recognises the dual requirements of the drainage system to provide for convenience and the protection of life and property for all storm events up to the defined flood event.

All design work undertaken should follow the guidelines set down in the *Queensland Urban Design Manual* (Third edition 2013 - provisional) unless otherwise instructed in this sub-section.

(3) Minor system criteria

(a) Minimum conduit sizes shall be as follows:

(i) pipes 375mm diameter; and

(ii) box culverts 600mm wide x 300mm high.

(b) Maximum velocity of flow in stormwater pipelines shall be 4m/sec. Minimum velocity shall be determined by ensuring self-cleansing velocity is achieved; this requirement shall be deemed to be satisfied if the product of slope and diameter (S x D) is not less than 0.0008m where S = slope (m/m) and D is pipe diameter (m).

(4) Roadway flow width and depth

(a) Flow width and depth criteria for major and minor storm events must comply with QUDM section 7.4.

(5) Inlet pits and Manholes

(a) Inlet pits and manholes must be provided:

(i) to enable access for maintenance;

(ii) at changes in direction, grade, level or class of pipe; and

(iii) at junctions.

(b) The maximum recommended spacing of pits and manholes where flow widths are not critical should be spaced every 80m for ease of maintenance purposes. Kerb inlets shall be constructed in accordance with SC6.4.4.8 Standard drawings SD 200.

(c) Pit entry capacity calculations must be undertaken to provide for adequate spacing of pits, and to ensure flow capture has been adequately analysed. Flow under weirs and/or orifice conditions must be carefully considered. Information on pit entry capacities is available in the following sources:

(i) Queensland Urban Drainage Manual;

(ii) Pit relationships given in Volume 1, Book 7 of AR&R 1998; and

(iii) manufacturers' design specifications.

(f) Blockage factors to be applied to theoretical inflow capacities of inlet pits are given in Table SC6.4.4.4.2:

Tables SC6.4.4.4.2 Allowable pit capacities

Condition	Inlet Type	Blockage factor
Sag	Side entry	20%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	"Letterbox"	50%
Continuous Grade	Side entry	20%
Continuous Grade	Grated	50%

Continuous Grade	Combination	90%
Field inlet	Flush	80%
Field inlet	Raised grate	50%

(6) Hydraulic losses

(a) Pressure change co-efficient "K" shall be determined from the appropriate charts given in *QUDM* Appendix 2.

(b) Allowable reduction in "K" due to benching is given in *QUDM* section 7.16.8.

(c) Computer program default pressure change co-efficient "K" shall not be acceptable unless they are consistent with those from the charts in *QUDM*. The chart used and relevant co-efficients for determining "K" value from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

(d) Bends may be permissible in certain circumstances and discussions with council regarding their use is required prior to detailed design. Appropriate values of pit pressure change co-efficient at bends are given in *QUDM*.

(e) The design must avoid clashes between services. However, where unavoidable clashes occur within the existing network, then the pressure change co-efficient "Kp" must be determined from the chart given in *QUDM* section 7.16.11.

(f) Requirements for private pipes entering council's system are given below:

(i) all pipe inlets, including subsoil pipes, must where possible, enter the main pipe system at junction pits. These must be finished off flush with and be grouted into the pit wall; and

(ii) if a junction has to be added then a junction pit shall be built at this location in accordance with this sub-section.

(g) Construction of a junction without a structure should be avoided where possible. Permission to do this is required by council prior to detailed design. Where this is unavoidable the pressure change coefficients Ku, for the upstream pipe and Kl, for the lateral pipe, must be determined from the chart given in *QUDM*.

(h) Going from larger upstream to smaller downstream conduits is not permitted without approval of council prior to detailed design. In going from smaller to larger pipes benching must be provided in pits to enable a smooth flow transition. Losses in sudden expansions and contractions are given in *QUDM*.

(i) Underground drainage systems must be designed as an overall system, with due regard to the upstream and downstream system and not as individual pipe lengths. Drainage system designs must clearly show the hydraulic grade line (HGL), especially in systems operation undue pressure.

(7) Major system – minimum freeboard criteria

(a) Where floor levels of adjacent buildings are above road level there must be a minimum freeboard of 300mm to floor level of adjacent buildings.

(b) Where floor levels of existing adjacent buildings are below, or less than 300mm above the top of kerb, and there is at least 100mm fall on the footpath towards the kerb, the maximum flow depth is 50mm above the top of kerb.

(c) Where floor levels of existing adjacent buildings are below, or less than 300mm above the top of kerb, and there is less than 100mm fall on the footpath towards the kerb, the maximum flow depth is at the top of kerb.

(d) Wave action wash that enters properties from passing vehicles must be considered.

(e) Road capacities and major system flood levels are to be determined adopting the roadway as an open channel. Assessment of flood impacts on adjoining properties must consider any effects of backwater from the adjacent waterway using backwater analysis techniques.

(8) Minimum grades

(a) Unlined drains must have a minimum grade of 0.5% and lined drains must have a minimum grade of 0.3%. This includes table drains and kerb and channel.

(b) Pipe and box culverts must have a minimum grade of 0.2%.

(9) Open channels

(a) Generally, open channels and swales must be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where council permits the use of an open channel to convey flows from a development site to the receiving water body, such a channel must comply with the requirements of this sub-section.

(b) Design of open channels must be in accordance with Volume 1, Book VIII of AR&R 1998. Open channels must be designed to contain the major system flow.

(c) Friction losses in open channels must be determined using Mannings "n" values. Mannings "n" roughness co-efficients for open channels must generally be derived from information in Chapter 14 of AR&R. Mannings "n" values applicable to specific channel types are given in the table below:

Surface Type	Mannings “n”
Concrete Pipes or Box Sections	0.011
Concrete (trowel finish)	0.014
Concrete (formed without finishing)	0.016
Sprayed Concrete (gunite)	0.018
Bitumen Seal	0.018
Bricks or pavers	0.015
Pitchers or dressed stone on mortar	0.016
Rubble Masonry or Random stone in mortar	0.028
Rock Lining or Rip-Rap	0.028
Corrugated Metal	0.027
Earth (clear of weeds and debris)	0.022
Earth (with weeds and gravel)	0.028
Rock Cut	0.038

For all grass channels refer to the *Road Drainage Manual* (Chapter 8) for grass retardance factors.

(d) Where the product of average Velocity and average flow Depth for the design flow rate is greater than 0.4 m^2/s, the design must specifically provide for the safety of persons who may enter the channel in accordance with Volume 1, Book VIII of AR&R 1998.

(e) Maximum side slopes on grassed lined open channels must be in accordance with section 9.5.3 of *QUDM* (3rd Edition 2013 – provisional, or as amended.).

(f) Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel. The width of the concrete lined channel section must be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor with an absolute minimum width of 1.5 m.

(g) Open channels should be wide and shallow in preference to narrow and deep in order to maintain natural invert level to reduce the expression of groundwater.

(h) Designers should also ensure that longitudinal grades are sufficient to prevent the ponding of storm water for periods of more than 2 days after a rain event.

(i) Transition in channel slopes is to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

(j) Drop structures must be designed in open channels were the water velocity exceeds 2m/s. The design must address the size and location of the structure as well as details of any stilling basins and revetment works surrounding the structure.

(k) Special consideration must be given to erosion control where sodic soils occur. Details of treatment proposals prepared by a competent person must be provided and approved by council.

(10) Major structures

(a) All major structures in urban areas, including bridges and culverts, must be designed for the 1% AEP storm event with minimal afflux. Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding does not inundate private property or critical infrastructure.

(b) A minimum clearance of 0.5m between the 1% AEP flood level and the underside of any structure is required to allow for passage of debris without blockage.

(c) Certified structural design must be provided for bridges and other major culvert structures and may be required on some specialised structures. Structural design must be carried out in accordance with the SC6.4.4.3 Bridges and other structures.

(d) Culverts (either pipe or box section) must be designed in accordance with information and charts provided in QUDM 3rd Edition - provisional (as amended).

(e) Safety limitations – overtopping of roadways. All floodwaters overtopping a major structure such as a culvert or bridge structures within a road are to be checked for safety and stability limitations for both pedestrians and vehicles. Assessment of the waterway crossing safety and stability is to be undertaken based on criteria outlined in *QUDM* 3rd Edition 2013 - provisional (as amended) – Table 7.4.3 and 7.4.4

Detention basins

(a) For each AEP a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin. Storm patterns shall be those given in Volume 1, Book III of AR&R. The critical storm duration with the retarding basin is likely to be longer than without the basin. A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

(b) Flood routing should be modelled by methods outlined in AR&R. Rational method approximations of flood hydrographs are unacceptable.

(c) The high level outlet to any retarding basin shall have capacity to contain a minimum of the 1% year AEP flood event. Additional spillway capacity may be required due to the hazard category of the structure. The hazard category should be determined by reference to ANCOLD.

(d) The spillway design shall generally be in accordance with the requirements for Open channel design in SC6.4.4.4.3(7) Open channels and *QUDM* (Chapter 5).

(e) The low flow pipe intake shall be designed in accordance with the requirements of QUDM, Section 5.08.

(f) Freeboard - Minimum floor levels of dwelling shall be 0.3m above the Defined 1% AEP flood level in the basin.

(g) Public safety issues - Basin design is to consider the following aspects relating to public safety:

(i) side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress;

(ii) water depths shall be, where possible, less than 1.5m in the defined AEP flood event. Where neither practical nor economic, greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered;

(iii) the depth indicators should be provided indicating maximum depth in the basin;

(iv) signage of the spillway is necessary to indicate the additional hazard;

(v) basins shall be designed so that no ponding of water occurs on to private property or roads;

(vi) no planting of trees in basin embarkment walls is allowed;

(vii) no basin spillway is to be located directly upstream of urban areas; and

(viii) submission of Drawings to the Dam Safety Committee is required where any of these guidelines are not met or council specifically requires such submission.

(ix) Stepped spillways are used in rare instances for energy dissipation and scour control. Guidance on hydraulic design and analysis of these structures is as per Chanson 1994.

(12) Tidal barriers

The use of tidal barriers on stormwater outlets are required in areas affected by tides. The device used should meet the following criteria:

(a) limited pressure head required to allow the discharge of stormwater from the system without any manual intervention. Specifications of the device used should be supplied to council prior to detailed design;

(b) barriers should not be able to be wedged open to an incoming tide by litter;

(c) council will not accept hinged flap gates as a suitable solution; and

(d) minimal requirements for repairs and maintenance of the device. Any maintenance information for the

device should be supplied to council prior to detailed design.

(13) Barriers at inlet and outlets

Provision shall be made for the safety of the public including children in regards to the inlet and outlet of the stormwater system and should be based on the following criteria:

(a) no opening into an underground system shall be wider than 150mm except at head walls to pipes and box culverts;

(b) headwalls on the inlets and outlets to underground drains in which the drain is longer than 30m and has a cross sectional area greater than 0.5m^2 must be protected with hand rails, guard rails or fencing which restricts easy access to the entry structure;

(c) trash screens or other forms of grates are not favoured across the front of inlets and are unlikely to be approved by council unless there is a tidal barrier on the outlet of the stormwater system – this may be considered by council;

(d) any grates over field inlet pits shall be set above the top of the pit so as to provide a 50mm gap between the top of the pit and the bottom of the grate. In areas of open space, marker posts must be used to identify each corner of the pit; and

(e) under no circumstances, should fixed barriers or grates be placed at the end of stormwater outlet.

SC6.4.4.4.4 Stormwater detention

(1) Installation of stormwater detention is required on all development sites where insufficient capacity in the downstream drainage systems exist and a minimum amount of detention will be that required to ensure no worsening of the flooding situation occurs during the defined flood event.

(2) The requirements for stormwater detention design are outlined in *QUDM.*

(3) The development must limit any increase in discharge rate for all storm events up to and including the defined flood event.

(4) The developed site must not discharge more stormwater than the discharge calculated for pre-development flows.

(5) Combined sedimentation and detention ponds must be designed in accordance with SC6.4.3.9 Water sensitive urban design guidelines so that remobilisation of sediment is minimised.

SC6.4.4.4.5 Interallotment drainage

(1) Interallotment drainage must be avoided wherever possible. Where interallotment drainage is proposed, the developer must demonstrate that no other drainage alternative is possible.

(2) Where interallotment drainage is unavoidable, it must not cover more than 2 allotments and must be contained within an easement not less than 3m wide. The easement must be provided over the entire length of the drainage structure in favour of lots benefiting from and affected by the pipe. All interallotment and allotment drainage, connector pipes and surface water collection infrastructure remains the responsibility of the lot owner.

(3) Where drainage is required over more than two allotments, a drainage easement is required in favour of council. See SC6.4.4.4.8 Drainage easements and drainage reserves.

(4) Interallotment drains must be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design AEP the same as the "minor system" per Table SC6.4.4.4.1.

(5) Major system flows within interallotment drains should be avoided where possible. In instances where this is unavoidable, the design of interallotment drainage must make allowance for major system flows, with appropriate freeboard.

(6) In lieu of a more detailed analysis, the fraction impervious for surfaces contributing runoff to the interallotment drain are as per SC6.4.4.4 Attachment A.

(7) Pipes must be designed to flow full at the design discharge without surcharging of inspection pits.

(8) Interallotment drainage pits must be located at all changes of direction. Pits must be constructed of concrete, with 100mm thick walls and floor and have a minimum 600mm x 600mm internal dimensions. Raised grated inlets are required at all locations. (including change in direction).

(9) The interallotment drainage must have a minimum longitudinal gradient of 0.2% or as agreed by council.

(10) The interallotment drainage must be constructed from either fibre reinforced concrete drainage pipe, reinforced

concrete pipe, or UPVC pipe which must conform respectively to the requirements of AS4139, AS/NZS4058 and AS/NZS1254 respectively.

(11) Where interallotment drainage and sewer mains are laid adjacent to each other they must be spaced with 1.5m between pipe centrelines (where the pipe inverts are approximately equal).

(12) Where there is a disparity in level between inverts the spacing must be submitted for approval.

(13) Where sewer mains are in close proximity to interallotment drainage lines they must be shown on the interallotment drainage plan.

SC6.4.4.4.6 Detailed design

(1) Conduits

(a) Pipe bedding and cover requirements for reinforced and fibre reinforced concrete pipes shall be determined from the Concrete Pipe Association's *Concrete Pipe Guide* or AS/NZS 3725. For uPVC pipes, the requirements shall be to AS/NZS 2032.

(b) Conduit jointing shall be in accordance with manufacturer's specifications. S.R.C pipes shall use external band joints.

(c) Drainage lines in road reserves shall generally be located behind the kerb line and parallel to the kerb. Drainage lines in easements shall generally be centrally located within easements. Refer to SC6.4.4.8 Standard drawing SD-015.

(d) Drop structures shall be designed on drainage lines where the pipe gradient exceeds 5 per cent or water velocity exceeds 4m/s. The design details shall address the size, and position in the trench as well as spacing along the line.

Note—Buried flexible drainage pipes
Particular situations may be identified during the design of a development for the use of buried flexible pipes instead of the pipes specified in SC6.4.6.6 Pipe drainage.

In such cases, the design will be required to select the flexible pipe type appropriate for the particular application and prepare the relevant technical specification clauses for the supply and construction with reference to AS/NZS 2566.1, Buried flexible pipelines Part 1: Structural design. The proposed additional clauses would then be submitted, as an addendum to the development consent, for review and approval by council.

(2) Pit design
Pits shall be designed in accordance with SC6.4.4.8 Standard drawings SD-200, SD-205, SD 210 and SD-215. Safety and safe access are important in pit design and grates shall be of "bicycle safe" design.

(3) Stormwater discharge

(a) Scour protection at culvert, pipe system or kerb and channel outlets shall be designed in accordance with the guidelines outlined in *QUDM 3rd Edition - 2013 – provisional*, Section 8.7. Council will discourage the use of any outlet structure that proposes ponding at the outlet

(b) Where a developer proposes to concentrate stormwater onto an adjoining property, council will require the Developer to provide written agreement from the adjoining owner(s) granting permission to the discharge of stormwater through their property and the creation of any necessary easements.

(c) Where it is proposed to discharge runoff to an area under the control of another statutory authority, the design requirements of that statutory authority are also to be met.

(d) Piped stormwater drainage discharging to recreation reserves is to be taken to a point of discharge nominated by council and in the manner nominated by council.

(4) Trench subsoil drainage
Subsoil drainage should be designed and installed as per SC6.4.4.8 Standard drawings SD 080.

SC6.4.4.4.7 Documentation

(1) Drawings

(a) Catchment area plans shall be drawn to scales of 1:500, 1:1000 or 1:5000, unless alternative scales are specifically approved by council and shall show contours, direction of grading of kerb and channel, general layout of the drainage system with pit locations, catchment limits and any other information necessary for the design of the drainage system.

(b) The drainage system layout plan shall be drawn to a scale of 1:500 for urban areas and 1:1000 rural areas and shall show drainage pipeline location, drainage pit location and number and road centreline chainage, size of opening and any other information necessary for the design and construction of the drainage system.

(c) The plan shall also show all drainage easements, reserves and natural water courses. The plan may be combined with the road layout plan.

(d) The drainage system longitudinal section shall be drawn to a scale of 1:500 horizontally and 1:50 vertically and shall show pipe size, class and type, pipe support type in accordance with AS/NZS 3725 or AS/NZS 2032 as appropriate, pipeline and road chainages, pipeline grade, hydraulic grade line and any other information necessary for the design and construction of the drainage system.

(e) Open channel cross sections shall be drawn to a scale of 1:100 natural and shall show the direction in which the cross sections should be viewed. Reduced levels are to be to Australian height datum (AHD), unless otherwise approved by council where AHD is not available.

(f) Details including standard and non-standard pits and structures, pit benching, open channel designs and transitions shall be provided on the drawings to scales appropriate to the type and complexity of the detail being shown.

(g) As constructed drawings shall be submitted to council upon completion of the drainage construction and prior to council's acceptance of completed works. The detailed drawings may form the basis of this information; however, any changes must be noted on these drawings.

(h) The as constructed plans must clearly identify the sections of the drainage system that will be owned by private residents as agreed by council.

(2) Easements and agreements

(a) Evidence of any Deed of Agreement necessary for the diversion of runoff through an adjoining property must be submitted prior to any approval of the engineering drawings required for operational works application. Easements must be created concurrently with the issue of the plan of survey.

(b) Where an agreement is reached with the adjacent landowners to increase flood levels on their property or otherwise adversely affect their property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to any approval of the application.

(3) Summary sheets

A copy of a Hydrological Summary Sheet providing the minimum information set out in SC6.4.4.4 Attachment B.

(4) Computer program files and program output

(a) Computer program output may be provided as long as summary sheets for hydrological and hydraulic calculations in accordance with this design specification are provided with plans submitted for checking and with final drawings.

(b) Copies of final computer data files (electronic and hard copy), for both hydrological and hydraulic models shall be provided for council's data base of flooding and drainage information in formats previously agreed with council.

SC6.4.4.4.8 Drainage easements and drainage reserves

(1) Specifications for new easements and reserves

(a) Easements must be of a size to enable necessary works including, but not limited to, construction, maintenance and inspection, to be carried out.

(b) Easement widths for drainage must be no less than the greater of the criteria in Table SC6.4.4.4.3.

Criteria	Type	Easement/Reserve Width
Pipe/Culvert	Pipe diameter/box culvert width ≤900mm	Minimum 3.0m
	Pipe diameter/box culvert width >900mm	Easement to extend to outside diameter/box culvert width + 1m each side of external edges of pipe/culvert
Channel/Drain	Base width ≤5m	Full bank width of channel/drain + 4m wide access path along one bank
	Base width ≤5m	Full bank width of channel/drain + 4m wide access path along both sides of channel/drain

(c) All drainage easements must be sized and located to ensure that they are not affected by, and do not impact on, an existing building's footing zone of influence, and give consideration to any future building footings on the subject or adjoining land.

(2) Residential, commercial and industrial areas
All major drainage is to be located within a drainage reserve with the minimum widths of that reserve being capable of containing the 1 per cent AEP design flows plus a 4m strip on each side for maintenance access and safety purposes.

(3) Rural residential areas

(a) Easement must be created over all drains and natural water courses through private property. Unless council determines the land is to be set aside for public use and is to be handed to council.

(b) In rural residential areas adjacent to a major watercourse, council may require drainage reserves or easements to be extended to cover identified areas of riparian vegetation, which maybe beyond the strip required for maintenance access and safety purposes.

(4) Rural areas

(a) Easements or reserves are not required over natural watercourses. However easements must be provided over all drains where stormwater is diverted from the natural flow path and be wide enough to contain the flows from the defined flood event plus adequate width for maintenance and safety purposes.

(b) Where the land falls away from the road, easements for drainage are required through private property over formed drains from road culverts and table drains. The location of these easements shall be fixed during design and approval of operational works for the roadworks concerned.

(5) Maintenance of easements

(a) A drainage easement over a property restricts the use of the area of land contained within the easement for drainage purposes. Council's level of service for drainage easements is restricted to ensuring the drainage easement is capable of performing its purpose of carrying stormwater flows through the property. If an owner desires a higher order of maintenance for other reasons, this will be at the owner's ongoing cost and must not compromise the drainage function of the easement. Altering of the drain in the easement by the owner without the approval of council may result in action being undertaken by council to restore the drainage path at the expense of the owner.

(b) Where subdividers are required to provide drainage easements and reserves over approved drainage paths, then these are to be acquired over the entire land at the first stage of subdivision. Where surcharge paths are terminated at the end of stages then drainage easements are required over balance lands, with such easements being released progressively with future stages that provide the surcharge path down the future roads or drainage reserves.

(6) Instruments relating to the terms – easements upon private property

Standard wording for the instruments setting out the terms for the various types of easements that can be acquired for drainage are to be utilised, with each document being cognisant of council's needs for future grading and on-going maintenance. The document is to also ensure that the responsibility and definition of maintenance within drains is clearly defined on the instruments that accompany the easement documents. This is particularly important in the rural residential areas where some residents have an expectation that council will maintain the land (easement) to a much higher standard than is needed for drainage purposes. In particular, in relation to inter-allotment drains that are not a part of the public drainage system, provision is to be made in the easement document to state that all maintenance is the owner's responsibility but with provision being made to enable the council to carry out necessary works at the cost of the defaulting owner.

SC6.4.4.4 Attachment A - Design AEPs and fraction impervious for land use zones

Development Category	Land use	Fraction impervious (fi)
Residential zones category	Low density residential	0.65
	Medium density residential	0.7
	High density residential	0.9
	Rural residential	0.6
	Character residential	0.55
Centre zones category	Neighbourhood centre	0.9
	Local centre	0.9
	District centre	0.9
	Major centre	1
	Principal centre (CBD)	1
	Specialised centre	0.9
	Mixed use	0.9
Community facilities and Open space zone category	Sport & recreation	0.2
	Open Space	0.2
	Community facilities	0.95
	Environmental management & conservation	0.4
Industry zones category	Low impact industry	0.9
	Medium impact industry	0.9
	High impact industry	0.9
Rural zones category	Rural	0.1
Other zones category	Emerging community	-
	Special purpose	-

SC6.4.4.4 Attachment B - Hydrologic and Hydraulic calculation sheets

Click here to view SC6.4.4.4 Attachment B - Hydrologic and Hydraulic calculation sheets

SC6.4.4.5 Earthworks (design)

SC6.4.4.5.1 Introduction

(1) Objectives

This sub-section provides advice, guidelines and standards for earthworks including to ensure the:

(a) efficient, sustainable and economical design;

(b) enhancement of the environmental character of the site whilst maintaining the natural features of the site;

(c) provision of safe conditions for construction commensurate with the proposed purpose of the development;

(d) equality of building conditions for residential development; and

(e) earthworks does not impact on adjoining properties and developments.

(2) Scope

(a) This sub-section sets out requirements for earthworks involved in land development and subdivision. Conceptual requirements are presented as necessary considerations when preparing designs for earthworks.

(b) The scope of this sub-section assumes that the Designer is familiar with requirements cited in the various construction specifications, specifically those related to earthworks, clearing and grubbing and erosion and sedimentation. Additionally the Designer is required to make reference to the associated design sub-sections related to stormwater drainage design, geometric road design and stormwater quality management, and any other relevant best practice documents.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

(i) Construction sub-sections
SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.11 Clearing and grubbing
SC6.4.6.10 Earthworks (construction)
SC6.4.6.26 Landscaping

(ii) Design sub-sections
SC6.4.3.8 Stormwater quality management plans for development
SC6.4.3.9 Water sensitive urban design guidelines
SC6.4.4.1 Geometric road design
SC6.4.4.4 Stormwater drainage design

(b) Australian Standards
AS3798 *Guidelines on earthworks for commercial and residential developments*
AS2870.1 *Residential slabs and footings - construction.*

(c) Qld Government Legislation
Work Health and Safety Act 2011

SC6.4.4.5.2 Earthworks concept design

(1) Areas of a site proposed for earthworks, building or recreational purposes may not be suitable in their natural state for their intended function without improvement works to:

(a) alleviate flooding of low-lying ground;

(b) fill gullies or create emergency flowpaths after underground stormwater piping has been installed;

(c) allow improved runoff from flat ground;

(d) regrade excessively steep slopes that would preclude economical construction of dwelling foundations; and

(e) allow effective recreational use or give reasonable access.

The Designer must review the natural surface contours as determined and identified on site and where

necessary must design finished surface levels that ensure the land is suitably prepared.

(2) Areas should be regraded to minimise the necessity for underground drainage systems with surface inlet pits, and allow surface water to flow naturally to roads or drainage reserves without excessive concentration.

(3) The Designer must consider the implications of earthworks in relation to the existing natural environment. Generally earthworks must be minimised in heavily treed areas.

(4) Care must be taken to provide depressions for overland flow from low points and over major drainage lines, to direct stormwater for storms up to a 1% annual exceedance probability (AEP).

(5) The design of earthworks areas in conjunction with the design of roadworks must be considered with the objective of balancing cut to fill and achieving both an economical development and minimising haulage of imported fill or spoil to and from the development site. Bulk haulage should always be considered as having an adverse effect on adjacent development and infrastructure.

SC6.4.4.5.3 Special treatment of particular areas

(1) All lots must be regraded to a minimum level at the1% AEP flood level. In doing so, the Designer must ensure that other areas are then not affected by flooding. The site must be identified on the Drawings with appropriate notation of site specific requirements.

(2) In the event that an area is known to be affected by or inundated by local stormwater flows, the Designer must investigate the existing conditions as they relate to the proposed development and advise the Developer in the preliminary design report on all data obtained in the investigation and recommend appropriate contour adjustments. The report should be accompanied by sketch plans to clarify recommendations and any other relevant data.

(3) Site constraints either natural or otherwise may be required to be identified as a burden on developed property. The Designer must take this into account when preparing the design. The property may ultimately be affected by a "restriction as to user", which may be controlled by a legal Instrument placed on title to the land and/or by a message advising prospective purchasers of any restrictions affecting the land.

(4) The finished surface of filled areas must be designed to levels allowing an adequate cover depth over the pipeline (if piped) and permitting surface stormwater flow to be guided to inlet pits if depressions are retained in the finished surface contouring.

(5) The location of such features must be clearly defined on the earthworks plans and defined by distance to corner boundaries etc. for purposes of relocation. A geotechnical report specifying the site specific preparation and compaction requirements must be incorporated in the earthworks plan. A description of the minimum acceptable quality of the fill must also be specified on the plans, supported by geotechnical recommendations. All documentation necessary from various authorities to support the filling of dams and watercourses must be supplied with the Drawings.

(6) The finished level of any building area must be designed to ensure a desirable surface grading of 0.5% minimum oriented in the direction of the drainage system designed to cater for its catchment.

SC6.4.4.5.4 General standard of lot preparation

(1) Special requirements will apply where necessary but generally lots are to be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the development. Prior consultation with council's officer responsible for tree preservation, or other authorised council officer, is necessary. Such requirements must be shown on the Drawings.

(2) All timber and other materials cleared from lots must be removed from the site. All roots, loose timber, etc. which may contribute to drain blockage must be removed. Such requirements must be shown on the Drawings.

(3) In areas to be filled over butts of trees, allowance must be made for clearing of all trees and replanting with a minimum of six advanced suitable species to each lot; planting must to be clear of probable future building location and services and utilities, and not to be commenced until filling has been completed and graded, with provision for watering and maintenance for duration of the contract. These specific requirements must be shown on the Drawings.

(4) Selected trees must be preserved by approved means to prevent destruction normally caused by placement of

conventional filling or other action within the tree drip zone. The Tree Preservation Officer, or other authorised council officer, must be consulted for advice and all specific requirements noted on the Drawings.

SC6.4.4.5.5 Standard of fill for lots

(1) The following notations are to be incorporated in the Drawings. "Filling is to be of sound clean material, reasonable standard and free from large rock, stumps, organic matter and other debris". "Placing of filling on the prepared areas shall not commence until the authority to do so has been obtained from the council".

(2) All work must be in accordance with AS3798. Fill must be placed in layers not exceeding 150mm compacted thickness. All fill must be compacted to 95% standard maximum dry density. Maximum particle size is 2/3 of the layer thickness.

(3) Fill comprising natural sands or industrial wastes or by-products may only be used after the material type and location for its use is approved by council and will be subject to specific requirements determined by prevailing conditions.

(4) It is essential that prior advice be given of intended use of such materials. It should be noted that failure to obtain council's approval may lead to an order for removal of any material considered by council or other relevant authorities as unsuitable or in any way unfit for filling.

(5) All areas where filling has been placed must be dressed with clean arable topsoil, fertilised and sown with suitable grasses. This work must be carried out in accordance with the sub section SC6.4.6.26 Landscaping.

SC6.4.4.5.6 Temporary diversion drains

(1) Where temporary drains are required to divert surface flows away from the earthworks area, the location and silt/erosion control treatment must be clearly identified on the Drawings. The scale of such works must reflect the volume of water to be diverted.

The objective will be to ensure minimal soil disturbances and material loss off the site.

The requirements identified in SC6.4.4.4 Stormwater drainage design, SC6.4.3.8 Stormwater quality management plans for development, and SC6.4.3.9 Water sensitive urban design guidelines must be addressed for technical details and any additional requirements.

SC6.4.4.5.7 Concurrence with the Department of Environment and Heritage Protection

The Designer is recommended to refer to the Department of Environment and Heritage Protection with regard to any items requiring specific consideration when preparing an earthworks plan. Such plans may need to incorporate sediment/siltation/erosion control devices with specific reference to the stage at which these are to be provided. The responsibility rests with the Developer to make enquiries with the Department of Environment and Heritage Protection and subsequently obtain council approval to proposed measures.

SC6.4.4.5.8 As-constructed drawings

The Designer must annotate on the earthworks plan, the site specific detail to be shown on the as-constructed plans. Such detail must include a geotechnical report certifying the works to be suitable for the intended purpose and any other certifications, testing and survey data, as required in this sub-section.

SC6.4.4.5.9 Cartage of soil

(1) The Designer must refer to council for acceptable haul roads with applicable load limits. This detail must be shown on the earthworks plan. The payment of a Bond, as determined by council, may be required by the Developer where council has some concern about the ability of a haul road to sustain the loads without undue damage or maintenance requirements.

(2) Unless specific application is made to council and approval obtained, the plans must be annotated as follows: "All topsoil must be retained on the development site and utilised effectively to encourage appropriate revegetation."

SC6.4.4.5.10 Effect on adjoining properties

(1) Where it is proposed to divert or direct piped stormwater into adjoining properties, drainage easement rights must be created over the adjoining lots in accordance with the SC6.4.4.4 Stormwater drainage design.

(2) A written agreement between the Developer and adjoining property owners to carry out construction work on adjoining properties must to be submitted to council prior to works commencing.

(3) Works must not cause ponding of stormwater on adjacent allotments and no stormwater formerly flowing onto the site may be diverted onto other neighboring allotments or reserves.

(4) Earthworks must be graded so that the new land forms are free draining and all stormwater naturally falling into the site is collected within the property boundaries and discharged to a lawful point of discharge as agreed with council.

SC6.4.4.7 Pathway and Cycleway

SC6.4.4.7.1 Introduction

(1) Purpose

This sub-section aims to set standards and document requirements related to the provision of pathways and cycleways for the use of pedestrians and cyclists, for both on road and off road which encourage pedestrian activities and cycling for transportation and recreational purposes. Pathways and Cycleways are to be safe and convenient and must maintain a satisfactory level of service for path users of all abilities including users with disabilities and/or limited mobility. Pathways and Cycleways should provide a clear and continuous accessible path of travel, void of tripping hazards and unsafe obstacles.

The design of a development must encourage the use of pedestrian and cycle facilities and ensure that priority is given to pedestrians with direct links between a building's main entrance and any adjoining local activities and public transport services and recreational areas.

(2) Scope

(a) This sub-section sets out requirements to be used in the design of various types of pathways and cycleways for the use of pedestrians and cyclists.

(b) All relevant design principles contained in the Austroads' Guides referenced below must be integrated in the design of all pathways and cycleways and their associated infrastructure.

(3) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
9.4.6 Transport impact, access and parking code
SC6.4.4.1 Geometric road design
SC6.4.4.8 Standard drawings
SC6.4.3.3 Footpath Treatment Policy
SC6.4.3.5 Car parking and public transport facilities guidelines
SC6.4.3.6 Landscape Policy

(b) Australian Standards

AS 1428.1	*Design for access and mobility Part 1: General requirements for Access – New building work*
AS 1428.2	*Design for access and mobility Part 2: Enhanced and additional requirements-Buildings and facilities*
AS/NZS 1428.4.1	*Design for access and mobility Part 4.1: Means to assist the orientation of people with vision impairment-Tactile ground surface indicators*
AS 2890.3	*Parking facilities Part 3: Bicycle parking facilities*

(c) Austroads
Guide to Road Design Part 3: *Geometric Design*
Guide to Road Design Part 4: Intersections and Crossings – General
Guide to Road Design Part 6A: Pedestrian and Cyclist Paths
Cycling Aspects of Austroads Guides
Guide to Traffic Management Part 11: Parking

(d) Queensland government
Department of Transport and Main Roads specifications, *Manual of uniform traffic control devices (MUTCD)*
Road Planning and Design Manual Volume 3 Part 6A TRUM Manual
Technical Standards Publications - Technical Notes
Queensland Development Code, MP 4.1 – *Sustainable Buildings*

(e) Other
Bicycle Network Victoria – www.bicyclenetwork.com.au
Institute of Public Works Engineering Australia, Queensland, *Complete Streets - Guidelines for Urban Street Design.*
Roads and Traffic Authority, *NSW Bicycle Guidelines*, Version 1.2, July 2005.

(4) Definitions

Pedestrian	A person walking, and including people in wheelchairs, on roller skates or riding vehicles such as skate boards or other vehicles, other than a bicycle, powered by effort or a motor and with a maximum speed of 7 km/h
Walking	to advance or travel on foot at a moderate speed or pace; proceed by steps; move by advancing the feet alternately to move about or travel on foot for exercise or pleasure.
Cyclist	Rider of a bicycle or human-powered vehicle. On a vehicle with one or more wheels that is built to be propelled by human power through a belt, chain or gears (whether or not it has an auxiliary motor), and includes a pedicab, penny-farthing and unicycle: but not a wheelchair, wheeled toy or pedelec.
Cycling	also called **bicycling** or **biking**, is the use of bicycles for transport, recreation, exercise or sport.[1] Persons engaged in cycling are referred to as "cyclists",[2] "bikers",[3] or less commonly, as "bicyclists".[4] Apart from two-wheeled bicycles, "cycling" also includes the riding of unicycles, tricycles, quadracycles, recumbent and similar human-powered vehicles (HPVs).
Path / Pathway	Series of links along a public way defining the connection between nodes in a network, reserved for the movement of pedestrians, motorised wheelchairs and personal mobility devices, and cyclists to chosen destinations via suitable desire lines.
Cycleway	Portion of a road or path devoted to the use of bicycles.

SC6.4.4.7.2 Consultation

The designer should consult with council, the applicant's landscape consultants and relevant authorities prior to and during the preparation of pathway and cycleway designs.

SC6.4.4.7.3 Design concepts

The Designer should be familiar with the different geometric design requirements for the various types of pathways and cycleways in terms of:

(1) width;

(2) grade;

(3) stopping sight distance;

(4) change in grade;

(5) horizontal curvature;

(6) crossfall and drainage; and

(7) sight distance on horizontal curves.

These requirements are discussed in the Austroads Guides.

SC6.4.4.7.4 Types of Pathways and Cycleways

(1) By definition pedestrian paths are "off road"in that, pedestrian facilities are usually designed adjacent to roadways, and meet the criteria outlined in Austroads Guides, SC6.4.4.8 Standard drawings, and SC6.4.4.1 Geometric road design, and to take into consideration SC6.4.3.3 Footpath treatment policy. Common pathway types include:

(a) foothpath;

(b) shared path; and

(c) separated path.

(2) Cycleways can be provided on road and off road. The Austroads Guides provide detailed descriptions, warrants, widths, pavement marking etc. for the majority of these cycleways. The Austroads Guides provide advice on the suitability of pavement conditions, drainage pit grates etc. for on road cycleways. All cycleways may diverge from the road alignment to provide a safer alternative access.

(3) Common cycleway types include:

(a) On road:

(i) bicycle lane;

(ii) bicycle awareness zone (BAZ);

(iii) cycle route; and

(iv) bicycle/car parking lane; and

(b) Off road:

(i) footpath;

(ii) shared path;

(iii) separated path; and

(iv) bicycle path.

(4) Common pedestrian path types include:

(a) footpath;

(b) shared path; and

(c) separated path.

By definition pedestrian paths are "off road" in that, pedestrian facilities are usually designed adjacent to roadways, and meet the criteria outlined in SC6.4.3.3 Footpath treatment policy and SC6.4.4.8 Standard drawings, and SC6.4.4.1 Geometric road design

All paths may diverge from the road alignment to provide a safer alternative access.

(5) Provisions for pathways and cycleways at structures.

Designers must consider the best way to provide for a safe uninterrupted movement of pedestrians and cyclists.

The reference and source documents provide information on:

(i) acceptable widths and clearances;

(ii) types of pathways and cycleways;

(iii) handrails;

(iv) bridges;

(v) approach ramps;

(vi) safety; and

(vii) crime prevention through environmental design (CPTED) principles.

(6) Developments must make appropriate provision for the safe and convenient movement and provide accessibility of pedestrians and cyclists, both on-site and to and from surrounding networks. Design should include the provision of suitable routes and end-of-trip facilities to encourage and facilitate these forms of movement.

SC6.4.4.7.5 End of trip facilities

(1) Where appropriate, consideration must be given to the provision of adequate facilities at destinations for cyclists and pedestrians, to encourage bicycle path and pedestrian path usage.

(2) Such facilities could include:

(a) seats;

(b) secure bicycle parking;

(c) toilets and showers; and

(d) picnic facilities.

(3) The provision of bicycle parking must meet appropriate criteria discussed in the *Austroads Guide to Traffic Management Part 11: Parking* and in accordance with AS 2890.3.

SC6.4.4.7.6 Signage and pavement marking

(1) Adequate signage design for pathways and cycleways must be provided.

(2) Signs and pavement marking must provide for the safe and convenient use of the facility. The signs and

pavement marking must comply with *MUTCD* and SC6.4.4.8 Standard drawings, SC6.4.6.22 Pavement markings and SC6.4.6.24 Signposting.

SC6.4.4.7.7 Design standards

(1) Notwithstanding the guidelines provided in this sub-section and referenced documents, the following minimum standards have been determined as shown in Table SC6.4.4.7.1. Where these values are less than those in the referenced documents, Table SC6.4.4.7.1 may only be used in special circumstances with separate approval.

Table SC6.4.4.7.1 Minimum design standards

	Footpath	**Shared Path**
Path width	1.5m minimum preferred 1.5m minimum for one wheelchair and pedestrian (people with disabilities) 1.8m desirable minimum for two wheelchairs	2.5m absolute minimum 3m – 4m (3.5m desirable) major recreation paths
Crossfall	2.5% maximum (1 in 40) Aids people with a disability	2.5% maximum (1 in 40)
Gradient	1:33 25 m interval* 1:20 15 m interval* 1:14 9 m interval for ramps*	1:33 25m interval* 1:20 15m interval* 1:14 9m interval for ramps*
* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction Intervals between 1:33 and 1:20 should be interpolated		
Lateral clearance beside path	0.3 m absolute minimum	1m desirable (cycling) 0.5m absolute minimum (0.3m absolute minimum fencing smooth features aligned parallel)
Vertical clearance	2.5m (pedestrians)	2.5m (cyclists)

Formation Width: During the design process allow 0.5 m minimum either side of reinstatement works. Ensure design for free draining across surface of the verge so as to not create ponding or tripping hazards.

Alternative situations

	Separated Path			**Bicycle Path**
Path width	**Two-way**			2.5m acceptable minimum 3.0m desirable for high speeds 2.0m absolute minimum very low use at all times
	Bicycle Path 2.5m desirable minimum	**Footpath** 2.0m desirable ≥1.5m absolute minimum	**Total** 4.5m	
	One-way			
	Bicycle Path 1.5m desirable 2.0m maximum	**Footpath** 1.5m	**Total** 3.0m	
Crossfall	2.5% maximum (1 in 40)			2%-4% on sealed surfaces Up to 5% on unsealed surfaces
Gradient	1:33 25m interval* 1:20 15m interval* 1:14 9m interval for ramps*			3% maximum 200m 5% maximum 20m (if 3% cannot be achieved) Steeper gradients should not be provided unless unavoidable
Superelevation for cycling	2.5% maximum			Consider horizontal radii 2.5% desirable Can go greater than or equal to 3% dependent on site and situation
* Level rest areas 1.2m long should be provided if length is exceeded, and at each change in direction intervals between 1:33 and 1:20 should be interpolated				

(2) To assist with the safety of pedestrians and cyclists during night time use, illumination of the off road pathways

and cycleways may be required. The lighting must be designed in accordance with AS/NZS 1158.3.1 Pedestrian area (Category P) lighting – Performance and design requirements and SC6.4.3.20 Public lighting and utilities services

(3) Safety and good alignment should not be compromised by inappropriate landscaping. The principles of crime prevention through environmental design (CPTED) should be a key design focus.

(4) Tactile ground surface indicators (TGSI) where required must be:

(a) standard yellow Polyurethane Tactile Indicator Studs (warning tactiles) and bars (directional tactiles), drill and lock installation; and

(b) supplied and installed in accordance with AS/NZS 1428.4.1, providing correct illuminance contrast; and AS1428.1 and AS4586 Slip Resistance of Pedestrian Surfaces and as per manufacturers specifications and in accordance with AS1884.

(5) Kerb ramps must be:

(a) in accordance with the standard drawings see SC6.4.3.3.3(3)(b) - SD-025: Kerb Ramp;

(b) in accordance with AS1428.1 *Design for Access and Mobility, Part 1: General requirements for access - New Building Works*;

(c) installed facing the direction of travel and aligned parallel and perpendicular with opposite kerb ramp ;

(d) located as per requirements for the flow of pedestrian traffic and the position of the signal button;

(e) constructed of broom finished plain natural concrete;

(f) installed with sharp transitions between adjacent surfaces (top and bottom); and

(g) Installed with Tactile Ground Surface Indicators (TGSI) in accordance wtih AS/NZS 1428.4.1 *Design for Access and Mobility, Part 4.1: Means to assist the orientation of people with vision impairment - Tactile ground surface indicators*.

SC6.4.4.8 Standard drawings

(1) Introduction

This sub-section comprises the current Townsville City Council standard drawings.

Standard drawings show the minimum standard that council has adopted with regard to certain types of work. Standards have been developed for works on drainage, irrigation, roads, sewerage, transport, water and other miscellaneous activities.

(2) List of standard drawings

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage
Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation
Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks
Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage
Table SC6.4.4.8.5 Townsville City Council standard drawings for transport
Table SC6.4.4.8.6 Townsville City Council standard drawings for water

Table SC6.4.4.8.1 Townsville City Council standard drawings for drainage

Drawing No.	Title	Revision number
SD-200	Precast Grated Kerb Inlet System and Cast Insitu Stormwater Manhole	C
SD-205	Stormwater Manhole Details	C
SD-210	Precast Stormwater Manhole – Slab Top Details	A
SD-215	Raised Grate Field Inlet Manhole	A

Table SC6.4.4.8.2 Townsville City Council standard drawings for irrigation

Drawing No.	Title	Revision No.
SD-4.1	XR 1 - 4 Panel and Screw Hole Layout	-
SD-4.2	XR 1 - 4 Terminal Layout and Power Diagram	-
SD-4.3	XR 1 - 4 Control Enclosure	-
SD-4.4	XR 1 - 4 Base and Antenna	-
SD-4.5	XR 1 - 4 Preferred Equipment List – Controller and Telemetry	-
SD-5.1	AC Irrinet ACE DR 24 – 48 Panel Layout	-
SD-5.2	AC Irrinet ACE DR 24 – 48 Terminal Layout	-
SD-5.3	AC Irrinet ACE DR 24 – 48 Control Enclosure	-
SD-5.4	AC Irrinet ACE DR 24 – 48 Base and Pole	-
SD-5.5	AC Irrinet ACE DR 24 – 48 Electrical Diagram	-
SD-5.6	AC Irrinet ACE DR 24 – 48 Screw Holes	-
SD-5.7	AC Irrinet ACE DR 24 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-5.8	AC Irrinet ACE DR 24 – 48 Panel Layout Photo	-
SD-5.9	AC Irrinet ACE DR 24 – 48 Chassis Mounting Photo	-
SD-5.10	AC Irrinet ACE DR 24 – 48 Door Layout Photo	-
SD-7.1	Irrigation Design Data Example	-
SD-7.2	Irrigation Cabling Wiring Schedule Example	-
SD-8.1	Plan Conventions	-
SD-9.1	Survey Dimensions	-
SD-10.1	Water meter assembly 50MM and Above Type A	-
SD-10.2	Water meter assembly 50MM and Above Type B	-
SD-10.3	Water meter assembly 25M-32MM Type A	-
SD-10.4	Water meter assembly 25M-32MM Type B	-
SD-10.5	Water Meter Stands	-
SD-10.6	Valve Assembly Side View	-
SD-12.1	Sprinkler Installation	-
SD-12.2	Sprinkler Riser Large and Small	-

Drawing No.	Title	Revision No.
SD-13.1	Subdivision Services Allocation (figure 1, 2, 3, 4, 5, 6)	-
SD-14.1	Drip Irrigation Overview	-
SD-14.2	Drip Valve Assemblies	-
SD-14.3	Drip Valve Assembly 25MM and 40MM Internal Reg	-
SD-14.4	Drip Valve Assembly 25MM External Reg	-
SD-15.1	Drip Tube Holding Pin	-
SD-16.1	Curved Road Sprinkler Layout	-
SD-17.1	Conduit Placement in Valves	-
SD-17.2	Valve Assembly - Plan View and Electrical Pit	-
SD-18.1	Typical Pipe Trench Details	-
SD-19.1	Scheduling Co-efficient	-
SD-20.1	AC Irrinet M Slave 12 – 24 Panel Layout	-
SD-20.2	AC Irrinet M Slave 12 – 24 Terminal Layout	-
SD-20.3	AC Irrinet M Slave 12 – 24 Control Enclosure	-
SD-20.4	AC Irrinet M Slave 12 – 24 Base and Pole	-
SD-20.5	AC Irrinet M Slave 12 – 24 Electrical Diagram	-
SD-20.6	AC Irrinet M Slave 12 – 24 Screw Holes	-
SD-20.7	AC Irrinet M Slave 12 – 24 Preferred Equipment List – Controller and Telemetry	-
SD-21.1	AC Irrinet M Slave 36 – 48 Panel Layout	-
SD-21.2	AC Irrinet M Slave 36 – 48 Terminal Layout	-
SD-21.3	AC Irrinet M Slave 36 – 48 Control Enclosure	-
SD-21.4	AC Irrinet M Slave 36 – 48 Base and Pole	-
SD-21.5	AC Irrinet M Slave 36 – 48 Electrical Diagram	-
SD-21.6	AC Irrinet M Slave 36 – 48 Screw Holes	
SD-21.7	AC Irrinet M Slave 36 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-22.1	AC Irrinet M 12 – 24 Panel Layout	-
SD-22.2	AC Irrinet M 12 – 24 Terminal Layout	-
SD-22.3	AC Irrinet M 12 – 24 Control Enclosure	-
SD-22.4	AC Irrinet M 12 – 24 Base and Pole	-
SD-22.5	AC Irrinet M 12 – 24 Electrical Diagram	-
SD-22.6	AC Irrinet M 12 – 24 Screw Holes	-
SD-22.7	AC Irrinet M 12 – 24 Preferred Equipment List – Controller and Telemetry	-
SD-23.1	AC Irrinet M 36 – 48 Panel Layout	-
SD-23.2	AC Irrinet M 36 – 48 Terminal Layout	-
SD-23.3	AC Irrinet M 36 – 48 Control Enclosure	-
SD-23.4	AC Irrinet M 36 – 48 Base and Pole	-
SD-23.5	AC Irrinet M 36 – 48 Electrical Diagram	-
SD-23.6	AC Irrinet M 36 – 48 Screw Holes	-
SD-23.7	AC Irrinet M 36 – 48 Preferred Equipment List – Controller and Telemetry	-
SD-26.1	Door Bracket	-
SD-26.2	Door Bracket Position	-
SD-26.3	Door Bracket – Irrinet M	-
SD-26.4	Door Bracket Position – Irrinet M	-
SD-27.1	Enclosure Earth Wiring	-
SD-28.1	Transceiver Interface Cable Type 1	-
SD-28.3	Aux Data Cable – RJ45 Modified Crossover Cable	-
SD-29.1	Rain Switch Installation	-
SD-31.1	Hydrometer Covers 50mm – 100mm	-
SD-31.2	Multijet Covers 25mm - 32mm	-

Drawing No.	Title	Revision No.
SD-32.1	Drinking Fountain Assembly	-
SD-32.2	Drinking Fountains Base	-
SD-33.1	Valve Nest Cover (sheet 1)	-
SD-33.2	Valve Nest Cover (sheet 2)	-
SD-33.3	Valve Nest Cover (sheet 3)	-
SD-33.4	Valve Nest Cover (sheet 4)	-

Table SC6.4.4.8.3 Townsville City Council standard drawings for roadworks

Drawing No.	Title	Revision No.
SD-001	Typical Road Cross Sections – Urban Streets	B
SD-002	Typical Road Cross Sections – Collector Roads	B
SD-003	Typical Road Cross Sections – Sub Arterial Roads	B
SD-004	Typical Road Cross Sections – Arterial Roads	B
SD-005	Typical Road Cross Sections – Industrial Roads	B
SD-006	Typical Road Cross Sections – B-Double Turning Path and Access Plan Example Drawing	B
SD-010	Typical Road Cross Sections – Rural Roads	B
SD-015	Verge Service Corridors – General Type Sections	E
SD-020	Concrete Kerbing	D
SD-025	Kerb Ramp	D
SD-030	Driveway Access Urban Residential Properties	I
SD-031	Driveway Access Industrial Properties	G
SD-032	Driveway crossovers urban residential properties	F
SD-055	Road Crossing and Footpath Reinstatement for Trench Laid Services	A
SD-060	Traffic Sign Installation	A
SD-065	Street Name Sign and Installation Details	A
SD-066	Miscellaneous Traffic Details – Shared Path Terminal Treatments Deflection Rail and Intersection at Side Road	B
SD-067	Miscellaneous Traffic Details – Pedestrian Refuge and Holding Rail	A
SD-070	Concrete Pathway Reinforced Concrete (Mesh) Alternative	D
SD-075	Concrete Pathway Reinforced Concrete (Fibre) Alternative	E
SD-080	Subsoil Drain	D
SD-085	Kerb and Channel Drainage Connections	A
SD-090	Driveway Access Rural Properties Type 1 - Access With Invert Slab H<300mm	B
SD-091	Driveway Access Rural Properties Type 2 - Conc. Access With Culvert Cast Insitu With Grate H≥300mm	B
SD-092	Driveway Access Rural Properties Type 3 - Gravel Access With Culvert Cast Insitu With Grate H≥300mm	B
SD-093	Driveway Access Rural Properties Type 4 - Conc. Access With Culvert Inverted Pre-cast Box Culvert H≥325mm	B
SD-094	Driveway Access Rural Properties Type 5 - Gravel Access With Culvert Inverted Pre-cast Box Culvert H≥325mm	B
SD-095	Driveway Access Rural Properties Type 6 – Access With Culvert Cast Insitu H≥450mm	B
SD-096	Driveway Access Rural Properties Type 7 - Conc. Access With Culvert 535mm<H<685mm	B
SD-097	Driveway Access Rural Properties Type 8 - Gravel Access With Culvert 535mm<H<685mm	B

Table SC6.4.4.8.4 Townsville City Council standard drawings for sewerage

Drawing No.	Title	Revision No.
SD-400	Sewerage Standard Drawing List	C
SD-405	Legends for Sewerage Drawings	C
SD-410	Typical Layout of Sewerage Details Example Plan	B
SD-411	Sewer Maintenance Shaft Typical Layout	B
SD-420	Small Sewerage Pump Stations Typical Plans, Sections and Details	C
SD-421	Sewerage Pump Stations Package Fibre Reinforced Plastic	B
SD-425	Small Sewerage Pump Stations Two Part Access Cover and Frame	B
SD-430	Sewerage Pump Stations Safety Grill Details	B
SD-435	Sewerage Pump Stations Washdown Service Installation	B
SD-440	Pressure Main Discharge to Maintenance Hole	B
SD-445	Overflow Maintenance Hole Arrangement	C
SD-450	Vents at Sewerage Rising Main Receiving Inspection Chambers and Pump Stations	D
SD-455	Property Connection Details Buried Interface Method	C
SD-460	Embedment and Trench Fill Typical Arrangement (sewer)	B
SD-461	Pipe Embedment Support Types	B
SD-463	Special Embedment - Piles, Concrete and Stabilised Supports	B
SD-470	Maintenance Holes - Sewers Less Than DN300 Cast In-Situ	C
SD-471	Maintenance Holes - Sewers Less Than DN300 Changes In Level Details and Channel Arrangements	C
SD-473	Maintenance Holes - Typical Channel Details	B
SD-474	Maintenance Holes - Alternative Drop Connections	D
SD-475	Maintenance Holes - Typical MH Cover Arrangements	B
SD-476	Maintenance Holes - Sewer DN375 to DN750	B
SD-480	Design Layouts - Longitudinal Sections	A
SD-481	Soil Classification Guidelines and Allowable Bearing Pressures for Bulkheads	A
SD-482	Trench Drainage Bulkheads and Trenchstop (sewer)	A
SD-483	Trench Drainage Typical Systems (sewer)	A
SD-484	Maintenance Holes - Pipe Connection Details	A
SD-485	Maintenance Holes - Connection Details DN110 to DN450 PE Pipes	A

Table SC6.4.4.8.5 Townsville City Council standard drawings for transport (21)

Drawing No.	Title	Revision No.
SD-500	Standard Bus Shelter Framing Details Sheet 1 of 2	E
SD-502	Standard Bus Shelter Slab and Footing Details Sheet 2 of 2	D
SD-505	Regional Bus Shelter Framing Details Sheet 1 of 2	C
SD-510	Regional Bus Shelter Construction Details Sheet 2 of 2	C
SD-515	Standard Bus Stop Urban Location Layout Details Type 1 and 2	D
SD-520	Regional Bus Stop Urban Location Layout Details Type 3 and 4	D
SD-525	Basic Bus Stop Layout Details Urban Location	B
SD-530	Standard Bus Stop Urban and Rural Locations Layout Details Type 7 and 8	B

Drawing No.	Title	Revision No.
SD-535	J Pole, Timetable Display Case, Rubbish Bin and Sleeve Installation Details	D
SD-540	School Bus Bus Stop Sign Details	B
SD-545	Bus Setdown – Urban Locations Layout Details	A
SD-550	Bus Setdown – Parking and Indented Details Urban Locations	A
SD-555	Bus Setdown Rural Location Layout Details	C
SD-560	Bus Setdown Rural Location Table Drain Precast Culvert Crossing	C
SD-565	Bus Setdown Rural Location Table Drain Cast-Insitu Culvert Crossing	B
SD-570	Standard-Country Bus Shelter – Framing, Slab and Footings Details	A
SD-575	Standard-City Bus Shelter Framing Details	B
SD-580	Standard-City Bus Shelter Slab and Footing	B
SD-585	Standard-City Bus Stop Urban Location Layout Details - Type 9 and 10	B
SD-590	Parking for People with Disabilities	A
SD-595	Taxi Rank	A
SD-596	Taxi sign details	A

Table SC6.4.4.8.6 Townsville City Council standard drawings for water

Drawing No.	Title	Revision No.
SD-300	Water Standard Drawing List	C
SD-305	Street Positioning of Mains, Valves, Hydrants and Domestic Water Service Connections	C
SD-310	Domestic Water Service Connections for 20mm Diameter Water Meters Rural Residential Area Only	C
SD-315	Typical Mains Construction Reticulation Main Arrangements	C
SD-320	Typical Mains Construction Connection to Existing Mains	B
SD-325	Embedment and Trench Fill Typical Arrangement (water)	C
SD-330	Standard Embedment - All Pipe Types	C
SD-335	Special Embedments - Inadequate and Poor Foundation	C
SD-340	Special Embedments - Concrete, Geotextile and Cement Stabilised Systems	C
SD-345	Valve and Hydrant Identification - Identification Markers and Marker Posts	C
SD-350	Typical Valve and Hydrant Installation Valve Arrangement	C
SD-355	Typical Valve and Hydrant Installation Hydrants and Air Relief Valves	C
SD-360	Typical Appurtenance Installation Scour Arrangements	B
SD-370	Soil Classification Guidelines and Allowable Bearing Pressures for Anchors and Thrust Blocks	A
SD-371	Thrust Block Details - Concrete Blocks	A
SD-372	Thrust and Anchor Blocks - Gate Valves and Vertical Bends	B
SD-373	Restrained Joint System DN100 to DN375 DI Mains	A
SD-374	Trench Drainage Bulkheads and Trenchstop (water)	A
SD-375	Trench Drainage Typical Systems (water)	A
SD-376	Buried Crossings Bored and Jacked Encasing Pipe Details	A
SD-377	Flanged Joints Bolting Details	A

SC6.4.5 Construction management

(1) This section outlines the standards and provides advice and guidelines for construction management of development and covers pre-construction, construction and quality management systems.

(2) All development works shall be supervised by a Registered Professional Engineer of Queensland with relevant experience. Where the owner or developer does not have such a Professional Engineer in their employ, a Registered Consulting Professional Engineer shall be retained for the purpose of supervising the development works prior to commencement of work.

(3) This section aims to clearly define the role of council, Superintendent, Consultant, Principal Contractor and the Developer. This section seeks to ensure that inherited development works are constructed to achieve a cost effective operation and maintenance asset and perform adequately for their design lives.

(4) Reference and source documents

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.1 Water sensitive urban design construction and establishment guidelines
SC6.4.6.2.5 Pipeline testing and restoration (Water supply sub-section)
SC6.4.6.3.4 Pipeline testing and restoration (Sewerage system sub-section)
SC6.4.6.19 Stabilisation
SC6.4.6.22 Pavement markings
SC6.4.6.29 Boundary fencing
SC6.4.6.30 Control of traffic

(b) Australian Standards

AS 1012.1	*Methods of testing concrete - Sampling of fresh concrete*
AS 1012.3.1	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Slump test*
AS 1012.14	*Methods of testing concrete - Method for securing and testing cores from hardened concrete for compressive strength*
AS 1012.4	*Methods of testing concrete - Determination of properties related to the consistency of concrete - Compactibility index*
AS 1012.8	*Methods of testing concrete - Method of making and curing concrete*
AS 1012.9	*Methods of testing concrete - Determination of the compressive strength of concrete specimens*
AS 1141.11	*Methods for sampling and testing aggregates - Particle size distribution*
AS 1141.12	*Methods for sampling and testing of aggregates - Materials finer than 75 micrometre in aggregates (by washing)*
AS 1141.14	*Methods for sampling and testing aggregates - Particle shape, by proportional caliper*
AS 1141.15	*Methods for sampling and testing aggregates - Flakiness index*
AS 1141.18	*Methods for sampling and testing aggregates - Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*Methods for sampling and testing aggregates - Wet/dry strength variation*
AS 1141.23	*Methods for sampling and testing aggregates - Los Angeles value*
AS 1141.24	*Methods for sampling and testing aggregates - Aggregate soundness - Evaluation by exposure to sodium sulphate solution*

AS 1141.25	*Methods for sampling and testing aggregates - Degradation factor*
AS 1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS 1141.42	*Methods for sampling and testing aggregates - Pendulum friction test*
AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289.3.2.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the plastic limit of a soil - Standard method*
AS 1289.3.3.1	*Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil*
AS 1289.3.6.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.7.1	*Methods of testing soils for engineering purposes - Soil classification tests - Determination of the sand equivalent of a soil using a power-operated shaker*
AS 1289.4.2.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method*
AS 1289.4.3.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the pH value of a soil - Electrometric method*
AS 1289.4.4.1	*Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials*
AS 1289.5.1.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.5.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method*
AS 1289.5.7.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1289.5.8.1	*Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture–Density gauge - Direct transmission mode*
AS 1289.6.1.1	*Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS 1477	*PVC pipes and fittings for pressure applications*

AS 1478	*Chemical admixtures for concrete, mortar and grout*
AS 1580.107.3	*Paints and related materials - Methods of test - Determination of wet film thickness by gauge*
AS 1741	*Vitrified clay pipes and fittings with flexible joints - Sewer quality*
AS 1742.3	*Manual of uniform traffic control devices - Traffic control for works on roads*
AS 2008	*Bitumen for pavements*
AS/NZS 2032	*Installation of PVC pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS 2280	*Ductile iron pipes and fittings*
AS 2150	*Hot mix asphalt - A guide to good practice*
AS 2544	*Grey iron pressure fittings*
AS 2638	*Gate valves for waterworks purposes*
AS 2758.1	*Aggregates and rock for engineering purposes - Concrete aggregates*
AS 2891.9.3	*Methods of sampling and testing asphalt - Determination of bulk density of compacted asphalt - Mensuration method*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 3439	*Low-voltage switchgear and controlgear assemblies*
AS 3582.1	*Supplementary cementitious materials for use with portland and blended cement - Fly ash*
AS 3583.1	*Methods of test for supplementary cementitious materials for use with portland and blended cement - Determination of fineness by the 45 micrometre sieve*
AS 3583.12	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of available alkali*
AS 3583.13	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of chloride ion content*
AS 3583.14	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of insoluble residue content*
AS 3583.2	*Methods of test for supplementary cementitious materials for use with portland cement - Determination of moisture content*
AS 3799	*Liquid membrane-forming curing compounds for concrete*
AS/NZS 3905.12	*Quality system guidelines - Guide to AS/NZS ISO 9001 for architectural and engineering design practices*
AS 3952	*Water supply - Spring hydrant valve for waterworks purposes*
AS 3972	*General purpose and blended cements*
AS 4198	*Precast concrete access chambers for sewerage applications*

AS 4373	*Pruning of Amenity Trees*
AS/NZS 4455	*Masonry units, pavers, flags and segmental retaining wall units*
AS 4687	*Temporary Fencing and Hoardings*
AS 4970	*Protection of trees on development sites*
AS 5101.4	*Methods for preparation and testing of stabilized materials - Unconfined compressive strength of compacted materials*
AS/NZS ISO 9001	*Quality management systems - Requirements*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10006	*Quality management systems - Guidelines for quality management in projects*
AS ISO 10013	*Guidelines for quality management system documentation*

(c) Department of Transport and Main Roads

Standard specifications roads

MRTS17 - Bitumen
MRTS18 - Polymer Modified Binder
MRTS21 - Bituminous Emulsion
MRTS22 - Supply of Cover Aggregate
MRTS30 - Dense Graded and Open Graded Asphalt

Materials testing manual

Q103A Particle size distribution (wet sieving)
Q104A - Liquid limit (cone penetrometer)
Q104D - One-point liquid limit (cone penetrometer)
Q105 - Plastic limit and plasticity index
Q113A - California bearing ratio (standard compactive effort)
Q115 - Unconfined compressive strength of compacted materials
Q142A - Dry density- moisture relationship (standard compaction)
Q201 - Flakiness index
Q205B - Ten percent fines value (wet)
Q205C - Wet/dry strength variation
Q208A - Degradation factor (source rock)

(d) Other

ASTM International, ASTM-D 2434-68 - *Standard Test Method for Permeability of Granular Soils (Constant Head)*
Environmental Protection (Noise) Policy (EPP (Noise))
International Erosion Control Association, *Best Practice Erosion and Sediment Control Document (BPESC)*
NSW Department of Transport, Roads and Maritime Services (RMS), *Test method T432: Rate of slaking of quicklime, October 2012*
TCC-001
Work Health and Safety Act 2011

SC6.4.5.1 Pre-construction guidelines

SC6.4.5.1.1 Pre-construction steps

The chart presented below indicates the steps required to be undertaken prior to commencement of works.

(1) Notice to commence works

The Developer must give council's Development Assessment Unit (DAU) notification of at least 5 business days (in writing) of their intention to commence construction works. Refer to SC6.4.5.1 Attachment A Development works – notice to commence works. Refer to the Development works - notice to commence works form for a list of requirements to be submitted prior to or at the pre-start meeting.

(2) Pre-start meeting

The nominated Consultant must ensure that a pre-start meeting is conducted on the premises between the contractor, supervising engineer (RPEQ), the design consultant and council representatives. This meeting represents a hold point and works may not proceed until the meeting is held and any further requirements identified during the course of the meeting have been satisfied. The pre-start meeting must be based on an agenda which includes:

(a) introduction of the principal contractor, supervising engineer (RPEQ), design consultant (including any specialist) and council representative. A statement of their respective roles and relevant personnel contact details must also be tabled and distributed at that meeting;

(b) confirmation that all relevant statutory permits/approvals have been obtained;

(c) evidence of current public liability insurance. Refer to SC6.4.5.2(21) Insurance and indemnity;

(d) review and discussion of all relevant conditions of the development approval;

(e) review and confirmation of the site establishment and access arrangements including all necessary site security fencing and signage requirements;

(f) review and discussion of the approved traffic management plan and haulage routes if applicable;

(g) review and discussion on a schedule of "hold-points" to be adopted throughout the construction phase. This schedule of "hold-points" is to be approved by council prior to construction proceeding;

(h) discussion of site specific workplace health and safety issues and an approved work method statement and safety plan in compliance with the *Work Health and Safety Act 2011*;

(i) review of the approved erosion and sediment control plan including site base stormwater management

plans and sediment controls during and post construction. Refer to SC6.4.5.2(11) Erosion and sediment control and SC6.4.3.8 Stormwater quality management plans for further details regarding this requirement;

(j) location confirmation and identification of all existing public utilities, services and council assets if applicable, including any approved demolition/rectification actions if required;

(k) scheduling and identification of all necessary responsible persons to undertake any council required works (e.g. disconnection of irrigation systems, sewer line connections etc.);

(l) review of the vegetation protection plan if applicable and confirmation that any necessary vegetation protection measures are in place;

(m) construction schedule and program and any other details that requires review before construction work commences e.g. work quality plan and/or quality manual review of quality requirements (SC6.4.5.3 Quality management system) and inspection test plan requirements;

(n) if required, a development notice (project sign in accordance with SC6.4.5.2.1(6) Development notice) is to be erected;

(o) confirmation of possession of site by the contractor; and

(p) any other relevant matters specified by the principal contractor, supervising engineer (RPEQ), consultant/s and/or council representative that may be pertinent to the successful completion of the project.

SC6.4.5.1 Attachment A Development works - notice to commence works form

Click here to view SC6.4.5.1 Attachment A Development works - notice to commence works form

Note—this form is to be completed, signed and submitted to council by the developer at least 10 working days prior to commencement of any development works.

SC6.4.5.2 Construction

SC6.4.5.2.1 General standards and guidelines

The following are general standards and guidelines during the construction of development works:

(1) Superintendent

The superintendent is to be nominated or appointed by the supervising engineer (RPEQ) and must be supervised by the RPEQ at all times throughout the construction period. The supervising engineer (RPEQ) is to take full responsibility for all construction work on the development site.

(2) Hours of work

Unless otherwise approved by council (in writing), works involving machinery of any description shall only be carried out on site from 6.30am to 6:30pm Monday to Saturday, subject to legislative requirements. No construction work is to take place on Sundays and public holidays without prior approval. Construction work includes deliveries to the site of the works and the onsite servicing of equipment.

(3) Relocation/alteration and repair to existing utility services

The location and level of all existing public utilities and services and the alignment for any new service utility or service in association are to be identifiedwith the relevant authority or council asset owner. The developer is responsible for any relocation and/or alteration to any public utility installation required as a result of any works carried out in connection with this development at no cost to council.

The contractor is to ensure that utmost care is to be exercised during the progress of the development works to prevent damage to any existing utility or service. Any damage to existing utilities or services directly resulting from the development works shall be the responsibility of the developer.

(4) Provision for traffic management

No works shall be conducted within an existing public road without approval (i.e. Road work permit). Any proposed road closure (partial or full), or traffic diversion is to be presented (with full details of proposed traffic management) for approval. Proposed traffic management is to comply with the relevant sections of SC6.4.6.30 Control of traffic.

The developer is to ensure that all appropriate approvals and permits are obtained from council for work zones, gantries and scaffolding prior to commencement of construction.

The developer shall be held responsible for implementing the approved traffic management plan including the safety of all vehicles, pedestrians and cyclists and must provide all necessary measures to prevent any accident, damage and loss.

(5) Condition of entry to adjoining properties

The developer or its representative must effectively protect all adjoining properties against any loss, damage or injury that may occur as a result of development works.

Works must not be undertaken on adjoining properties without prior written consent of the lawful owner. All adjoining property which has been disturbed as a result of the development shall be reinstated to a finish similar to its pre-development state or to an alternative state agreed to in writing by the affected property owner.

Upon completion of the development works, written approval from any affected property owners will be required by council prior to acceptance of the completed development works.

(6) Development notice

Where required, a project sign is to be erected within the site boundaries on the road frontage of the subject site or any other council approved location that is prominent and visible to the public. The developer is responsible for maintaining the signage for the duration of the construction. The signage shall have the following information (as a minimum):

(a) description of development (include an overall concept plan);

(b) name of developer;

(c) name of project;

(d) street address of the site;

(e) supervising engineer's name and phone number;

(f) consultant's name and phone number;

(g) principal contractor's name and phone number; and

(h) other specialist consultants' names and phone numbers.

(7) Signage and security

All necessary signage and site security shall be provided wholly within the site and in strict accordance with current Workplace Health and Safety (QLD) guidelines and requirements.

(8) Site access

The construction site shall be accessed via one convenient access from a public road. The location and details of this access point is to be approved by council prior to construction commencing. This access point shall be used by all vehicles, equipment and personnel during the approved construction hours of the site. Appropriate vehicle "shake-down" facilities are to be provided at the point of access in accordance with appropriate water quality management objectives for the site. The vehicle shake-down facility is to be a minimum 1.5m long by 3m wide for one-way or 6m wide for two way entrances.

(9) Site fencing

The developer must erect a temporary man-proof fence to restrict unauthorised access into the construction site. The fence is to extend around the entire perimeter of the site with access being provided as outlined above. The developer is to refer to SC6.4.6.29 Boundary fencing for details of the temporary fence.

(10) Site management

The Contractor is responsible for the management of the construction site and control of construction activities throughout the period of works, with particular attention to reducing the impact of the construction work on the public, adjacent and nearby properties and other areas of the site not part of the works. The primary objective is to eliminate the impacts of the temporary and permanent works having regard to:

(a) work health and safety;

(b) erosion control;

(c) acid sulphate soils;

(d) run-off;

(e) traffic management;

(f) disposal of all materials;

(g) gaseous discharges and odour;

(h) noise; and

(i) dust.

Adjacent waterways shall be regularly monitored for turbidity plumes, algal blooms and dead marine life which may be attributable to the construction of the works.

(11) Erosion and sediment control

During the construction phase and up until council accepts the development works or at the end of the defect liability period the contractor shall be responsible for the installation and maintenance of all erosion and sediment control measures on site.

The approved erosion and sediment control plan (ESCP) submitted as part of the operational works or compliance application must be presented during the pre-start meeting. This plan must be presented to council's nominated representative for review and "fit-for-purpose" implementation on the site. If the ESCP requires revision to suit the current conditions of the development site, the plan must be amended to achieve the approved set of water quality outcomes required by council. Upon approval of the ESCP, the procedures

and guidelines outlined in the plan for establishing, managing (inspection and monitoring) and maintaining water quality across the development site shall be the responsibility of the contractor.

At the end of the agreed period of implementation and maintenance, all identified temporary sediment control measures must be removed by the developer and the ground reinstated to council's satisfaction.

(12) Suppression of dust
At all times the Contractor shall ensure that dust resulting from the proposed works, including excavation, backfilling, grading and stockpiles is kept to an absolute minimum and to the satisfaction of council, by approved methods.

(13) Noise control
All construction work is to be undertaken pursuant to the *Environmental Protection (Noise) Policy (EPP (Noise))*. Construction works shall be carried out in accordance with the requirements and restrictions relating to hours of work specified in SC6.4.5.2.1(2); and the *Environmental Protection Act 1994*.

(14) Hazardous material
Hazardous materials are to be stored in a hazardous goods store such that it is free from flood and storm tide inundation. The hazardous goods store must ensure that materials cannot enter the environment or cause a public safety nuisance or hazard. Hazardous goods may only be kept on site for the duration of construction and are to be safely removed from site at completion of works, unless otherwise approved by council.

(15) Machinery refuelling
During construction, fuel and petroleum products shall not be stored on the site nor shall construction equipment and machinery be serviced on the site. Procedures shall be developed and implemented by the contractor for the refuelling of machinery and equipment which will minimise any potential for contamination of the site by way of spillage. The procedures shall ensure that refuelling on the site occurs within a designated area that does not drain directly into adjacent stormwater systems or waterways. Any procedures developed and implemented in this regard must include bunding of the refuelling area.

Any spillage of fuels and petroleum products during construction shall be reported to the superintendent. All steps necessary to rectify the contamination shall be undertaken by the contractor prior to the completion of the works and at no cost to council.

(16) Material storage
Materials shall not be stored on site unless approved in writing by the Superintendent or unless material storage details are shown on the drawings and approved by council.

All necessary measures shall be implemented to reduce the potential for environmental damage, which may arise from the storage of materials.

(17) Stockpiling of materials
Wherever possible, materials shall be installed directly in place or continually removed from site, eliminating the need for stockpiles. In all other cases, stockpiling of materials shall be on a temporary basis at the discretion of superintendent.

The location of approved stockpiles shall be in accordance with the ESCP and as a minimum stockpiles shall:

(a) Remain on site for as little time as practical;

(b) Be limited to a height of 2m;

(c) Not to be located within 10m of a residential boundary;

(d) Have batter slopes, covers and drainage which limit the potential for erosion and/or segregation;

(e) Be managed in accordance with SC6.4.5.2 Attachment B;

(f) The contractor is to erect and maintain a temporary sediment fence around all stockpiles for the duration

of the stockpile being on the site.

(18) Vegetation disposal

Burning or burying of waste vegetation on site is not permitted unless otherwise approved by council. Clearing and grubbing of the development site shall otherwise be undertaken in accordance with SC6.4.6.11 Clearing and grubbing.

(19) Work adjacent to trees and protection of environmentally significant vegetation

(a) Protection of trees and vegetation – general

All existing and newly planted trees and vegetation should be noted on the drawings and protected from damage during construction. The approved vegetation protection plan should be available onsite prior to commencement and during works. The vegetation protection plan will identify key stages where monitoring and certification will be required.

As specified in the vegetation protection plan, a vegetation protection zone must be established on site to ensure the required retention of existing trees and vegetation identified for protection and retention. The vegetation protection zones must be identified as *"no-go"* areas for construction traffic and meet the following requirements:

(i) For trees, the extent of the vegetation protection zone is to be determined in accordance with the tree protection zone (TPZ) requirements of AS 4970 - *Protection of trees on development sites.*

(ii) For areas of vegetation not including trees, other areas of natural heritage or hydrologically sensitive features, the extent of the Vegetation Protection Zone is to be determined by a qualified arborist, ecologist, or other approved officer.

(iii) The Vegetation Protection Zone is to be fenced or barricaded to prevent unauthorised vehicle and machinery access, as per AS4970 *Protection of trees on development sites* and AS4687 *Temporary Fencing and Hoardings*.

(iv) Signage to indicate "Vegetation Protection Zone - No Access" should be installed as per AS4970 *Protection of trees on development sites* and AS1319 *Safety signs for the occupational environment*.

(v) Where required, the tree bark is to be protected by wrapping a triple layer of hessian or rubber matting around the tree trunk.

(vi) Fixing of temporary service wires, nails, screws, stays, guys and or any other fixing device to trees should be avoided.

(vii) No fuel, oil dumps or chemicals are allowed to be used or stored within the Vegetation protection zone and the servicing or re-fuelling of equipment and vehicles must be carried out away from the vegetation protection zones.

(viii) Deposition of wind-blown materials (such as cement) into the protection area should be avoided through the attaching of cloth to the Vegetation Protection Zone fencing.

(ix) Soil compaction and removal of top soil within the Vegetation Protection Zone is to be avoided. Where compaction occurs, hand methods to de-compact the soil should be used.

(x) No vehicles are to access or be parked within the Vegetation Protection Zone. Where traffic is unavoidable within the zone, a 300 mm thick layer of mulch over a geotextile fabric should be placed in the area to protect the trees surface roots and to reduce the risk of soil compaction.

(xi) No storage of material, equipment or temporary building is to take place within the Vegetation Protection Zone, including the placing of spoil from excavation against tree trunks.

(b) Fill and excavation near trees and vegetation

(i) Any underground service installations within the Vegetation protection zone must be bored and the utility authorities must utilise a common trench where possible. Where practical, trenching is to be combined with locations where roots need to be severed for other reasons.

(ii) Within the Vegetation protection zone, all excavation must be carried out by hand digging or with the use of "air-excavation" techniques.

(iii) Where required, trees roots or branches are to be cut cleanly without tearing, with clean, sharp tools (chainsaw, secateurs or hand saw) in accordance with the AS 4373 *Pruning of Amenity Trees* and under the supervision of a qualified arborist with formal qualifications (Level 3 Australian Qualification Framework) or at least 5 years recognised experience in arboriculture.

(iv) Cutting of tree roots exceeding 50 mm in diameter should be avoided. Where roots must be cut, this should not unduly disturb the remaining root system.

(v) Any ripped or torn roots are cleanly re-cut as soon as noted.

(vi) Roots to be left exposed for any period of time are covered with wet hessian and maintained in a moist condition until recovered.

(vii) Immediately after cutting of any roots, Copper Naphthanate or an equivalent alternative solution is to be applied to the cut surface to prevent the incursion of rot or disease - as deemed necessary.

(viii) Backfill to excavations around tree roots should be with a soil mix similar in consistency and pH value to that of the existing soil.

(ix) Backfill should be placed in layers of 300 mm loose depth and be compacted to a dry density similar to that of the original surrounding soil using hand methods or light compaction equipment.

(x) Backfill layers should generally match the soil horizon of the surrounding soil.

(xi) The depth of fill within the vegetation protection zone should not exceed 200 mm from the original surface level. Immediately after placing any fill around a tree, the area should be watered thoroughly.

(c) Trees to be transplanted

(i) Trees to be transplanted shall be noted on the drawings and/or shall be marked on site by the superintendent prior to the commencement of construction.

(ii) Requirements and procedures for transplanting of trees are to be issued by council for each particular species.

(d) Damage to tree or vegetation

(i) Any unauthorised removal, damage or disturbance undertaken prior to the identification of the protected zone/s (without the required approval) or within the identified protected zone/s shall be rehabilitated by the contractor to the satisfaction of council and at no cost to council.

(ii) In the event of an unauthorised removal and that rectification works to damaged tree/s or vegetation is impractical, or the rectification work has been carried out by the contractor and is rejected by council, then council may direct the contractor to remove the trees/vegetation as part of the rectification work. The contractor will:

(A) replace the damaged tree/vegetation with a tree/vegetation of the same species and similar size to council's satisfaction; or

(B) replace the damaged tree/vegetation with a tree/vegetation of a similar size but different species to council's satisfaction; or

(C) pay for the cost of replacing the tree/vegetation with the same size and species to council's satisfaction; or

(D) replace the damaged tree/vegetation with a smaller tree/vegetation of an approved species and pay for the difference in cost between the new replacement and a specimen of the same size and species, to council's satisfaction.

(iii) The replacement value of an existing tree/vegetation will be calculated using the Revised Burnley Method under the Draft Australian Standard DR99307 *Amenity Trees – Guide to Valuation system*.

(20) Stormwater quality

Development works may cause changes to the quality, quantity and flow rate of stormwater discharged from the site. During the construction phase where soil disturbance and construction activity significantly increases the risk of soil erosion or where the development is required to implement a Stormwater Quality Management Plan (SQMP) that has been approved during the operational works approval phase. Council will then require a detailed maintenance regime to control stormwater quality during the construction phase to be presented during the pre-start meeting for review and acceptance by council unless a detailed maintenance regime has

been presented and accepted by council during the design process.

If the development works involves construction of stormwater quality device/s or is part a catchment with an existing stormwater quality device, then the developer and his contractor must ensure that no stormwater discharge will be permitted to enter such device (directly or indirectly) unless otherwise permitted by council. Refer to SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

Any temporary stormwater quality device proposed as part of the development works is to be removed and any land or existing infrastructure disturbed or damaged during the installation of any temporary stormwater quality device shall be reinstated to its former condition to the satisfaction and at no cost to council.

(21) Insurance and indemnity

From the commencement of construction until council accepts the development works or the commencement of the maintenance period, the developer or contractor must insure the works against public liability ($10 million dollar minimum cover) and other claims arising from the works, and indemnify council against that liability. Council must be included as an interested party to the insurance policy. The developer must provide council with evidence and a certificate of currency for the insurance and indemnification before commencing the construction works.

(22) Dilapidation survey

Where required by council and where development is directly adjacent to existing infrastructure and improvements, it may be prudent for the developer or his contractor to carry out a dilapidation survey of all the existing adjoining structures prior to construction commencing. This may reduce any damage claims during the construction period. Any damages to adjacent structures as a result of the development works shall be the responsibility of the developer.

(23) Fencing

While undertaking development works, and where appropriate, site fencing is to be erected for the duration of construction activities. Fencing is required to restrict unauthorised site access and to ensure the safety of persons from the subject site and any works on the adjoining road reserve and/or premises.

If existing fencing is to be altered or if there is no existing site fencing, temporary fencing, as a minimum, shall be provided and maintained for the duration of the construction to prevent unauthorised entry into the property or work area from any adjoining road reserve or property. The reinstatement of fencing and removal of temporary fencing on completion of the work shall be undertaken.

A construction site may provide any additional amount of security and/or fencing that is considered necessary that will improve the safety of the public or persons working on the site.

(24) Environment

All work shall be carried out in such a manner as to avoid nuisance and/or Environmental Harm. Development shall be planned and executed so that the works undertaken avoid contamination of the site and its surroundings by taking all reasonable and practical measures to prevent or minimise harm (general environmental duty).

Herbicides and other toxic chemicals shall not be used on the site without the prior written approval of the council or other relevant authority.

(25) Lighting

All lighting associated with the construction activity shall be installed and used so that lighting does not adversely affect the adjoining amenity of nearby sensitive uses, sensitive environmental areas or pose a safety hazard on adjacent road networks. All public road/street lighting systems must be designed in accordance with AS 1158 and must be approved by Ergon prior to construction.

(26) Blasting

Blasting will generally not be permitted. If blasting is necessary and there are no alternatives, it shall be carried out strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual.

(27) Vibration

Ground vibration levels, transmitted from the construction works, rock breaking, drilling, and piling, operating items of plant or other noisy activities shall not exceed levels that are close to the lower level of human perception nor is it to cause any unacceptable damage to any adjoining buildings or infrastructure. Acceptable practices and vibration thresholds shall be determined in accordance with current Statutory Regulations.

Acceptable practices and vibration thresholds shall be determined in accordance with current Statutory Regulations.

A complaints management system should be devised which includes corrective and preventative actions. Consultation with and information supplied to nearby residents, workers and any other sensitive noise receptors is to be undertaken when vibration is known to be generated and is considered sufficient to warrant notification.

Editor's note—the results and recommendations of reporting on noise and vibration, as detailed in SC6.4.3.15 Noise and vibration assessment guidelines, associated with a particular development will be required to be implemented.

Editor's note—the Contractor shall be responsible for any damage and compensation payments as a result of vibration.

The control of ground vibration as a result of blasting shall be strictly in accordance with SC6.4.6.10 Earthworks (construction) and any other relevant construction specifications found in SC6.4.6 of the Development manual and will be solely at the risk and responsibility of the developer.

SC6.4.5.3 Quality management system

(1) Townsville City Council requires an emphasis on quality for the development works being delivered by developers. Where a condition for the approval of the development works requires the works to be completed as a "Quality Controlled and Assured Development", the developer must engage consultants and contractors with the necessary level of Quality Assurance accreditation to undertake and certify the development works.

(2) Quality management system – It is a requirement for a "Quality Controlled and Assured Development Contract" that the contractor shall plan, develop and maintain a documented Quality System in accordance with this section and the current requirements of AS/NZS ISO 9001.

(a) Quality manual
This is a document setting out the general quality policies, procedures and practices of an organisation. The development of this document shall cover and include the requirements as specified in the Quality System Documentation section of AS/NZS 3905.12 with guidance to preparation by AS/NZS ISO 10013. Additionally, it must include standard method statements and inspection and test plans for the activities undertaken by the Contractor. The following details shall be provided by appropriate annexures to the Company Quality Manual:

(i) Organisational Structure – this provides information regarding the management structure of the project with details of the specific responsibilities and authorities of the nominated personnel, which includes but is not limited to:

(A) a project quality management representative – is appointed by the Contractor for a specific project with the authority and responsibility for the implementation and operation of the quality plan, to ensure that Quality System requirements are not subordinated to design and productivity. Details of this person's qualifications, technical experience and present position are also to be provided;

(B) the contracted testing organisation – details of the personnel who will be conducting each type of compliance inspection of testing; and

(C) the person authorised to change construction processes on site; and

(ii) Register of Method Statements – the register shall list all Method Statements that are to be included in the project quality plan for the development contract and shall include any suitable method statements already incorporated in the Company Quality Manual.

(b) Project quality plan
The Quality System as expressed in the project quality plan shall be used throughout the course of the construction to ensure that the quality of the Contractor's and any sub contractor's work complies with all the requirements under this section. The Company Quality Manual, method statements and checklists and other project specific components shall make up the Project Quality Plan. The project quality plan must generally conform to the recommendations of AS/NZS ISO 10006. A concept illustration is shown in Figure SC6.4.5.3.1 Project quality management system documentation.

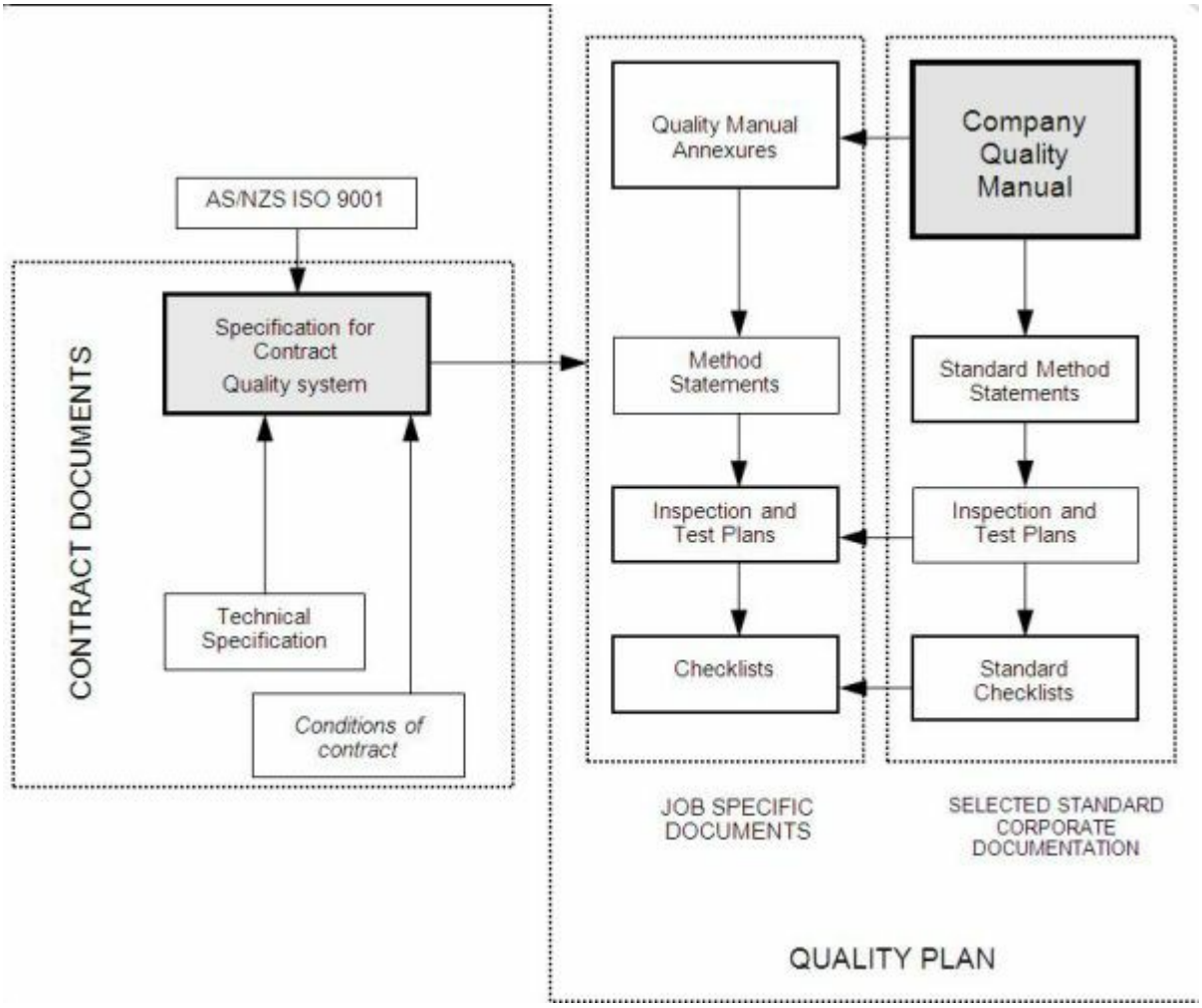


Figure SC6.4.5.3.1 Project quality management system documentation

(3) Where a "Quality Controlled and Assured Development" is not a requirement, a quality plan is not therefore required to be provided but it will be necessary as a minimum requirement that:

(a) the nominated Superintendent or Consultant are suitably and appropriately qualified and experienced;

(b) a work quality plan must be submitted to council for review and acceptance prior the pre-start meeting or commencement of works. The work plan must outline a program of inspection and testing regime that will ensure an adequate control of the progress and correctness of the work in accordance with the accepted design plans and specification;

(c) upon completion of the development works and prior to council accepting the completed development works, all records as required on the work quality plan must be submitted to council to demonstrate compliance with the accepted work quality plan; and

(d) the full cost of all required testing as per the work plan shall be the responsibility of the developer or the contractor. These tests are required to ensure that the materials and the works that were carried out conform to the accepted design specification and standard.

(4) Quality management system procedures

(a) Quality control system

(i) Lots

All items of work shall be subdivided into lots. Each lot shall be given a unique lot number and shall be chosen by the Contractor but must be within the limits given in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies. In general, the size of the lot shall not exceed one day's output for each work process designated for lot testing.

The lot numbers shall be used as identifiers on all surveys and test results. The Contractor shall determine the bounds of each lot before sampling and shall identify each lot clearly. The

boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous.

The lot identification system and sample numbering system shall allow test results to be positively identified with material incorporated in the works.

(ii) Sampling and testing
All compliance inspections and tests shall be based on lots. The maximum lot sizes and minimum testing frequencies are listed in the Attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies.

Where no minimum frequency of testing, or maximum lot size is stated in the sub-section, the Contractor shall nominate appropriate frequencies for the Superintendent's approval. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or sub-section, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the sub-section.

Where test methods are nominated in the sub-section, sampling and testing shall be carried out by a (NATA) National Association of Testing Authorities registered laboratory accredited for those test methods and sampling procedures. Sampling shall be conducted by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and shall be supervised by the approved signatory from that laboratory. Test results shall be reported on NATA endorsed test documentation which shall include a statement by the approved signatory certifying that the correct sampling procedures have been followed.

Random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B Random sampling defines the method to be used for determining test locations of random sampling in each lot. For quality control of processes other than compaction of layers of earthworks, flexible pavement and asphalt, the sampling locations will be proposed by the Contractor and will require the approval of the Superintendent. All samples shall be each considered to be representative of the lot and all test results will be required to meet the appropriate tolerances for the lot.

The latest NATA advice of the terms of registration and current signatories for the laboratories are to be included within the quality plan shall which will be providing the compliance test reports.

The NATA registered laboratory must provide inspection, testing and measuring equipment capable of producing the precision and/or degree of accuracy specified in the referenced test methods and this shall be made available by providing evidence or records of calibration.

(iii) Surveying
The Contractor shall engage qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all Surveying Control.

(iv) Surveying Control shall include all measurement, calculation and record procedures necessary to:

(A) set out the works;

(B) verify conformance to the drawings and sub-section in relation to dimensions, tolerances and three dimensional position; and

(C) determine lengths, areas or volumes of materials or products, where required for measurement of work.

The procedures and equipment used must be capable of attaining the tolerances required in the relevant construction specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report to the Superintendent for each lot or

component where design levels, position and/or tolerances have been specified. The report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

(v) Records and quality control documentation
Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall submit all conformance records to the Superintendent for inspection and approval. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the Developer.

The Contractor shall maintain a quality register which contains all quality control records such as test results, completed check lists, certificates of compliance, and consignment dockets for materials procured.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council through the Superintendent a copy of the quality register and other required quality control documents as required in this section.

(5) Quality assurance system – is the management of actions covering planning, quality control testing, inspection and verification procedures integrated with production to provide a product fit for the purpose.

(a) Inspection and test plan (ITP) is the document which identifies the specific inspections and tests required to be carried out for on development works including hold points. The ITP is to be prepared by an appropriately experienced consultant identifying specific inspections and tests to be carried out for each item of development works. Refer to council’s minimum ITP requirement on SC6.4.5.3 Attachment D Minimum inspection and test plan.

As a minimum, the inspection and test plans must contain the following information:

- lot references;
- activity description;
- specification requirements (if not provided, referenced specification);
- sampling methodology;
- test frequency and method; and
- identify responsibilities for inspection and testing and approval.

The superintendent shall audit the contractor’s work on a regular basis and provide sufficient site presence and in particular at inspection points identified in the Inspection and testing plan as set out in the construction schedules and agreed to and accepted by council. Inspections by council shall not in any way diminish the responsibility of the consultant and the superintendent to adequately audit the works. Auditing shall include regular site inspections which will be conducted with the presence of the contractor’s representative to confirm acceptability of works as complying with the design intent and other council requirements.

Inspection and test plans will typically have an associated check list which shall require completion for each particular lot. Prior to council’s acceptance of completed development works all documentation relating to compliance to the agreed and accepted ITP are to be submitted by the Contractor and/or the Superintendent which will form part of the Consultants’ certification that the works have been carried out and inspected in accordance with the agreed and accepted ITP.

(A) Inspections
The contractor shall ensure that any particular stage of work to be inspected has been satisfactorily completed before requesting an inspection by the superintendent and/or council. A minimum of 24 hours’ notice (except for off maintenance inspection which requires a minimum of 7 days) is required to enable arrangements to be made for an

inspection. Responses to the requests within the prescribed minimums are not guaranteed, although every effort will be made by council to accommodate request where possible. All council required inspections must be carried out Monday to Friday unless other arrangements have been agreed.

Incoming inspections shall be required for deliveries of materials that will be subsequently included in one or more lots. When completing check lists for particular lots the inspection status shall be cited.

In-process and compliance inspections shall be completed by a responsible officer nominated in the check list and certified by the Contractor's Quality Management Register (QMR) indicating that the work has been completed in accordance with the contract documents.

The Contractor shall establish and maintain a system to ensure and demonstrate that all products or parts of products requiring inspection and/or testing are so inspected and/or tested. The Contractor shall also establish and maintain a system for identifying the inspection status for all lots of work.

(B) Hold points and witness points

To assure compliance with the specified standards and requirements, mandatory hold points shall apply. Hold points are those stages during the construction/manufacturing process where the technical specifications require "approval by the Superintendent" or where a non-conformance report (NCR) or notice of non-conformance (NNC) has been issued. The Contractor shall not proceed past the hold point until approval has been received from the Superintendent to proceed. For ease of identification hold points may also be annotated on the margins of technical specifications.

To obtain the approval to proceed from the Superintendent, the Contractor shall:

- provide the information required by the technical specifications;
- ensure and certify that the particular lot/process is conforming;
- ensure and certify that all underlying and adjacent lots affected by the lot in question are conforming; and
- submit the appropriate form (check list, NCR or NNC) at least 24 hours prior to the time the Contractor wishes to proceed with the placement/construction of the next lot, unless some alternative arrangements have been agreed with the Superintendent.

If the hold point has resulted from a NCR or NNC, the Superintendent's approval may be conditional on a witness point being included.

(b) Quality assurance activities

(A) Document control

In addition to the requirements of AS/NZS ISO 9001 and AS/NZS 3905.2, the quality plan shall specify the method of keeping quality registers, tracking and handling of NCRs, NCC, NNCs and other site correspondence.

(B) Method statements

A document that specifies the key steps and sequence in the manufacture/construction for an activity; what, how and by whom it shall be done; what materials and equipment shall be used to achieve the required quality standards.

Method statements shall be provided for all activities scheduled in SC6.4.5.3 Attachment C Method statement requirements. This requirement applies to both contract and subcontracted work. The documentation shall cover, as applicable, planning, methods, verification and control.

The presentation of method statements may be either descriptive, in the form of flow charts or a combination of both. In either case it must be accompanied by a check list which shall include the

relevant inspection and test points, surveying control points and Hold Points and the officer responsible to verify each check point.

A system audit of each method statement shall be carried out by the Contractor whilst the process is in effect. In the absence of a method statement for activities where it has been specified, this will automatically create a hold point.

(C) Identification of lots and traceability

All items of work shall be subdivided into lots. Lots shall be chosen by the Contractor but shall be within the limits given in SC6.4.5.3 Attachment A. lot numbers are to be used as identifiers on all quality system data. Each lot shall be given a unique lot number. The allocation of lot numbers shall be carried out by the Contractor specific to each item of work and provides a lot numbering system which conforms to these requirements:

The Quality Register must contain records of lot number which provides information such as:

- location of the lot (e.g. start and end chainage, layer and lateral location or a particular structure);
- note regarding conformance/non-conformance (e.g. NCR, CPAR Registers); and
- table of test results (summary) and their respective locations and numerical identification.

In cases where non-conforming lots are identified, a new identification number shall be allocated to the resubmitted documentation, but reference to the original lot number must be included.

The Contractor is responsible in determining the bounds of each lot before sampling and shall physically identify each lot clearly. The physical identification of a lot shall be maintained until the Contractor has ensured that the lot has achieved the specified quality.

To ensure all site personnel can readily identify where the particular lots are in the field, the Contractor shall implement a field identification system which will clearly identify the bounds of each lot and the lot number. This identification system shall be detailed in the quality plan and shall be maintained during all stages of construction of the lot.

The boundaries of a lot may be changed if subsequent events cause the original lot to be no longer essentially homogeneous. This will require appropriate notation in the Quality Register by the QMR.

The lot identification system, site records and sample numbering system shall allow test results to be positively identified with material incorporated in the works. Traceability is required for concrete loads, asphalt loads and steel plate as follows:

- concrete used in bridge components, cast-in-place box culverts, retaining walls, road pavement sub base and base. Asphalt used in wearing courses, intermediate courses and drainage layers;
- the trace shall start at the batch plant and finish at the location where the concrete or asphalt is incorporated in the Works. Records shall be kept of the batch quantities, mix and despatch time, testing details and location of placement; and
- steel plate in bridge girders and bridge columns. The trace shall start at the steelworks and finish at the location of the plate in the girder or column. Records shall be kept of the steel heat number, testing details and location of the plate in the girder or column.

(D) Surveying control

Surveying control shall be treated as a separate system element and shall include all measurement, calculation and record procedures necessary to:

- set out the Works;
- verify conformance to the drawings and specification in relation to dimensions, tolerances and three dimensional position; and
- determine lengths, areas or volumes of materials or products, where required for

measurement of work.

The method statements for surveying control shall address the process control parameters in AS/NZS 3905.2 for special processes which cannot be fully verified by subsequent inspection and test.

The Contractor shall appoint qualified surveyors who are eligible for membership of the Institution of Surveyors, Australia or the Institution of Engineering and Mining Surveyors, Australia to supervise and take responsibility for all surveying control.

The procedures and equipment used must be capable of attaining the tolerances nominated in the specification. Sampling for conformance verification purposes shall not be restricted to the locations used to set out the Works.

The Contractor shall submit a survey conformance report for each lot or component where design levels, position and/or tolerances have been specified.

The survey conformance report shall show “specified vs. actual” for position (defined by co-ordinates or chainage and offset), level and tolerance as appropriate and shall be certified by the qualified surveyor responsible for the verification survey.

Where work is to be covered up after conformance has been achieved, a hold point shall apply until the survey conformance report has been submitted.

All survey records shall be included in the quality records and recorded in the quality register. Verification field book pages shall be clearly labelled, dated and signed by the surveyor with cross indexed references to equipment used lot/component identification and associated survey conformance reports. Where automatic data recording systems are used for verification surveys, a printout of both raw (field) data and reduced data shall be retained in a similar manner as conventional field books.

(E) Sampling and testing

The inspection and test plans shall include details of the sampling methods. Sampling shall not be restricted to locations dimensioned or otherwise defined for setting out the works in the drawings or specification, but shall be undertaken in a random or unbiased manner, as approved by the Superintendent, at any location within the works to demonstrate its compliance with the specification.

The maximum lot sizes and minimum testing frequencies are listed in the attachments to the relevant sub-sections and/or in SC6.4.5.3 Attachment A to this sub-section. Where no minimum frequency of testing, or maximum lot size is stated in the specification, the inspection and test plan(s) shall nominate appropriate frequencies for the Superintendent's approval.

The inspection and test plans shall also uphold any time limits for testing which may be imposed by the specifications. The responsibility for completion of inspections, tests and documentation shall be stated in the quality plan.

Statistical techniques - random sampling techniques shall be used for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt. SC6.4.5.3 Attachment B defines the method to be used for determining test locations of random sampling in each lot. SC6.4.5.3 Attachment A lists the maximum lot sizes and minimum test frequencies for the specified activities.

For compaction control of processes other than layers of earthworks, flexible pavement and asphalt, the sampling procedure will be proposed by the Contractor in his method statement and will require the approval of the Superintendent. In such cases the samples shall be each considered to be representative and all test results will be required to meet the appropriate

tolerances for the lot.

Every testing agency or person providing written test reports for any and all testing undertaken shall use unique consecutive project specific serial numbering of the reports for identification and auditing purposes.

The Contractor shall reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity. The reinstatement shall be to a standard which is at least equal to the specified requirements for the particular work.

(F) Records and quality assurance documentation

The Contractor shall keep and maintain all Quality System records in a Quality Register as required by AS/NZS ISO 9001, AS/NZS 3905.2 and this sub-section. They shall be systematically recorded, indexed and filed so as to be retrievable and accessible to the Superintendent or an appointed Quality Auditor on a job basis within 1 working day of requisition.

Conformance records shall be stored and maintained such that they are readily retrievable and in facilities that provide a suitable environment to minimise deterioration or damage and to prevent loss.

The Contractor shall make the quality records available to the Superintendent at all reasonable times. If requested by the Superintendent, the Contractor shall provide copies of the records or test results at no cost to the developer.

Prior to achieving practical completion or the commencement of the defects liability period or prior to acceptance of work as “Finally Complete”, the Contractor shall provide council, through the Superintendent, a copy of the quality register and other required quality assurance documents as required in this section.

(G) Non-conformance

In circumstances where there is a concern about workmanship, construction methodology or materials (e.g. variation to the approved work specification), council’s representative and/or Superintendent may require the Consultant and/ or contractor respectively to provide a non-conformance certificate (NCC) (template provided at SC6.4.5.3 Attachment E Non-conformance certificate template). The NCC will be required to be endorsed by the relevant design Consultant. A non-conformance report (NCR) (template provided at SC6.4.5.3 Attachment F Non-conformance report template) is required to be issued by the Contractor addressing intended variations to approved specifications, work method statements or standards by providing proposed disposition.

In the event that the above has not been satisfied and to ensure compliance with the required standards, Superintendent and/or council may issue a Notice of Non-Conformance (NNC) (template provided at SC6.4.5.3 Attachment G Notice of non-conformance template) to the Contractor. The NNC shall be issued within 1 working day of the non-conformance being identified during an inspection or during scheduled audit inspections, i.e. hold points and witness points. Upon issuance of the NNC, the Contractor must not continue the particular work in question unless an appropriate disposition (to be provided within five working days from issuance of the corrective and preventive action request (CPAR)) has been provided and agreed in accordance with the CPAR (template provided on SC6.4.5.3 Attachment H Corrective and preventative action request template). This is to be undertaken by the Contractor if the NNC identifies non-conforming work which has been provided by the relevant design or construction consultant (Superintendent). Similarly, for council initiated NNC, work shall commence upon council’s acceptance of the proposed disposition in accordance with the CPAR. To avoid recurrence of non-conformance issues, all CPARs shall require joint sign off by the Contractor and Superintendent, and council for a council issued NNC. This procedure will require the Contractor to record the CPAR on the relevant issued NNC. Under no circumstances will the deliberation on the disposition of a non-conformance issue be used to justify delays to the construction schedule/period.

The Contractor shall advise the Superintendent in the NCR of the proposed disposition of the particular non-conformance. This proposed disposition will constitute corrective action for the lot or lots referred to in the NCR and may comprise one of the following:

- propose additional works to bring the lot up to the specified standard; or
- replace all or part of the lot to bring it up to the specified standard; or
- request utilisation of a lot for a reduced level of service if such a clause exists in the relevant technical specification; or
- for incidental defects, request that the Superintendent accept the lot without alteration as an exception with or without alteration to the respective unit rates.

Any proposed disposition shall be subject to the approval of the Superintendent. Reworked/replaced lots shall be verified to conform to the specified requirements.

The contractor shall establish a suitable numbering and registration system for all NCRs and NNCs. All non-conformance reports and relevant documentation are required to be submitted to council prior acceptance of development works, to ensure that all departure from the originally accepted requirement and appropriate disposition has been done in accordance with the agreed CPAR.

A process flow diagram of the above processes is shown on Figure SC6.4.5.3.2.

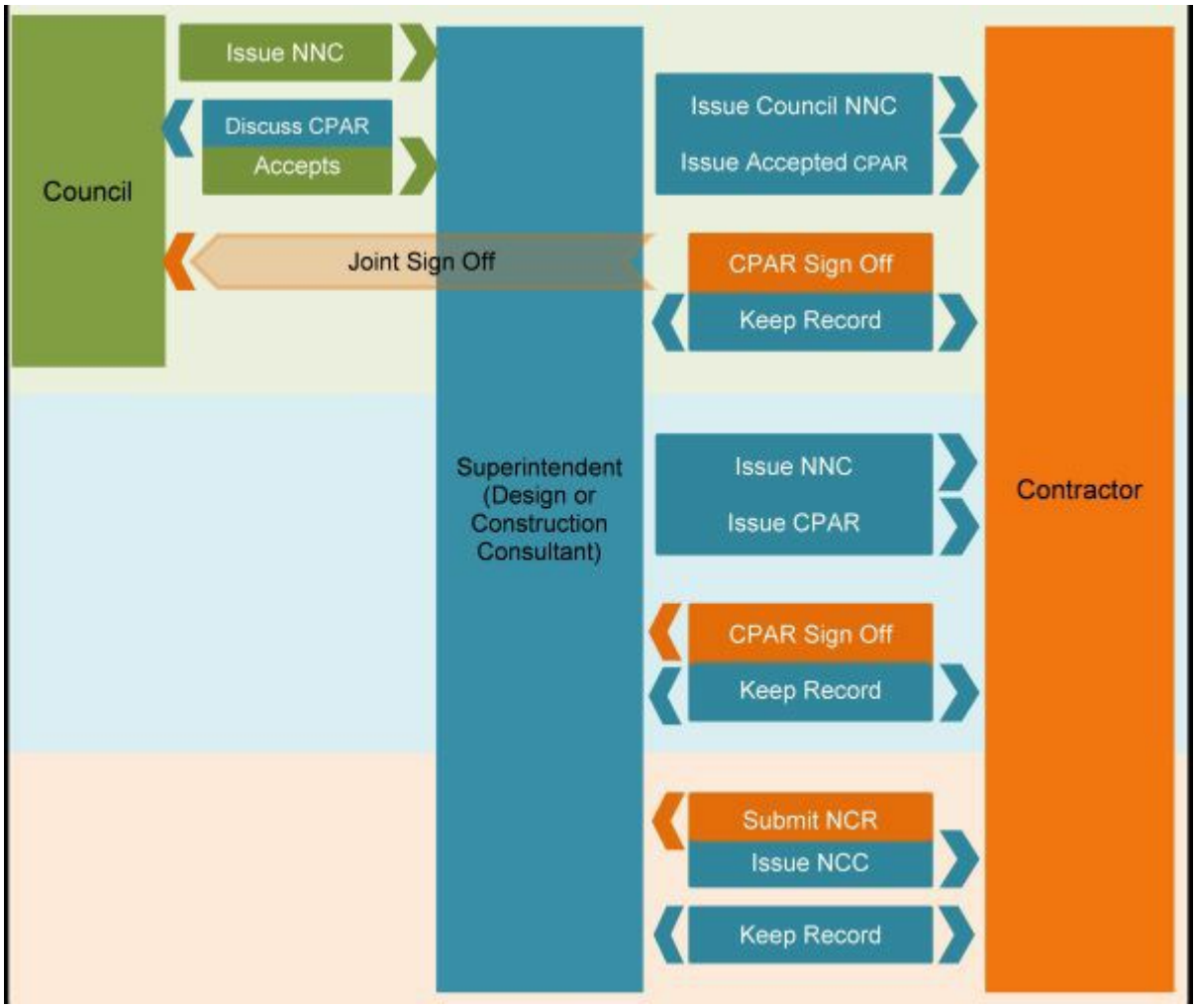


Figure SC6.4.5.3.2 Non-conformance flow diagram

(H) Inspection fees

A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the development works being accepted by council at on maintenance or final completion.

SC6.4.5.3 Attachment A Maximum lot sizes and minimum test frequencies

General

Where material/product quality certification can be obtained from the supplier, tests listed per contract/separable part need not be repeated and where no Queensland Department of Transport and Main Roads (DTMR) Test Methods are available, Australian Standards or NSW Roads and Traffic Authority (RTA) Test Methods are specified.

Table SC6.4.5.3.1 Earthworks (SC6.4.6.10)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Stripping Topsoil	Surface Levels	10,000m2	1 Cross Section per 25m	Survey
Excavation	Geometry	10,000m2	1 Cross Section per 25m	Survey
Floor of Cuttings	Material Quality—CBR	5,000m2	1 per 1,000m2* or Material Type	AS1289.6.1.1 DTMR Materials Testing Manual
	Compaction	10,000m2	1 per 500m2	AS1289.5.4.1
Deflection Control	Benkelman Beam Deflection or Equivalent	Per days production	4 per 1000 m2 or minimum 10 per lot	DTMR Materials Testing Manual
	No visible vertical movement under proof roll	One layer 5,000m2 or max 1 day's placement	Whole area	Visual
Foundation for Embankments	Compaction	5,000m2	1 per 500m2	AS1289.5.4.1
Embankments				
• General	Geometry	One layer 10,000m2	1 Cross Section per 25m	Survey
	Material Quality - CBR	One layer 5,000m2	1 per 800m3 or Material Type	AS1289.6.1.1
	Compaction/Moisture Content	One layer 5,000m2	1 per 250m3	AS1289.5.1.1 AS1289.5.4.1 AS1289.5.7.1
Road Carriageway Embankments				
• Select Zone	Geometry	One layer 10,000m2	1 Cross Section per 25m	Survey
	Material Quality			
	• Maximum Particle Size	10,000m2	1 per 1,000m3*	AS1289.6.1.1
	• CBR	10,000m2	1 per 500m3* or Material Type	
	Compaction/Moisture Content	One layer 5,000m2	1 per 500m2	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

Fill Adjacent to Structures: Bridges, Retaining Walls and Cast-in-Situ Culverts	Material Quality			
	• Maximum Particle Size	1 Structure	1 per 200m3	AS1289.3.3.1 AS1141.11
	• Plasticity Index	1 Structure	1 per 200m3	AS1289.3.3.1
	Compaction/Moisture Content	1 Structure	2 per lot	AS1289.5.1.1, AS1289.5.4.1 AS1289.5.7.1

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.2 Stormwater drainage (SC6.4.6.4), Drainage structures (SC6.4.6.5), Pipe drainage (SC6.4.6.6), Precast box culverts (SC6.4.6.7) and Open drains (SC6.4.6.9)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Supply of Precast Units	Precast Quality— Suppliers documentary evidence and certification	1 batch	1 per type/size/class per batch	
Siting and Excavation	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Foundation	Compaction	1 drainage line/structure	1 per 40 lin m*	AS1289.5.4.1, AS1289.5.7.1 Visual
Material surrounding Steel Structures	Material Quality • pH/Electrical Resistivity	1 drainage line/structure	1 per material	AS1289.4.3.1 AS1289.4.4.1
Bedding *(Bed, haunch, sides and overlay for HS type support)*	Material Quality • Particle Size Distribution	1 contract	1 per 200m3*	AS1141.11
	Compaction/Moisture Content	1 drainage line/structure	1 per layer, per 40 lin m	AS1289.5.7.1, AS1289.5.4.1
Concrete Bedding or Lining	Geometry		1 Cross Section per 25m	Survey and 3m Straight Edge
Installation of Precast Units	Geometry	1 drainage line/structure	1 per drainage line/structure	Survey
Selected Backfill *(Backfill, sides and overlay for non HS type support)*	Material Quality • Maximum Particle Size	1 contract	1 per 500m3*	
	• Plasticity Index	1 contract	1 per 500m3*	AS1289.3.3.1
	Compaction/Moisture Content	1 drainage line/structure	2 per lot	AS1289.5.7.1, AS1289.5.4.1
Rock Fill for Gabions/ Wire Mattresses	Material Quality:			
	• Wet Strength	1 contract	1 per contract	AS1141.22
	• Wet/Dry Strength Variation	1 contract	1 per contract	AS1141.22
Kerb and Gutter	Geometry	1,000 lin m	1 Cross Section per 25m and change of direction	Survey and 3m Straight Edge

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.3 Subsoil, foundation and pavement drains (SC6.4.6.20), Subsurface drainage (SC6.4.6.21), Drainage mats (SC6.4.6.8)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Material Supply	Material Quality—Supplier's documentary evidence and certification of:			
	Pipe	1 contract/size	1 per type/size	
	Filter Material			
	• Grading (Type A, B, C, D)	1 contract/size	1 per type	AS1141.11
	• Coefficient of Permeability (Type B)	1 contract/size	1 per type	AS1289.5.5.1 ASTM-D2434-68
	• Grading Variation after Treatment (Type B)	1 contract/size	1 per type	AS1141.11
	• Wet Strength (Type C, D)	1 contract/size	1 per type	AS1141.22
	• 10% Fines Wet/Dry (Type C, D)	1 contract/size	1 per type	AS1141.22
	• Appearance (Type D)	1 contract	1 per type	Table B1 Appendix B of AS2758.1
	Geotextile - Supplier's documentary evidence	1 contract	1 per type	AS3706 (Test) AS3705
Excavation - Trench Base	Line and Grade	1 drainage line	1 per drainage line	Survey
Bedding and Backfill				
• Filter Material	Geometry	1 drainage line	Visual	Survey
	Compaction	1 drainage line	1 per line	AS1289.5.6.1
• Selected Backfill	Geometry	1 drainage line	Visual	Survey
	Compaction	1 drainage line	1 per line	AS1289.4.1
• Earth Backfill	Geometry	1 drainage line	Visual	Survey
Drainage Mat	Geometry	2000m^2	1 Cross Section per 25m	Survey

Table SC6.4.5.3.4 Stabilisation (SC6.4.6.19)

Activity	Key quality verification requirements	Maximum lot size	Minimum test frequency	Test method
Material Supply	Material Quality - Supplier's documentary evidence and certification of (as per MRTS07A, MRTS07B, MRTS07C and MRTS08):			
	• Cement	1 contract	Type	AS3972
	• Quicklime			
	• Available Lime (CaO content)	1 contract	Type	AS3588.12
	• Slaking Rate	1 contract	1 per contract	T432
	• Particle Size Dist'n	1 contract	1 per contract	AS1141.11
	• Hydrated Lime			
	• Available Lime ($CaOH_2$)	1 contract	1 per contract	AS3583.12
	• Residue on Sieving	1 contract	1 per contract	AS3583.14
	• Ground Blast Furnace Slag	1 contract	1 per contract	AS3583.2
	• Flyash	1 contract	1 per contract	AS3583.1
	• Blended Stabilising Agent	1 contract	1 per contract	
	• Water			
	• Chloride ion content	1 contract	1 per contract	AS3583.13
	• Sulphate ion content	1 contract	1 per contract	AS1289.4.2.1
	• Undissolved solids	1 contract	1 per contract	
Mix Design	NATA certification - Supplier's documentary evidence and certification	1 mix	1 per mix	
Stationary Mixing Plant	Application rate of stabilising agent	1 day's production	1 per 100t	
	Unconfined Compressive strength of product	1 day's production	1 per 400t	AS5101.4
In-Situ Spreading	Spread rate	1 layer 1,000m^2	1 per lot or 1 per 500m^2	DTMR Materials Testing Manual
	Mix uniformity	1 layer 1,000m^2	1 per 500m^2	Visual
	Unconfined Compressive Strength of product	1 day's production	1 per 100t	AS5101.4

Trimming and Compaction	Geometry	1 layer 3,000m2, or 1day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m lane length*	3m Straight Edge
	Average Layer thickness	"	1 per lot	
	Average Width	"	1 per lot	Measure/Survey
	Compaction	1 layer 5000m2 or min. of 3 if less than 5000m2	1 per lot	As specified in SC6.4.6.19(5)

Note— or part thereof, per lot.

Table SC6.4.5.3.5 Flexible pavements (SC6.4.6.12)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Pavement Materials Supply	Material Quality - Supplier's documentary evidence and certification to meet MRTS05, MRTS07B and MRTS08 requirements - Type 2.1 for base, Type 2.3 for subbase and Type 2.4 for lower subbase.	1 contract		
	• Particle Size Distribution		1 per 1,000t	Q103A, AS1289.3.6.1
	• Fine and Particle Size Distribution Ratio			
	• Liquid Limit		1 per 1,000t	Q104A, Q104D
	• Plastic Limit		1 per 1,000t	Q105, AS1289.3.2.1
	• Plasticity Index		1 per 1,000t	Q105, AS1289.3.2.1
	California Bearing Ration (soaked)		1 per 5,000t	Q113A
	• Particle Shape		1 per 1,000t	Q201, AS1141.15
	• Ten Percent Fines Value (Wet)		1 per 5,000t	Q205B, AS1141.22
	• Wet/Dry Strength Variation		1 per 5,000t	Q205C, AS1141.22
	Degradation Factor (Source Rock)		1 per contract	Q208A, AS1141.25.1
	• Unconfined Compressive Strength (Standard Compaction)		1 per 5,000t	TCC-001, Q115, AS5101.4

	• Unconfined Compressive Strength (Bound/Modified)	1 contract	1 per mix design	Q115, AS5101.4
	Lime modified/Modified pavement materials	1 contract	1 per type	As specified in SC6.4.5.3.4 Stabilisation
Compaction Assessment	Geometry: Alignment and Level	One layer 2,000m2 or	1 Cross Section per 15m	Survey
	Width and Surface Trim	max 1 day's placement	10 per selected 200 lin m*	Measure and 3m Straight Edge
	Compaction/Moisture Content/	One layer 5,000m2 or	10 per 5,000m2 layer or	AS1289.5.1.1, Q142A,
	Dry Density Testing	max 1 day's placement	3 per lot if less	AS1289.5.4.1 AS1289.5.8.1
Deflection Control	Benkelman Beam Deflection or Equivalent	Per days production	4 per 1000 m2 or minimum 10 per lot	Q701
	No visible vertical movement under proof roll	One layer 5,000m2 or max 1 day's placement	Whole area	Visual

* **Note**—or part thereof, per lot.

Table SC6.4.5.3.6 Sprayed bituminous surfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Suppliers documentary evidence and certification of:			
	• Class 170 Bitumen	1 contract	1 per contract	MRTS.17
	• Refinery Cutback Bitumen	1 contract	1 per contract	MRTS.17
	• Polymer Modified Binder	1 contract	1 per contract	MRTS.18
	• Bitumen Adhesion Agent	1 contract	1 per contract	
	• Cutback Oils	1 contract	1 per contract	
	• Aggregate Precoating Agent	1 contract	1 per contract	
	• Aggregate	1 contract	1 per contract	MRTS.22
Application Rates	Binder	1 day's operation	Calculate per spray run	As per spray sheet
	Aggregate	1 day's operation	Calculate per spray run	As per spray sheet

Note— one per contract or change in material.

Table SC6.4.5.3.7 Asphaltic concrete (SC6.4.6.13)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	Coarse and Fine Aggregates			MRTS 30
	• Grading	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Moisture Content	1 wk's prod'n	1 per contract or material change	MRTS 30
	- Wet Strength	1 contract	1 per contract or material change	MRTS 30
	- Wet/Dry Strength Variation	1 contract	1 per contract or material change	MRTS 30
	- Particle Shape	1 contract	1 per contract or material change	MRTS 30
	- Fractured Faces	1 contract	1 per contract or material change	MRTS 30
	• Polishing Agg Friction Value	1 contract	1 per contract or material change	MRTS 30
	- Mineral Filler	1 contract or 1 month's production	1 per contract or material change	MRTS 30
	- Bitumen Binder	1 refinery batching	1 per contract or material change	MRTS 17
	Polymer Modified Bitumen			MRTS 18
	• Elasticity Recovery at 60ºC	1 production batch by supplier	1 per contract or material change	MRTS 30
	• Viscosity on ER at 60ºC			MRTS 30
	• Torsional Recovery at 25ºC			MRTS 30
	• Viscosity at 180ºC - Bitumen Adhesion Agent	1 contract	1 per contract or material change	MRTS 30
	• Resistance to Stripping			
	• Reclaimed Asphalt Pavement (RAP)	1 stockpile	1 per contract or material change	MRTS 30

	• Bitumen Emulsion	1 contract	1 per contract or material change	MRTS 21
Mix Design-Nominated Mix	Approval of mix and NATA certification. Supplier's documentary evidence and certification	1 mix per contract	1 per mix	
Production Mix	Temperature Moisture Content Grading Binder Content	1 per truck load SC6.4.6.13 Asphaltic concrete as included as separate table below. Additionally, max lot size one 12 hr shift's production.		Measure MRTS 30 MRTS 30 MRTS 30
Laying and Compaction	Temperature	1 day's laying per site	1 per truck load	Measure
	Levels	1 day's laying per site	1 cross section per 25m	Survey
	Shape	1 day's laying	10 per 200m* lane	3m Straight Edge
	Relative Compaction/Layer Thickness	1 day's laying	6 cores per lot or 10 nuclear density tests per lot	As per MRTS30 Compaction requirements or Nuclear Density Meter

Note—* or part thereof, per lot.

Table SC6.4.5.3.8 Minimum testing frequencies for asphalt production

Quantity of Asphalt in production lot	Minimum Frequency of Testing
Less than 100 tonnes	MRTS 30
101 to 300 tonnes	MRTS 30
301 to 600 tonnes	MRTS 30
Over 600 tonnes	MRTS 30

Table SC6.4.5.3.9 Ready-mixed concrete production and supply (SC6.4.6.14 and SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Raw Materials Supply	Material Quality—Supplier's documentary evidence and certification of:	1 contract	1 per contract or material change	
	• Cement	1 contract	1 per contract or material change	AS 3972
	• Flyash	1 contract	1 per contract or material change	AS 3582.1
	• Water	1 contract	1 per contract or material change	AS3583.13, AS1289.4.2.1
	• Admixtures	1 contract	1 per contract or material change	AS 1478
	Fine Aggregates (SC6.4.615 only)	1 contract	1 per contract or material change	
	• Grading	1 contract	1 per contract or material change	AS1141.11
	• Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B or Q102D
	• Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	• Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	• Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	• Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	• Material Finer 2µm	1 contract	1 per contract or material change	AS 2758.1
	• Deleterious Material (Impurities/Reactive)	1 contract	1 per contract or material change	AS 2758.1
	• Combined Aggregates (SC6.4.6.14 and SC6.4.6.15)	1 contract	1 per contract or material change	Q102A, Q102B or Q102D
	• Grading	1 contract	1 per contract or material change	AS1141.11
	• Moisture Content	1 contract	1 per contract or material change	

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Wet Strength	1 contract	1 per contract or material change	AS1141.22
	• Wet/Dry Strength Variations	1 contract	1 per contract or material change	AS1141.22
	• Sulphate Soundness	1 contract	1 per contract or material change	AS1141.24
	• Particle Shape	1 contract	1 per contract or material change	AS1141.14
	• Fractured Faces	1 contract	1 per contract or material change	AS1141.18
	• Bulk Density	1 contract	1 per contract or material change	AS 2758.1
	• Unit Mass (particle density)	1 contract	1 per contract or material change	AS 2758.1
	• Water Absorption	1 contract	1 per contract or material change	AS 2758.1
	• Material Finer 75µm	1 contract	1 per contract or material change	AS 2758.1
Raw Materials Supply	• Weak Particles	1 contract	1 per contract	AS 2758.1
	• Light Particles	1 contract	1 per contract	AS 2758.1
	• Deleterious Materials (Impurities/Reactive)	1 contract	1 per contract	AS 2758.1
	• Iron Unsoundness	1 contract	1 per contract	AS 2758.1
	• Falling/Dusting Unsoundness	1 contract	1 per contract	AS 2758.1
Mix Design (kerb mix)	Compressive Strength	1 contract mix	1 per mix per contract	AS1012.1, AS1012.8, AS1012.9
	Aggregate Moisture Content	1 contract mix	1 per mix per contract	Q102A, Q102B or Q102D
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
	Consistency - Slump	1 contract mix	1 per mix per contract	AS1012.3.1
	Air Content	1 contract mix	1 per mix per contract	AS1012.4.2 (Method 4.2)
	Shrinkage	1 contract mix	1 per mix per contract	AS1012.13

Table SC6.4.5.3.10 Mass concrete subbase (SC6.4.6.14)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table SC6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4.2 (Method 4.2)
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	- Compactibility Index	50m^3	1 per load	AS1012.3.4
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3	AS1012.1 AS1012.8 AS1012.9
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
Placement	Thickness	50m^3	5m grid on plan area	Survey and check with subgrade survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS1160 (Bitumen Emulsion)
	Application Rate	1 day's work	1 per 1000m^2*	AS3799 - Liquid membrane forming curing compound for concrete
Joints	Geometry	50m^3	All joints	Survey

* **Note**—or part thereof, per lot

Table SC6.4.5.3.11 Plain or reinforced concrete base (SC6.4.6.15)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Concrete Supply	Refer to Table 6.4.3.30			
	Concrete/Air Temperature	50m^3	1 per 50m^3	Measure
	Air Content	50m^3	1 per 50m^3	AS1012.4 Method 2
	Consistency - Slump	50m^3	1 per load	AS1012.3.1
	Mass per unit volume (prior crushing of 7-day specimen)	50m^3	1 per 50m^3	AS1012.12.2
	Compressive Strength (7 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
	Compressive Strength (28 day)	50m^3	1 pair per 50m^3*	AS1012.1 AS1012.8 AS1012.9
	Non Conformance - Compressive Strength	Superintendent to determine		AS1012.14
Steel Reinforcement	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS4671
	- Splicing (welded)	1 contract		AS1554.3
Placement	Relative Compaction			
	• Machine Placed	50m^3	1 per 50m^3*	AS1012.14 AS1012.2
	• Hand Placed	Area between 2 consecutive const. joints or 50m^3 (whichever is the lesser)	2 per lot	AS1012.14 AS1012.2
	Thickness	50m^3	5m grid on plan area	Survey
	Geometry	50m^3	1 cross section per 15m	Survey and 3m Straight Edge
Ride Quality	Profile Factor	1000m^2	10/lane/lot	3m Straight Edge
Surface Texture	Texture Depth	1000m^2	2 per lot	Survey
Curing	Material Quality—Supplier's documentary evidence and certification	1 contract	1 per production batch	AS1160 (Bitumen Emulsion)

	Application Rate	1 day's work	1 per 1000m²*	AS3799 - Liquid membrane
Joints	Sealant Material Quality Supplier's documentary evidence and certification	1 contract	1 per prod'n batch	
	Geometry	50m³	All joints	Survey

*** Note—**or part thereof, per lot

Table SC6.4.5.3.12 Bituminous microsurfacing (SC6.4.6.17)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Bitumen (prior to emulsification)	1 contract	1 per contract or change in material	AS2008
	• Bitumen Emulsion - Residual Binder Content (Residue from Evaporation)	1 contract	2 per bulk delivery	AS1160, App.D
	• Mineral Aggregates - Degradation Factor	1 contract	1 per contract or 6 month period	AS1141.25
	- Los Angeles Value	1 contract	"	AS1141.23
	- Aggregate Wet Strength	1 contract	"	AS1141.22
	- Wet/Dry Strength Variation	1 contract	"	AS1141.22
	- Polished Aggregate Friction Value	1 contract	"	AS1141.42
	- Sand Equivalent	1 contract	"	AS1289.3.7.1
	• Mineral Filler	1 month's prod'n	"	AS2350
	• Combined Aggregate Grading	1 contract	"	AS1141.11 AS1141.12
Mix Design—Nominated Mix	Approval of mix and NATA certification—Supplier's documentary evidence and certification	1 contract	1 per mix	
Production Mix	Grading	1 day's prod'n or 50m³ (whichever is the lesser)	2 per 50m³*	AS2891.3.1
	Residual Binder Content		2 per 50m³*	AS2891.3.1
Laying	Levels	1 layer, max 200m³	1 cross section per 15m	Survey
	Surface Quality	1 layer, max 200m³	10 per 100m* lane length	3m Straight Edge

*** Note—**or part thereof, per lot

Table SC6.4.5.3.13 Segmental paving (SC6.4.6.18)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Concrete Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	• Clay Segmental Paving Units	1 contract	1 per contract	AS/NZS 4455
	• Bedding Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
	• Joint Filling Sand - Grading	1 contract	1 per contract or change in material	AS1141.11
Base	Geometry	One layer 5000m2, max 1 day's placement	One cross section per 25m	Survey
	Surface Quality	"	10 per 200m2 or lot	3m Straight Edge
Edge Restraints	Refer SC6.4.6.28 Minor Concrete Work	1 day's placement	1 per 10 lin m	Measure/Survey
Laying Paver Units	Joint Width	1 day's placement	All joints	Measure
	Geometry	1 day's placement	One cross section per 15m	Survey
	Surface Quality	1 day's placement	10 per 200m2 or lot	3m Straight Edge

Table SC6.4.5.3.14 Minor concrete works (SC6.4.6.28)

1 per contract or material change

1 per contract or material change

1 per contract or material change

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Subgrade	Compaction	1000 lin m or 1000m^2	1 per 200 lin m or 200m^2	AS1289.5.4.1
Gravel Subbase Construction	Compaction	1 days placement	1 per 100 lin m or 100m^2	AS1289.5.4.1
	Subbase Geometry	1 days placement	1 per 25 lin m	3m Straight Edge
Steel Reinforcement	Material Quality—Suppliers documentary evidence and certification	1 delivery	1 per production batch	AS4671
Fibre Reinforcement concrete	Requirements as per SC6.4.6.28.6(1) - Reinforcement of concrete (Minor concrete works)			
Ready-Mixed Concrete Supply	Material Quality—Suppliers documentary evidence and certification	1 contract	1 per mix type	
	Consistency - Slump	15m^3	1 per load	AS1012.3.1 (Method 1)
	Compressive Strength (7 and 28 day)	15m^3	2 pairs per 15m^3	AS1012.1, AS1012.8, AS1012.9
	ALL TESTING—MINIMUM LOT SIZE 3m^3. No testing on loads less than 3m^3 if supplier can provide documentation of in production testing.			
Raw Materials Supply	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per contract or material change	
	Cement	1 contract	1 per contract or material change	AS3972
	Water	1 contract	1 per contract or material change	AS3583.13 AS1289.4.2.1
	Admixtures	1 contract	1 per contract or material change	AS1478.1

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Fine Aggregrates			
	Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B, Q102D
	Bulk Density	1 contract	1 per contract or material change	AS2758.1
	Water Absorption	1 contract	1 per contract or material change	AS2758.1
	Mineral Finer 2µm	1 cantract	1 per contract or material change	AS2758.1
	Deleterious Material (Impurities/Reactive)	1 contract	1 per contract or material change	AS2758.1
	• Coarse			
	Aggregate Grading	1 contract	1 per contract or material change	AS1141.11
	Moisture Content	1 contract	1 per contract or material change	Q102A, Q102B, Q102D
	Crushing Value	1 contract	1 per contract or material change	AS1141.21
	Soundness	1 contract	1 per contract or material change	AS1141.24
	Particle Shape	1 contract	1 per contract or material change	AS1141.14
	Bulk Density	1 contract	1 per contract or material change	AS2758.1
	Unit Mass (particle density)	1 contract	1 per contract or material change	AS2758.1
	Water Absorption	1 contract	1 per contract or material change	AS2758.1
	Mineral Finer 75 µm	1 contract	1 per contract or material change	AS2758.1
	Weak Particles	1 contract	1 per contract or material change	AS2758.1
	Light Particles	1 contract	1 per contract or material change	AS2758.1

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Deleterious Materials (Impurities/Reactive	1 contract	1 per contract or material change	AS2758.1
	Iron Unsoundness	1 contract	1 per contract or material change	AS2758.1
	Fall/Dusting Unsoundness	1 contract	1 per contract or material change	AS2758.1
	Percentage Wear	1 contract	1 per contract or material change	AS1141.23
Concrete Supply (Mixing at site)	Consistency - Slump	15m^3	1 per load	AS1012.3.1
	Compressive Strength (7 days) Compressive Strength (28 days)	15m^3 15m^3	2 pairs per 15m^3 or part thereof, 1 pair for 7 day test and the other pair for the 28 day test	AS1012.1, AS1012.8
Concrete Placement	Finished Levels	15m^3	1 cross section per 15m	Survey and 3m Straight Edge
	Surface Dimensions	Single fabrication	As required to confirm design dimensions	Measure
	Finishing of unformed surfaces Geometry	15m^3	1 cross section per 15m^3	Survey and 3m Straight Edge
	Joints - Geometry	50m^3	All joints	Survey
Curing	Material Quality - Supplier's documentary evidence and certification	1 contract	1 per production batch	AS3799
	Application Rate	1 day's work	1 per 1000m^{2*}	
Backfilling	Material Quality			
	• Maximum particle size	1 contract/ material type	1 per 200m^3	Q103
	• Plasticity Index	1 contract/ material type	1 per 200m^3	AS1289.3.3.1
	Compaction	1 days work or max 200m^2	1 per 200m^2	AS1289.5.4.1
Sprayed Concrete	Test Panels and Cores	1 contract	3 test panels and 4 cores per mix design	AS1012.4, AS1012.9 AS1012.14

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	Compressive Strength Cores	15m^3	per 15m^3	AS1012.4 AS1012.9 AS1012.14
	Curing Material Quality— Supplier's documentary evidence and certification	1 contract	1 per production batch	

*** Note—**or part thereof, per lot

Table SC6.4.5.3.15 Pavement markings (SC6.4.6.22)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality - Supplier's documentary evidence and certification of:			
	• Paint	1 contract	1 per contract or change in material	
	• Glass Beads	1 contract	"	
	• Thermoplastic Material	1 contract	"	
	• Raised Pavement Markers (including temporary raised pavement markers)	1 contract	"	
Paint Application	Wet Film Thickness	1 contract	1 per site visit	AS 1580.107.3 Or Q513
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A
Thermoplastic Application	Cold Film Thickness	1 contract	1 per site visit	Measure by micrometer
	Application Rate of Glass Beads	1 contract	1 per contract	SC6.4.6.22 Attachment A

Table SC6.4.5.3.16 Signposting (SC6.4.6.24)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• Sign Blanks	1 contract	1 per contract, or change in material	
	• Aluminium Extrusion Backing	1 contract	"	
	• Retro-reflective Material	1 contract	"	
	• Non-reflective Paint	1 contract	"	
	• Non-reflective Sheet Material	1 contract	"	
	• Steel Sign Support Structures	1 contract	"	
Concrete Foundations	Refer SC6.4.6.28			

Table SC6.4.5.3.17 Water reticulation (SC6.4.6.2)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• uPVC Pipes	1 contract	1 per contract	AS2977
	• Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	• Copper Pipe	1 contract	1 per contract	AS1432
	• Polyethylene Pipe	1 contract	1 per contract	AS1159
	• Stop Valves Material	1 contract	1 per contract	AS2638 and AS2129
	• Non Return Valves	1 contract	1 per contract	AS3578
	• Spring Hydrants	1 contract	1 per contract	AS2544 or AS3952
Siting and Excavation	Geometry	1 line	1 per line	Survey
Bedding	Material Quality			

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
	• Grading	1 contract	1 per contract per source	AS2032
Thrust and Anchor Blocks	Refer to Table SC6.4.5.3.14			
Chamber Covers and Frames	Geometry	1 cover/frame	1 per cover/frame	survey
Testing of Pipelines	Pressure testing Bacteriological testing	1 line 1 line	1 per line 1 per line	As specified in SC6.4.6.2.5 As specified in SC6.4.6.2.5(3) and (4)
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1, AS1289.5.4.1
Switchgear and Control gear Assembly	Electrical function	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	

Table SC6.4.5.3.18 Sewerage system (Construction specification SC6.4.6.3)

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Materials Supply	Material Quality—Supplier's documentary evidence and certification of:			
	• uPVC Pipes	1 contract	1 per contract	AS1477
	• Ductile Iron Pipes	1 contract	1 per contract	AS2280 and AS2129
	• Vitrified Clay Pipes	1 contract	1 per contract	AS1741
	• Precast Access Chambers	1 contract	1 per contract	AS4198
Siting and Excavation	Geometry	1 line/structure	1 per line/ structure	Survey
Bedding	Material Quality • Grading	1 contract	1 per contract per source	Q103
Concrete Bedding	Refer Table SC6.4.5.3.14			

Activity	Key Quality Verification Requirements	Maximum Lot Size	Minimum Test Frequency	Test Method
Laying and Jointing of Pipes, Access Chambers, Structures	Geometry	1 line	1 per line	Survey
Thrust and Anchor Blocks	Table SC6.4.5.3.14			
Cast-in-situ Access Chambers	Material Quality			
	• Tri-Calcium Aluminate Content	1 contract	1 per contract per source	AS3972
	• Fineness Index	1 contract	"	AS3972
	• Minimum Cement Content	1 contract	"	AS3972
Acceptance Test of Gravitation Mains and Access Chambers	• Compressed Air Testing	1 line	1 per line	As specified SC6.4.6.3.4
Testing of Rising Mains	• Hydrostatic test pressure	1 line	1 per line (max 1000m)	As specified in SC6.4.6.3.4(10)
Backfill and Compaction	Compaction	1 line	1 per 2 layers max 100m^2	AS1289.5.7.1, AS1289.5.4.1 per SC6.4.6.3(24)
Switchgear and Control gear Assembly	Electrical Compliance	each installation	1 factory test per installation	AS3439
Commissioning of Pumping Station	Certification testing of electrical installation in accordance with relevant Australian Standards	1 installation	1 per installation	As specified in SC6.4.6.3.5(9)

SC6.4.5.3 Attachment B Random sampling

(1) General

Random sampling of test locations shall be used to control relative compaction of each layer of (which are generally rectangular in area):

(a) earthworks;

(b) selected material zone; and

(c) stormwater drainage.

The number of samples (n) per lot shall be as indicated in the specific sub-sections which are summarised in SC6.4.5.3 Attachment A.

(2) Locations

Sampling locations within a lot for the control of relative compaction shall be determined as follows:

(a) representing the lot as a rectangle, sub-divide the lot lengthwise into equi-area sub-lots in accordance with the number of samples selected (n) in accordance with Table SC6.4.5.3.19;

(b) establish six grid lines within the lot, as illustrated in Figure SC6.4.5.3.3;

(c) throw a die to select a number between 1 and 6. This determines which grid line to use for the sample location in sub-lot 1;

(d) throw die to select a group (1-6) in Table SC6.4.5.3.19;

(e) throw die twice to select two random numbers (between 1 and 6) for row and column in Table SC6.4.5.3.19 and obtain random fraction R;

(f) length co-ordinate for sample location in Sub-lot 1 = RL/n; and

(g) for sample location in next sub-lot:

(i) add L/n to previous length co-ordinate; and

(ii) add 1 (on a cycle of 6) to previous grid line.

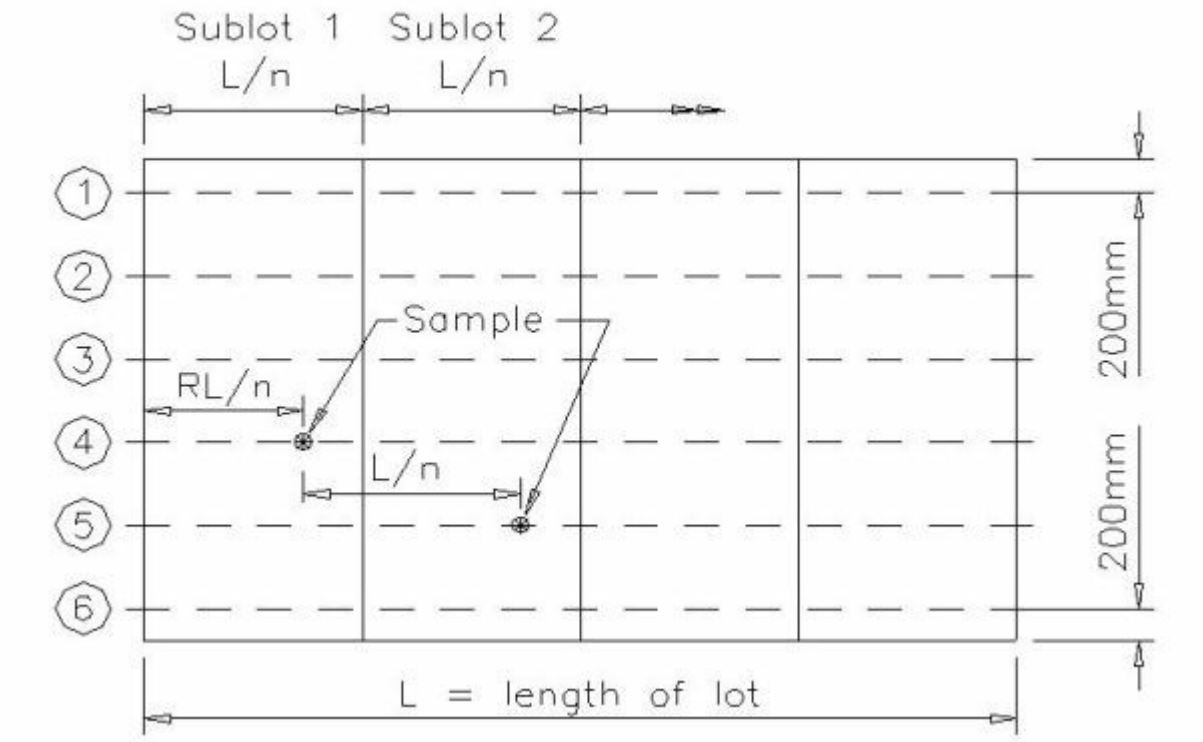


Figure SC6.4.5.3.3 Sampling locations for rectangular lot

Table SC6.4.5.3.19 Table of random fractions

GROUP	ROW	COLUMN					
		(1)	(2)	(3)	(4)	(5)	(6)
(1)	(1)	0.78178	0.45467	0.00347	0.27296	0.00020	0.36517
	(2)	0.59678	0.67931	0.25434	0.59054	0.32444	0.41504
	(3)	0.14464	0.17269	0.61154	0.18291	0.83242	0.50776
	(4)	0.89010	0.44764	0.07451	0.20428	0.49513	0.91440
	(5)	0.91941	0.47726	0.33160	0.30670	0.65114	0.36852
	(6)	0.51085	0.38148	0.22169	0.66578	0.67050	0.69559
(2)	(1)	0.81891	0.48626	0.88892	0.82994	0.16941	0.81528
	(2)	0.37410	0.60232	0.12070	0.79017	0.32981	0.34908
	(3)	0.45921	0.15648	0.58052	0.37413	0.08124	0.97145
	(4)	0.86614	0.94719	0.78872	0.91972	0.45149	0.15107
	(5)	0.26590	0.41140	0.95477	0.81267	0.24018	0.07324
	(6)	0.95205	0.39438	0.73697	0.59427	0.71146	0.00575
(3)	(1)	0.18694	0.36502	0.17828	0.84312	0.57003	0.58583
	(2)	0.91211	0.86936	0.43030	0.27672	0.47393	0.10342
	(3)	0.80714	0.34295	0.00775	0.90855	0.33368	0.21842
	(4)	0.67579	0.92686	0.18005	0.00645	0.11256	0.05278
	(5)	0.03184	0.69876	0.16676	0.43346	0.86992	0.03275
	(6)	0.15623	0.02905	0.72763	0.19095	0.80847	0.39729
(4)	(1)	0.72109	0.17970	0.22505	0.35561	0.98935	0.27818
	(2)	0.37348	0.19381	0.43331	0.75033	0.99963	0.42232
	(3)	0.12129	0.32386	0.56705	0.87165	0.84460	0.92955
	(4)	0.54948	0.08844	0.47061	0.78419	0.18731	0.93485
	(5)	0.15097	0.44967	0.48759	0.84161	0.19212	0.05146
	(6)	0.32360	0.66850	0.99382	0.94050	0.96449	0.96217
(5)	(1)	0.68091	0.54191	0.10910	0.94237	0.23161	0.15167
	(2)	0.97121	0.83626	0.70896	0.45296	0.69475	0.11264
	(3)	0.19723	0.98260	0.57429	0.94789	0.64457	0.20809
	(4)	0.84036	0.14095	0.29451	0.40256	0.34521	0.64924
	(5)	0.97500	0.98056	0.82276	0.97130	0.77329	0.89855
	(6)	0.83244	0.30828	0.06882	0.68471	0.71081	0.91649
(6)	(1)	0.75892	0.29685	0.70044	0.91238	0.53356	0.45239
	(2)	0.13229	0.19701	0.36074	0.32254	0.62045	0.26691
	(3)	0.34789	0.22179	0.91891	0.87651	0.91011	0.97469
	(4)	0.97211	0.68943	0.12831	0.50006	0.20793	0.61151
	(5)	0.24954	0.17809	0.56093	0.51524	0.69135	0.68967
	(6)	0.10062	0.11852	0.47089	0.64765	0.44644	0.35548

SC6.4.5.3 Attachment C Method statement requirements

General

(1) Method statements are required to describe the key steps and sequence in the construction activities, how and by whom each step shall be undertaken and what materials and equipment shall be used. Method statements may include a flow chart to clarify the sequence of key steps. One or more method statements may address a construction activity.

(2) Each method statement will be supported by a check list which shall identify relevant inspections, test points, materials requirements and hold points. Each requirement on the check list will have an officer responsible

identified and will require the nominated officer to sign off the requirement so indicating its satisfactory execution.

(3) Method statements and check lists shall be compatible with the appropriate Inspection and test plan. Check lists will be completed for each lot of work during construction and compiled with other documents to comprise the quality register.

(4) The Contractor shall submit method statements and check lists to describe the key steps in those construction activities listed below that are identified with a preceding asterisk (*).

Item	Enter * here if required	Activity	Sub-section Number
1		Control of Traffic	SC6.4.6.30
2		Temporary Roadways and Detours	SC6.4.6.30
3		Clearing and Grubbing	SC6.4.6.11
4		Earthworks - Cut	SC6.4.6.10
5		Earthworks - Unsuitable Material	SC6.4.6.10
6		Earthworks - Embankment	SC6.4.6.10
7		Compaction and Quality Control	SC6.4.6.10
8		Siting, Excavation, Bedding, Backfilling and Compaction of Stormwater Drainage	SC6.4.6.4
9		Installation of Pipe Drainage	SC6.4.6.6
10		Installation of Precast Box Culverts	SC6.4.6.7
11		Siting and Installation of Drainage Structures	SC6.4.6.5
12		Construction of Lined Open Drains including Kerb and Gutter	SC6.4.6.9
13		Stabilisation of Pavement or Subgrade Materials	SC6.4.6.19
14		Provision of Subsurface Drainage as subsoil drains, pavement drains or free draining layer	SC6.4.6.20-21, SC6.4.6.8
15		Construction of Flexible Pavement Layers	SC6.4.6.12
16		Construction of Concrete Pavement Layers	SC6.4.6.14-15
17		Construction of Asphaltic Concrete Pavement Layers	SC6.4.6.13
18		Sprayed Bituminous Surfacing	SC6.4.6.16
19		Bituminous Microsurfacing	SC6.4.6.17
20		Construction of Segmental Paving	SC6.4.6.18
21		Pavement Marking	SC6.4.6.22
22		Minor Concrete Works	SC6.4.6.28
23		Landscaping	SC6.4.6.28

SC6.4.5.3 Attachment D Minimum inspection and test plan

Table SC6.4.5.3.20 Water supply-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Council (Water Authority)
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Water Authority.	1 week	Council (Water Authority)
Earthworks–Excavation near existing services	Approval from relevant Authority for the excavation.	1 week	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Minimum Trench Width for Pipelines–Excavation across paved or improved surfaces	Approval from the Authority or Owner prior to commencing any excavation across paved or improved surfaces.	1 week	Superintendent
Pipe Bedding–Trench completed	Present the completed excavated trench prior to pipe laying, jointing and bedding.	2 working days	Superintendent
Laying and Jointing of Pipes–Existing asbestos cement pipe cutting and disposal	Submit method statement for approval.	2 working days	Superintendent
Pipe testing and restoration			
Testing of Pipelines	Conduct pressure testing.	7 days	Superintendent and Council
Testing of Pipelines–unsatisfactory test results, defects and leakage	Conduct pressure testing upon completion of rectification work.	3 days	Superintendent and Council
Backfill and Compaction–Completion of work	Present the laid and jointed pipes for approval prior to the commencement of trench backfilling.	2 working days	Superintendent
Restoration of Surfaces	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
Pumps	Provide written warranty from the manufacturer for approval.	2 weeks before ordering	Superintendent
Electrical Compliance–ompliance with required standard	Supply a proof of compliance**–**Test certificate.	1 week	Superintendent
Electrical Installation–oute of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Water Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Water Authority and Superintendent
Construction compliance			
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	2 weeks before operating	Water Authority and Superintendent

Table SC6.4.5.3.21 Water supply-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/ Item	Requirement	Notice for inspection
Materials		
General–Compliance with manufacturers recommendations	Contractor to inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves and Hydrants)
Pipeline construction		
Location–Set out	Confirm the set out locations prior to construction.	3 working days
Crossings–Crossings authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation.	Progressive
Laying and Jointing of Pipes–Inspection prior laying	Contractor to present to the Superintendent materials prior laying (if required).	Progressive
Pipe testing and restoration		
Disinfection and Flushing of Pipelines	Provide evidence of compliance with this requirement.	2 working days upon completion of activity.
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior spreading/disposal.	2 working days progressive

Table SC6.4.5.3.22 Sewerage systems-hold points

Clause title/ Item	Requirement	Notice for inspection	Release by
Materials			
General	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pipeline construction			
General–Work accreditation	Provide proof of accreditation for approval.	1 week prior commencement of work	Superintendent
General–Change of Pipeline Alignment	Approval of the proposed alignment from the Sewer Authority.	1 week	Superintendent and Council (Sewer Authority)
Earthworks–Prior Excavation	Approval from relevant Authority for the excavation.	1 week	Superintendent
Excavation near underground services–Protection of other services	Submit for approval give notice of any interference to the works caused by an existing service and submit a proposed work method statement.	1 week	Superintendent
Pipe Bedding–Foundation Condition/Water Charged Ground	Notify Superintendent and confirm method of foundation support from the designer.	Progressive	Superintendent
Wrapping Pipelines–Damage to sleeving	Rectify any damage to sleeving before backfilling trench.	Progressive	Superintendent

Clause title/ Item	Requirement	Notice for inspection	Release by
Bedding and Backfill Compaction Requirements–Notification of pipeline laid and jointed.	Present the laid and jointed pipes for approval before the trench backfilling.	Progressive	Superintendent
Bedding and Backfill Compaction Requirements–Embankment	Submit proposal for construction of embankments.	1 week	Superintendent
Pipeline testing and restoration			
Acceptance Test of Gravitation Sewers and Maintenance Holes– acceptance Testing	Present all sewers and maintenance holes for acceptance testing.	1 week	Superintendent and Sewer Authority
Acceptance Test of Gravitation Sewers and Maintenance Holes–Hydrostatic testing	Submit proposed alternative testing regime for approval.	1 week	Superintendent and Sewer Authority
Connection to Existing Sewers	Submit request to connect to the existing sewer and give notice of works including any affected occupants.	3 weeks before connection	Superintendent and Sewer Authority
Testing of Rising Mains–Pressure Test	Present rising main for acceptance testing.	1 week	Superintendent and Sewer Authority
Restoration of Surfaces– Original condition requirement	Restore progressively and as soon as possible after the section of works is completed.	2 working days	Superintendent
Pump stations			
General–Authorised products and materials	Submit alternative products and materials for approval.	2 weeks before ordering	Superintendent
Pumps	Provide written warranty of the equipment.	Upon delivery on site	Superintendent
Electrical Compliance– Compliance with required standard	Supply a proof of compliance – Test certificate.	1 week	Superintendent
Electrical Installation–Route of underground cabling	Submit underground cabling requirements and route for approval.	2 weeks	Superintendent
Testing and Commissioning of Pump Station–Compliance with the Specification Requirements	Submit required test results.	1 week	Sewer Authority and Superintendent
Testing and Commissioning of Pump Station–Commissioning	Give notice of intention to undertake commissioning. Provide pre-commissioning record sheets.	2 weeks	Sewer Authority and Superintendent
Practical Completion of Pump Station	Fulfil all the requirements for issuance of Certificate of Practical Completion.	2 weeks	Superintendent
Construction compliance			
Works–as–executed details and Operation and Maintenance Manuals	Submit work-as executed drawing and Operating and Maintenance Manuals.	1 week before operating	Sewer Authority and Superintendent

Table SC6.4.5.3.23 Sewerage systems-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/item	Requirement	Notice for inspection
Materials		
General–Compliance with Manufacturer's recommendations	Contractor to Inspect material and products at time of delivery for compliance.	2 working days
General–Certification	Provide product or material certification prior to delivery to the works.	3 working days (Pipes and Fittings) 1 week (Valves)
Pipeline construction		
Crossings–Crossings Authority approvals	Approval from relevant Authority and payment of fees.	2 weeks
Earthworks–Open excavation	Contractor to provide appropriate safety measures for open excavation	Progressive
Bedding and Backfill Compaction Requirements–NATA	Provide NATA certified test results for all testing.	2 working days progressive
Thrust and Anchor Blocks for Rising Main–Verification of Bearing Pressures	Give notice if the allowable bearing pressure of the ground and the design pressure of the pipeline differ from actual pressures on site.	1 week
Pipeline testing and restoration		
General–Initial Tests (Sewers and Maintenance Holes)	Give notice prior commencement of initial testing.	2 days progressive
Ovality Test and CCTV Inspection–Deflection testing and pipeline verification	Submit proposal for deflection testing (Ovality Test). Submit CCTV Results.	1 week (Ovality Test) 2 days upon completion of inspection
Acceptance Test of Gravitation Sewers and Maintenance Holes	Submit acceptance test results.	Progressive
Visual Inspection and Measurement of Infiltration–Infiltration testing	Submit method of infiltration testing.	1 week
Testing of Rising Main	Submit acceptance test results.	Progressive
Restoration of Surfaces–Disposal of surplus material	Superintendent approval is required prior to spreading/disposal.	2 working days progressive
Pump stations		
General - Conformance with manufacturers recommendations	Inspect material and products at time of delivery.	2 working days
Electrical Compliance–approval of all design and materials	Submit all design drawings and materials to each Authority having jurisdiction for approval.	2 weeks before ordering

Table SC6.4.5.3.24 Stormwater drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Temporary drainage–Erosion and Sediment Control	Confirmation of accepted project ESCP and completion of erosion and sedimentation control measures.	1 week prior to site commencement	Superintendent and Council
Siting of Culverts–Survey set-out	Submit survey set-out of culvert inlets and outlets for approval.	1 week prior to proceeding	Superintendent
Siting of Culverts–Changes by Contractor	Submit proposed changes for approval.	1 week prior to proceeding	Superintendent
Excavation–Public utilities	Obtain approval for adjacent excavation with relevant authorities.	1 week prior to proceeding	Superintendent
Construction traffic–Protection measures	Submit certification and verification of protection measures.	3 working days	Superintendent

Table SC6.4.5.3.25 Stormwater drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Excavation–Notice	Identify unsuitable materials and inadequate support material for removal and disposal at the foundation level of the structure.	progressive
Backfilling–In situ concrete structures	Do not backfill against in situ concrete structures within 14 days of concrete placement.	progressive
Backfilling–Tolerance	Check shape of culvert during backfilling.	progressive
Compaction adjacent to culverts or drainage structures	Inform the Superintendent prior rectification any damage.	2 working days before proceeding

Table SC6.4.5.3.26 Drainage structures-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Construction			
Precast Units–Product drawings and Quality	Submit details of precast or proprietary items for approval and Submit quality test results.	1 working day and 3 working days before delivery respectively	Superintendent
Excavation	Excavation and compaction of foundation as documented.	1 working day	Superintendent
Backfill–Commencement	Obtain approval for commencement.	1 workday day	Superintendent

Table SC6.4.5.3.27 Drainage structures-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Construction		
Headwalls and Wingwalls – Batter retention	If dimensions on drawings are unable to satisfy batter retention, notify the Superintendent.	3 working days
Precast units	Give notice of installation of precast pits and junction boxes.	1 week
Construction	Submit for approval part omission of concrete lining.	3 working days

Table SC6.4.5.3.28 Pipe drainage-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Common requirements			
General–Material Certification	Submit conformance certificate and other relevant manufacturer quality documentation.	24 hours in advance of dispatch to site	Superintendent
General–Alternative materials	Submit full product details in accordance with AS/NZS 2566.1.	4 weeks prior to commencing work	Superintendent and Council
General–Backfilling	Present the completed installation and jointed pipes for inspection.	Progressive before backfilling	Superintendent and Council
General–Protection of structures	Submit design proposal for protective measures for approval.	3 days prior	Superintendent and Council
Steel pipes and pipe arches			
Materials and Surface Treatment	Engineer's certification for the pipe materials and surface treatments.	Prior to practical completion	Superintendent
UPVC pipes			
Materials–Proprietary product with external diameter of ≥450mm	Submit for approval prior to construction.	4 weeks	Superintendent and Council

Table SC6.4.5.3.29 Pipe drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Precast reinforced concrete and fibre reinforced concrete pipes		
Excavation–Wide Trench Condition	If deemed as a wide trench, confirm appropriate pipe strength/trench support.	Progressive
Bedding	Source of bedding material -advise Superintendent.	Progressive
Bedding–Cementitious stabilisation	Provide if erosion of bedding material may occur.	1 week

Table SC6.4.5.3.30 Precast box culverts-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
Culvert Units, Link and Base Slabs	Submit certificate of conformance.	3 working days prior to dispatch	Superintendent
Proof load testing	Submit certificate and test results.	3 working days prior to dispatch	Superintendent
Construction			
Construction of coffer dams	Submit construction details for approval.	1 week prior to construction	Superintendent
Prior placement of bedding	Inspection of foundation and approval of proposed bedding.	2 days before placing material	Superintendent
Backfill—Inspection of seals	Present joints and seals for before backfilling.	1 working day	Superintendent
Construction loading on culvert —Constraint	Do not load base slab until strength has reached 20 MPa.	1 working day	Superintendent

Table SC6.4.5.3.31 Precast box culverts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Materials		
Handling, Delivery and Storage	Inspect box culvert units for conformance.	1 week prior to installation
Construction		
Coffer Dams—Timber or bracing removal	Inspect removal of bracing materials.	1 working day
Installation of Precast in situ base slabs	Attainment of concrete minimum compressive strength.	1 working day

Table SC6.4.5.3.32 Drainage mats-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Type A mats / Type B mats			
Geotextile, Damaged geotextile	Approval of condition or repair of geotextile.	1 working day before next activity	Superintendent
Filter material, Thickness	Approval of thickness and layers of filter material.	3 working days before placing filters	Superintendent

Table SC6.4.5.3.33 Drainage mats-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Type A mats /Type B mats		
Filter material, Protective layer	Inspection of placement of protective layer over mat extension.	3 working days before placing materials
Discharge, Outlets	Inspection of outlet proposals.	7 days before set-out of layers

Table SC6.4.5.3.34 Open drains-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Pre-construction planning			
Provision for traffic	Submit Traffic Guidance Scheme for approval.	2 weeks prior to site commencement	Superintendent
Temporary drainage	Submit details of procedures/devices for approval.	2 weeks prior to site commencement	Superintendent
Materials			
Proprietary Products	Submit proprietary products and manufacturer's instructions.	7 days prior to commencement on site	Superintendent
Gabions/Wire mattresses	NATA compliance certificates for proposed Gabions.	7 days prior to commencement on site	Superintendent
Rock fill material	NATA compliance certificates for proposed rock fill material.	7 days prior to commencement on site	Superintendent
Geotextile	NATA compliance certificates for proposed Geotextile material.	7 days prior to commencement on site	Superintendent
Open drains			
Excavation	Approval to divert drain to avoid trees and/or rocks.	1 working day before set-out.	Superintendent.
Excavation	Location and construction of drains to prevent salination.	1 working day before set-out.	Superintendent.
Kerb and channel (gutter)			
Foundation	Approval for shape and compaction of foundation material.	1 working day before forming	Superintendent

Table SC6.4.5.3.35 Open drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Open drains		
Excavation	Unsuitable material removal and disposal.	Progressive
Excavation	Spoil site locations.	Prior to placement
Embankment	Embankment compaction and revegetation.	Progressive
Construction	Grade and compaction of open drains.	Progressive
Construction	Proprietary items installed to manufacturers recommendations.	Progressive
Types	Maintain catch drains.	Progressive
Types	Construct minor diversion and contour drains, table drains, swales and depressed medians.	Progressive
Types	Channels preserving the existing stream bed.	Progressive
Lining		
Concrete lining	Instruction on weephole location.	1 working day before concreting.
Concrete lining	Joints and tolerances.	1 working day before concreting.
Stone pitching	Bedding material and placement.	1 working day before concreting.
Kerb and channel (gutter)		
Stormwater outlets	Positive drainage to channel.	Progressive
Vehicular or pedestrian access	Siting, location and bedding compaction.	Progressive
Backfilling and reinstatement		
Backfill behind kerbs	Backfilling timing, material and compaction.	1 working day prior to backfilling
Pavement backfill	Backfill adjacent new gutter material and location.	1 working day prior to backfilling
Rock filled wire mattresses and gabion– Completion	Inspection of rockfill material and filling method.	On completion of works

Table SC6.4.5.3.36 Earthworks-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Stockpile Sites	Approval to use any stockpile site not shown on the Drawings.	3 working days before stockpiling	Superintendent
Treatment of Floors of Cuttings–Prior ripping floors of cuttings	Present in situ material for inspection to determine suitability of pavement support.	Before ripping commences	Superintendent
Treatment of Floors of Cuttings–Compacting floors of cuttings	Inspection of compacted cutting floor.	Prior to placing any subsequent layers over the completed cutting floor	Superintendent and Council
Unsuitable material–Floor inspection	Re-present the floor of the excavation after the removal of unsuitable material.	Prior to backfilling with replacement material	Superintendent
Foundations for Embankments	Inspection of the embankment foundation area.	1 working day prior to next activity	Superintendent
Foundation for Embankments–Other Embankments (Bridging layer)	Inspection and direction for bridging layer where required	3 working days before proceeding	Superintendent
Trimming tops of embankments	Inspection of the completed surface to receive subsequent pavement layers.	Prior to placing any subsequent pavement layers	Superintendent
Selected material zone	Inspection of the completed select material zone surface prior to placing any subsequent pavement layers.	1 working day before proceeding	Superintendent
Fill adjacent to structures–General	Concrete strength required for early filling to structures.	3 working days prior to fill placement	Superintendent
Deflection monitoring or proof rolling	Present the completed work for deflection monitoring or proof rolling.	2 working days before next activity	Superintendent and Council

Table SC6.4.5.3.37 Earthworks-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Natural Surface and Earthworks Materials	Survey method and results, including any discrepancies.	At least 7 days notice
Cuttings–Floors of cuttings	Floors to be no more than 50 mm above or below the designed floor and provide suitable support.	1 working day before next activity
Batters–Excavation beyond the batter line	Minor change in the general slope of the batter to suit the site conditions.	1 working day before next activity
Transition from cut to fill–Terrace	Excavate a terrace for the width of the selected material zone to a depth of 900 mm below and parallel to the cutting floor.	1 working day before excavating terrace
Unsuitable Material	Material deemed unsuitable for embankment or pavement support in its present position.	Progressive
Placing Fill for Embankment Construction–Rock material	Modify grading of fill material to achieve compaction.	Progressive
Fill adjacent to structures–Treatment at weepholes	Proposal to use synthetic membrane geotextile.	3 working days before proposed use
Spoil–Haulage disposal	Obtain planning approval and any permits.	3 working days before commencing activity
Borrow–Requirement	Obtain planning approval and any permits.	3 working days before commencing activity

Table SC6.4.5.3.38 Clearing and grubbing-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Limits of clearing			
Survey	Decision on the removal of miscellaneous items.	7 days before proposed removal	Superintendent
Extent of clearing	Submit peg out and extent of clearing survey.	7 days before proposed commencement of clearing	Superintendent and Council
Clearing Operations			
Tagging	Confirm clearing perimeters and mark trees to be preserved.	7 days before proposed site clearing	Superintendent and Authorised Council Officer
Work near trees noted for protection	Work method statement for works within the exclusion zone.	7 days before proposed works	Superintendent
Excavation within 4m of tree trunks	Develop appropriate work methods to avoid damage to the tree for approval.	7 days before proposed excavation	Superintendent
Trees within proposed embankment areas	Direction to remove or protect trees within proposed embankments.	7 days before proposed site clearing	Superintendent
Unsound trees in road reserve	Direction on removal of trees or branches not within the clearing limits.	7 days before proposed site clearing	Superintendent
Timber falling on private property	Written consent of owner to leave in place or to enter property to remove.	Prior to carrying out works	Superintendent
Damage	Approval for any rehabilitation of vegetation or fauna habitat.	3 working days prior to carrying out works	Superintendent and Authorised Council Officer
Grubbing			
Blasting	Explosives not permitted without prior approval.	Progressive	Superintendent
Disposal of materials			
Burning of material	Approval prior to disposal of timber and other combustible materials by burning.	Prior to burning	Superintendent

Table SC6.4.5.3.39 Clearing and grubbing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Existing Utility services–Marking	Locate all underground pipe and cables.	Before commencing any earthworks
Trees to be preserved–Work near trees noted for protection	Exclusion zone around protected trees.	Progressive
Trees to be preserved–Tree protection	Trees and roots not to be cut or damaged.	Progressive
Grubbing–Backfill	Backfill and compact grub holes.	Progressive
Chipping of cleared vegetation–Stockpiling	Stockpile location approval.	Prior to stockpiling

Table SC6.4.5.3.40 Flexible pavements-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Activity plan			
Pavement construction plan	Prepare and submit pavement plan.	4 weeks before commencing site work	Superintendent
Inspection, sampling and testing			
Notification	Written notice for testing times and provide test results.	3 working days prior to testing or inspection	Superintendent
Materials			
Proposed materials	Prepare and submit schedule detailing material properties including NATA test results and certificate.	2 weeks before ordering materials	Superintendent
Bound or modified materials	Complete and submit (SC6.4.6.19 Attachment A).	2 weeks before ordering materials	Superintendent
Variations to approved materials	Submit details of changes to approved materials.	1 week before use in works	Superintendent
Lime modified base and subbase materials			
Lime modification	Submit proposals to modify materials.	2 weeks before placing	Superintendent
Stationary Plant or In-situ lime modification	Submit proposals for the in-situ use of hydrated lime or quicklime.	2 weeks before activity	Superintendent
Spreading			
Underlying layer	Inspection to determine suitability of underlying layer.	1 working day before placing next layer	Superintendent
Temperature	Submit proposal to proceed outside allowable conditions.	1 working day before placement	Superintendent
Trimming, compaction and curing			
Plant	Submit details of proposed hand operated plant.	1 week before use	Superintendent
Subsequent layers	Submit completed test results of previous layer.	1 working day before placing next layer	Superintendent
Acceptance of compaction			
Lots for acceptance	Submit compaction test results.	1 working day after testing	Superintendent
Compaction requirements and acceptance	Submit evidence that compaction is within tolerances.	1 working day after test results	Superintendent
Tolerances			
General	Submit lot survey reports.	1 working day before next activity	Superintendent
Action on rejection			
Corrective action–rejected unbound layers	Submit proposal for corrective action.	1 working day before next activity	Superintendent
Corrective action–rejected bound layers	Submit proposal for corrective action.	3 working days before next activity	Superintendent
Removal and replacement of rejected course			
Extent of removal	Submit proposal to remove less than full width.	1 working day before next activity	Superintendent

Clause title/Item	Requirement	Notice for inspection	Release by
Prior to replacement	Give notice for inspection of underlying material.	1 working day before next activity	Superintendent
Replacement	Submit proposed methods to make good.	1 working day before next activity	Superintendent
Maintenance before completion of wearing course			
Pavement condition before primerseal	Dry-back, re-prepare and give notice for inspection.	3 working days before next activity	Superintendent and Council
Opening bound pavement to traffic	Give notice of proposed opening to traffic.	3 working days before proposed opening	Superintendent

Table SC6.4.5.3.41 Flexible pavements-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Delivery to site		
Delivered materials	Give notice for inspection.	Progressive
Delivery of modified or bound materials		
Delivery of materials	Provide delivery dockets at point of delivery.	Progressive
Stockpiling of unbound materials		
Location	Give notice of proposed alternative locations.	2 weeks before stockpiling
Trimming, compaction and curing		
Compaction	Give notice of proposal to use alternative layer thickness.	2 weeks before activity
Rework	Give notice for inspection of reworked wetted up layer.	Progressive
Curing of bound materials	Give notice of water curing activities.	Progressive
Acceptance of compaction		
Nuclear density Meter testing	Give notice of proposal to use Nuclear density meter.	1 working day before use
Tolerances		
Layer width	Give notice of completion of layer width.	Progressive
Levels and Surface Trims	Give notice of completed surface layer.	Progressive

Table SC6.4.5.3.42 Asphaltic concrete-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Plant	Evidence that plant is registered and insured.	2 weeks before using plant	Superintendent
Delivery—work records	Submission for counter signing.	Each day for daily completion	Superintendent
Asphalt mix design			
Approved Mix	Submit approved mix design for Superintendent confirmation.	7 days before using mix	Superintendent
Production Mix— Production Sampling and Testing	Submission of all documented test results.	Within 7 days of delivery of material	Superintendent
Asphalt mixes incorporating RAP	Mixes containing more than 20% RAP to be submitted for assessment.	7 days before using mix	Superintendent
Placing	Present surface prior spreading.		Superintendent
Joints—General	Submit plan of joints location for approval.	7 days before commencing	Superintendent
Preparation of Pavement — Rectification of Pavement Surface	Prepare surface to the satisfaction of the Superintendent.		Superintendent
Laying—Paver	Provide notice of proposed pavers.		Superintendent
Removal and Replacement of Rejected Material	Present surface after removal of the rejected material.		Superintendent

Table SC6.4.5.3.43 Asphaltic concrete-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Plant	Superintendent to assess faulty plant.	Progressive
Production	Superintendent to access the mixing plant to verify production procedures and the supplier's compliance with the Contractor's Project Quality Manual and Quality Plan.	Progressive
Aggregate—General	Source subject to inspection and approval of Superintendent.	3 weeks before importing aggregate

Table SC6.4.5.3.44 Mass concrete subbase-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials for concrete			
Materials	Submit details of concrete mix and materials.	Submit as part of confirmation of nominated mix	Superintendent
Design and control of concrete mixes			
Nominated mix	Submit details of concrete mix and materials including NATA certificates and test results.	21 working days before using the nominated mix (Progressive)	Superintendent and Council
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials.	21 working days before implementing change	Superintendent
Conformance for concrete strength and thickness			
Sampling, curing and testing of fresh concrete	Inspection of sampling procedure.	Progressive	Superintendent
Acceptance criteria	Submit test results.	Progressive	Superintendent
Acceptance criteria for cored concrete (non-conformance)	Submit test results.	Progressive	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed work methods.	At least 21 working days before starting	Superintendent
Placing and finishing concrete subbase			
Subbase Paving plan	Submit as part of Quality plan.	21 working days before starting	Superintendent
Construction—Placing	Written notice to commence (including trial section).	7 days before starting	Superintendent
Trial Concrete Subbase —Construction	Inspection of the trial concrete subbase.	1 working day after placing trial section	Superintendent
Trial Concrete Subbase —Deficient trial section	Provide justification of the methods used in producing deficient work for assessment.	1 working day after deficiency identified	Superintendent

Table SC6.4.5.3.45 Mass concrete subbase-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Conformance for concrete strength and thickness		
Testing by specimens cut from the work	Coring witnessed by Superintendent	3 working days
Restoration after coring	Inspection of restoration work	3 working days after cutting
Placing and finishing concrete subbase		
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Average application rate	Average rate checked by the Contractor and certified by the Superintendent	Progressive
Bond breaker and spall treatment		
Treatment of Unplanned Cracks	Check for cracks and repair/reject	Progressive

Table SC6.4.5.3.46 Plain and reinforced concrete base-hold points

Clause title / Item	Requirement	Notice of inspection	Release by
Design and control of concrete mix			
Nominated mix	Submit details and certificates for nominated concrete mix and material constituents including NATA certificates and test results	21 working days before using the nominated mix	Superintendent
Variations to nominated mix and materials	Submit details of any change to nominated mix and materials	21 working days before implementing change	Superintendent
Steel reinforcement			
Placing and cover requirements	Approval of placement and fastening of reinforcing steel	4 working hours before concrete placement	Superintendent
Production, transport and consistency of concrete			
Concrete production and transport	Submit proposed methods and equipment	4 weeks before starting	Superintendent
Placing and finishing concrete base			
Subbase survey	Work-as-executed survey of the subbase.	7 days before starting any works	Superintendent
Surface texture	Submit details of proposed texturing device and method of texturing	Before texturing	Superintendent
Trial of Concrete Base Construction	Obtain approval for the trial section	5 working days before main works	Superintendent
Trial of Concrete Base—Deficient trial section	Provide justification of the methods used in producing deficient work for assessment	2 working days after construction	Superintendent
Joints			
Permanent sealing—General	Submit proposed method for permanent joint sealing	4 weeks before installation	Superintendent
Slab anchors			
Excavation	Submit compacted excavated surface	1 working day before concreting	Superintendent
Testing of concrete for compressive strength			
Sampling	Inspection of sampling procedure	Progressive	Superintendent
Acceptance criteria	Submit test results	Progressive	Superintendent
Acceptance criteria for cored concrete	Submit test results	Progressive	Superintendent
Removal and replacement of base			
General	Submit proposed method of removal to preserve adjoining base and underlying subbase	7 working days before replacement works	Superintendent

Table SC6.4.5.3.47 Plain and reinforced concrete base-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Witness Points Off Site		
Clause/ subclause	**Requirement**	**Notice of inspection**
Materials for concrete		
Aggregates - Storage	Storage and handling to preserve quality of aggregate	Progressive
Steel reinforcement		
General	Provide NATA certificates and manufacturer's information.	Before delivering to site
Bar chairs	Demonstrate load bearing capacity	Before delivering to site
Joints		
Silicone Sealant	Provide NATA certificate and manufacturer's information	4 weeks before joint work
Witness Points On Site		
Joints		
Permanent Sealant	Locations as shown on drawings and change to spacing	Progressive
Placing and finishing concrete base		
Consistency	Provide slump check test results	Progressive
Protection of Work - Ambient conditions	Provide details of protection methods for cold or hot weather and rain	Progressive
Traffic considerations	Provide traffic management measures	Progressive
Rate of Evaporation and moisture loss	Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits	Progressive
Paving (Mechanical and Hand Paving)	Construction joint if hand or mechanical paving is disrupted	Progressive
Alignment and Surface Tolerances - Assessment of base thickness	Survey of base surface, edge alignment and thickness	Progressive
Curing – Efficiency Index	Submit certificate of compliance for the curing compound	Progressive
Testing of concrete for compressive strength		
Testing of specimens cut from the work	Carry out coring in presence of the Superintendent	
Repair and Restore work after coring	Restore holes with non-shrink cementitious concrete	After coring
Conformance of concrete strength, compaction and thickness		
Relative Compaction	Testing conformance of required relative compaction	Progressive

Table SC6.4.5.3.48 Sprayed bitumen surfacing-hold points

Clause title/Item	**Requirement**	**Notice for inspection**	**Release by**
Design of bituminous surfacing			
Confirmation of Design and Materials Compliance	Submit the sprayed seal design and additional details for approval	2 weeks before commencing work	Superintendent
Plant	Evidence that plant is registered and insured	2 weeks before using plant	Superintendent

Table SC6.4.5.3.49 Sprayed bitumen surfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Application and rolling of aggregate		
Removal of loose aggregate, Loose aggregate particles	Completion within specified time	Various to allow inspection of performance in conformance with Tables of time limits
Removal of surplus and waste material	Demonstrate that materials are properly disposed	Progressive
Protection - New work	Demonstrate that line marking and warning signs are in place to protect new work	Progressive

Table SC6.4.5.3.50 Bituminous microsurfacing-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Mix design			
Nominated Mix—Design and control of bituminous mix	Submit details of nominated mix with NATA Certification	7 days before commencing	Superintendent
Production and paving			
Production mix Bituminous —microsurfacing	Target application rate and nominal layer thickness for approval	7 days before commencing	Superintendent
Sampling and testing of production mix	Compliance with maximum permitted variations from approved mix	During mixing	Superintendent
Weather limitations	Cease works if weather conditions are not appropriate	Progressive	Superintendent
Paving unit calibration	Documentation for detailed calibration	7 days before using paving unit	Superintendent
Preparation of Pavement	Provide cleaned surface for inspection	1 working day prior to spreading works	Superintendent
Spreading—Traffic	Capable of carring traffic in short period after slurry surfacing to the approval of Superintendent	One hour after spreading	Superintendent
Surface texture—Test run	Demonstrate surface texture	1 working day before commencing	Superintendent
Non-conformance—Materials and finished surfacing	Approval for correction or replacement	1 working day before corrective action	Superintendent

Table SC6.4.5.3.51 Bituminous microsurfacing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/Item	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Binder—Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Mineral Aggregates—Quality	Submit NATA test results for the nominated mineral aggregates	7 days prior to commencing works
Mineral Filler—Quality Compliance	Submit NATA test results for the nominated binder	7 days prior to commencing works
Witness Point On Site		
Spreading—Clean up	Leave road fixtures in clean and satisfactory condition	Progressive

Table SC6.4.5.3.52 Segmental paving-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
Materials			
General—Nominated materials	Submit segmental paving materials and supplier.	2 weeks before ordering	Superintendent
Construction			
Subgrade Preparation—Dimensions and specification	Present the finished subgrade for approval	1 working day before proceeding	Superintendent
Subbase—Dimensions and specification	Present finished subbase for approval	1 working day before proceeding	Superintendent
Base—Dimensions and specification	Present the finished base for approval	2 working days before proceeding	Superintendent

Table SC6.4.5.3.53 Segmental paving-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
Opening to Traffic—Inspection	Regularly inspect joints after completion	Progressive

Table SC6.4.5.3.54 Stabilisation-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials proposed for use in the work	Submit NATA certificate of compliance	14 days prior to commencement of works	Superintendent
Field Working Period —Laboratory	Nominate the specific field working period specified in the Stabilisation Mix Design	14 days prior to commencement of works	Superintendent
Materials			
Cement—Storage	Re-test cement stored in excess of 3 months	2 working days prior to usage	Superintendent
Stabilisation Process —Proposed equipment and procedures	Submit a Work Plan nominating proposed plant and work sequence	14 days prior to commencement	Superintendent
Application of stabilising agent—In situ application	Proposals for special processes of supply of stabilising agent into the mixing bowl	7 days prior to mixing	Superintendent
Mixing—In situ mixing process	Demonstration of equipment mixing efficiency in trial section	7 days prior to production stabilisation	Superintendent
Trimming and Compaction—Trimming	Work methods to exclude laminations and slurrying	3 working days prior to production stabilisation	Superintendent
Trimming and Compaction—Survey control methods	Use of trimmed material as fill or spoil	3 working days prior to disposition	Superintendent
Curing—Method statement	Submit details of proposed curing method	As directed	Superintendent
Trial section of stabilised earthworks			
General	Submit a trial section of stabilised earthworks	5 working days prior to commencement of works	Superintendent and Council
General	Any deficient sections will require to be investigated and may be directed to remove	Progressive	Superintendent and Council

Table SC6.4.5.3.55 Stabilisation-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Witness Points Off Site		
Materials		
Cement	Proof of quality and source	Progressive
Quicklime	Proof of quality and source	Progressive
Hydrated lime	Proof of quality and source	Progressive
Ground granulated blast furnace slag	Proof of quality and source	Progressive
Flyash	Proof of quality and source	Progressive
Blended stabilising agent		
Blended stabilising agent —Standard	Proof of quality and source	Progressive
Blended stabilising agent —Handling and storage	Comply with supplier's handling and storage requirements and arrange sampling of agent	Progressive
Witness Points On Site		
Quality Requirements—Compaction	Adjustment of Field Working Period for site conditions	Progressive
Application of stabilising agent —Stationary mixing plant	Monitoring application of stabilising agent at the plant	Progressive
Application of stabilising agent —Stationary mixing plant	Removal of spilled stabilising agent	Immediately upon spillage event
Application of stabilising agent —Spreading out	Actual spread to be recorded and checked	Progressive
Application of stabilising agent —Spreading out	Record average spreading rate using load cells	Progressive
Mixing—Stationary mixing plant	Test unconfined compressive strength	Progressive
Mixing—In situ mixing process	Visual inspection to ensure uniform mixing and record	Progressive
Mixing—In situ mixing process	Additional passes of mixing equipment to improve uniformity	Progressive
Trimming and Compaction—Survey control methods	Survey to confirm pavement layer thickness remains within tolerances after trimming	Progressive
Trimming and Compaction —Straight edge test	Conform to surface tolerances prior to sealing or practical completion of work component	As directed by Superintendent
Dimensions—Width	Random measurement of stabilised layer width	As directed by Superintendent

Table SC6.4.5.3.56 Subsoil, foundation and pavement drains-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Construction			
Subsoil and Sub-Pavement Drains / Foundation drains—Excavation	Inspect excavated trench	1 working day prior to filling	Superintendent
Subsoil and Sub-Pavement Drains / Foundation drains—Laying of Pipes	Present bedding of compacted filter material laid to line and grade	3 working days before next activity	Superintendent
General—Filter material	Type of filter material	3 working days before ordering material	Superintendent
Intra-pavement drains —Laying of pipe	Provide certification that drain has adequate crushing strength	3 working days before ordering	Superintendent
Intra-pavement drains —Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent
Edge drains—Laying of pipe	Submit details of proposed method of securing pipes	7 days before pipe laying	Superintendent

Table SC6.4.5.3.57 Subsoil, foundation and pavement drains-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
Construction		
Subsoil and Sub-Pavement Drains / Foundation drains—Pipes	Lay on compacted bed to documented line and level	1 working day before filling
Subsoil and Sub-Pavement Drains —Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Foundation drains—Backfilling	Backfilling to documented level and relative compaction	1 working day before covering with geotextile
Geotextile—Installation	Placement of fabric conformance	1 working day before filling
Geotextile—Installation	Ensure exposure periods are within the constraints	Progressive
Cleanouts—Field testing	Perform flushing test	Progressive (timing depending on the construction of pavement layers)

Table SC6.4.5.3.58 Subsurface drainage-witness points

Item/Clause title	Requirement	Notice for inspection	Release by
General			
Siting of Work	Submit the proposed set-out in addition to the designed set-out	7 days before planned execution	Superintendent
Siting of Work—Proposed changes	Present the proposed new set-out for approval	3 days before planned execution	Superintendent
Excavation—Existing underground services	Submit evidence of approval of the relevant authorities.	14 days before planned excavation	Superintendent
Excavation—Trenches	Approval of completed trenches required prior to installation of drainage work	1 working day prior to installation of drainage work	Superintendent
Materials			
Subsurface drainage pipes—General	Submit compliance certificates	7 days before proceeding to provide pipes	Superintendent
Other subsurface drainage pipes	Submit details of proposed alternative pipes and evidence of conformity for approval.	7 days before proceeding to provide pipes	Superintendent
Geotextile—General	Provide documentation of conformity of geotextile and installation process	14 days before proceeding to provide geotextile	Superintendent
Recording of drainage			
Recording of subsurface drainage Information	Progressive supply of subsurface drainage details	5 working days after completion of each drain or drainage system	Superintendent

Table SC6.4.5.3.59 Subsurface drainage-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item/Clause title	Requirement	Notice for inspection
General		
Temporary drainage during construction	Locate materials and equipment clear of water courses	7 days prior to positioning

Table SC6.4.5.3.60 Pavement markings-hold points

Clause title/subclause	Requirement	Notice for inspection	Release by
General			
Material Quality	Submit NATA Test Reports on materials	7 days before work is scheduled to commence	Superintendent
Surface preparation—Wet Weather	Superintendent direction on suspension of work	Progressive	Superintendent
Removal of pavement markings			
General—Removal of redundant markings	Submit method for approval	1 working day before commencement of activity	Superintendent

Table SC6.4.5.3.61 Pavement markings-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause title/subclause	Requirement	Notice for inspection
General		
Setting Out—Net	Set out in accordance with the drawings	Progressive
Pavement marking paint		
Application of Paint Beads—Glass beads applied to other paint markings	Application method to be approved by Superintendent	Progressive
Field testing—Application Rate	Application to be checked for quality	Progressive
Thermoplastic pavement marking material		
Field testing—Application Rate	Application to be checked for quality	Progressive
Pavement marking tape		
Removal of Pavement Marking Tape	Direction to remove pavement marking tape	Progressive
Raised pavement markers		
Installation of Raised Pavement Markers	Installation to be checked for quality (allow adhesive to set)	Progressive

Table SC6.4.5.3.62 Guide posts-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Materials—Proprietary posts—Proposed supplier	Supply details of the proposed guide posts	Two weeks before manufacture	Superintendent
Construction			
Erection of Guide Posts —Proprietary guideposts	Provide manufacturers anchorage instructions	5 working days	Superintendent
Erection of Guide Posts —Guide posts on concrete pavements	Provide fixing details	5 working days	Superintendent

Table SC6.4.5.3.63 Guide posts-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/ subclause	Requirement	Notice for inspection
Construction		
General—Location of guide posts and proximity to underground services	Locations shown on drawings or as specified Check for existing underground services	Two weeks before installation
Erection of Guide Posts—Backfilling	Firm embedment in ground	Progressive
Delineators—Fixing	Arrangement of delineators relative to traffic direction	Progressive

Table SC6.4.5.3.64 Signposting-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
Materials			
General—Approved Supplier	Details of proposed suppliers provided to the Superintendent including documentary evidence	1 week prior to ordering	Superintendent
General—Documentary Evidence	Evidence that materials and parts proposed comply with the requirements of this specification	1 week prior to engaging supplier	Superintendent
Retro-Reflective Material for Background and Legend	Details of material and compatibility in application and durability	1 week prior to ordering	Superintendent
Sign Support Structures —Attachment of signs	Details of proposed attachment systems	2 weeks prior to fabricating attachment systems	Superintendent
Erection of new signs			
Setting Out	Approval of the location and alignment of the sign support structure	1 week prior to erection	Superintendent
Setting Out—Existing underground services	Locate services and protect against damage	1 week prior to erection	Superintendent
Special requirements			
Street Name, Service and Tourist Signs	Submit details of manufacturer for approval by council	1 week prior to ordering	Council

Table SC6.4.5.3.65 Signposting-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/subclause	Requirement	Notice for inspection
Erection of new signs		
Setting Out	Submit details of and set out for each support structure	1 week before installing signs
Clearing	Clear vegetation after set-out on advice from council	3 working days before clearing
Sign Structure Footings —Excavation	Excavation as shown on drawings and as directed, including disposal of material	1 working day before next activity
Erection—Sign Damage	Repair or replace damaged signs	1 week before installing signs
Adjustment of existing signs and support structures		
General	Conform to Drawings and Superintendent direction	1 week before adjusting signs

Table SC6.4.5.3.66 Non rigid road safety barrier system-hold points

Item/Clause title	Requirement	Notice for inspection	Release by
Materials			
Certification—Evidence of Conformance	Provide documentary evidence of conformity of steel components	1 week prior to erection	Superintendent
Construction			
General— Set Out	Set out to drawings or as directed	2 working days prior to erection	Superintendent
End Treatment of Road Safety Barriers—MELT	Submit alternative MELT locations	1 week prior to ordering	Superintendent

Table SC6.4.5.3.67 Non rigid road safety barrier system-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Construction		
General—Sequence of Construction (pavements)	Erection after pavement activities	1 week before installation – progressive
General—Underground Obstruction	Alternative method due to obstructions	1 week before setting posts
Erection of Steel Posts—Damage to posts	Assessment by Superintendent for replacement	3 working days before removal of damaged post
Erection of Road Safety Barrier Rails—Excessive damage to rails	Assessment and rejection by Superintendent	1 working day after perceived damage

Table SC6.4.5.3.68 Minor concrete works-hold points

Clause/subclause	Requirement	Notice for inspection	Release by
General			
Excavation and Foundation General—Ground preparation—Base preparation	Inspect prepared surface or sand underlay	1 working day prior to covering	Superintendent
Excavation and Foundation General—Ground preparation—Polymeric film underlay installation	Inspect membrane or film underlay installed	1 working days prior to covering	Superintendent
Approval of Formworks Design	Formwork design certificates	3 working days	Superintendent
Erection—Formwork	Certification of installed formwork and inspection	1 working day prior to covering	Superintendent
Materials for concrete			
Nominated Mix	Submit details of nominated mix for approval	7 working days	Superintendent
Reinforcement for concrete			
Steel reinforcement placement—Approval of reinforcement before concrete placement	Inspect reinforcement placement	1 working day prior to covering	Superintendent
Cores, fixings and embedded items—General	Shop drawings for cores, fixings and embedded items	7 working days prior to commencing works	Superintendent

Clause/subclause	Requirement	Notice for inspection	Release by
Loads on minor concrete structures	Approval for early loading of the structure by design strength in situ tests	3 working days	Superintendent
Sprayed concrete general—Method statement	Submit proposal for spraying	14 days prior	Superintendent

Table SC6.4.5.3.69 Minor concrete works-witness points

Clause title/Item	Requirement	Notice for inspection
General		
Ground preparation—Mass concrete bedding on earth foundations	Inspect concrete blinding slab prior to placing forms or materials	1 working day prior to covering
Concrete quality requirements —Formwork	Check erection tolerances	1 working day
Materials for concrete		
Certificate of compliance	NATA certificates for all materials	7 days prior to commencing on site
Handling and treatment of concrete		
Mixing of concrete—Hand Mix On Site	Submit proposal for use	7 days prior
Mixing of concrete—Pre-mixed supply	Submit delivery dockets and subcontractors details	Progressive
Concrete quality requirements —Flatness	Confirm unformed surfaces	1 working day
Concrete quality requirements —Surface quality	Confirm surface quality	1 working day
Concrete curing	Certified test results for curing compound	7 days prior
Joints	Submit proposal for sawn joints	7 days prior
Concrete placing and compaction —Testing	Certified test results for compressive strength	Progressive
Reinforcement for concrete		
Steel reinforcement placement —Delivery and receipt of reinforcement	Submit notice for test inspection	7 days
Steel reinforcement placement —Placing	Submit proposed changes to reinforcement	2 days prior to commencing on site
Steel reinforcement placement —Damaged galvanising	Submit proposed repair method	2 working days prior
Steel reinforcement placement —Provision for concrete placement	Submit proposed changes to spacing, cover, splicing or welding or reinforcement	2 working days prior
Cores, fixings and embedded items—Cutting or coring	Approval for cutting or coring hardened concrete	2 working days prior
Sprayed concrete—Sprayed concrete test panel	Approval of sample panels	7 days

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Table SC6.4.5.3.70 Boundary fencing-hold points

Clause title / item	Requirement	Notice for inspection	Release by
Materials			
General—Material approval	Submit source, type, Certificate of compliance and manufacturer for each type of material	One week before ordering each type	Superintendent
Construction			
General—Clearing and grubbing	Confirm approval for tree removal	One week before next activity	Superintendent
Erection of posts			
Depth of posts	Method of installing and proposed type of posts to be used	One week before manufacture or order	Superintendent
Erection of wires—General	Approval for any proprietary fasteners	One week before manufacture or order	Superintendent
Flood gates—General	Approval to proceed with flood gates and type	One week before fabricating flood gates	Superintendent
Removal and disposal of surplus material and rubbish	Approval required for burn off for combustible materials	Prior to burning	Superintendent
Bedding—Cattle Grids	Approval for bedding requirements	One week before fabricating flood gate	Superintendent

Table SC6.4.5.3.71 Boundary fencing-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Item	Requirement	Notice for inspection
Materials		
Galvanised Posts, Braces and Rails —Welded Joints	Welding sites to be cleaned and painted	Progressive
Gates—Dimensions and Fittings	Fitting alternatives	3 working days before fabrication
Construction		
Stock-Proof Fencing—Erection of posts—Depth of posts	Posts sunk to the required depths	Progressive
Crossing of Watercourses and Depressions	Secure by installing longer posts as directed	Progressive
Flood gates—Small water courses	Provide required waterway area	Progressive
Erection of Gates	Double gates to be directed	One week before ordering
Removal and disposal of surplus material and rubbish	All surplus material to be removed	Progressive

Table SC6.4.5.3.72 Control of traffic-hold points

Clause title/Item	Requirement	Notice for inspection	Release by
General			
Traffic guidance scheme (TGS)—Approval	Approval of Traffic guidance scheme	2 weeks before proposed commencement on site	Superintendent.
Traffic guidance scheme (TGS)—Relevant Authority Approval	Provide evidence of approvals from Council and other Authorities	4 weeks before proposed commencement on site	Superintendent
Traffic Guidance Scheme (TGS)—Non-complex TGS	Carry out a risk assessment for works not involving complex TGS or staged works	4 weeks before proposed commencement on site	Superintendent.
Side Roads and Property Accesses—Proposed access	Provide Proposal for access	5 working days prior to carrying out works	Superintendent.
Side Roads and Property Accesses—Notice to property owners	Approval to deny vehicular access and provide notice to property owners	3 working days prior to carrying out works	Superintendent.
Temporary roadways and detours			
Approval	Submit design of all proposed temporary roadways and detours	5 working days prior to carrying out works	Superintendent.
Opening to Traffic	Present completed temporary roadways and detours to the Superintendent for approval prior allowing traffic	5 working days prior to carrying out works	Superintendent.
Arrangements for traffic			
Construction Under Traffic—Approval	Approval required to construct under traffic	3 working days prior to carrying out works	Superintendent.
Construction Under Traffic—Details	Submit full details of temporary signposting, traffic control devices and traffic control methods for approval	5 working days prior to carrying out works	Superintendent.
Opening Completed Work—Written Notice	Provide written notice to the Superintendent confirming date of opening of completed works.	5 working days prior to opening of completed works	Superintendent.
Traffic control devices			
Adequate Traffic Control Devices—Default by Contractor	Rectify inadequate traffic control devices	1 working day of notice	Superintendent.

Table SC6.4.5.3.73 Control of traffic-witness points

Note—the Contractor must notify the Superintendent and/or council of impeding works, where the option of attendance may be exercised by the Superintendent and council.

Clause/Item	Requirement	Notice for inspection by the Superintendent
General		
Traffic Guidance Scheme (TGS)—Site Copy	A copy of the approved Traffic Guidance Scheme must be kept on site	Progressive
Traffic Guidance Scheme—Safety Audit	For complex traffic arrangements and staged works carry out safety audits	Progressive
Traffic Controllers—Personnel	Submit names and declaration of proposed traffic controllers	Prior to commencing work
Temporary Speed Zoning—Record	Diary and method of works	Progressive
Temporary roadways and detours		
Drainage—Pavements	Pavement designed and constructed not to pond water	Progressive
Surfacing—Extent	Width of wearing surface and position of finish tying into existing works	3 working days prior to carrying out works
Traffic control devices		
Arrangement of traffic control devices	Arrangement and placement as per the approved TGS	Progressive
Temporary markings—Line Marking	Ineffective line marking, remark within 48 hours.	Progressive
Temporary markings—Old Markings Removed	Obliterate or remove old markings.	Progressive
Raised Pavement Markers—Ineffective Markers	Replace ineffective markers within 24 hours.	Progressive

SC6.4.5.3 Attachment E Non conformance Certificate (NCC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment F Non Conformance Report (NCR) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment G Notice of Non Conformance Report (NNC) - Template

Click here to obtain a copy of the following form.

SC6.4.5.3 Attachment H Corrective and Preventive Action Request (CPAR) - Template

Click here to obtain a copy of the following form.

SC6.4.6 Construction standards

SC6.4.6.1 Water sensitive urban design construction and establishment requirements

SC6.4.6.1.1 Introduction

This sub-section is a supporting document to the Water by Design, 2010, *Construction and Establishment Requirements: Swales, Bioretention Systems and Wetlands* (Construction and Establishment Guidelines), South East Queensland Healthy Waterways Partnership, Brisbane. The Construction and Establishment Guidelines are adopted in whole, with the exceptions and additions as noted in this planning scheme policy.

Editor's note—the most up to date version of the Construction and Establishment Guidelines can be purchased from Water by Design.

SC6.4.6.1.2 Irrigation

Supplementary irrigation may be required to maintain system functionality during prolonged periods of dry. Water supply to bioretention and wetland systems is greatly influenced by localised residential runoff; hence council imposed water restrictions or prolonged periods of dry should be met with supplementary irrigation. Irrigation (temporary or permanent) may be requested by council during landscape installation. All irrigation plans are to be approved for use by council.

Editor's note—use Form D: Swales; Form G: Bioretention systems; Form H: Constructed Wetlands from the Construction and Establishment Guidelines.

SC6.4.6.1.3 Vegetation establishment

Throughout the sub-section, reference is made to building phase protection by temporary measures. Where 80-90% of the building phase is referred to in the text the developer should ensure upwards of 90% build out before removal of temporary measures and establishment of the approved vegetation.

SC6.4.6.1.4 Weed management

Typha spp have shown an ability to dominate systems in Townsville and disable their functionality and maintainability. Although some Typha species are native they are considered an environmental weed whose control is recommended (Queensland Government Department of Primary Industries and Fisheries, October 2010). As such Typha spp should be removed from systems early to prevent spread and actively managed to ensure that the system is free of the weed at the point of handover. This will ensure that hydrological functioning is maintained, reduce snake habitat (both real and/or perceived), increase vector control, protect desirable, approved species; and reduce fuel loads when systems dry out.

The Developer is to ensure that all waterways are free of Typha spp at the end of the defects liability period.

SC6.4.6.1.5 Dredge spoil dewatering areas

As council refuse facilities do not accept "wet waste", the developer will need to incorporate dredge spoil dewatering areas for sediment and aquatic weeds removal into their design. Any dewatering area proposed should be suitable for maintenance vehicle access. The area should be positioned as close as practical to the constructed wetland/drainage channel, be an adequate size and designed to contain the excavated material and associated runoff. The dredge spoil area will not only meet the needs of the developer during the construction and operational phases. Dredge spoil areas must be identified and approved by council prior to any excavation.

Dredge spoil areas are to be retained for the duration of the construction and operational phases of the wetland/drainage canal that is being maintained.
The developer must determine dredge spoil area locations based on the following criteria:

(1) Estimated amount and frequency of dredge material to be dewatered;

(2) Proximity to existing residential and commercial properties;

(3) Proximity to proposed wetland/drainage channel; and

(4) Potential for dredge spoil to emit offensive odours (ie high clay/weed content).

Editor's note—use Form A: Swales; Form A: Bioretention Systems; Form C: Constructed Wetlands from the Construction and Establishment Guidelines.

SC6.4.6.1.6 Saltwater intrusion

Section 4.9 of the Construction and Establishment Guidelines lists potential failures. Saltwater intrusion should be considered as an additional defect or failure.

Table SC6.4.6.1.1 Potential failure scenarios for swales and rectification actions

Defect or Failure	Causes	Rectification
Saltwater Intrusion	Physical disturbance/excavation of clay liner during routine maintenance works. Drying/cracking of clay liner during routine maintenance and system resetting works. System overtopping during Highest Astronomical Tide (HAT): (1) System should be designed for highest expected tide over lifespan of asset; and (2) Overtopping in tidal areas during storm surge and heavy rainfall typically appears manageable due to stratification of fresh on salt during high tides. This should be taken into account. Poor design/construction. No liner present. Low lying wetland encroaching water table.	Provide supplementary water to lower salinity of intruded water and/or leach accumulated salts from underlying soils. Review construction designs such as spill weir heights and clay liners for deficiencies/inefficiencies. Engage soil scientist and water sensitive urban design specialist to review soils/clay lining and species compositions if system fails.

SC6.4.6.2 Water supply

SC6.4.6.2.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the construction of water supply infrastructure including:

(a) mains up to DN600 nominal size; and

(b) small pump stations.

This sub-section excludes the construction of:

(a) reservoirs, including repainting of reservoirs;

(b) treatment plants;

(c) dams;

(d) headworks, including bores and weirs;

(e) dosing plant; and

(f) larger pump stations.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents, and, in particular, in accordance with the requirements of the *Water Supply Code of Australia* except as otherwise specified herein.

(2) Reference and source documents

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Water Supply Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub section, these references are identified by part and section numbers and enclosed in brackets thus (WSA Part, Section).

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works

Note—SC6.4.4.8 Standard drawings shall take precedence over the WSAA standard drawings. Where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards

Note—references in this sub-section or on the drawings to Australian Standards are noted by their prefix AS or AS/NZS. Where not otherwise specified in this sub-section or the drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS1112	*ISO metric hexagon nuts*
AS1152	*Specification for test sieves*
AS/NZS1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS1272	*Unsintered PTFE tape for thread sealing applications*
AS1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS1289.5.6.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Density index method for a cohesionless material*

AS1289.5.7.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid method)*
AS1349	*Bourdon tube pressure and vacuum gauges*
AS1432	*Copper tubes for plumbing, gasfitting and drainage applications*
AS1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS1477	*PVC pipes and fittings for pressure applications*
AS1565	*Copper and copper alloys – Ingots and castings*
AS1579	*Arc welded steel pipes and fittings for water and waste water*
AS/NZS1594	*Hot-rolled steel flat products*
AS1627.4	*Metal finishing – Preparation and pre-treatment of surfaces - Abrasive blast cleaning of steel*
AS1646	*Elastomeric seals for waterworks purposes*
AS1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS1830	*Grey cast iron*
AS60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS2032	*Installation of PVC pipe systems*
AS2033	*Installation of polyethylene pipe systems*
AS2129	*Flanges for pipes, valves and fittings*
AS/NZS2280	*Ductile iron pipes and fittings*
AS2419.2	*Fire hydrant installations – fire hydrant valves*
AS2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS2566.1	*Buried flexible pipelines – Structural design*
AS/NZS2566.2	*Buried flexible pipelines – Installation*
AS2638	*Gate valves for waterworks purposes – Metal and resilient seated*
AS2837	*Wrought alloy steels – Stainless steel bars and semi- finished products*
AS/NZS3000	*Electrical installations (Wiring rules)*
AS/NZS3008	*Electrical installations – selection of cable*
AS3439	*Low voltage switchgear and control gear assemblies*
AS/NZS3518	*Acrylonitrile butadine styrene (ABS) compounds, pipes and fittings for pressure applications*
AS3571	*Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS3681	*Application of polyethylene sleeving for ductile iron piping*
AS3690	*Installation of ABS pipe systems*
AS3879	*Solvent cement and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings*
AS3862	*External fusion-bonded epoxy coating for steel pipes*
AS3952	*Water supply –Spring hydrant valve for waterworks purposes*
AS3996	*Access covers and grates*
AS/NZS4087	*Metallic flanges for waterworks purposes*
AS/NZS4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZS4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*
AS/NZS4321	*Fusion bonded medium density polyethylene coating and lining for pipes and fittings*
AS/NZS4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS4794	*Non-return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010

Water Services Association of Australia (WSAA) - *WSA 03 – 2011 - Water Supply Code of Australia*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control, 2008*

British Standard - *BS 410 - Specification for test sieves*

SC6.4.6.2.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub-section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by Townsville Water and Waste, the design drawings and this sub-section, an approval from Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M)

Unplasticised PVC (uPVC) and modified PVC (PVC-M) pipes and fittings for mains and suction pipes shall comply with AS/NZS1477 and AS/NZS4765, shall be suitable for use with rubber ring (elastomeric) seals complying with AS1646 joints and shall be of the class and size as shown on the Design drawings. (WSA 03 – 2011, Part 1, Section 4.)

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Acrylonitrile butadine styrene (ABS)

ABS pipes and fittings shall comply with AS/NZS3518 to the class, size, use, shape and colour as shown on the Design drawings and installed in accordance with AS/NZS2566.2 and AS3690.

ABS pipes and fittings shall be joined in accordance with the manufacturer's instructions using solvent cement to AS 3691.

(4) Glass reinforced plastic (GRP)

The use of this material is not permitted by council.

(5) Ductile iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS2280 and shall be of the class, size and lining, as shown on the Design drawings, and installed in accordance with AS/NZS2566.2. Jointing shall be with rubber rings (elastomeric), complying with AS1646, to the class and type as shown on the design drawings.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS4321, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline and fittings

Steel pipelines and fittings shall comply with AS1579 and AS/NZS1594 and shall be of the class, size, lining and coating as shown on the design drawings. (WSA 03 – 2011, Part 1, Section 4).

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric), complying with AS1646, unless shown otherwise on the design drawings.

The Contractor shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines.

(7) Copper pipe and fittings

Copper tube and fittings shall comply with AS1432 and shall be of the size and type as shown on the design drawings.

The Contractor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the design drawings (WSA 03).

(8) Polyethylene (PE)

Polyethylene pipe shall comply with AS/NZS4129 and AS/NZS4130 and shall be of the class and size as shown on the design drawings and installed in accordance with AS2033 (WSA 03 – 2011, Part 1, Section 4).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

Fittings up to 110mm shall comply with AS/NZS4129. Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS2280 and coated internally and externally in polyethylene in accordance with AS/NZS4129.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(9) Steelwork

Structural steelwork, including ladders, brackets, and covers, complying with AS1657, shall be abrasive blast cleaned to AS1627.4 Class 2.5 and hot dip galvanised to AS/NZS4680. (WSA 03 – 2011, Part 1, Section 4.)

SC6.4.6.2.3 Valves and hydrants

(1) General

The Contractor shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that the valves and hydrants are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer’s recommendations, the requirements shown on the design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material. (WSA 03 – 2011, Part 2, Section 15.13.)

The type of external corrosion protection of buried valves and hydrants shall be fusion-bonded medium density polyethylene coating to AS3862 and AS/NZS4321 or thermal-bonded polymeric coating to AS/NZS4158.

Flanges shall comply with AS2129 and AS4087 and shall be of the class and size shown on the design drawings.

(2) Stop valves

Sluice valves shall be resilient seated valves manufactured in accordance with AS2638. The valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Drawings (WSA 03 - 2011 Part 1, Section 8.2).

Ball valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Butterfly valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Knife Gate valves shall be flanged where permitted by the Townsville Water and Waste unless shown otherwise on the Design drawings (WSA 03 - 2011 Part 1, Section 8.2).

Scour valve assemblies shall be as shown on the Design drawings.

Valves shall be operated by a removable key. The Contractor shall size “Tee Key” valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels, where specified, shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

(3) Air valves

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80, and shall be installed as shown in the Design drawings (WSA 03 – 2011 Part 1, Section 8.4).

Air valves shall be installed such that they can be maintained without affecting supply.

The Contractor shall obtain the consent of Water Authority for the use of other types of air valves.

(4) Non-return valves

Non-return valves shall be of the swing check type to AS3578 or AS4794 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway (WSA 03 – 2011 Part 1, Section 8.5). Wafer style non-return valves shall not be used.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body.

Where shown on the design drawings, non-return valves shall have an extended spindle, minimum grade 316 stainless steel complying with AS1449, fitted with an adjustable counterweight, together with a proximity switch to indicate a no-flow condition.

No flow switches shall have the following features:

(a) be of the eccentric cam operated limit switch type.

(b) have a minimum rating of 10 amps, 240 V AC, 50- Hz.

(c) be oil tight and dust proof to IP 65.

(d) be suitable for 25mm conduit entry.

(e) be mounted on rigid stainless steel complying with AS1449 adjustable brackets. The brackets shall be free of sharp edges and exposed corners.

(5) Spring hydrants

Spring hydrant bodies shall be manufactured in accordance with AS3952 and installed in accordance with AS2419.2 except as varied below (WSA 03 - 2011 Part 1, Section 8.8).

The top of spring hydrants shall be between 100mm and 300mm below finished surface level as detailed in SC6.4.4.8 Standard drawings SD-350. If necessary, this shall be achieved by the use of hydrant risers of various heights.

Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS4158, or equivalent protection approved by the Superintendent.

(6) Pressure reducing valves

Pressure reducing valves shall be of the type as shown on the design drawings.

Pressure reducing valves shall be installed with isolating valves to facilitate maintenance.

SC6.4.6.2.4 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent for approval prior to the release of the hold point.

The Contractor shall not change the pipeline alignment without prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the mains and pump stations, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the design drawings. The pipelines shall be laid to grades and locations shown on the design drawings and to tolerances in the Water Supply Code unless directed otherwise by the Superintendent (WSA 03 – 2011, Part 2, Section 21). The Contractor shall confirm the locations immediately prior to construction (WSA 03 – 2011, Part 2, Section 11).

(3) Cover over pipelines

The minimum depth of cover to be provided for mains, measured vertically from the finished ground level to the top of any socket, shall be in accordance with SC6.4.4.8 Standard drawings SD-325:

Lesser cover may be provided where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent.

The maximum cover shall be 1200mm, however, greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

(4) Crossings

Where a pipeline crosses a road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. (WSA 03 - 2011 Part 2, Section 15.16.) The Contractor shall obtain the written approval from the Authority prior to commencement of work. Such written approval shall be supplied to the Superintendent if requested. The Superintendent shall advise at the time of notification by the Contractor whether the option to request the written approval is to be exercised.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the mains. The installation of the main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 03 – 2011 - Part 2, section 15.15).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1m behind the back of kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings or as directed by the Superintendent within the specified tolerances.

With excavation near existing underground services and structures, the Contractor shall be responsible in obtaining approval of the appropriate Authority and comply with all the requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners (WSA 03- 2011, Part 2, Section 13). The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor's expense.

The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossings across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise all affected residents beforehand. All installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control.*

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open. (WSA 03 - 2011 Part 2, Sections 13.1 and 13.2.)

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in Table SC6.4.6.2.1.

Table SC6.4.6.2.1 Minimum trench widths

NOMINAL SIZE OF PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
100	450	450
150	450	450
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved or improved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges. The Contractor is responsible in obtaining approval from the relevant Authority and/or owner before starting any excavation across paved or improved surface.

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Excavation depth

The Contractor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains to be laid on other than rock foundations or as otherwise shown on the design drawings.

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

(8) Support of excavation

The Contractor shall adequately support all excavations to statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls (WSA 03 – 2011 Part 2, Section 13.5).

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(9) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent’s approval of the excavated trench is required prior to the release of the hold point.

Crusher screenings shall only be used for pipe bedding where sand or other non-cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations. (WSA 03 – 2011 Part 2, Section 14.)

Pipes (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100mm below the barrel and socket of the pipe, where rock or other hard material occurs in the bottom of the trench. The bedding material shall conform to the sands classification described in SC6.4.4.8 Standard drawings SD-370, either loose clean sand and /or medium dense clean sand.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 75mm below the underside of the pipe barrel and socket, side support and overlay to a depth of 150mm above the top of the pipe) as shown in Figure 5.1 in AS2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within the limits in Table SC6.4.6.2.2, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above provided also that the material meets the requirements for passing sieve sizes 9.5mm and 6.7mm shown in Table SC6.4.6.2.2:

Table SC6.4.6.2.2 Grading of bedding material for PVC and PE pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5 mm	3/8 inch	100
6.7 mm	1/4 inch	90 - 100
425 µm	No. 36	40 - 90
150 µm	No. 100	0 - 10

All mains laid on grades steeper than 50% shall be encased in concrete as detailed on the design drawings.

(10) Laying and jointing of pipes

Unless detailed otherwise in this sub-section, the Contractor shall install pipes in accordance with AS/NZS2032, AS2033, AS/NZS2566.1 or AS3690 as appropriate (WSA 03 - 2011 Part 2, Sections 15, SC6.4.4.8 Standard drawings SD- 315 and SD-320).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll-on or skid type or, where shown on the Design drawings, mechanical joints, either fixed flange or bolted gland type.

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Pipes may be cut as needed or directed by the Superintendent to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed hand saw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol engined pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the

Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

The Contractor shall conform to the relevant statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes and submit a method statement for approval of the Superintendent.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2o or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface. Detectable identification tape shall be laid along the line of non-metallic mains within 150mm of the finished surface (SC6.4.4.8 Standard drawings SD-325).

(11) Trench stops

Where a pipe is laid on bedding at a grade of 5% to 14%, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed: (SC6.4.4.8 Standard drawings SD-374)

(a) at the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level; and

(b) the bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

The distance between trench stops shall be determined by the following formula:

$$D = \frac{100}{G}$$, whereby

D = Distance between stops in m

G = Grade of pipe expressed in %.

(12) Concrete bulkheads

Where a pipe is installed at a grade of 15% to 29%, the Contractor shall construct concrete bulkheads. Where a pipe is installed at a grade 30% to 50%, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is to be installed at a grade of 50% or more the Contractor shall provide a site specific design. Bulkheads shall be of 25MPa concrete complying with SC6.4.6.28 Minor concrete works, 150mm minimum thickness as follows: (SC6.4.4.8 Standard drawings SD-374 and WSA 03 – Part 2, Section 15.10)

(a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 300mm below finished surface level or such other level as directed by the Superintendent.

(b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.

(c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick

surround of gravel 2 to 10mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula:

Concrete bulkhead (grade of 15% to 29%)

$$D = \frac{L}{G}$$

Concrete encasement (continuous) and concrete bulkhead (grade of 30 per cent to 50 per cent)

$$D = \frac{100}{G}$$, whereby

L = 80 X Pipe length, m

= 450m max

if L> 100m use intermediate trench stops at spacing < 100/G

D = Distance between bulkheads in m

G = Grade of pipe expressed in %

(13) Valve and hydrant chambers

The Contractor shall construct around each valve and hydrant a chamber of the type and to the details shown on the Design drawings (WSA 03 – 2011, Part 2, Section 15.13).

The concrete shall comply with SC6.4.6.28 Minor concrete works.

Valve chamber covers shall be painted with white pavement marking paint while hydrant chamber covers shall be painted with yellow pavement marking paint.

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Contractor shall either wrap the valve using a tape consisting of synthetic fibre open weave cloth impregnated with saturated hydro-carbons, applied in accordance with the valve manufacturer's written instructions, or apply at least one coat of corrosion preventing material to the valve body after the valve has been installed but before backfilling. The coating material shall be compatible with the coating material which has been applied to the valve prior to delivery.

(14) Chamber covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

Tolerances for the dimensions on the COVER shall be - 3mm + NIL.

Tolerances for the dimensions on the FRAME shall be - 3mm + 3mm.

Covers shall be seated as shown on the design drawings or as directed by the Superintendent.

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 25mm above the surface of the ground, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

Cast iron covers and frames shall be manufactured in accordance with AS3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

The Contractor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

(15) Service connections

Not applicable.

(16) Thrust and anchor blocks

Thrust and anchor blocks shall be constructed where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur (SC6.4.4.8 Standard drawings SD-371 and WSA 03 – 2011, Part 2, Section 15.7).

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(17) Concrete encasement

The use of Concrete encasement shall not be permitted unless otherwise approved by the Townsville Water and Waste.

(18) Wrapping of pipelines

Where shown on the design drawings, the Contractor shall enclose a pipeline or a section thereof, in lay-flat polyethylene sleeving (WSA 03 – 2011, Part 2, Section 15.11).

The materials to be used shall be high impact resistance polyethylene sleeving, of minimum thickness 0.2 mm polyethylene film approved by the Superintendent and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

For dual trenching, pipelines shall be identified by colour sleeving, blue stripe for potable water and lilac for recycled water, or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 25 0mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeving material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene sleeving before, during or after backfilling of the trench.

(19) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent, consisting of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer’s recommendations or as directed by the Superintendent. Bolts and nuts shall be dry, clean and

free from rust immediately before wrapping.

SC6.4.6.2.5 Pipeline testing and restoration

(1) Testing of pipelines

The hydrostatic pressure testing shall be conducted in accordance with Section 6 and Appendix M of AS/NZS 2566.2.

The Contractor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled provided that:

(a) if so specified, or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than seven days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall flush and clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be 1200 kPa.

The Contractor shall maintain the specified test pressure as long as required by the Superintendent while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing of a section shall be considered to be satisfactory if:

(a) there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) there is no visible leakage;

(c) the measured leakage rate for pipes other than PE does not exceed the permissible leakage rate as determined by the following formula:

$Q_1 = 0.14DLH$

where:

Q_1 = permissible leakage rate (litres per hour)

D = nominal diameter of pipe (m)

L = length of section tested (km)

H = average test head (m): and

(d) for PE pipes:

$V_2 \leq 0.55V_1 + 0.14DLH$
where:
V_1 = water volume (litres) added between Hour 2 and Hour 3 to maintain test pressure
V_2 = water volume (litres) added between Hour 4 and Hour 5 to maintain test pressure
D = nominal diameter of pipe (m)
L = length of section tested (km)
H = average test head (m)

Any failure, defect, or visible leakage which is detected during the pressure testing of the pipeline or during the defects liability period shall be made good by the Contractor at the Contractor's expense. This constitutes a hold point.

Unless directed by the Superintendent, the maximum test length shall be 1000m.

(2) Connection to existing pipes

Connections to existing pipes carrying water shall be made at such times as will cause the least interference with the supply. The Contractor shall make arrangements with Townsville Water and Waste or other Authority concerned for the timing of the work including the need to isolate the existing mains and notification of affected dwelling occupants. The Superintendent shall be given 5 working days notice of such arrangements (WSA 03 – 2011 Part 2, Section 22.).

(3) Disinfection and flushing of pipelines

The Contractor shall disinfect all water mains after satisfactory testing in accordance with this sub-section (WSA 03 – 2011 Part 2, Section 20). The Contractor shall adopt procedures for the disinfection of the mains with the concurrence of Townsville Water and Waste. All test results submitted are required to be NATA certified.

After disinfection and testing is completed, the Contractor shall flush all water mains to ensure that the disinfected water used in the process do not enter sections of the system already in service. Flushing and disposal of disinfected water shall be in accordance with WSA 03 – 2011 Part 2, Section 20.2.

(4) Bacteriological testing

(a) General

Disinfection of a water main may be required to ensure suitable water quality parameters are maintained. When disinfection of a main is required, bacteriological testing of the disinfected water must be undertaken.

Disinfection may also be required where there is a likelihood of contamination. A bacteriological test must also be undertaken on all new disinfected mains following satisfactory completion of swabbing/flushing and pressure testing of the water main.

(b) Test procedure

Water mains shall be tested as follows:

(i) scour past the sampling point;

(ii) engage a NATA registered laboratory to collect representative water samples from the test section of the water main; and

(iii) dispose of testing water in accordance with the relevant environmental Regulator and/or Water Agency requirements.

(c) Satisfactory bacteriological test

The water main will be deemed compliant if:

(i) the test results fall within the water quality parameter limits specified in the Table SC6.4.6.2.3; or

(ii) the water quality parameter test results in the test section of water main are no worse than the water quality parameter test results measured by testing an influent sample of existing mains water, provided that the influent sample was collected by the NATA registered laboratory at the

same time as water sample from the test section of water main was collected.

Table SC6.4.6.2.3 Water quality parameter limits

Water quality parameter	Unit	Acceptable range
pH	-	6.8–8.5*
Chlorine (free)	mg/L	0.5–2.0
Total Coliform count	cfu/100mL	0
Faecal Coliform count or E.Coli count	cfu/100mL	0
Heterotrophic Plate count	cfu/mL	0–10

* for cement mortar lined mains an upper level pH of 9.2 is acceptable

For failed tests, the water main shall be swabbed, flushed and/or disinfected and then re-tested. This shall be undertaken until all test results are satisfactory.

(5) Backfill and compaction

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to the commencement of trench backfilling. The Superintendent's approval to the laid and jointed pipes is required prior to the release of the hold point. Backfill shall not be placed until the Superintendent has given approval.

Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified SC6.4.6.2.4(9) Pipe bedding. The material shall be compacted in layers of not more than 150mm to a Density Index of 70 as determined in accordance with AS1289.5.6.1 and with reference to WSA 03 – 2011, Part 2, Section 16.3.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows: (WSA 03 – 2011, Part 2, Section 17).

(a) where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be (WSA 03 – 2011, Part 2, Section 17):

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits detailed herein for pipe bedding, and compacted to Density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials:

(A) below 0.3m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95% of the standard maximum dry density of the material when determined in accordance with AS1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(b) elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS1289.5.7.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor shall carry out compaction tests 75mm to 100mm below the level being tested.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above.

The Contractor may compact backfill by trench flooding only where:

(i) the ground and backfill material is cohesionless sand;

(ii) water for flooding has been sourced at the site;

(iii) the process will not create mud which would be moved off site by vehicles or construction plant. The process is closely monitored to ensure adequate volumes are added to sufficiently compact the materials to achieve the compaction requirements as specified in WSA 03 – 2011, Part 2 – Table 19.1; and

(iv) additives are not used.

(6) Valve and hydrant marking

The Contractor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with SC6.4.4.8 Standard drawings SD-345 and/or shall be consistent with the method(s) in use by Townsville Water and Waste.

Where, in the opinion of the Superintendent, a valve or hydrant is at too great a distance from any existing wall, fence, kerb face, or post, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the valve or hydrant in metres, to an accuracy of 0.1m, shall be permanently marked on the plate with legible numbers a minimum 80mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions;

(b) when installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm; and

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall fix marking plates as soon as practicable after each valve or hydrant is installed. However, the Contractor shall temporarily cover marking plates for hydrants using masking tape or other approved cover which the Contractor shall remove on satisfactory completion of the pressure testing of the pipeline.

For hydrants, the Contractor shall affix blue two-way reflective raised pavement markers to the road pavement in accordance withSC6.4.4.8 Standard drawings SD-345.

(7) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with turf imported from a source approved by the Superintendent (WSA 03 – 2011, Part 2, Section 23). The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored

surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel, asphaltic concrete or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Contractor shall level trenches at the time of backfilling or otherwise as directed by the Superintendent. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.2.6 Pump stations

(1) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	
Casing and suction bend	Cast iron AS1830 Gr T200
Wear rings	Cast iron AS1830 Gr T200
Impeller	316 Stainless steel AS1449
Impeller nut	Gunmetal AS 1565-905C
Shaft	316 Stainless steel AS2837
Shaft sleeve	Phosphor bronze AS1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS1565-9060
Gland	Cast Iron AS1830 Gr T200
Gland studs	316 Stainless steel AS 2837
Gland nuts	316 Stainless steel AS2837
Fixing nuts and bolts handhold	316 Stainless steel AS2837
Covers	316 Stainless steel AS1449
Fitted bolts and nuts, casing and dowels	316 Stainless steel AS2837
Forcing screws	316 Stainless steel AS2837
Water thrower and drip tray	316 Stainless steel AS1449
Pump set base plate	Cast iron AS1830 Gr T200/Fabricated steel
MOTOR	

Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Cast iron/Mild steel
Motor fan cover	Mild steel
Motor fan	Metal
HOLDING DOWN BOLTS	316 Stainless steel AS2837
MECHANICAL SEALS	
Seal faces	Tungsten carbide or equal
Springs	Nickel chrome steel
Secondary seal	Fluoro carbon or nitrile rubber

The Contractor shall provide a written warranty from the Manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The Manufacturer's warranty shall require the Manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within two years after the date of delivery of any piece of equipment used in Work under the Contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS1111 and AS/NZS1112 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS1449 and AS2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluoroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(2) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150mm and larger. In pipework less than 150mm, gauges and fittings shall be screwed into a tapping band. Where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(3) Electrical compliance

The Works shall be in accordance with the requirements specified in SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the Design drawings indicate otherwise. The technical requirements detailed on the Design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS/NZS3000, the service rules of the supply authority and all relevant statutory authorities.

The Contractor shall supply the Superintendent a proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(4) Switchgear and control gear assembly (SCA)

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

Starter contactors shall have the appropriate rating for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the Design drawings.

The Contractor shall liaise with the electricity supply authority to supply pad locks for the metering equipment, at the Contractor’s expense. The Superintendent shall supply pad locks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current: 14kA for 1 second.
Peak Factor: 2.2
Power Factor Correction (Determined in consultation with Townsville Water and Waste)
Earthing (M.E.N. system)

All cables shall enter the SCA from below.

The Contractor shall supply data from the switchgear supplier confirming Type “2” co ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to standard specification TCC24 clause 18 for starter selection requirements and functional specification

for the project.

The Contractor shall carry out factory tests in the presence of the Superintendent's Representative and in accordance with the requirements stipulated in SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS3439.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall ensure, after approval has been given by the Superintendent, that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(5) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority’s requirements, with a minimum 500mm below the finished ground level in non-trafficable areas and 600mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150mm wide and stamped with the words “DANGER – ELECTRIC CABLES BELOW” or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read “DANGER – ELECTRICAL CABLES BELOW”. The Superintendent’s approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer’s connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers’ mains shall be sized to satisfy the following requirements:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum;

(b) be sized for a voltage drop less than 1.5% to the maximum demand as calculated;

(c) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS/NZS3000 and AS/NZS3008.

In addition to the requirements of the Supply Authority and as specified in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines) the main earthing conductor shall be run in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the Queensland Electricity Connections and Metering Manual.

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(6) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for "running in";

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc.,

depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc.) including setting and adjustment of equipment in accordance with the requirements in SC6.4.3.21.4 Electrical and mechanical (Townsville Water planning and design guidelines).

The Contractor shall arrange for all testing, commissioning and any adjustments to be carried out by qualified personnel.

(7) Practical completion of pump station

The Contractor shall fulfil the following requirements before the Certificate of Practical Completion is issued:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of Operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(8) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall operate automatically by control signals from the telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(9) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor's name, address and telephone number;

(ii) client's contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list;

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling - type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures: for switching and isolating the supply and distribution system;

(ii) description of operation;

(iii) maintenance procedures: recommended maintenance periods and procedures;

(iv) tools: particulars of maintenance equipment and tools provided, with instructions for their use.

(v) equipment: a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling: where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts: a list of the spare parts provided.

(10) Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

(11) Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.2.7 Construction compliance

(1) Work-as-executed details and operation and maintenance manual

The Contractor shall submit to the Superintendent work-as-executed drawings showing the actual location and alignment of pipelines, and all pump station details together with operating and maintenance manuals.

Details shall include the size, type, levels of pipelines, valve and hydrant chamber types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details.

The Contractor shall ensure that a Registered Surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

SC6.4.6.3 Sewerage system

SC6.4.6.3.1 Introduction

(1) Scope

This sub-section is for the construction of the following:

(a) gravitation sewers up to DN600 nominal size;

(b) common effluent sewers, both gravity and pressurised;

(c) vacuum sewerage systems;

(d) rising mains up to DN600 nominal size;

(e) standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers; and

(f) small pump stations, usually limited to single wells with submersible pumps.

This sub-section excludes the construction activities for:

(a) treatment plants;

(b) headworks;

(c) dosing plant;

(d) larger pump stations; and

(e) works controlled by others, including overflow management.

The Contractor shall carry out the work, and supply materials meeting the requirements of the reference documents and, in particular, in accordance with the requirements of the Water Services Association of Australia publications WSA 02-2014 – *Gravity Sewerage Code of Australia*, WSA 07 – 2005 - *Sewerage Pumping Station Code of Australia*, and WSA 07-2011 *Pressure Sewerage Code of Australia*, except as otherwise specified herein. Sewerage works should be designed in accordance with SC6.4.3.21 Townsville Water planning and design guidelines in conjunction with Department of Energy and Water Supply's *Planning Guidelines for Water Supply and Sewerage.*

For the purposes of this sub-section, "access chambers" are referred to as "maintenance holes".

(2) Reference and source documents to be read and applied in conjunction with this policy is sub-section are as follows:

Documents referenced in this sub-section are listed below whilst being cited in the text in the abbreviated form or code indicated. The Contractor shall possess, or have access to, the documents required to comply with this sub-section.

References to the *Sewerage Code of Australia* are made where there are parallel sections or equivalent clauses to those in this sub-section. Where not called up as part of this sub-section, these references are identified by edition, part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section).

(a) Development manual planning scheme policy sub-sections:

SC6.4.3.21 Townsville Water and Waste planning and design guidelines
SC6.4.4.8 Standard drawings
SC6.4.6.28 Minor concrete works
SC6.4.6.30 Control of traffic

Note—where any standard drawing used in conjunction with this sub-section includes technical requirements that conflict with this sub-section, the requirements of this sub-section shall take precedence.

(b) Australian Standards:

Note—references in this sub-section or on the design drawings to Australian Standards are noted by their prefix AS or

AS/NZS. Where not otherwise specified in this sub-section or the design drawings, the Contractor shall use the latest Australian Standard, including amendments and supplements, available within two weeks of close of tenders.

AS/NZS 1111	*ISO metric hexagon commercial bolts and screws*
AS/NZS 1112	*ISO metric hexagon nuts,*
AS 1152	*Specification for test sieves*
AS/NZS 1260	*PVC-U pipes and fittings for drain, waste and vent applications*
AS 1272	*Unsintered PTFE tape for thread sealing applications*
AS 1289.5.4.1	*Methods of testing soils for engineering purposes – Soil compaction and density tests- Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1	Methods of testing soils for engineering purposes – Soil compaction and density tests- *Compaction control test – Hilf density ratio and Hilf moisture variation (Rapid Method)*
AS 1349	*Bourdon tube pressure and vacuum gauges*
AS 1444	*Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties*
AS 1449	*Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 1565	*Copper and copper alloys – Ingots and castings*
AS 1579	*Arc welded steel pipes and fittings for water and wastewater*
AS/NZS 1594	*Hot-rolled steel flat products*
AS 1627.4	*Metal finishing – Preparation and pre-treatment of surfaces- Abrasive blast cleaning of steel*
AS 1646	*Elastomeric seals for waterworks purposes*
AS 1657	*Fixed Platforms, walkways, stairways and ladders – Design, construction and installation*
AS 1741	*Vitrified clay pipes and fittings with flexible joints – sewer quality*
AS 1830	*Grey cast iron*
AS 60529	*Degrees of protection provided by enclosures (IP Code)*
AS/NZS 2032	*Installation of PVC pipe systems.*
AS 2033	*Installation of polyethylene pipe systems*
AS 2129	*Flanges for pipes, valves and fittings*
AS/NZS 2280	*Ductile iron pipes and fittings*
AS 2528	*Bolts, studbolts and nuts for flanges and other high and low temperature applications*
AS/NZS 2566.1	*Buried flexible pipelines – Structural design*
AS/NZS 2566.2	*Buried flexible pipelines – Installation*
AS 2837	*Wrought alloy steels – Stainless steel bars and semi-finished products*
AS/NZS 3000	*Electrical installations (Wiring Rules)*
AS/NZS 3008	*Electrical installations –Selection of cables*
AS 3439	*Low voltage switchgear and controlgear assemblies*
AS 3518	*Acrylonitrile butadine styrene (ABS) compounds pipes and fittings for pressure applications*
AS 3571	*Glass filament reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin – Pressure and non-pressure drainage and sewerage*
AS 3578	*Cast iron non-return valves for general purposes*
AS 3681	*Application of polyethylene sleeving for ductile iron pipelines and fittings*
AS 3690	*Installation of ABS pipe systems*
AS 3972	*General purpose and blended cements*
AS 3996	*Access covers and grates*
AS/NZS 4058	*Precast concrete pipes (pressure and non-pressure)*
AS 4060	*Loads on buried vitrified clay pipes*
AS/NZS 4087	*Metallic Flanges for waterworks purposes*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS 4198	*Precast concrete access chambers for sewerage applications*

Note—read “maintenance hole” for “access chamber”

AS 4321	*Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
AS/NZS 4765	*Modified PVC (PVC-M) pipes for pressure applications*
AS 4794	*Non return valves – Swing check and tilting disc*

(c) Other

Department of Energy and Water Supply, *Planning Guidelines for Water Supply and Sewerage*, April 2010
Water Services Association of Australia (WSAA):

WSA 02-2014 - *Gravity Sewerage Code of Australia*
WSA 04-2005 - *Sewerage Pumping Station Code of Australia*
WSA 05-2013 - *Conduit Inspection Reporting Code*
WSA 07-2007 - *Pressure Sewerage Code of Australia*

British Standard - BS 410 - *Specification for test sieves*
International Erosion Control Association (IECA) - *Best Practice Erosion and Sediment Control*.

SC6.4.6.3.2 Materials

(1) General

The Contractor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this sub section.

Prior to the delivery of products and materials, the contractor is expected to obtain relevant product or material certification from the manufacturer which shall be presented to the Superintendent if requested.

The Contractor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the design drawings.

If the Contractor proposes to use alternative products and materials other than the products and materials authorised by the Townsville Water and Waste, the design drawings and this sub-section, an approval from the Townsville Water and Waste is required prior to delivery and use of alternative products or materials.

(2) Unplasticised and modified PVC (uPVC and PVC-M) pipe and fittings

Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class and size as shown on the design drawings (WSA 02- 2014, Part 2, Section 13.).

Unplasticised PVC (uPVC) pipes and fittings for rising mains and suction pipes shall comply with AS/NZS 1477 and AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings. Modified PVC (PVC-M) pipes and fittings shall comply with AS/NZS 4765, shall be suitable for rubber ring (elastomeric) joints and shall be of the class and size as shown on the design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS/NZS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of shelter.

(3) Polyethylene (PE) pipe and fittings

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the design drawings and installed in accordance with AS 2033 (WSA 02-2014, Part 2,Section 13.).

Jointing shall be by butt thermal fusion or by electrofusion couplings, or with compression fittings.

The Contractor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the design drawings.

(4) Glass reinforced plastic (GRP) pipe and fittings

Glass filament reinforced thermosetting plastics (GRP) pipes shall comply with AS 3571 and shall be of the class and size as shown on the design drawings and installed in accordance with AS/NZS 2566.1 (WSA 02-2014, Part 2, Section 13.).

Pipes and fittings are to be handled and stored protected from sunlight. The Contractor shall provide protection for the pipes and fittings from ultra violet light and damage. The Contractor shall take account of the time for storage and type of cover.

(5) Ductile iron (DI) pipe and fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the design drawings and in accordance with WSA 02-2014, Part 2, Section 13.

Flanges shall be to the table shown on the design drawings. Bolts and nuts for flanged joints shall be galvanised, or stainless steel as for the pumps specified herein, unless shown otherwise on the design drawings.

All pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be thermal bonded polymeric coated, in accordance with AS/NZS 4158, or wrapped. The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

(6) Steel pipeline

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the design drawings or as specified in WSA 02- 2014, Part 2, Section 13.

The Contractor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Superintendent.

The jointing system shall be rubber ring (elastomeric) unless shown otherwise on the design drawings.

(7) Vitrified clay

Vitrified clay (VC) pipes and fittings shall comply with AS 1741 and shall be of the class of pipe, complying with the loading requirements of AS 4060, and size as shown on the design drawings and suitable for rubber ring (elastomeric) joints (WSA 02-2002, Part 2, Section10).

(8) Precast maintenance holes (MH)

Precast maintenance hole components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-2014, Part 2, Section 17.2).

If approved by the Superintendent, precast systems, complying with the drawings, may be used in lieu of cast in-situ systems (WSA 02-2014, Part 2, Section 17.2.2). Precast system components shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(9) Preformed maintenance shafts (MS) and terminal maintenance shafts (TMS) including cover

Preformed maintenance shaft and terminal maintenance shaft components shall comply with AS/NZS 1477 for PVC, AS 2033 for PE, AS 3518 for ABS, AS 3571 for GRP and AS 4198 for concrete (WSA 02-2014, Part 2, Section 17).

(10) Maintenance hole covers and frames

Cast iron maintenance hole covers and frames shall comply with AS 3996 and shall be of a type that is flush top cast cover, identifiable as SEWER, size, opening and class as shown on the design drawings. Covers and frames shall not be delivered to the site before satisfactory documentary evidence has been submitted to the Superintendent that quality tests have been carried out.

(11) Steelwork

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanised to AS/NZS 4680.

SC6.4.6.3.3 Pipeline construction

(1) General

The Contractor, employees, or subcontractors, engaged in excavations, including tunnelling, are to be accredited for the work. Proof of accreditation must be provided to the Superintendent prior to the release of the hold point (WSA 02-2014, Part 2, Section 16.).

The Contractor shall not change the pipeline alignment without the prior concurrence of Townsville Water and Waste. The Contractor shall provide full details, of any proposed changes to the pipeline alignment, to the Superintendent for submission to Townsville Water and Waste. The Superintendent shall obtain the decision of Townsville Water and Waste prior to the release of the hold point.

(2) Location

The location of the sewers, maintenance holes, rising mains and pump stations, sizes and grades of sewers and rising mains, the types of maintenance holes and maintenance hole covers and the classes of pipes shall be as shown on the design drawings. The Contractor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the Superintendent. The Contractor shall lay pipelines to grades and locations shown on the design drawings unless directed otherwise by the Superintendent (WSA 02-2014, Part 2, Section 16.).

(3) Cover over pipelines

The minimum depth of cover to be provided over pipelines shall be as follows: (WSA 02-2014, Part 1, Section 5.6.3).

LOCATION	MINIMUM COVER (mm)
Private property non vehicular new developments	600
Private property non vehicular existing developments	450
Private residential property subject to vehicular loading	750
Footpaths, sealed roads (non arterial)	900
Unsealed roads	1200
Arterial roads	1200

Lesser covers may be permitted where special protection of the pipelines has been shown on the design drawings or directed by the Superintendent (WSA 02-2014, Part 1, Section 5.6.3.)

(4) Crossings

Where a pipeline crosses a main or state road, creek or involves features shown on the design drawings, under the control of any Authority, the Contractor shall carry out the work in accordance with the requirements of that Authority. The Contractor shall provide written notification to the Authority of the intention to carry out the work, and pay the appropriate fees. The Contractor shall obtain the written approval from the Authority prior to

commencement of work. Such written approval shall be supplied to the Superintendent if requested.

Where shown on the design drawings, the Contractor shall use trenchless methods for the installation of the sewer mains. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation (WSA 02-2014, Part 2, Section 14.12).

The Contractor shall address, in its method statement for trenchless conduit installation, the following:

(a) general description of method and sequence of operation;

(b) size, depth and position of temporary pits required;

(c) use of specialist subcontractors;

(d) specialist equipment to be used; and

(e) grout type and method of injection.

The encasement pipe shall be as detailed on the design drawings. The encasement pipe shall extend 1.0 m behind the back of the kerb on either side of the carriageway.

The carrier pipe shall be positioned on support cradles and the carrier pipe shall be centrally located within the encasement pipe.

After installation and pressure testing of the carrier pipe, the Contractor shall fill the annular space between the carrier pipe and the encasement pipe with suitable grout or cementitious grout filler.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

(5) Earthworks

The Contractor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the design drawings, or as directed by the Superintendent, within the specified tolerances.

Prior commencement of excavation, the Contractor shall be responsible in obtaining approval from the appropriate Authorities and shall comply with all requirements of the approval including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

The Contractor shall leave a clear space of 600 mm minimum between the edge of any excavation and the inner toe of stockpiles. No excavated materials shall be stockpiled against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Contractor shall install safety fencing to statutory requirements along the edges of open excavations to isolate them from the public. The Contractor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Contractor shall locate, protect and repair, as necessary, all services affected by the Works at the Contractor’s expense. The Contractor shall give notice of any interference to the works caused by an existing service and submit a proposed work method statement.

The Contractor shall carry out erosion and sedimentation control at all construction sites in accordance with *Best Practice Erosion and Sediment Control*.

The Contractor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

(6) Minimum trench width for pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in Table SC6.4.6.3.1 (SC6.4.4.8 Standard drawings SD-460).

Table SC6.4.6.3.1 Minimum trench widths

Nominal size of PIPE (DN)	Minimum clear width of trench(mm) (inside timbering or sheet piling, if any)	
	Pipe other than PVC/PE	PVC/PE Pipe
80	400	350
100	400	350
150	450	400
200	500	450
225	550	500
250	550	500
300	600	550
375	700	650
400	700	650
450	750	700
500	850	800
525	850	800
600	950	900

Where the design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum. Bitumen and concrete surfaces shall be carefully cut, by sawcutting, or other means approved by the Superintendent, so as to provide a neat straight line free from broken ragged edges (WSA 02-2014, Part 2, Section14.7).

The Contractor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

(7) Maximum trench width

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table SC6.4.6.3.2.

The Superintendent may, however, restrict the width of trench due to local conditions. The Superintendent shall not restrict the width of trench to less than as shown in column (iii) of Table SC6.4.6.3.2.

Where the depth to invert exceeds that shown in column (ii) of Table SC6.4.6.3.2 – Maximum trench widths, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150 mm above the top of the pipe shall be as shown in column (iii) of Table SC6.4.6.3.2.

Table SC6.4.6.3.2 Maximum trench widths

Nominal size of pipe (mm) (i)	Maximum depth to invert, unlimited width trench (m) (ii)	Maximum trench width, depths greater than in column (ii) (mm) (iii)
150	8.0	750
225	6.5	825
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150 mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400 mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580 mm plus the outside diameter of the pipe barrel.

The Contractor shall supply a method statement of any special construction control, where shown on the design drawings, to the Superintendent's approval.

(8) Excavation depth

The Contractor shall excavate trenches to a minimum of 100 mm below the underside of the pipe barrel and socket or coupling except for rising mains to be laid on other than rock foundations or as otherwise shown on the design drawings (SC6.4.4.8 Standard drawings SD 461).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

(9) Support of excavation

The Contractor shall adequately support all excavations to Statutory requirements as the Works proceed. When withdrawing supports, the Contractor shall exercise every precaution against slips or falls.

The Contractor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

(10) Pipe bedding

When excavation of the trench has been completed the Contractor shall obtain the Superintendent's approval prior to commencing pipe laying, jointing and bedding. The Superintendent's approval of the excavated trench is required prior to the release of the hold point, or where sewers are to be located in water charged ground (present or predicted to occur) will require specialist geotechnical analysis and design. The contractor shall inform the Superintendent immediately upon encountering ground water and await further direction.

Crusher screenings may only be used for pipe bedding where sand or other non- cohesive material is not readily available locally or where the Contractor can demonstrate that its use will not impede repair operations.

Pipes for gravitation sewers (excluding PVC/PE pipes), shall be bedded on sand or other non-cohesive material. Pipe bedding shall consist of a non-cohesive granular material, having a minimum thickness of 75 mm below the barrel and socket of the pipe, and its grading shall generally fall within the following limits shown in Table SC6.4.6.3.3.

Table SC6.4.6.3.3 Grading of bedding material for pipes other than PVC and PE

Sieve size aperture width (AS 1152)	Equivalent BS sieve size (BS410)	Percentage passing
22.4 mm	1 inch	100
6.7 mm	¼ inch	90 - 100
425 µm	No. 36	40 - 90
75 µm	No. 200	0 - 10

Pipes for rising mains (excluding PVC/PE pipes) may be laid directly on other than rock foundation. The Contractor shall provide non-cohesive granular bedding, having a minimum thickness of 100 mm below the barrel (SC6.4.4.8 Standard drawings SD-461) and socket of the pipe, where rock or other hard material occurs in the bottom of the trench or where specified or directed by the Superintendent. The bedding material shall be either loose clean sand and /or medium dense clean sand or as directed by the Superintendent.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100 mm below the underside of the pipe barrel (SC6.4.4.8 Standard drawings SD-461) and socket, side support and overlay to a depth of 150 mm above the top of the pipe) as shown in Figure 5.1 in AS 2032 shall be in sand or other non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes, except that where the materials cannot be reasonably sourced from within the vicinity, the Contractor may use materials satisfying the classification in the second paragraph above, provided also that the material meets the requirements for passing sieve sizes 9.5 mm and 6.7 mm as shown in Table SC6.4.6.3.4.

Table SC6.4.6.3.4 Grading of bedding material for PVC and PE Pipes

Sieve size aperture width (AS1152)	Equivalent BS sieve size (BS410)	Percentage passing
9.5mm	3/8 inch	100
6.7mm	1/4 inch	90 - 100
425µm	No. 36	40 - 90
150µm	No. 100	0 - 10

The Contractor shall bed all gravitation sewers laid on grades of 15 per cent to 50 per cent on 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works. Such concrete bedding shall have a thickness of at least 75 mm below the underside of the barrel and socket of the pipe and shall extend to a level above the bottom of the pipe of one quarter of the external diameter of the pipe and a width across the trench not less than the minimum width shown in Table SC6.4.6.3.1 Minimum trench widths.

The Contractor shall encase all gravitation pipelines and rising mains, laid on grades steeper than 50 per cent, in concrete as detailed on the design drawings.

(11) Laying and jointing of pipes

Unless detailed otherwise in this Specification, the Contractor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate (WSA 02-2014, Part 2, Section 16).

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Contractor and, if required by the Superintendent, the Contractor shall suspend each one in a sling to enable the

The Superintendent to inspect it. If directed by the Superintendent, the Contractor shall oil valves and repack valve glands.

The Contractor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Contractor shall remove any temporary supports prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the design drawings, mechanical joints (either fixed flange or bolted gland type).

For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Contractor, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Contractor shall withdraw the pipe and remake the joint.

For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Contractor shall make the joint such that the witness mark shall, at no point, be more than 1 mm from the end of the socket.

Pipes may be cut as needed, or directed by the Superintendent, to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Contractor shall ensure that fire fighting equipment, in working order, is on the site prior to the field cuts being made. If the Contractor proposes to use a petrol-engine pipe cutter in an excavation, the Contractor shall ensure that a safe atmosphere is maintained in the excavation at all times.

The Contractor shall prepare the ends of any pipes cut in the field to the manufacturer’s written instructions, or as directed by the Superintendent.

Where pipes are cut in the field, the Contractor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Contractor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Contractor shall refer to the socket manufacturer for the correct marking depth.

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

(a) for jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Contractor shall use a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.

(b) for jointing PVC/PE to ductile iron, the Contractor shall use a rubber ring (elastomeric) joint with an adaptor coupling.

The Contractor shall conform with the relevant Statutory and work, health and safety requirements when cutting and disposing of asbestos cement pipes.
Gravitation pipelines shall be constructed to the following tolerances:

(c) the maximum horizontal deviations to either side from the design axis of a pipeline shall be 20mm for all sizes of pipes (WSA 02-2014, Part 2, Section 22.1); and

(d) the invert level shall not deviate from the design grade line by more than 10 mm (WSA 02-2014, Part 2, Section 22.2).

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Contractor shall comply with the manufacturer’s written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The maximum angle of deflection between adjacent pipes shall be limited to 2º or 0.035 radian in areas subject to mine subsidence or slippage.

Unless otherwise directed by the Superintendent, the Contractor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main within 150 mm of

the finished surface or as otherwise directed by the Superintendent (WSA 02-2014, Part 2, Section 16.11.2 and SC6.4.4.8 Standard drawings SD-460).

(12) Connections to maintenance holes and structures

The Contractor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600 mm long pipes such that two flexible joints are provided, the first joint being at or within 150 mm of the face of the structure. The contractor shall not core any connections into wall sections of precast or cast insitu manholes <150 mm from any joint to the closest edge of core. Where flexible joints cannot be made with cut pipes, the Contractor shall select pipes from the various lengths provided in order to make the second joint within 300 mm of the position shown on the drawings (SC6.4.4.8 Standard drawings SD-470 and SD484).

The Contractor may vary slightly the positions of maintenance holes shown on the design drawings, subject to final approval by the Superintendent immediately prior to construction, to suit changes, such as erection of structures, growth of flora and installation of services. The positioning of a maintenance hole shall be such as to comply with occupational health and safety requirements for access by maintenance staff, providing a proper working area around the top and access into the hole. Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

(a) for deviations from the design levels of maintenance holes as shown on the design drawings or as directed by the Superintendent during construction, the following tolerances shall apply (WSA 02-2014, Part 2, Section 22):

(i) where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

Pipe Tolerance
Inlet - nil; + 10 mm
Outlet - 10 mm; + nil; and

(ii) where the difference in levels, as above, is greater than 100 mm:

Pipe Tolerance
Inlet - 10 mm; + 10 mm
Outlet - 10 mm; + 10 mm; and

(b) allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

(13) Junctions and property connection sewers

The Contractor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this sub-section and the design drawings. Such junctions shall be inserted along pipelines in locations shown on the design drawings or directed by the Superintendent, with the service connection, where not shown on the design drawings, provided at a depth no deeper than 1.5 m provided the property still has service to the sewer, as follows:

(a) for existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies; and

(b) for vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Where the sewer is intended to serve a large block and/or where the sewer line is located more than 75 m from the premises, the Contractor shall extend the property connection sewer onto that block such that the maximum horizontal measurement in a straight line between the sewer connection point and the premises on the block is not more than 75 m.

Concrete support shall be provided for the full trench width in accordance with SC6.4.4.8 Standard drawings SD-455 complying with sub-section SC6.4.6.28 Minor concrete works.

Except where concrete encasement is ordered by the Superintendent, the Contractor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500 mm upstream and downstream of the riser. Compaction density shall

be as for the requirements for the trench pipeline.

All property connection sewers and junctions shall have a minimum diameter of 150 mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10 m.

(14) Marking of junctions and property connection sewers

The Contractor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods but the location of the mark or peg shall be consistent with the method(s) in use by Townsville Water and Waste and to the approval of the Superintendent (WSA 02-2014, Part 2, Section 16.9).

Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50 mm high shall be painted thereon. An underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.

Elsewhere, the Contractor shall drive into the ground, a peg, 75 mm x 50 mm x 600 mm long at that position, and left flush with the surface of the surrounding ground. The Contractor shall connect the peg to an underground identification tape as specified hereafter.

The Contractor shall tie the identification tape to the junction or end of the property connection sewer, hold the tape in a vertical position during backfilling operations and finish tape flush with finished ground level.

The identification tape shall be 75 mm wide fawn coloured polyethylene tape with the inscription "Caution - buried sewer line", printed in heavy black letters every 200 mm.

(15) Trench stops

Where a sewer or rising main is laid on bedding at a grade of 5 per cent to 14 per cent, the Contractor shall construct, as below, trench stops consisting of bags filled with clay, or sand or cement stabilised sand and sealed. Reference shall be made to SC6.4.4.8 Standard drawings SD-482 and SD-483.

(a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100 mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300 mm below finished surface level.

(b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.
The distance between trench stops shall be determined by the following formula:

D = 100, whereby G
D = Distance between stops in m
G = Grade of pipe expressed in per centum.

(16) Concrete bulkheads

Where a gravitation sewer or rising main is installed at a grade of 15 per cent to 29 per cent, the Contractor shall construct concrete bulkheads. Where a gravitation sewer or rising main is installed at a grade 30 per cent to 50 per cent, the Contractor shall construct concrete bulkheads integral with concrete encasement. Where any sewer line is to be installed with a grade exceeding 50 per cent, the contractor must provide a site specific design to incorporate all aspects of the site conditions including soil conditions. Bulkheads shall be of 20 MPa concrete complying with sub-section SC6.4.6.28 Minor concrete works, 150 mm minimum thickness as follows: (SC6.4.4.8 Standard drawing SD-482, WSA 02-2014, Part 1, Section 9.10 and WSA 02-2014, Part 2, Section 16.6)

(a) where concrete bedding or encasement to pipe is required, the 150 mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150 mm. The bulkhead shall extend to 150 mm below finished surface level or such other level as directed by the Superintendent;

(b) where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150 mm for the full width of trench; and

(c) a 75 mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20 mm in size within 150 mm in all directions upstream and above the invert of the drain hole beyond which another 150 mm thick surround of gravel 2 to 10 mm in size shall be placed.

The distance between concrete bulkheads shall be determined by the following formula: (WSA 02-2014, Part 1, Section 9.10.)

Concrete bulkhead

$$S = \frac{L_P}{G}$$

Concrete encasement (continuous) and concrete bulkhead S = 100/G, whereby

L_P = 80 X Pipe length, m

= 450 m max

if L_P > 100 m use intermediate trench stops at spacing < 100/G

S = Distance between bulkheads in m

G = Grade of pipe expressed in per centum

(17) Thrust and anchor blocks for rising mains

The Contractor shall construct thrust and anchor blocks where shown on the design drawings to the dimensions depicted therein or as otherwise directed by the Superintendent where it is deemed that the allowable bearing pressure of the ground and the design pressure on the pipeline are different to the actual pressures on site. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Contractor shall provide permanent thrust blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Superintendent.

The Contractor shall provide permanent anchor blocks of 20 MPa concrete, complying with sub-section SC6.4.6.28 Minor concrete works, of a volume and dimension not less than that directed by the Superintendent.

The Contractor shall provide temporary anchorages adequate to restrain the pipe when under test. The cost of providing such anchorages shall be deemed to be included in the rates tendered for laying and jointing rising mains.

The Contractor shall obtain the consent of Townsville Water and Waste for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

(18) Rising main fittings

The Contractor shall install rising mains, air release valves and inspection pipes where shown on the design drawings or directed by the Superintendent. All rising mains shall be topped with an appropriate identification tape.

The Contractor shall provide marking plates bearing the letters "DAV" for double air valves, "SCOUR" for scour pipes and "SRM" for sewage rising main at changes of direction and at such chainages that the location of the main is marked, at least once each 100 metres, as specified hereinafter. In urban areas, the kerb adjacent to each fitting is to be painted with 2 coats of non-slip paint coloured black.

Where, in the opinion of the Superintendent, a valve or fitting is at too great a distance from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Contractor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1 m, shall be permanently marked on the plate with legible numbers a

minimum 80 mm high. Wooden posts are not to be used where there is evidence, by rotting or termite activity, that the integrity of the posts will be affected.

The post shall conform to the following requirements:

(a) the post shall be of sufficient length to be set firmly in place under saturated ground conditions.

(b) when installed, the post shall project 1000 mm above the ground, provided that where tall grass or crops are likely to obscure the post, or where directed by the Superintendent, its height above the ground shall be increased to 1500 mm.

(c) the post shall be painted with 2 coats of white enamel for exterior use.

The Contractor shall encase in concrete pipes in gravity sewers or rising mains, as shown on the design drawings, with less than the specified cover above the top of the pipe barrel, or where directed by the Superintendent. Concrete shall be 20 MPa complying with sub-section SC6.4.6.28 Minor concrete works and have the following minimum dimensions (WSA 02-2014, Part 1, Section 9.7 and SC6.4.4.8 Standard drawing SD-463):

(a) for trenches in other than rock: 150 mm minimum under, on both sides and on top of the pipe barrel; and

(b) for trenches in rock: 100 mm minimum under the pipe barrel, 150 mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12 mm thick shall be formed in the concrete encasement at the face of each socket or at one face of each coupling.

Reinforcement in concrete encasement shall be as shown on the design drawings.

(19) Wrapping of pipelines

Where shown on the design drawings or directed by the Superintendent, the Contractor shall enclose a pipeline or a section thereof, in layflat polyethylene sleeving (WSA 02-2014, Part 2, Section 16.10).

The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2 mm polyethylene film, approved by the Superintendent, and 50 mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Superintendent. The Contractor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of 250 mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three circumferential turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately 1 metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. The Contractor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Contractor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench. The Contractor shall present the wrapped pipeline for inspection by the superintendent prior to commencing backfilling operations.

(20) Corrosion protection of steel bolts and nuts

The Contractor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape, approved by the Superintendent consisting

of synthetic fibre open weave cloth impregnated with saturated hydrocarbons applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

(21) Cast-in-situ maintenance holes

For all maintenance holes concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below (WSA 02-2014, Part 2, Section 17.2.3 and SC6.4.4.8 Standard drawings SD-470 and SD-476).

Cement used in all concrete shall be Type SR to AS 3972. The Contractor may use fly ash additive to a maximum 20 per cent. Cement used shall be no older than 3 months since manufacture.

The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

(22) Covers and frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3 mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4 mm radius.

Tolerances for the dimensions on the COVER shall be – 3 mm + NIL.

Tolerances for the dimensions on the FRAME shall be -3 mm +3mm.

Maintenance hole covers shall be seated on a layer of bitumen impregnated fibre board, having a cross-section of 25 x 25 mm. Alternatively another seating material of a cross-section and composition approved by the Superintendent may be used.

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25 mm above the surface of the ground where not shown otherwise on the design drawings, or such other level as directed by the Superintendent, in a manner designed to avoid as far as possible, the entry of surface water.

In locations where shown on the design drawings or directed by the Superintendent, the Contractor shall install a cast iron cover and frame. Where it is evident, or otherwise shown on the design drawings, the Contractor shall install bolt down frames and covers in areas subjected to 1 in 100 year flooding. Cast iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

(23) Preformed maintenance hole and maintenance shaft systems

The Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Generally, preformed maintenance holes shall be made up in accordance with the design drawings, with components consisting of a base section, shaft sections, converter, cover and frame. Make-up Rings (1 only) of 100-150 mm may be used between converter section and cover to make up height differentials. The wall thickness of any reinforced component below the frame shall not be less than 84 mm.

Preformed maintenance shafts shall be made with section lengths that once constructed comprise the least amount of joints as required to satisfy height parameters and unit joint/wall penetration coring clearances.

The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements.

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to the required finished surface level according to location requirements. If

necessary, the Contractor shall import and compact non-cohesive granular material.

(24) Bedding and backfill compaction requirements

After laying and jointing of a pipeline has been completed the Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling (WSA 02-2014, Part 2, Section 19). Backfill shall not be placed until the Superintendent has given approval.

Material for the bedding, side support and overlay of the pipe shall be as for pipe bedding specified in SC6.4.6.3.3(10) Pipe bedding. The material shall be compacted in layers of not more than 150 mm to a Density Index of 70 for the material used when determined in accordance with AS 1289.5.6.1.

The Contractor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150 mm thick as follows:

(a) Where the trench is within a roadway, proposed roadway, the remainder of the trench shall be:

(i) backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table SC6.4.6.3.3, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1:

(A) below 0.3 m of the subgrade road surface; and

(B) in the road reserve, up to top of overlay zone;

(ii) backfilled with selected material, and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to top of subgrade level of the road surface, but excluding the pavement layers;

(iii) backfilled with selected material, and compacted to 95 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to finish surface level of the areas of trench outside of roadways; and

(iv) backfilled with road base and sub-base material as per existing or proposed pavement layers and compacted to 100 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1.

(b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98 per cent of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Contractor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Contractor is to submit to the Superintendent for approval any proposal for construction of embankments in conformance with the drawings, including the method of placement and compaction and any limitations to the placement/ compaction over the top of any pipeline.

Where a roadway is to be sited over existing infrastructure, excavation of trench material down to overlay zone and subsequent backfilling with appropriate select material to the underside of sub-base to the compaction requirements stated above must be undertaken by the contractor.

The Contractor may compact backfill by trench flooding only where:

- the ground and backfill material is cohesionless sand;
- water for flooding has been sourced at the site;
- the process will not create mud which would be moved off site by vehicles or construction plant; and
- additives are not used.

The contractor shall carry out compaction tests to the full depth of zone being tested and present NATA certified test results to the Superintendent.

SC6.4.6.3.4 Pipeline testing and restoration

(1) General

The Contractor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and backfilling is completed (WSA 02-2014, Part 2, Section 21).
All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

Where a vacuum system has been specified, the Contractor shall test the system in accordance with the testing schedule as shown on the design drawings.

(2) Initial test of gravitation sewers

The Contractor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipe laying on the section shall be completed, and backfill shall be compacted to at least the level of the top of overlay section of trench filling. The Superintendent shall advise at the time of notification by the Contractor whether the option to inspect the initial testing is required.

The initial test shall not be carried out before risers and/or property connection sewers are constructed.

Where the Superintendent approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

The Contractor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

(3) Initial test of maintenance holes

The Contractor shall test each maintenance hole for leakage, as soon as practicable after the maintenance hole is constructed and the maintenance hole cover surround fitted.

Maintenance holes may be tested in conjunction with both upstream and downstream sections of mains using the low pressure vacuum method for the initial testing only in accordance with WSA 02-2014, Part 2, Section 21.4.2.2. It is advised that a pressure relief valve be installed inline with a maximum setting release of 50 kPa.

Alternatively, the Contractor may request to test manholes initially using hydrostatic means. The test shall be made by plugging all pipe openings in the walls and by filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole. The Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(4) Ovality test and CCTV inspection

The Contractor shall carry out deflection (ovality) testing in conformance with WSA 02-2014 Part 2, Section 21.6.2 upon completion of placement and compaction of trench and embankment fill. Submit proposal for deflection testing to the Superintendent for acceptance. Carry out a CCTV inspection of the sewer system and maintenance structures to WSA 05 Attachment E and WSA 02-2014 Part 2, Section 21.7 and SC6.4.2.2.6 Conduit assessment.

The Contractor shall undertake ovality testing as follows:

(a) all sewers to DN 300 shall be tested to determine any excessive ovality using either a proving tool approved by the council or by CCTV light ring and approved measurement software. Ovality testing shall be undertaken after all earthworks on the subdivision are complete and no sooner than 14 days after backfill of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested (WSA 02-2014, Part 2, Section 21.6.2 & WSA 05-2013);

(b) the proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as specified in WSA 02-2014, Appendix K;

(c) the proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size and the prover outside diameter;

(d) Maximum Allowable Deflection = 3% of Mean Outside Diameter; and

(e) the testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded.

(5) Acceptance test of gravitation sewers and maintenance holes

Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained. (WSA 02-2014, Part 2, Section 21.) The Contractor shall make the acceptance test on all components in the section of the sewer in the same manner and to the same methods as the initial test. The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

The Superintendent may permit hydrostatic testing as an alternative to air testing for acceptance of gravitation pipelines and maintenance holes after approval from council.

Where the project contains a combination of precast and cast insitu maintenance holes, then each group must be regarded as a separate population and testing frequencies shall be in accordance with WSA 02-2014, Part 2, Table 21.5.

The Superintendent may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

(6) Testing with compressed air

The Contractor shall supply and keep all necessary equipment in a condition acceptable to the Superintendent.

All test gauges must have a current calibration certificate and have a range that is suitable to be able to read decimal increments. The minimum diameter of readable face shall be 100 mm.

Sewer lines may be tested by either vacuum (negative pressure) or by positive pressure. The use of inline manhole through connectors can be utilised for ease of testing multiple lines. Manholes and sewer lines shall be tested separately.

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1 m^3/minute at 35 kPa. The air shall be fed through a pressure-reducing valve capable of reducing pressure from that supplied to 28 kPa ± 4 kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50 kPa, a pressure relief valve that shall be set to blow off at 28 kPa ± 4 kPa and a gate valve to the pipeline to be tested.

The method of setting up and carrying out the test shall be as specified in WSA 02-2014, Part 2, Section 21.4.2.

(7) Allowable pressure drop times

The time taken for the pressure to drop from 25 kPa to 18 kPa shall be greater than that specified in WSA 02-2014, Part 2, Table 21.3.

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Contractor shall apply a hydrostatic test.

(8) Hydrostatic testing

The Contractor shall not carry out hydrostatic testing unless prior approved by the superintendent.

The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:

(a) for initial test:

(i) when no property connection sewers or risers are constructed – a minimum head of 2 metres above the pipe invert at the upstream end of the line under test; or

(ii) where property connection sewers and/or risers are constructed – a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers;

(b) for acceptance test, a minimum head of 2 metres above the highest invert in the line under test, including its risers and property connection sewers, or above the free standing level of ground-water in the vicinity whichever is the higher; and

(c) such other lesser head as the Superintendent, at the Superintendent's discretion, may direct.

The Contractor shall determine, at the Contractor's expense, the free standing level of groundwater, by a method acceptable to the Superintendent.

After allowing an interval for absorption, to be determined by the Superintendent, any fall of the free water surface shall be made good by adding extra water to the container. The Contractor shall measure the fall in water level during ten minutes thereafter.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25 mm for each standard test length of the pipeline under test including property connection sewers and/or risers.

A standard test length in metres is defined as 1370 m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

(9) Visual inspection and measurement of infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500 mm or more above the soffit of the sewer main provided that groundwater is at least 150 mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration upon request to the Superintendent.

In such circumstances, the Contractor shall propose full details of the method by which the infiltration is to be measured (WSA 02-2014 Part 2, Section 21.5).

If the Superintendent, at the Superintendent's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Superintendent shall determine the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:

Rate of Infiltration

$$Q.I. = 0.65 (L^1d^1h^1 + L^2d^2h^2 + \ldots\ldots\ldots L^nd^nh^n) + H^a$$

Where:

Q.I. = rate of infiltration in litres/hour

L = length of pipe in metres

d = nominal size of pipe in metres

h = average head of groundwater over the invert level of the pipe in the section under test

H^a = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the

maintenance hole is included in the infiltration test.

The Contractor shall determine the head of groundwater, by a method approved by the Superintendent.

(10) Testing of rising mains

The Contractor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. Acceptance testing shall be carried out before the issue of the Certificate of Practical Completion. Rising mains failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained (WSA 07-2007, Part 3, Section 21). The Contractor shall submit to the Superintendent satisfactory test results from the acceptance testing.

Pipelines shall be tested in sections approved by the Superintendent as soon as practicable after each section has been laid, jointed and backfilled, provided that:

(a) if so specified or if the Contractor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Superintendent; and

(b) the pressure testing shall not be commenced earlier than 7 days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves. A maximum length of 1000 m can be tested in one continuous section unless otherwise approved by the superintendent.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Superintendent.

During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Contractor shall clean it to the satisfaction of the Superintendent and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to 1.25 times the maximum operating pressure of the pipeline but do not exceed 1.25 times the maximum operating pressure rating of the lowest rated pipe/fitting. The test procedure shall be in accordance with WSA 07-2007, Part 3, Section 21.4.

The Contractor shall maintain the specified test pressure for as long as required by the Superintendent, while the Contractor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 4 hours. For the purpose of determining the actual leakage losses, the Contractor shall carefully measure and record the quantity of water added in order to maintain the pressure during the period of testing.

The pressure testing (pipes other than PE) of a section shall be considered to be satisfactory if:

- there is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- there is no visible leakage; and
- the measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

  $Q_1 = (0.14 \times D \times L \times H)$

  where:

  Q_1 = permissible leakage rate (litres per hour)

  D = nominal internal diameter of pipe (m)

L = length of section tested (km)
H = average test head (m)

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the defects liability period shall be rectified by the Contractor at the Contractor's expense. Where a thrust block or an anchor block fails, and such thrust block or anchor block has been constructed in accordance with the design drawings, and the failure is not, in the opinion of the Superintendent, the fault of the Contractor, the thrust or anchor block shall be strengthened or reconstructed as directed by the Superintendent. The cost of strengthening or reconstruction of such thrust or anchor block and the cost of retesting shall be paid as a Variation to the Contract, at such rates as are determined in accordance with the provisions of the General Conditions of the Contract.

For PE rising mains, testing shall be in accordance with WSA 07-2007, Part 3, Section 21.5.

Alternatively, the rising main may be tested by the use of compressed air. In this case, the Contractor shall provide details of the alternative method proposed, for approval by the Superintendent, prior to its use.

(11) Connection to existing sewers

The Contractor must request approval (request for private works quotation) for connection to existing sewers from Townsville Water and Waste. Works shall be either performed by the Sewer Agency or delegated to the contractor at the discretion of the Sewer Agency. Approval must only be requested upon satisfactory completion of all backfilling and testing. All necessary works required in completing connections to "live" maintenance holes (that is, accesses to sewer system that is currently in service), including all works undertaken by the Sewer Agency at "live" maintenance holes in delivering the works shall be the responsibility of the Contractor (WSA 02-2014, Part 2, Section 23).

(12) Restoration of surfaces

The Contractor shall clean pavements, lawns and other improved areas and leave them in the same order as they were at the commencement of the Works. The Contractor shall restore any fencing removed during construction and shall restore lawns with turf cut and set aside from the original surface and with imported turf from a source approved by the Superintendent. (WSA 02-2014, Part 2, Section 24.) The restoration works shall be done progressively and as soon as possible after the section of works is completed.

The Contractor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the defects liability period applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the defects liability period. The Contractor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Immediately the backfilling of a trench excavated through a pavement has been completed, the Contractor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration. The Contractor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out in accordance with SC6.4.4.8 Standard drawings SD-055 to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Superintendent, the removal of temporary restoration.

In other than roadways, the Contractor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the defects liability period in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor. Where dry weather conditions have persisted after the original backfilling, including during the defects liability period, the Contractor shall take all necessary steps to consolidate the trench before removing surplus materials from the site.

In locations where, in the opinion of the Superintendent, surplus material left in the vicinity of the trench would

not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Superintendent in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the expiry of the defects liability period.

Where, within public or private property, the reasonable convenience of persons will require such, the Superintendent may order the Contractor to level trenches at the time of backfilling. The Contractor shall make good any subsequent settlement, as required by placing additional fill.

The Contractor shall immediately restore any damaged or disturbed private property and services.

Should the Contractor elect to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces, and payment shall be made for the restoration of the surfaces as though they had been removed and replaced. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the defects liability period.

The Contractor shall provide notice to affected property owners of any pending works.

SC6.4.6.3.5 Pump stations

(1) General

Provide only products and materials authorised by Townsville Water and Waste, the drawings and this specification. The Contractor shall submit for approval any alternative or not authorised products and materials.

The Contractor must conform to manufacturer's recommendations for handling, transport and storage of materials and in a manner to prevent damage or deterioration or excessive distortion. Inspect all products and materials at the time of delivery and reject products and materials not in conformance with this specification and the manufacturers' recommendations. Maintain protective crating or packaging until immediately before use.

Damaged or defective materials are not to be installed or used, including coatings and linings, outside the manufacturer's recommended limits.

(2) Pumps

Pump construction materials for centrifugal end suction pumps shall comply with the following:

DESCRIPTION	MATERIAL
PUMP	Cast iron AS 1830 Gr T200
Casing and suction bend	Cast iron AS 1830 Gr T200
Wear rings	316 Stainless steel/AS 1449
Impeller	Gunmetal AS 1565-905C
Impeller nut	316 Stainless steel/AS 2837
Shaft sleeve	Phosphor bronze AS 1565-9060/316
Neck bush, lantern ring	Phosphor bronze AS 1565-9060
Gland studs	Cast Iron AS1830 Gr T200
Gland nuts	316 Stainless steel/AS 2837
Fixing nuts and bolts handhole	316 Stainless steel/AS 2837
Covers fitted bolts and nuts, casing and dowels	316 Stainless steel/AS 2837
Forcing screws	316 Stainless steel/AS 1449
Water thrower and drip tray	316 Stainless steel/AS 2837
Pump set base plate	316 Stainless steel/AS 2837
	316 Stainless steel/AS 1449
	Cast iron AS 1830 Gr T2000/Fabricated steel
MOTOR	Cast iron/Mild steel
Motor frame and end shield	Cast iron/Mild steel
Motor terminal box	Mild steel
Motor fan cover	Metal
Motor fan	
HOLDING DOWN BOLTS	316 Stainless steel/AS 2837
MECHANICAL SEALS	Tungsten carbide or equal
Seal faces	Nickel chrome steel
Springs	Fluoro carbon or nitrile rubber
Secondary seal	

The Contractor shall provide a written warranty from the manufacturer of the equipment. This action constitutes a hold point. The Superintendent's approval of the warranty is required prior to the release of the hold point.

The manufacturer's warranty shall require the manufacturer to accept liability for any defect in materials or workmanship which becomes apparent at any time within 2 years after the date of delivery of any piece of equipment used in work under the contract.

All nuts and bolts shall be manufactured in accordance with AS/NZS 1111 and AS/NZS 1112, 150 metric series and fitted with washers beneath bolts heads and nuts. Requirements are:

(a) all bolts, nuts and washers shall be stainless steel to AS 1449 and AS 2837, minimum grade 316. All bolts, nuts and washers are to be of the same grade and supplied passivated;

(b) all threads are to be rolled;

(c) all bolt heads and nuts shall be hexagonal;

(d) all bolts, studs, set screws and nuts for bolting flanges and other pressure containing purposes shall conform to AS 2528;

(e) all nuts and bolts subjected to vibration shall be fitted with lock washers or lock nuts;

(f) all concrete anchor bolts, nuts, locking nuts and large series washers required for the bolting down of pump set discharge bends shall be provided. These anchor bolts shall be as recommended by the equipment designer with a minimum diameter of 16 mm; and

(g) concrete anchor bolts shall be chemical masonry anchor type, set to their full depth, suitable for the required duty.

Bolts on all flanges will protrude no more than 10 mm past the nut when tightened.

The Contractor shall apply sufficient anti-seize/anti-galling material to the threads of all stainless steel fasteners. The material shall be Polytetrafluroethylene (PTFE), either tape to AS 1272, dipped or sprayed, or molybdenum disulphide.

(3) Preformed pump stations and package pump stations

Preformed components or systems, complying with the design drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of in-situ construction provided:

(a) preformed concrete wall units are to be manufactured to AS 4058 except as modified as for the requirements for precast maintenance hole units;

(b) joints shall be internal flush; and

(c) the Contractor shall supply components that make a watertight system and have a satisfactory surface finish.

Package pump stations may be supplied and installed provided:

(a) The proposed packaged system has been appraised and recommended by WSAA;

(b) all components comply with the requirements of this sub-section; and

(c) the units are at least equivalent to the requirements of this sub-section and the design drawings.

(4) Electrical compliance

The Works shall be in accordance with the requirements contained in clause SC6.4.3.21.4 Electrical and mechanical except where this sub-section or the design drawings indicate otherwise. The technical requirements detailed on the design drawings shall take precedence over the requirements of this sub-section should clauses be in disagreement.

Except where clause SC6.4.3.21.4 Electrical and mechanical requires a higher standard, works shall be carried out in accordance with AS 3000, the Service Rules of the Supply Authority and all relevant statutory authorities.

The Contractor shall supply proof of compliance with a standard or specified test. Such proof shall comprise a test certificate from an approved independent testing authority.

The Contractor shall submit all designs and material, to each Authority having jurisdiction for approval. The Contractor shall arrange for each Authority having jurisdiction to inspect the Works. The Superintendent shall be advised a minimum of 7 working days in advance of the date of any inspection by an Authority. The Superintendent shall advise at the time of notification by the Contractor whether the option to attend the inspections is to be exercised.

(5) Switchgear and control gear assembly (SCA), controls

The Contractor shall supply and install the SCA designed and assembled by a manufacturer approved by the Superintendent.

The SCA shall be of outdoor, stationary, free standing, metal-enclosed, cubicle type series with a minimum degree of protection of IP56D as specified in AS 60529.

All equipment shall be securely mounted on suitable mounting panels and comprise individual compartments. A hot dipped galvanised steel channel base shall be provided.

The Contractor shall provide an effective barrier to prevent gases from the wet well entering the SCA.

Starter contactors shall have appropriate ratings for the proposed pumps to AC3.

All necessary terminals with terminal and cable numbers shall be supplied and installed in accordance with the design drawings.

The Contractor shall liaise with the electricity supply authority to supply padlocks for the metering equipment, at the Contractor's expense. The Superintendent shall supply padlocks for use on the SCA at no cost to the Contractor.

The electrical characteristics of the SCA shall be:

Main Circuit: 415/240 V, 50 Hz, 3-phase, 4-wire.
Motor Control Circuit: 240 V, 50 Hz.
Common Control Circuit: 240 & 24 V, A.C.
Prospective short-circuit current:
14kA for 1 second. Peak Factor: 2.2
Power Factor Correction (determined in consultation with the Superintendent)
Earthing (M.E.N. system)
Characteristics

All cables shall enter the SCA from below:

The Contractor shall supply data from the switchgear supplier confirming Type “2” co-ordination between contactors, motor protection relays and corresponding circuit breakers, to the Superintendent.

Refer to Standard Specification TCC24 clause 18 for starter selection requirements and functional specification for the project.

The Contractor shall carry out of factory tests in the presence of the Superintendent's Representative and in accordance with clause SC6.4.3.21.4 Electrical and mechanical and the results shall comprise all routine Tests specified in AS 3439. The Superintendent shall be given 7 days notice of the proposed date of such tests.

Inspections and functional tests shall be in accordance with TCC24 clause 21.

The Contractor shall pack the equipment for transport after satisfactory final factory inspection and tests, and after approval has been given by the Superintendent. The Contractor shall ensure that any relays, programmable logic controllers, and fittings likely to be adversely affected during delivery shall be adequately protected or shall be removed and packed separately in protected containers. Where equipment has been removed, cover plates shall be provided.

The Contractor shall be responsible for any damage that may occur during transit and unloading at site.

The Contractor shall ensure that spare parts, tools etc., are packed separately from the main plant and shall be marked “Spare Parts”, “Tools” etc., as applicable.

The Contractor shall supply spare parts in accordance with the schedule supplied by the Superintendent.

Automatic control of the pump station pumping equipment shall be by way of hydrostatic level sensor providing single pump duty operation unless shown otherwise on the drawings. The level sensor will be compatible with those in use in the system. A float switch shall be used to provide a HIGH HIGH(overflow) level alarm. Refer to TCC24 clauses18.2, 18.2, 19.1 and 19.2.

The following wet well levels shall be used in the automatic control of the pump operation system:

(a) STOP level;

(b) Duty Start level;

(c) Standby Start level; and

(d) High level.

Pump operation requirements are described in TCC24 clause 18.

The Contractor shall supply and install control equipment that is compatible with the existing equipment.

(6) Electrical installation

The Contractor shall liaise with the Supply Authority for the electricity supply to the pump station site.

The Contractor shall be responsible for all facilities required by the Supply Authority for revenue metering equipment and the payment of all associated connection, inspection fees and capacity charges.

The Contractor shall supply and install all cabling including consumer mains, motor, control and instrumentation cables, conduits and electrical pits.

The Contractor shall install all wiring in HD-PVC underground conduits laid in accordance with the Supply Authority's requirements, with a minimum 500 mm below the finished ground level in non-trafficable areas and 600 mm below the finished ground level in trafficable areas. The trench and backfill material shall be free of rocks and other foreign matter likely to damage the conduits.

The Contractor shall run electrical marker tape 150 mm below the finished ground level directly above the conduits for the entire length of the conduits. Marker tape shall be orange in colour, 150 mm wide and stamped with the words "DANGER – ELECTRIC CABLES BELOW" or similar.

The Contractor shall route all underground cabling with the approval of the Superintendent. Brass marking plates shall be positioned on a concrete surround clearly showing the direction of the incoming consumer mains. Wording and markings shall read "DANGER – ELECTRICAL CABLES BELOW". The Superintendent's approval of the route of all underground cabling is required prior to the release of the hold point.

The Contractor shall determine the points of attachment on site and the Contractor shall supply and install any consumer's connection poles for the consumer mains required by the Supply Authority.

The consumer mains shall be generally run underground and commence at the point of attachment on a steel consumers pole (if applicable), installed near the property boundary and run in conduit to the switchboard.

No aerial conductors are to be installed over structures, access road or vehicle manoeuvring areas.

The minimum size of the consumers mains shall be sized to satisfy the following:

(a) current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30 per cent minimum;

(b) be sized for a voltage drop less than 1.5 per cent to the maximum demand as calculated;

(c) be single core PVC/PVC cables. XLPE insulated cable may also be used;

(d) comply with the requirements of the Supply Authority; and

(e) AS 3000 and AS 3008.

In addition to the requirements of the Supply Authority and clause SC6.4.3.21.4 Electrical and mechanical, the Contractor shall run the main earthing conductor in conduit to the main earthing electrode. The main earthing connection shall be contained in an earthing electrode connection box similar to ALM type ERB-1 up to 50 mm2 cable and a Type 4 pit for larger cable.

Earth electrode shall be bonded and suitably labelled with an engraved brass label.

Surge diverters shall be earthed in accordance with manufacturer's instructions.

The Contractor shall bond the pump station metallic pipework to the main earth.

Refer also to TCC24 clause 28.1 for installation instruction requirements.

Metering equipment and installation shall comply with the *Queensland Electricity Connections and Metering Manual.*

The Contractor shall gland cables entering the outdoor SCA compartment using non-ferrous metallic or plastic glands with neoprene compression seals and connect the on-flow switch and pump motor cables to the appropriate terminals. Cables shall not be jointed.

The Contractor shall seal, at the completion of commissioning tests, all conduits into the outdoor SCA with a non-setting sealing compound to prevent the ingress of vermin.

(7) Pressure gauges

The Contractor shall install one diaphragm protected, glycerine oil filled, direct mounting, bottom connection pressure gauge complying with AS 1349 per centrifugal pump installation. Cases shall be fabricated from stainless steel complying with AS 1449 or bronze. The protective diaphragm shall be suitable for dismantling for cleaning without affecting the accuracy of the gauge.

The gauge face shall be 100 mm in diameter and calibrated in metres head of water. The gauge shall accurately indicate the pump operating head and the pump no-flow head.

Each gauge shall be supplied with the nominally sized metric equivalent of three of the following bronze fittings: gate valve, union, nipple and reducing nipple.

Gauges and fittings shall be screwed into the pipe wall of ductile iron pipes, or pipe fittings, 150 mm and larger. In pipework less than 150 mm, gauges and fittings shall be screwed into a tapping band. On rising mains, where shown on the design drawings, the Contractor shall install a ball valve to allow removal of the gauge.

The pressure gauge range for single or parallel pumps duty shall be 0 to 1.7 times the closed valve head of the pumps.

(8) Valves

The Contractor shall ensure that the valves supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Contractor shall ensure that valves are installed so as to facilitate maintenance. The Contractor shall take into account the manufacturer’s recommendations, the requirements shown on the design drawings, the type of connection, and lubrication of connecting bolts.

Flanges shall comply with AS 2129 to the class shown on the design drawings.

Unless shown otherwise on the design drawings, all valves shall be anti-clockwise closing.

The Contractor shall size “Tee” Key valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel.

Hand wheels shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

One “Tee” key operator per pump station, of suitable length for operating the respective valve from the surface level, shall be provided for each size of valve installed in each pump station.

Non-return valves shall be of the swing check type to AS 3578 of cast iron or steel body, cover and disc with bronze body and disc seat rings. The leaf shall swing clear and provide an unobstructed waterway.

The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve.

Each non-return valve shall have an extended spindle, minimum grade 316 stainless steel, fitted with an adjustable counterweight.

The knife gate valve shall be constructed in accordance with the following:

(a) the design shall include an enclosed bonnet;

(b) the spindle shall be of the non-rising type;

(c) valves shall be anti-clockwise closing;

(d) the gland around the spindle shall be adjustable or formed by a double O-ring;

(e) flange jointing shall be rubber O-rings; and

(f) seating shall be achieved by flexible seats which shall be designed in a manner that will allow easy replacement. The material of the seat is to be nominated.

All assembly bolts and nuts shall be fitted with fibre or nylon isolating washers to prevent bimetallic corrosion where required.

Each valve spindle shall be fitted with a cast steel or forged steel spindle guard secured to the valve spindle with a gun metal set screw or a handwheel secured to the spindle with gun metal set screw and washer.

Valves shall be drilled and threaded, where required, in accordance with AS 2129.

(9) Testing and commissioning of pump station

The Contractor shall test and/or inspect all materials, equipment, installation and workmanship to prove compliance with the sub-section requirements. The submission to the Superintendent of satisfactory test results constitutes a hold point. The approval of the Superintendent is required prior to the release of the hold point.

Tests and inspections shall comply with relevant Australian Standards.

Testing shall include pre-commissioning, field testing and performance testing of each part of the whole installation.

Pre-commissioning is the preparation of plant or equipment so that it is in a safe and proper condition and ready for commissioning and operation. It includes all aspects of plant operation such as safety, electrical, mechanical and instrumentation.

The Contractor shall conduct pre-commissioning in a logical sequence in accordance with the programme prepared by the Contractor and approved by the Superintendent.

The Contractor shall prepare pre-commissioning record sheets for each item of equipment to ensure results of tests are satisfactorily recorded and that all necessary checks or tests have been performed.

Specific requirements for pre-commissioning shall include, but are not limited to:

(a) initial charges of lubricant in addition to any special lubricant requirements for initial flushing or treatment of the system or for “running in”;

(b) physical checks and tests such as completeness of assembly, rotational tests (including checking that the rotation of electrical motors is in the correct direction), alignment checks, balancing and vibration checks, temperature, pressure and flow measurements, clearances, belt alignment and tension, etc., depending on the type of equipment;

(c) electrical and instrument installation tests, including motor insulation tests and checking instruments against certified instruments and correcting as necessary;

(d) tests of the correct functioning of automatic and manual control and protection equipment, including simulating danger conditions, mal-operations or failures, to check that all instruments and controls function correctly. These tests shall also include adjusting instrument set points and alarm settings and proving correct operation of alarms; and

(e) equipment and system operating tests. The Contractor shall certify compliance of each item and submit a signed copy to the Superintendent prior to commissioning.

The Contractor shall carry out pre-commissioning tests to the satisfaction of the Superintendent and shall record the results of the tests on the appropriate Pre-commissioning Record Sheet.

Refer to TCC24 clause 28.1.11 for electrical test documentation requirements.

The Contractor shall furnish the Superintendent with one signed copy of each completed Pre-commissioning Record Sheet countersigned by the Superintendent's Representative who witnessed the test.

Commissioning is the running of the plant and equipment to ensure flow through the pumping system, carrying out any necessary testing and adjustments until it is ready and suitable for normal starting and running under service conditions.

The Contractor shall give the Superintendent 5 working days notice of the Contractor’s intention to undertake commissioning and supply to the Superintendent the copies of each of the pre-commissioning record sheets and three copies of the operational and maintenance manuals at the time that notice of commissioning is given.

The Contractor shall conduct commissioning in a logical sequence in accordance with a programme prepared by the Contractor and approved by the Superintendent.

Throughout commissioning the Contractor shall be responsible for the test programme.

The Contractor shall provide continuous supervision by personnel experienced in the operation of the equipment and shall have qualified personnel in attendance to carry out all necessary adjustments and/or remedial work during the commissioning tests.

The Contractor shall prepare, schedules, test record sheets and programmes for approval by the Superintendent prior to each stage of the overall commissioning.

The Contractor shall carry out final testing and commissioning (min 1 day duration) of the electrical services in conjunction with the mechanical equipment (e.g. pump, etc) including setting and adjustment of equipment in accordance with SC6.4.3.21 Townsville water and planning design guidelines.

The Contractor shall arrange for all testing, commissioning and any adjustments.

(10) Practical completion of pump station

The Contractor shall fulfill the following requirements before the Certificate of Practical Completion can be issued which constitutes a hold point:

(a) receipt by the Superintendent of a certificate of approval from the relevant statutory authorities;

(b) pump station is in working order as demonstrated by the testing and commissioning;

(c) approval by the Superintendent of operating and maintenance manuals; and

(d) receipt by the Superintendent of as-built drawings of the pump station.

(11) Telemetry

The Contractor shall make provision for equipment to link the pump station to the existing telemetry network to be provided by Townsville Water and Waste at the Contractor's expense. Refer to TCC24 clause 17.1, 28.2, Appendix B2 and Appendix C.

The pump station shall be capable of being operated automatically by control signals from the existing or proposed telemetry system. In addition, either one or any combination of pumps may operate at any one time by control signals from the telemetry system.

(12) Operation and maintenance manuals

(a) Manuals shall contain the following information:

(i) contractor’s name, address and telephone number;

(ii) client’s contract number, job name; and

(iii) pump station general arrangement drawing showing pumps, motors, valves, pipework, switchboard and electrical installation.

(b) Manuals for pumps shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing of pump and motor;

(v) sectional arrangement drawing with parts and list; and

(vi) dimensioned sectional arrangements detailing:

(A) maximum and minimum shaft/bearing clearance (radial);

(B) maximum and minimum impeller/bowl clearance (radial);

(C) maximum and minimum impeller/bowl clearance (axial);

(D) impeller/bowl wear rings;

(E) motor/pump coupling – type, make and model number; and

(F) mechanical seals where applicable.

(c) Manual for motors shall contain the following information:

(i) manufacturer;

(ii) type and model number;

(iii) serial number;

(iv) dimensioned general arrangement drawing;

(v) sectional arrangement drawing for submersible motor power cabling where applicable;

(vi) gland sealing arrangement drawing for submersible motor power cabling where applicable;

(vii) cables where applicable; and

(viii) terminal block arrangement drawing where applicable.

(d) Manuals for electrical equipment shall comply with TCC24 clause 23 and requirements for electrical drawings are described in TCC24 clause 22.

(e) Manuals for valves shall contain a dimensioned sectional arrangement drawing with parts and material list for all valves.

(f) Manuals shall contain the following test curves:

(i) pump witnessed test curves;

(ii) motor test curves; and

(iii) motor torque/speed/efficiency characteristic curves.

(g) The operating and maintenance manual shall include:

(i) safe working procedures - for switching and isolating the supply and distribution system;

(ii) comprehensive description of operation, including flow charts detailing each operational activity (e.g. manual pump operation, routine test procedures);

(iii) maintenance procedures - recommended maintenance periods and procedures;

(iv) tools - particulars of maintenance equipment and tools provided, with instructions for their use;

(v) equipment - a technical description of the equipment supplied, with diagrams and illustrations where appropriate;

(vi) dismantling - where necessary, procedures for dismantling and reassembling equipment; and

(vii) spare parts - a list of the spare parts provided.

Trouble shooting instructions shall be included for pumps, motors, valves and SCA.

Step by step procedures for dismantling and reassembly of pumps, motors and valves using any special tools shall be detailed together with step by step procedures for replacement of wearing parts such as bearing, seals, wear rings, etc.

SC6.4.6.3.6 Construction compliance

(1) As-constructed details and operation and maintenance manuals

The Contractor shall submit as-constructed drawings showing the actual location and alignment of pipelines, maintenance holes and junctions, all pump station details together with operating and maintenance manuals in accordance with SC6.4.7. Refer to SC6.4.3.21.3(5)(n) for the pump station documentation requirements.

Details shall include the size, type, levels, grade of pipelines, maintenance hole, and maintenance shaft location, types and cover details, easement requirements for maintenance, pump details, switchboard equipment details and station structural details. The Contractor shall record on as-constructed drawings the area of side fill which should not be disturbed in future without special precautionary measures where side fill construction is part of the structural integrity of a constructed pipeline of a diameter more than 225 mm.

The Contractor shall ensure that a registered surveyor certifies the plans showing location and alignment.

The Contractor shall provide records, for Townsville Water and Waste's Asset Register, to the Superintendent at the time of practical completion of the Contract. The records are to be in a form consistent for inputting into the Asset Register as directed by the Superintendent.

(2) Video records

Unless advised otherwise by the Superintendent, the Contractor shall provide a video recording of the internal condition of all mains. The video recording shall be undertaken at the time of practical completion of the Contract.

SC6.4.6.4 Stormwater drainage

SC6.4.6.4.1 Introduction

(1) Introduction

Drainage works shall form a complete system carrying water through and away from the Works.
This is the general sub-section common and applicable to all types of drainage lines, open drains, kerb and channel, and drainage structures and shall be read in conjunction with drainage specifications:

(a) SC6.4.6.6 Pipe drainage;

(b) SC6.4.6.7 Precast box culverts;

(c) SC6.4.6.5 Drainage structures; and

(d) SC6.4.6.9 Open drains.

(2) General scope

The work to be executed under this sub-section consists of:

(a) preparation for stormwater drainage construction;

(b) temporary drainage during construction;

(c) siting of pipes, pipe arches and box culverts;

(d) all activities and quality requirements associated with excavation and backfilling; and

(e) all concrete work associated with stormwater drainage.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(3) Extent of work

Details of the work are shown on the drawings. The extent of works under this specification is summarised as follows:

(a) pipe culvert stormwater drainage;

(b) precast box culvert stormwater drainage;

(c) drainage pits, headwalls, wingwalls and aprons;

(d) kerb and channel;

(e) open concrete dish drains;

(f) scour protection of open drains at outlets to drainage structures; and

(g) demolition and removal of existing redundant pipe culverts, headwalls and pits.

(4) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*
AS 1597 - *Precast reinforced concrete box culverts*
AS/NZS2566.2 - *Buried flexible pipelines installation*
AS/NZS3725 - *Design for installation of buried concrete pipes*

(c) other:
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.4.2 Construction

(1) Temporary drainage during construction

(a) For each part of the drainage system, complete the erosion and sedimentation control measures before commencing the drainage works (except those parts of the drainage system forming part of the control measures). Measures for erosion and sedimentation control must be provided in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.

(b) The Contractor shall make adequate provision for runoff flows at drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities.

(c) The Contractor shall not implement any proposals to dam up or divert existing watercourses (either temporarily or permanently) without the prior approval of council by way of approved drawings or written instruction.

(d) The Contractor's material and equipment shall be located clear of all watercourses.

(2) Siting of culverts

(a) Before commencing construction of any culvert, the Contractor shall set out on site the culvert inlet and outlet positions to the location and levels shown on the drawings, and shall present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the inlet or outlet locations or designed levels or the culvert length to suit actual site conditions. Any such amendments must ensure no negative impacts on neighbouring land parcels and existing properties. Prior approval must be sought from council.

(c) Should the Contractor propose changes to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit the construction procedures, the Contractor shall present the proposed culvert set-out in addition to the designed set-out for consideration by the Superintendent and council. No changes shall be made unless prior written approval from council is obtained.

(3) Excavation

(a) Before undertaking stormwater drainage excavation, topsoil shall be removed in accordance with SC6.4.6.10 Earthworks (construction).

(b) In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(c) Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(d) Excavation by blasting, if permitted by council, shall be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed culvert or drainage structure does not exceed 25mm per second. The Contractor shall comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(e) Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed by the Contractor.

(f) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable and inadequate to support the proposed drainage structure shall be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section and the sub-sections for particular culvert types. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, shall be parallel with the specified level and slope of the culvert.

(g) The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(4) Backfilling

Backfilling shall be carried out in accordance with the requirements of the relevant culverts or drainage structures sub-sections and to the compaction requirements specified in SC6.4.6.4.2(5) Compaction.

In situ concrete structures are not to be backfilled in accordance with Clause 6.4.6.5.2 8(a) unless otherwise directed by the Superintendent.

The shape of the culvert must be checked by the Contractor during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure do not vary from the manufacturer's specified dimensions by more than ± 2% for pipes and pipe arches.

(5) Compaction

Foundations, bedding (other than for pipe drainage) and backfilling shall be compacted to the following requirements when tested in accordance with AS 1289.5.4.1 or AS 1289.5.7.1 for standard compactive effort.

Refer to Table SC6.4.6.4.3 for details of compaction and moisture tolerances.

Compaction requirements adjacent to pipe drainage for concrete, steel or UPVC pipes are set out in sub-section SC6.4.6.6 Pipe drainage.

(6) Concrete work

For all concrete work, the Contractor shall comply with sub-section SC6.4.6.28 Minor concrete works in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

(7) Sprayed concrete

If sprayed concrete has been specified, shown on the drawings or directed by the Superintendent, it shall comply with requirements in sub-section SC6.4.6.28 Minor concrete works.

(8) Construction traffic

If proposing to move heavy construction plant or vehicles over pipe or box culverts structures, provide verification and certification of protective measures to the Superintendent for confirmation and approval of protection measure proposed.

SC6.4.6.4.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.4.3 below:

Table SC6.4.6.4.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting**		
	(a) peak particle velocity	≤25mm/sec	SC6.4.6.4.2(3)
2.	**Relative Compaction (Standard)**		
	(a) Foundations or trench base to a depth of 150mm below foundation levels.	95%	SC6.4.6.4.2(5)
	(b) Material replacing unsuitable material.		
	(c) Bedding material.		
	(d) Selected backfill and ordinary backfill material: • other than sub-grade (sand 70% Density Index) • other than sub-grade (other than sand) • at sub-grade level to 300mm below • in a pavement zone		
	(e) Backfill material within the selected material zone.		
3.	**Backfill**		
	(a) Layers	≤ 150mm	SC6.4.6.4.2(5)
	(b) Moisture Content	>60%, <95%	SC6.4.6.4.2(5)

SC6.4.6.5 Drainage structures

SC6.4.6.5.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction of drainage structures and shall be read in conjunction with the sub-section SC6.4.6.4 Stormwater drainage, and other drainage specifications as applicable:

(i) SC6.4.6.6 Pipe drainage;

(ii) SC6.4.6.7 Precast box culverts; and

(iii) SC6.4.6.9 Open drains.

(b) This sub-section details the construction of headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators, batter drains and other supplementary structures.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editors note - A reference to drawings is a reference to construction drawings.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.4 - Stormwater drainage
SC6.4.6.6 - Pipe drainage
SC6.4.6.7 - Precast box culverts
SC6.4.6.9 - Open drains
SC6.4.6.28 - Minor concrete works

(b) Australian Standards
AS 3996 - *Access covers and grates*

SC6.4.6.5.2 Construction

(1) General

(a) Drainage structures shall be constructed in concrete and in accordance with sub-section SC6.4.6.28 Minor concrete works.

(b) All structures shall be constructed as soon as practicable and shall be completed not later than 28 days after the construction of the associated culverts, unless otherwise approved by the Superintendent.

(2) Alignment

(a) Unless otherwise shown on the drawings, headwalls and pits shall be constructed parallel to the road centreline and wingwalls at 120º to the headwall or as shown on the drawings.

(b) Where the culvert is laid skew to the road, the wingwalls and headwalls shall be splayed so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.

(c) Energy dissipaters shall be constructed in accordance with the drawings and with centreline on the axis of the culvert.

(3) Headwalls and wingwalls

(a) The wingwalls shall be constructed to retain the batters effectively. Where the dimensioned drawings do

not satisfy this requirement the Superintendent shall be notified before the headwalls and wingwalls are constructed. The Superintendent shall direct the Contractor as to the action to be taken. Where rock is encountered at the bottom of excavations for wingwalls and headwalls, and after approval is given by the Superintendent, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown in the drawings, but must be not less than 150 mm into sound rock.

(4) Pits

(a) All new pits, including access covers, gully grates and frames complying with AS 3996, shall be constructed to the details shown on the drawings. Modification of existing pits is only to be carried out if shown on the drawings.

(b) Where the full depth of the excavation is in sound rock, and the Superintendent approves, part of the concrete lining of gully pits and sumps may be omitted, provided that a neatly formed pit of the required dimensions is constructed. In all such cases the wall of the pit adjacent to and parallel to the road shall be constructed of concrete

(c) Inlet and outlet pipes shall be integrally cast into the pit at the time of pouring the concrete for the pit walls.

(d) Step irons are not required.

(e) A subsoil drain where required shall be installed into the pit or headwall in accordance with the general requirements in sub-section SC6.4.6.6 Pipe drainage.

(5) Precast units

(a) Where precast units including kerb inlet lintels, are provided in the design they shall be handled and installed in accordance with the manufacturer's instructions.

(b) If the Contractor proposes to use precast units, detailed drawings and complete details of installation procedures shall be submitted for the approval of the Superintendent.

(c) The Superintendent is required to adopt pre-cast units which are in accordance with council’s standard drawings and specifications unless otherwise agreed by council.

(6) Jointing

Where drainage structures abut concrete paving, kerb and channel or other concrete structures, a 10 mm wide joint shall be provided between the structure and paving, or kerb and channel or other concrete structures. The joint shall consist of preformed jointing material of bituminous fibreboard.

(7) Mass concrete bedding

(a) Mass concrete bedding for reinforced concrete bases shall not be placed on earth or rock foundations until the foundations have been inspected and approved by the Superintendent. Following such approval, the surface of the foundation shall be dampened and a layer of concrete not less than 50 mm thick, shall be placed over the excavated surface and shall be finished to a smooth even surface.

(b) Unreinforced concrete bases may be cast on earth or rock foundations without the mass concrete bedding.

(8) Backfill

(a) Backfilling shall not commence until the compressive strength of concrete has reached at least 15MPa unless otherwise approved by the Superintendent.

(b) Selected backfill shall be placed against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure.

(c) Selected backfill shall consist of a granular material in accordance with the requirements in sub-section SC6.4.6.6 Pipe drainage.

(d) Special care shall be exercised to prevent wedge action against vertical surfaces during the backfilling. Where the sides of the excavation are steeper than 4 horizontally to 1 vertically they shall be cut in the form of successive horizontal terraces at least 600 mm in width, as the backfill is placed.

(e) Backfill on both sides of the structure shall be carried up to level alternately in layers so as to avoid wedge action or excessive horizontal forces. Backfilling and compaction shall commence at the wall. Compaction shall be in accordance with sub-sections C6.4.6.4 Stormwater drainage and SC6.4.6.6 Pipe drainage.

(9) Tolerances

(a) On the completed works shall be as detailed in subsection SC6.4.6.28 Minor concrete works.

SC6.4.6.5.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.5.1 below.

Table SC6.4.6.5.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Cut-off Walls**		
	Depth into sound rock	>150mm	SC6.4.6.5.2(3)
2.	**Mass Concrete Bedding**	>50mm	SC6.4.6.5.2(7)

SC6.4.6.6 Pipe drainage

SC6.4.6.6.1 Introduction

(1) Scope

(a) This sub-section covers the supply and installation of pipe culverts and pipe arches for stormwater drainage.

(b) This sub-section should be read and applied in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(c) The work to be executed under this sub-section consists of supply of pipes and pipe arches, bedding, installation and backfilling.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS 1141.11 - *Particle size distribution –sieving method.*
AS 5101.4 - *Unconfined compressive strength of compacted materials.*
AS/NZS 1254 – *PVC-U pipes and fittings for stormwater or surface water applications.*
AS 1289.3.3.1 - *Calculation of the plasticity index of a soil.*
AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.4.3.1 - *Determination of the pH value of a soil - Electrometric method.*
AS 1289.4.4.1 - *Determination of the electrical resistivity of a soil – Method for sands and granular materials.*
AS 1289.5.6.1 - *Compaction control test - Density index method for a cohesionless material.*
AS 1397 – *Continuous hot-dip metallic coated steel sheet and strip – coatings of zinc and zinc alloyed with aluminium and magnesium.*
AS 1646 - *Elastomeric seals for waterworks purposes.*
AS 1762 - *Helical lock-seam corrugated steel pipes - Design and installation.*
AS/NZS 2032 - *Installation of PVC pipe systems.*
AS/NZS 2041 - *Buried corrugated metal structures.*
AS/NZS 2566.1 - *Buried flexible pipelines - structural design*
AS/NZS 2566.2 – *Buried flexible pipelines - Installation*
AS/NZS 2666.1 - *Buried flexible pipes*
AS/NZS 3725 – *Design for installation of buried concrete pipes*
AS/NZS 3750.9 – *Paints for steel structures - Organic zinc-rich primer.*
AS/NZS 3750.15 - *Paints for steel structures - Inorganic zinc silicate paint.*
AS 4058 - *Precast concrete pipes (pressure and non-pressure).*
AS/NZS 4131 - *Polyethylene (PE) compounds for pressure pipes and fittings*.
AS 4139 - *Fibre reinforced concrete pipes and fittings.*
AS/NZS 4680 - *Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.*
AS/NZS 5065 - *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.*
AS/NZS ISO 9001:2008 *(as amended) - Quality management systems - Requirements*.

(c) Department of Transport and Main Roads Technical Standards:

MRTS 25 - Manufacture of pre-cast concrete pipes
MRTS 26 - Manufacture of fibre reinforced concrete drainage pipes

(d) Other:
AASHTO Standard, *M190 - Bituminous coated corrugated metal culvert pipe and pipe arches.*
ASTM F2562/F2562M-08 - *Specification for steel reinforced thermoplastic ribbed pipe and fittings for non-pressurised drainage and sewerage*
Safety in Design CWPHESS

SC6.4.6.6.2 Common requirements

(1) General

(a) Pipes and/or pipe arches shall not be placed in position until the Contractor has produced documentary evidence to the Superintendent, that the manufacture of the products to be used in the works has complied with the Manufacturer's Quality Plan in accordance with ISO 9001.

(b) Documentation shall comprise a conformance certificate to AS 4058 or AS 4139 as appropriate for each batch of pipes or pipe arches to be included in the works, including manufacturer's installation recommendations. The above documentations certificates are to be supplied at least 24 hours in advance of dispatch to site.

Note—Table 3.6 of AS 4058 shall be replaced by Table 7A of *MRTS 25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(c) Each unit shall be marked at time of manufacture with:

(i) class and size;

(ii) manufacturer's name; and

(iii) date of casting.

(d) Where a Contractor wishes to use drainage pipe other than the pipes described in SC6.4.6.6.3(1) to (5) inclusive, the Contractor shall submit, for agreement by the Superintendent, full details in accordance with AS/NZS 2566.1 of the characteristics of the pipe materials and embedment and design loads, together with certification from the manufacturer of its suitability and quality for use in each particular application. Certification of the suitability of any pipe will address the bedding requirements, deflection, strength, buckling and any other considerations appropriate to the particular application. Upon agreement, the Superintendent must submit an application for a variation to the development consent for approval by council.

(e) The Contractor shall take all necessary steps to drain the excavation to allow the foundation, the bedding and any backfilling to be compacted to the specified relative compaction.

(f) Culverts shall be installed within 10mm of the grade line and within 50mm of the horizontal alignment specified on the drawings. The Contractor shall relay any culvert which is not within these tolerances. Where longitudinal gradients are less than 0.5 per cent, culverts shall be installed within +/- 6mm of the grade line.

(g) Where shown on the drawings at the discharge end of culverts terminating at pits and headwalls a 3m length of 100mm diameter subsurface drain shall be laid in the trench 100mm above the invert level of the culvert and discharging through the wall of the pit or headwall at 100mm above the invert level of the culvert or headwall. The subsurface drainage pipe shall be sealed at the upstream end and shall be enclosed in a seamless tubular filter fabric in accordance with SC6.4.6.21 Subsurface drainage.

(h) Excavation and backfilling for pipe drainage shall be undertaken in a safe manner and in accordance with all statutory requirements. The Contractor must present to the Superintendent the installed pipe drainage upon completion of backfill to the top side of the side zone for inspection prior completion of backfill.

(i) Where the Contractor proposes to travel construction plant in excess of 5 tonnes gross mass over pipe drainage structures, the Contractor shall design and provide adequate protective measures for the crossings and shall submit the proposals to the Superintendent for prior approval.

(j) Upon completion of installation of pipe drainage, the Contractor shall submit relevant test results to demonstrate compliance to the requirements indicated on clauses.

SC6.4.6.6.3 Precast reinforced concrete

(1) Pipes

(a) Precast reinforced concrete pipes shall comply with AS 4058 and shall be of the class and size as shown on the drawings.

Note—Table 3.6 of AS 4058 shall be replaced by Table 7A of *MRTS25 - Manufacture of Precast Concrete Pipes* in determining the acceptability of pipe wall and joint surface defects.

(b) Fibre reinforced concrete drainage pipes shall comply with AS 4139 and shall be of the class and size as shown on the drawings.

(c) Unless specified otherwise, joints shall be flush type with external elastomeric bands complying with AS 1646 and as recommended by the manufacturer.

(d) Where precast pipes are to be installed into a marine or saline environment, the contractor is to ensure and provide documentation that the supplied pipes are “fit for purpose” and are suitable for the intended site application.

(2) Excavation

(a) Unless otherwise indicated on the drawings, or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

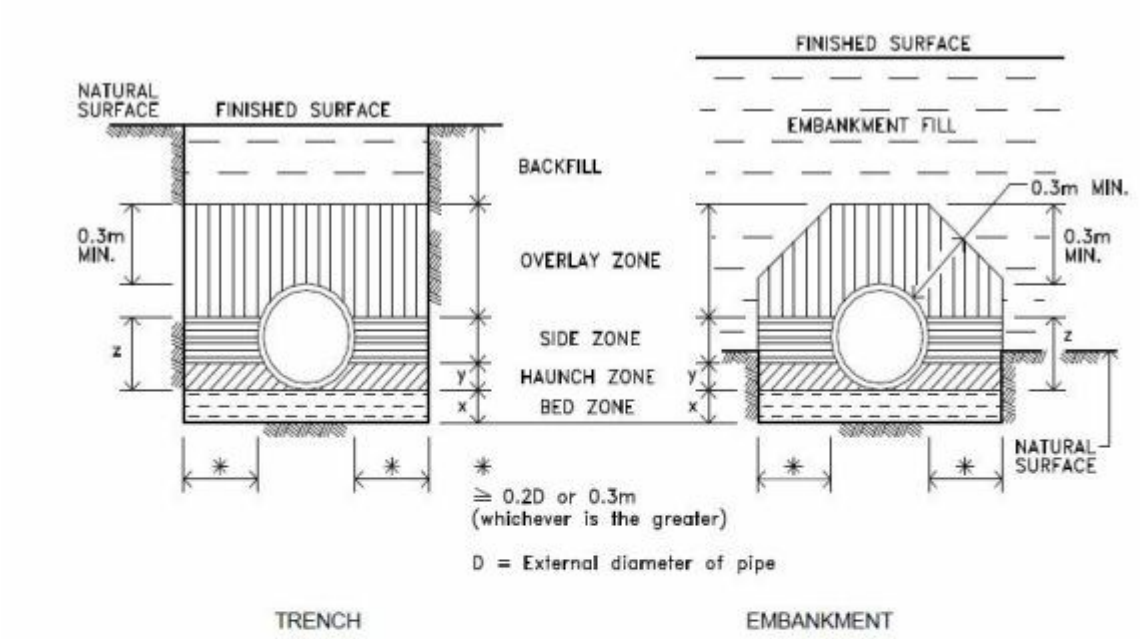
(b) For normal trench conditions, the pipe shall be laid in an excavated trench with bedding as specified in SC6.4.6.6.2(3). The trench shall be excavated to a width as specified in Figure SC6.4.6.6.1.

(c) Care is necessary to avoid laying pipe drainage in trenches excavated to excessive width. Pipes laid in wide trench conditions will be deemed to be in embankment conditions (positive projection). Wide trench conditions apply when, for a single pipe, the width of trench, $W \geq D + 0.6$ metre where D is the pipe diameter. For multi-cell pipes wide trench conditions apply when the width of trench, $W \geq \sum D + \sum S + 0.6$ metre where S is the square spacing between the pipelines. This definition of wide trench conditions as equivalent to embankment conditions relates to the size and geometry of the excavation utilised at construction. Pipes shown on the drawings to require trench conditions shall not be placed under embankment conditions without a design check for compliance of the pipe strength and trench support requirements in accordance with AS 3725.

(3) Bedding

(a) Bedding shall be in accordance with this sub-section, AS 3725 and AS 3725 Supplement 1 for the pipe support types as shown on the drawings. Where the pipe support type is not shown on the drawings, the support type shall be HS3 within road reserves (HS3 is recommended for high embankment fill) and H2 elsewhere.

(b) Figure SC6.4.6.6.1 below and Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions for all AS 3725 pipe support types.



		Pipe Support Type						
		U	H1	H2	H3	HS1	HS2	HS3
Dimension (minimum)	x	75 on rock Nil on soil	100 for D ≤ 1500 150 for D > 1500		0.25 D but >100	100 for D ≤ 1500 150 for D > 1500		
	y	—	0.1D	0.3D	0.3D	0.1D	0.3D	0.3D
	z	—	—	—	—	≥ 0.7D		

D = External diameter of pipe

Figure SC6.4.6.6.1 Pipe installation conditions

(c) Bedding material for the bed and haunch zones shall consist of a granular material having a grading, determined by AS 1141.11, complying with Table SC6.4.6.6.1 Bedding Material Grading Limits, and a Plasticity Index, determined by AS 1289.3.3.1 of less than 6. Select fill material in the side zones, for pipe support type HS, shall also comply with Table SC6.4.6.6.1.

Table SC6.4.6.6.1 Bedding material grading limits

Sieve size mm	Weight passing %	
	Bed and Haunch Zones	Side Zones/Overlay Zones
75.0	-	100
19.0	100	-
9.5	-	50 - 100
2.36	50 -100	30 - 100
0.60	20 - 90	15 - 50
0.30	10 - 60	-
0.15	0 - 25	-
0.075	0 - 10	0 - 25

(d) The Contractor shall advise the Superintendent of the source of bedding material.

(e) All material shall be compacted in layers not exceeding 150mm compacted thickness except where explicitly approved by the Superintendent, for the first placed layer above the pipe crown in the overlay zone, in order to protect the pipe from construction damage. Each layer shall be compacted to the relative compaction specified before the next layer is commenced. Cohesionless materials can be

compacted in one operation by saturation and vibration to achieve the minimum Density Index (DI) specified.

(f) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(g) Compaction of select fill material in the bed and haunch zones shall be to the appropriate pipe support requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) in AS/NZS 3725, when tested in accordance with AS 1289.5.6.1. H3 Pipe Support includes concrete bedding. Concrete shall be grade N20 to AS 3600. Pipe shall be suitably reinforced in accordance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 Pipe Support. Unless specifically selected pipes are nominated for use with H3 bedding, a design check shall be required to confirm the suitability of the proposed pipes.

(h) The top 0.1Dmm of the bedding and haunch material directly under the pipe shall be placed and shaped accurately to house the pipe after compaction is achieved in the bedding and haunch zone external to the area of direct pipe support.

(i) Where the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material is considered by the Superintendent to be a likely problem, the Superintendent may specify cementitious stabilisation of the bedding material used in the bedding and haunch zones.

(4) Installation

(a) General

Pipes shall be laid with the socket (female) end placed upstream. Pipes which have marks indicating the crown or invert of the pipes shall be laid strictly in accordance with the markings. Unless specified, no individual length of pipe shall be shorter than 1.2m.

The contractor is to ensure that all trenching is to conform to the requirements of Workplace Health and Safety (WHS) Act and regulations and Excavation Work Code of Practice 2013.

Pipes can be stiffened temporarily by the use of timber structs, erected before filling is placed. Struts shall be of hardwood measuring at least 100mm by 100mm or 125mm diameter. One strut shall be placed in a vertical position at each pipe joint, thence at a spacing not greater than 1,200mm. Struts shall bear against a sill laid along the invert of the pipe and a cap bearing against the crown of the pipe. Both the sill and the cap shall be continuous throughout the length of the pipe. Struts shall be made to bear tightly against the pipe by the use of wedges between the top of the struts and the cap. Struts, sills and caps shall be removed on completion of the embankment, unless removal is ordered earlier.

Lifting holes in all pipes shall be sealed with plastic preformed plugs approved by the Superintendent, or a 3:1 sand:cement mortar, before the commencement of backfilling.
Bulkheads shall be constructed in accordance with SC6.4.6.5 Drainage structures on all lines where the pipe gradient exceeds 5 per cent.

The Contractor shall present the laid and jointed pipes for inspection by the Superintendent prior to commencement of trench backfilling.

(b) Joints in reinforced concrete pipes

(i) Rubber Ringed Joints

Before making the joint, the spigot and socket and the rubber ring shall be clean and dry.

The rubber ring shall be stretched on to the spigot end of the pipe, square with the axis and as near as possible to the end, care being taken that it is not twisted. The spigot end of the pipe shall then be pushed up to contact the socket of the pipe with which it is to join, and be concentric with it. The spigot end shall then be entered into the socket of the already laid pipe and forced home by means of a bar, lever and chain, or other method approved by the Superintendent.

The joint shall be tested to ensure that the rubber ring has rolled evenly into place.
Where wedge shaped “skid” rubber rings are prescribed the Manufacturer’s instructions, which include the use of lubricants, shall be followed.

(ii) Flush or butt jointsThe ends of the pipes shall be butted together so as to be as tight and as even as possible.

The joints shall be sealed externally with proprietary E.B bands, supplied and installed in accordance with the manufacturer's recommendations, care being taken that the bands are not twisted.

(c) Joints in fibre-reinforced cement pipes

(i) New Pipes
Joints shall be of a flexible type. Rubber rings shall be used to seal joints in both rebated and spigot and socket jointed pipes in the manner specified in SC6.4.6.6.3(4) Installation.
Alternatively, a jointing compound comprising plasticised butyl rubber and inert fillers may be used to seal such pipes in accordance with the manufacturer's instructions.

(ii) Direct Side Connections to Other Pipes
Direct side connections to other pipes shall be as detailed on the drawings.

(5) Backfill

(a) Select fill material to the side zones shall be compacted to the requirements shown in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725 when tested in accordance with AS 1289.5.4.1 for standard compactive effort.

(b) Ordinary fill to the side zones and overlay zones, for all pipe support types, except type HS shall consist of Selected Backfill as defined in SC6.4.6.10 Earthworks (construction) or alternatively cohesionless material in accordance with Table 6.4.6.6.1 Bedding material grading limits. It shall be placed around the pipe to the dimensions shown in Figure SC6.4.6.6.1 Pipe installation conditions.

(c) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725.

(d) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(e) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(f) When compacted adjacent to culverts or drainage structures, the Contractor shall adopt compaction methods which will not cause damage or misalignment to any culvert or drainage structure. Any damage caused shall be rectified by the Contractor. Backfilling and compaction shall commence at the pipe or wall so as to confine remaining uncompacted material at commencement.

SC6.4.6.6.4 Steel pipes and pipe arches

(1) Nestable steel pipe and drainage units

(a) Nestable steel pipes and drainage units shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings.

(b) The galvanised steel sheets used in manufacture shall comply with AS 1397 for steel base grade G250

and a minimum coating Class of Z600.

(c) Where specified, the pipes and drainage units shall be given a protective coating over the steel, after assembly of a coal tar epoxy paint or equivalent as approved by the Superintendent, to a thickness of 400 microns.

(d) Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of zinc-rich organic primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15.

(2) Helical lock-seam corrugated steel pipe

(a) Helical lock-seam corrugated steel pipe shall be supplied in accordance with AS 1761 and AS 1762 and shall be of the class and size as shown on the drawings.

(b) The galvanised steel sheet used in manufacture shall comply with AS 1397 for steel based grade G250 and a minimum coating Class of Z600.

(c) Unless otherwise approved by the Superintendent, no part of the pipe shall incorporate steel strips which have been joined by welding. Field cut ends shall be carefully wire brushed to remove any scale followed immediately by two coats of organic zinc-rich primer complying with AS/NZS 3750.9 or two coats of inorganic zinc silicate paint complying with AS/NZS 3750.15. Pipes and coupling bands shall be given a protective hot-dip coating of bitumen on both sides to AASHTO standard M190 or equivalent as part of the process of manufacturing.

(3) Bolted steel pipes, pipe arches and special shapes

(a) Bolted steel pipes, pipe arches and special shapes shall be supplied in accordance with AS 2041 and shall be of the class and size as shown on the drawings. The corrugated pipe or plate shall be hot-dip galvanised on both sides after fabrication in accordance with the requirements for coating thickness and mass for articles in AS/NZS 4680.

(b) Also, after assembly, all bolted steel pipes, pipe arches and special shapes shall be given a protective coating on the outside of the steel plate, of a coal tar epoxy paint complying with AS 3887 or equivalent paint approved by the Superintendent. Invert plates shall be coated on the outside before they are placed on the pipe bed. The plate surface shall be cleaned and degreased with a cleaning solution recommended by the protective coating manufacturer. The protective coating shall be applied to give a uniform minimum dry thickness of 400 microns. Any coating damaged shall be recoated by first cleaning any grease, mud or other foreign matter from the affected area. The area shall then be recoated so that the minimum dry thickness of the coating is 400 microns.

(4) Materials and surface treatment of steel pipes and pipe arches

All steel pipes and pipe arches will require an Engineer's certification that the pipe materials and surface treatments are adequate to provide for installation and in-service loading, as well as corrosion protection for a satisfactory design life of 100 years, unless indicated otherwise on the drawings. Such certification shall address the chemistry of the soil, groundwater, stream and backfill material as specified SC6.4.6.6.4(5).

(5) Materials against steel structures

(a) The severity of corrosive attack on steel structures will depend on the pH value and electrical resistivity of the soil surrounding the structure and the pH value of the water in the stream.

(b) Besides meeting the normal requirements of the bedding, selected backfill materials and the materials used for embankment construction above the steel structures and within a horizontal distance from the structure equal to the height of the filling over the structure, the pH and resistivity limits as shown in Figure SC6.4.6.6.2 will determine the level of corrosion protection required.

(c) Notwithstanding the height of fill, embankment material within 6m of the structure shall conform to these requirements.

(d) The pH and electrical resistivity of the material shall be determined in accordance with AS 1289.4.3.1 and AS 1289.4.4.1.

(e) The Contractor shall nominate the sources of the various materials and submit documentary evidence

from a NATA registered laboratory that the representative samples conform to the requirements of this clause and the protective treatment provided. The samples shall be pre-treated if necessary so as to represent the condition and grading when compacted and in service.

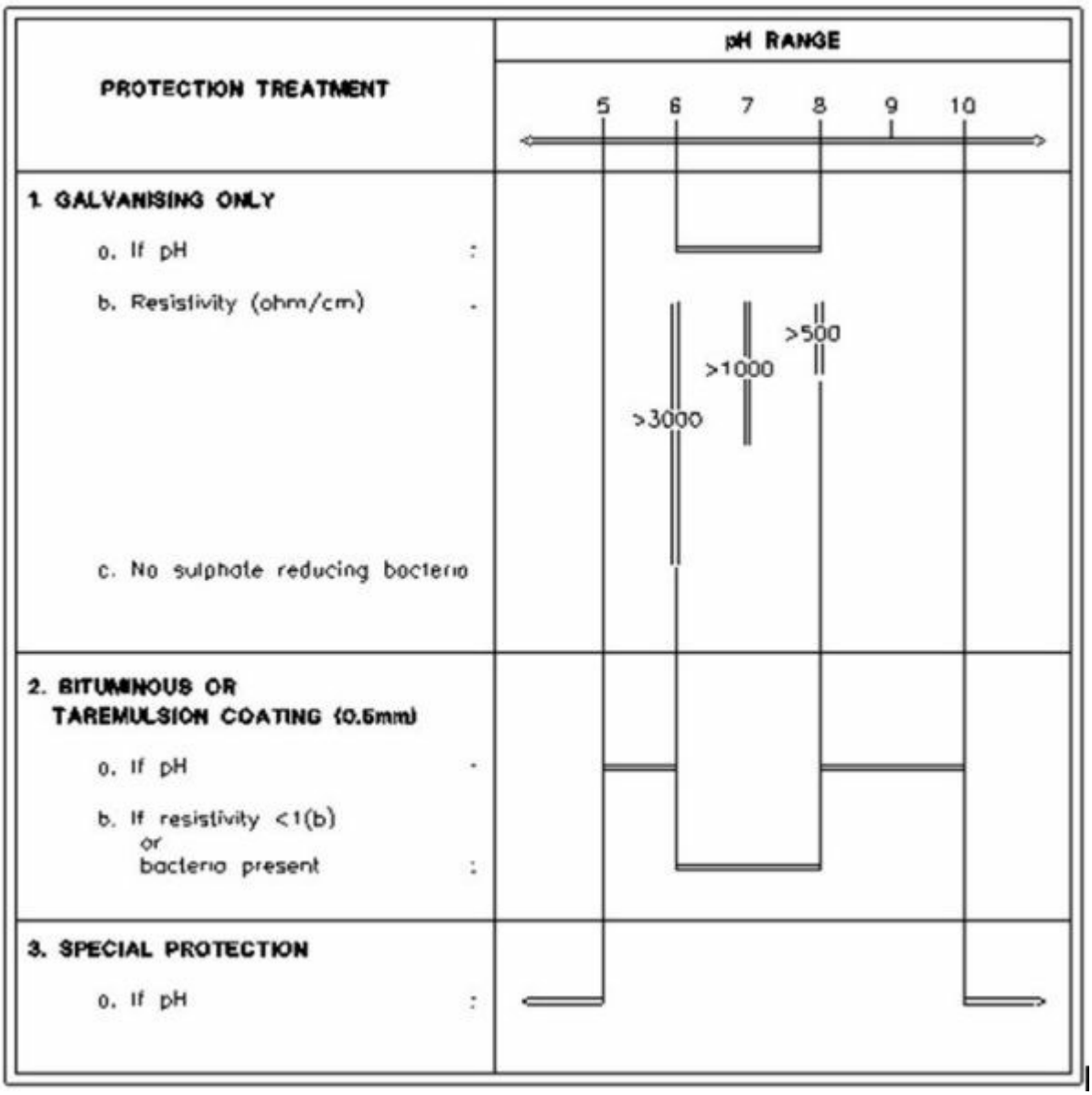


Figure SC6.4.6.6.2 Corrosion protection requirements for steel structures

(6) Excavation and foundation preparation

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) The trench shall be excavated to a level 75mm below the design invert and for a minimum width of 600mm on each side of the structure.

(c) Where unsuitable material, as determined by the Superintendent, is encountered at the foundation level, it shall be removed to a depth approved by the Superintendent. The additional excavation shall be backfilled with material complying with, selected material as per SC6.4.6.10 Earthworks (construction).

(d) Where rock is encountered at the foundation level, the foundation shall be excavated for an additional depth of 250mm, or 0.25 times the structure width, whichever is the lesser and for a width equal to the width of the structure. The additional excavation shall be backfilled with material complying with, and compacted to, the requirements for HS3 pipe support as specified in SC6.4.6.6.3 3(b).

(7) Bedding

Bedding shall meet the requirements of SC6.4.6.6.3(3)(f). The thickness of uncompacted bedding material

between the foundation and the outer surface of corrugation shall not be less than 75mm. The uniform blanket of loose material which provides the minimum 75mm thick bedding, shall be placed on the shaped, compacted selected material foundation to allow the corrugations of the structure invert to bed in and become filled with the material.

(8) Installation

(a) General
The assembly of all corrugated steel pipes and pipe arches as well as helical lock-seam corrugated steel pipes shall be carried out in accordance with the manufacturer's recommendations. These recommendations shall be submitted to the Superintendent before assembly or laying of the culverts is commenced.

If deemed necessary after consultation with the manufacturer, temporary bracing of corrugated steel pipes or pipe arches shall be carried out in accordance with the manufacturer's recommendations.

(b) Joints
Corrugated steel pipes or pipe arches shall be joined in accordance with the manufacturer's recommendations and AS 2041.

Where helical-lock seam corrugated steel pipes are to be joined, both ends of the join shall be rerolled with four annular corrugations of pitch 68mm. Coupling of the re-rolled ends shall be made in accordance with AS 1761 by using semi-corrugated bands. Rubber ring joint seals shall be used in conjunction with the coupling bands except where specifically indicated otherwise in the drawings.

All joints or lap joints in pipes or pipe arches (excluding rubber ring joint coupling bands) shall be covered with strips of non-woven geotextile material, of minimum 250mm width and of minimum mass 270 grams per square metre in accordance with the requirements for geotextile in SC6.4.6.20 Subsoil, foundation and pavement drains, to prevent loss of sand backfill or bedding into the pipe.

(9) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of clause SC6.4.6.6.3(5) except that the required relative compaction in the side support and overlay zones shall be 95 per cent (AS 1289.5.4.1 standard compaction). Backfill shall be placed around the steel pipe or structure, to a minimum dimension equal to the pipe width, on both sides.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

(e) The Contractor shall check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure shall not vary from the manufacturer's specified dimensions by more than plus or minus 2 per cent for pipes and pipe arches.

(10) Invert protection of corrugated steel pipes and pipe arches

(a) Where shown on the drawings, the invert of corrugated steel pipes and pipe arches shall be protected using sprayed concrete.

(b) The sprayed concrete shall be placed to a thickness of not less than 100mm over the crest of the

corrugations and to a width such that the bottom third of the pipe circumference is covered symmetrically about the invert of the pipe.

(c) All foreign material shall be removed from the surface to be protected. Where corrosion has occurred all loose scale shall be removed.

(d) The production, application and curing of sprayed concrete shall be in accordance with sub-section SC6.4.6.28 Minor concrete works.

(e) The sprayed concrete shall be reinforced with a fabric of hard drawn steel wire 4mm diameter with 200mm square mesh. The fabric shall be securely supported at a central location within the sprayed concrete by non-metallic supports.

(f) Laps in fabric shall be 300mm and a cover of 50mm of sprayed concrete shall be provided to the fabric at all edges.

(g) Immediately after placement of the sprayed concrete, all free water shall be removed and the surface coated with cement slurry.

(h) No water shall be allowed to flow over the surface of the sprayed concrete for twenty-four hours after the placement of sprayed concrete.

SC6.4.6.6.5 UPVC pipes

(1) Materials

(a) Unplasticised PVC (UPVC or similar material) Pipes and Fittings shall be manufactured in accordance with AS/NZS 1254 and shall be of the type and size as shown on the drawings. Where pipes with extreme external diameter are equal to or greater than 450mm (375mm nominal internal diameter) are proposed, a separate approval from the Superintendent and council is required.

(b) Embedment material in the bedding, side support and overlay zones shall be in accordance with bed and haunch zone material in SC6.4.6.6.3(3).

(c) Trench backfill material shall satisfy the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction).

(2) Excavation and bedding

(a) Unless otherwise indicated on the drawings or approved by the Superintendent, the formation shall be completed to subgrade level and the pipes then installed in the normal trench condition.

(b) Figure SC6.4.6.6.3 and Table SC6.4.6.6.2 indicate the dimensions of bedding and backfilling for pipes laid in trench conditions and embankment conditions, unless otherwise indicated on the drawings.

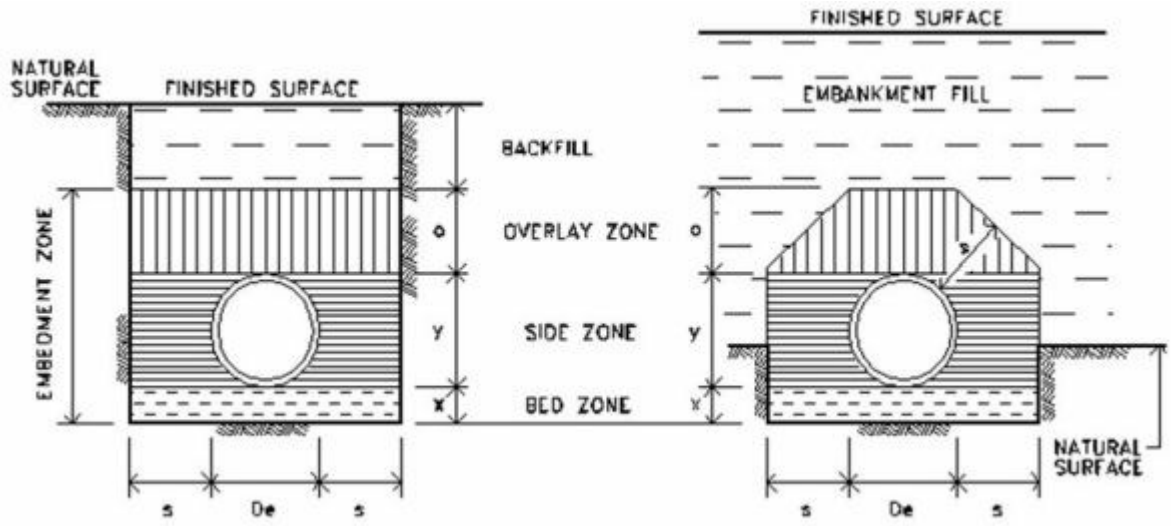


Figure SC6.4.6.6.3 Pipe installation conditions

Table SC6.4.6.6.2 Trench and embedment dimensions

Extreme External	Minimum Dimensions (mm)			
Dia (De)mm	x	s	o	y
[3]75≤150	75	100	100	Pipe dia.
>150≤300	100	150	150	Pipe dia.
>300≤450	100	200	150	Pipe dia.

Note—Where multiple pipes are laid side by side, the minimum distance between the pipes shall be dimension "s" for the larger of adjacent pipes.

(c) Bedding zone material shall be placed and compacted in accordance with the requirements in Table 5.5 of AS/NZS 2566.2.

(3) Installation

(a) Embedment of the UPVC pipe shall be in accordance with the requirements of AS/NZS 2566.2 and to the dimensions shown in Figure SC6.4.6.3.

(b) Pipe laying shall be in accordance with Part 7 of AS 2032 and solvent-cement pipe jointing shall be in accordance with Part 3 of AS 2032. Jointing may be performed with the pipes either in the trench or at ground level. All pipes, or jointed pipelines, shall be lowered into the trench without being dropped. Pipelines shall be placed so that joints are not strained.

(4) Backfill

(a) Compaction of the material in the side support and overlay zones shall comply with the requirements of SC6.4.6.6.3(5) for HS3 support type.

(b) All material shall be compacted in layers not exceeding 150mm compacted thickness. Each layer shall be compacted to the relative compaction specified before the next layer is commenced, or compacted in one operation by saturation and vibration to achieve a minimum Density Index as specified in Table 5.5 of AS/NZS 2566.2 – Buried Flexible Pipelines – Installation.

(c) At the time of compaction, the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content, which, unless otherwise approved by the Superintendent, is neither less than 60 per cent nor more than 95 per cent of the apparent optimum moisture content, as determined by AS 1289.5.4.1 (standard compaction).

(d) The remainder of the trench to the underside of the subgrade, or selected material zone as specified in SC6.4.6.10 Earthworks (construction), shall be backfilled with material satisfying the requirements for embankment material as defined in SC6.4.6.10 Earthworks (construction). Where excavation is approved through the selected material zone, the section of trench within the select material zone shall be backfilled with selected material as defined in SC6.4.6.10 Earthworks (construction).

SC6.4.6.6.6 Limits and tolerances

The limits and tolerances for materials and product performance related to the various clauses in this sub-section are summarised in Table SC6.4.6.6.3 Summary of Limits and Tolerances below:

Table SC6.4.6.6.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
	Culvert Position	± 10mm	SC6.4.6.6.2(1)
	(a) Grade Line	± 6mm	
	(b) Grade line <0.5%		
	(c) Horizontal Alignment	± 50mm	SC6.4.6.6.2(1)
	Bedding		
	(a) Bed and Haunch Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(3)

Backfill - Concrete Pipes (a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725	SC6.4.6.6.3(5)
Backfill - Steel Pipes		
(a) Side and Overlay Zone Compaction	Table 5 – Bedding factors for Working Dead Loads (U, H and HS Supports) of AS/NZS 3725, HS3	SC6.4.6.6.4(9)
(b) Pipe/Structure		
(i) Horizontal and Vertical Variation	< 2% of specified dimensions	SC6.4.6.6.4(9)
Sprayed Concrete		
(a) Over crest of corrugations over bottom third of pipe circumference	> 100mm	SC6.4.6.6.4(10)
Bedding Zone Compaction	DI 70	SC6.4.6.6.5(2)
Backfill - UPVC Pipes		
(a) Side and Overlay Zone Compaction	³95%, DI 70	SC6.4.6.6.5(4)

SC6.4.6.7 Precast box culverts

SC6.4.6.7.1 Introduction

(1) Scope

(a) This sub-section covers the installation of precast concrete box culverts and should be read in conjunction with sub-section SC6.4.6.4 Stormwater drainage.

(b) The work to be executed under this Specification consists of:

(i) preparation of foundations;

(ii) provision of bedding;

(iii) construction of base slabs;

(iv) installation of precast culvert units;

(v) headwalls and wingwalls;

(vi) backfilling against structures;

(vii) provision and removal of coffer dams; and

(viii) excavation of inlet and outlet channels.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.4 Stormwater drainage
SC6.4.6.9 Open drains
SC6.4.6.12 Flexible pavements
SC6.4.6.28 Minor concrete works

(b) Australian Standards:
AS1597.1 - *Precast reinforced concrete box culverts - Small culverts*
AS1597.2 - *Precast reinforced concrete box culverts - Large culverts*
AS/NZS ISO 9001:2008 - *Quality management systems - Requirements.*

(c) Other:
Austroads, *Guide to Geotextiles*
Department of Transport and Main Roads
MRTS05 - *Unbound Pavements*
MRTS24 - *Manufacture of precast concrete culverts*

SC6.4.6.7.2 Materials

(1) Culvert units, link and base slabs

(a) The supply and testing of precast reinforced concrete box culvert units, link and base slabs shall be in accordance with AS1597 with the following alterations or additional requirements:

(i) proof load testing must be arranged by the Contractor in batches as specified in either AS1597.1 or AS 1597.2 as appropriate;

(ii) proprietary lifting anchors must be provided in the culvert units, link and base slabs;

(iii) delivery and unloading is the Contractor's responsibility; and

(iv) the supplier must implement and maintain a Quality System in accordance with ISO 9001 to ensure materials, manufacture and proof load testing conform to the appropriate Standards.

(b) A conformance certificate, to AS1597 must be submitted to the Superintendent at least 3 working days prior to dispatch.

(c) Each unit must be marked at time of manufacture with:

(i) type and size;

(ii) casting date;

(iii) manufacturer's name; and

(iv) inspection pass and date.

(2) Handling, delivery and storage

(a) Ensure adequate equipment and load shifting machineries are available for safe handling and unloading.

(b) Upon delivery of precast units, ensure that the following criteria have been achieved:

(i) 70% of the minimum concrete strength;

(ii) small culvert units: Cured to AS 1597.1 clause 2.6.3; and

(iii) large culvert units: Cured to AS 1597.2 clause 2.7.

(c) Prior inspection of the stored precast box culvert units is to be undertaken for dimensional accuracy and defects following delivery. Results of the inspections must show that the units conform to the following:

(i) small culvert unit: To AS 1597.1; and

(ii) large culvert unit: To AS 1597.2.

(3) Concrete

The concrete and reinforcement for cast-in-situ base slabs shall comply with sub-section SC6.4.6.28 Minor concrete works.

(4) Selected backfill

The quality of selected backfill shall comply with the requirements in AS 1597.2, or alternatively comply with the requirements of side/overlay zone materials in Table SC6.4.6.6.1 *Bedding material grading limit* of sub-section SC6.4.6.6 Pipe drainage.

(5) Ordinary backfill

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which are in accordance with the requirements for the upper 0.3 m of embankment construction as detailed in SC6.4.6.10 Earthworks (construction).

SC6.4.6.7.3 Construction

(1) Coffer dams

(a) At some sites it may be expedient for the Contractor to construct a coffer dam. The construction of coffer dams shall be the responsibility of the Contractor.

(b) Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Coffer dams shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure.

(c) A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the Superintendent, but the Contractor shall be responsible for the successful construction of the work.

(d) Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide the clearances specified. This work will be at the Contractor's expense.

(e) No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Coffer dams, including temporary piles, shall be removed at least to the level of the invert after completion of the

structure. Upon completion of works, remove coffer dams, including temporary piles, at least to the level of the culvert invert after completion of the structure. Ensure that no material associated with the coffer dam or dewatering can enter the culvert.

(2) Excavation

Excavation shall be carried out in accordance with the provisions in sub-section SC6.4.6.4 Stormwater drainage.

(3) Foundations

(a) Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed.

(b) Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material.

(c) Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock.

(d) Earth foundations shall be finished to line and level to the underside of bedding shown on the drawings. Care shall be taken to avoid disturbing material below this level.

(e) All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the Superintendent and backfilled in accordance with sub-section SC6.4.6.4 Stormwater drainage.

(4) Bedding

(a) Cast-in-situ base slabs

No bedding material shall be placed until the foundations have been inspected and approved by the Superintendent.

Bedding shall be either mass concrete or lightly bound paving material which complies with the requirements of at least a Type 3, Subtype 3.3 material as defined in the Specification MRTS05 (04/11), whichever is shown on the drawings.

Mass concrete bedding blinding layer shall be 20 mpa compressive strength and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of ±10mm in level and ±50mm in line. The bedding shall be finished to a smooth surface. Where longitudinal gradients are less than 0.5 per cent, concrete blinding layers shall be installed with +/- 6mm of the grade line.

(b) Precast base slabs

Precast base slabs, U-shaped culvert units and one piece culvert units shall be supported on a bed zone of selected backfill of minimum compacted depth 150mm in accordance with AS 1597.2.

If suitable compaction of the trench subgrade cannot be achieved, it will be the responsibility of the developer to recommend an alternate solution to council to achieve the desired bearing capacity for the structure prior to construction.

(5) Cast-in-situ base slabs

(a) Cast-in-situ base slabs shall be constructed to the dimensions shown on the drawings and in accordance with the requirements of sub-section SC6.4.6.28 Minor concrete works. The invert levels shall be within -10mm to +10mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position ±50mm. Where longitudinal gradients are less than 0.5 per cent cast insitu base slabs shall be installed within +/- 6mm of the grade line.

(b) Recesses or nib walls to accommodate the walls of the precast crown units shall be formed in the base

slab to the dimensions shown on the drawings.

(6) Installation of precast units

(a) Precast units shall not be installed until the base slab has attained a minimum compressive strength of 20 MPa.

(b) Precast crown units shall be placed on a bed of mortar either on the slab or in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes and butt joints between units shall be packed or sealed with cement mortar or grout or flexible joint filler.

(c) Before placement of top slabs on U-shaped units or link slabs on adjacent crown units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of precast unit.

(d) Lifting anchor recesses shall be filled to the surface with cement mortar.

(e) In the case of multi-cell culverts, a nominal 50mm gap shall be provided between adjacent cells. This gap shall be filled with cement mortar or grout.

(f) All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

(g) All external surfaces of vertical joints between precast crown units, shall be covered full length, and minimum 100mm width, with strips of denso tape or similar as an alternative to joint filling.

(7) Backfill

(a) All bracing and formwork shall be removed prior to backfilling. Prior to backfill placing, present to the Superintendent for inspection all seals, joints and levels.

(b) Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. Alternatively cohesionless materials can be compacted in one operation by saturation and vibration to achieve a minimum Density Index of 70. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with SC6.4.6.10 Earthworks (construction).

(c) Backfill shall be placed against wingwalls, headwalls and retaining walls in accordance with SC6.4.6.28 Minor concrete works.

(d) Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it.

(e) Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m width before the backfill is placed.

(8) Excavation of inlet and outlet channels

(a) Excavation of inlet and outlet channels shall be carried out as shown on the drawings and shall extend to join the existing stream bed in a regular manner as detailed SC6.4.6.9 Open drains.

(9) Construction loading on culverts

(a) Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 32 MPa.

(b) Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2.

SC6.4.6.7.4 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.7.1 Summary of Limits and Tolerances below:

Table SC6.4.6.7.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clauses
1.	**Mass Concrete Correction**		
	a) Over highest points of rock	50mm	SC6.4.6.7.3(3)
2.	**Mass Concrete Bedding**		
	a) Level	± 10mm	SC6.4.6.7.3(4)
	b) Level where grade line <0.5%	+/- 6mm	
	c) Line	± 50mm	SC6.4.6.7.3(4)
3.	**Culvert Location**		
	a) Invert Level	±10mm	SC6.4.6.7.3(5)(a)
	b) Invert where grade line is <0.5%	+/- 6mm	
	c) Grade	5mm in 2.5m (1 in 500)	SC6.4.6.7.3(5)(a)
	d) Plan Position	±50mm	SC6.4.6.7.3(5)(a)

SC6.4.6.8 Drainage mats

SC6.4.6.8.1 Introduction

(1) Scope

(a) The purpose of this policy sub-section is to provide standards advice and guidelines for the use and installation of drainage mats.

(b) Drainage mats shall be constructed where and as shown on the drawings or as directed by the Superintendent.

(c) This sub-section should be read in conjunction with SC6.4.6.21 Subsurface drainage.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the SC6.4.5 Supervision and construction guidelines

(2) Terminology

Type A drainage mats	are intended to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.
Type B drainage mats	are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section one as follows:

SC6.4.6.21 Subsurface drainage
SC6.4.6.20 Subsoil, foundation and pavement drains

(b) Australian Standards:

AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*

(4) Order of construction

(a) Type A drainage mats shall be constructed after the site has been cleared and grubbed and before commencement of embankment construction.

(b) Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

SC6.4.6.8.2 Construction

(1) Type A mats

(a) Type A drainage mats shall be constructed under embankments as and where shown on the drawings or as directed by the Superintendent.

(b) After the embankment foundation has been trimmed and any necessary trench drains installed, a geotextile complying with the requirement of SC6.4.6.21 Subsurface drainage, shall be laid on the embankment foundation. The area of geotextile laid shall be sufficient to cover the area of the Type A drainage mat and an additional amount for enclosing the sides of the drainage mat after the filter material has been placed. Laps of minimum width of 500 mm shall be provided at each join in the geotextile.

(c) Type C filter material or Type D filter material, as shown on the drawings or as determined by the Superintendent, shall be placed on the geotextile and compacted to the satisfaction of the Superintendent. The minimum thickness of the compacted filter material shall be 300 mm plus an allowance for the expected consolidation of the embankment foundation under the embankment load or 500 mm if the amount of the expected total consolidation of the embankment foundation is not known.

The filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250 mm.

(d) After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat.

(e) An additional layer of geotextile shall be placed on the drainage mat under the base of any rock facing which may be placed as part of the embankment construction. The additional layer of geotextile shall extend beyond the outside and inside faces of the bottom layer of rock.

(f) Care shall be taken not to damage the geotextile during the construction of the drainage mat or during placement of subsequent layers of filter material, earth filling or rock facing. Any geotextile so damaged shall be repaired or replaced by the Contractor to the satisfaction of the Superintendent. The cost of repairing or replacing such damaged geotextile shall be borne by the Contractor.

(g) Type A drainage mats shall extend 2 m beyond the toes of embankments and such extensions shall be covered by a 300 mm thick layer of Type C filter material or Type D filter material, as determined by the Superintendent. This protective layer shall be placed immediately after completion of construction of each drainage mat.

(h) Outlets from Type A drainage mats may be surface outlets at the toes of embankments or piped outlets connected to other drainage systems. Where piped outlets are constructed they shall conform to the requirements of SC6.4.6.21 Subsurface drainage.

(2) Type B mats

(a) Type B drainage mats shall be constructed in cuttings as and where shown on the drawings or as directed by the Superintendent. Type B drainage mats shall be constructed for the full width of cuttings and for the pavement width in other locations.

(b) After the subgrade material has been compacted and trimmed, a geotextile complying with the requirements of SC6.4.6.21 Subsurface drainage, shall be laid on the subgrade. Laps of minimum width of 500 mm shall be provided at each join in the geotextile.

(c) Slotted thick walled unplasticised PVC pressure pipe complying with AS 1477, shall be laid on the geotextile at a distance of 200 mm from and parallel to the longitudinal edges of the drainage blanket as shown in the drawings. Details of slot sizes and spacings are shown in SC6.4.6.20 Subsoil, foundation and pavement drains.

(d) Type A filter material shall be placed on the geotextile and compacted to achieve a relative compaction, determined by AS 1289.5.4.1, of at least 100 per cent (standard compaction). Alternatively, the Superintendent may approve the use of a coarser filter material having a maximum particle size of 75 mm and a maximum D90/D10 ratio of three.

(e) The thickness of the compacted filter material shall be as shown on the drawings or as directed by the Superintendent. If the required thickness of compacted filter material is greater than 250 mm, the filter material shall be placed in two or more layers so that no layer, when compacted, has a thickness greater than 250 mm.

(f) After completion of placement and compaction of the filter material, geotextile shall be placed on top of and around the sides of the filter material so that the filter material is completely enclosed by geotextile. The geotextile shall be secured in such a manner as to prevent movement of the geotextile by wind or by construction plant placing pavement layers over the drainage mat.

(g) Outlets from Type B drainage mats shall conform to the requirements of SC6.4.6.21 Subsurface drainage.

Table SC6.4.6.8.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Filter Material**		
	(a) Layer thickness	250 mm max	SC6.4.6.8.2(1) SC6.4.6.8.2(2)
	(b) Compaction (Relative) Type A filter material	100% Standard	SC6.4.6.8.2(2)
2.	**Type B Mats**		
	(a) Design level at top of mat	+0, -40 mm	SC6.4.6.8.2(2)

SC6.4.6.9 Open drains

SC6.4.6.9.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction, lining and protection of all types of open drains including the construction of rock filled wire mattresses and gabions associated with stormwater drainage infrastructure.

(b) This sub-section should be read in conjunction with SC6.4.6.4 Stormwater drainage, and other drainage sub-sections as applicable:

(i) SC6.4.6.6 Pipe drainage;

(ii) SC6.4.6.5 - Drainage structures; and

(iii) SC6.4.6.7 Precast box culverts.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editors note - A reference to drawings is a reference to construction drawings.

(2) Terminology

Open drains	are all drains other than pipe and box culverts and include catch drains, contour drains, diversion drains, table drains, batter drains, swales, channels, gutters and kerb and channel.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.4 Stormwater drainage
SC6.4.6.6 Pipe drainage
SC6.4.6.5 Drainage structures
SC6.4.6.21 Subsurface drainage
SC6.4.6.28 Minor concrete works
SC6.4.6.7 Precast box culverts
SC6.4.6.26 Landscaping

(b) Australian Standards:

AS 1141.22 - *Wet/dry strength variation*
AS 1289.5.4.1 - *Compaction control test – Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.7.1 - *Compaction control test Hilf density ratio and Hilf moisture variation (rapid method)*
AS 2758.4 - *Aggregate for gabion baskets and wire mattresses*
AS 2876 - *Concrete kerbs and channels (gutters) – Manually or machine placed*
AS/NZS 4534 - *Zinc and zinc/aluminium-alloy coatings on steel wire.*
AS/NZS 4680 - *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other:

Austroads, *Guide to Pavement Technology, Part 4B – Asphalt (AGPT04B)*
Austroads, *Guide to Pavement Technology, Part 4G – Geotextiles and Geogrids (AGPT04G)*
ASTM International, ASTM A975 - *Standard specification for double-twisted hexagonal mesh gabions and revet mattresses (metallic coated steel wire or metallic coated steel wire with PVC coating)*
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.9.2 Unlined open drains general

Open drains shall be designed and constructed in accordance with the relevant clauses in Chapter 9 of QUDM 2013. Locate and construct open drains to avoid recharging groundwater, a shallow water table and salinity degradation of

adjacent land.

Any unsuitable material must not be used for the bed and banks of the drain and must be removed from the site. Where a tree is marked for preservation, any drain must be diverted around it with sufficient clearance to avoid damage to the tree's root system.

Where open drains pass through private property, drainage easements of sufficient width to contain the flow and vehicular access for maintenance must be provided and registered as an encumberance on the title of the land through which the drain passes.

Prior to works commencing, temporary drainage measures must be implemented in accordance with the requirements of Best Practice Erosion and Sediment Control.

(1) Types

Catch drains shall be provided above the top and at the toe of embankments as part of the construction of the adjacent roadway. The edges of catch drains shall be positioned not less than 2 m from the tops of cuttings or the toes of embankments nor more than is necessary to maintain the fall of the drains unless otherwise approved.

Minor diversion and contour drains shall be constructed where shown on the construction drawings. Minor diversion drains shall have the same capacity as the nearest pipe culvert on the line of the drain unless otherwise approved by the Superintendent.

Table drains, swales and depressed medians shall be constructed to the line and level shown or calculated from the drawings. Their construction is deemed to be part of the earthworks.

(2) Inlet, outlet and diversion drains shall extend to join the existing stream bed and be of sufficient size to accommodate the design flows from the upstream catchment. The drain shall be excavated to the full width of the structure and care must be taken to ensure the stream bed can accommodate the additional flow with only minimal disturbance.

(3) Construction material excavated from drains shall be placed on the lower sides of the drains and formed as banks with slopes graded in accordance with QUDM Third edition 2013 – Provisional. This material shall be compacted in accordance with AS 1289.5.4.1 and shall be not less than 95 per cent for standard compactive effort.

The Contractor shall ensure that none of the activities associated with the work disturbs any watercourse outside the site. Any excavation below the level of the natural channel shall be backfilled with suitable material compacted to a density equal to and compatible with that existing naturally.

Any excess material shall be legally and responsibly disposed of by the Contractor.
Unlined drains and areas adjacent to open drains shall be treated and revegetated immediately after the drains are complete, in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.9.3 Lined open drains general

(1) The Contractor must only use proprietary products which are suited to the terrain and have been approved for use by council. This would include the use of

(a) organic fibre and vegetation mats installed in accordance with the manufacturer's instructions;

(b) rock filled wire mattresses; or

(c) concrete where there is insufficient width to accommodate the required water way area, or the flow velocity in the drain will exceed the non-scouring velocities or where the trail is likely to be used as a bikeway of footpath during dry periods. Lining shall conform to the profile of the drain and shall be provided as soon as possible after forming the drain.

Before placing any lining material, the foundation material shall be shaped and compacted to not be less than 95 per cent for standard compactive effort as determined by AS 1289.5.7.1 or AS 1289.5.4.1

This section does not include kerb and channel.

(2) Concrete lining

Concrete lining for open drains shall be cast-in-situ or sprayed concrete supplied and placed to a minimum thickness of 100 mm measured at right angles to the surface of the lining in accordance with sub-section SC6.4.6.28 Minor concrete works.

Polyfibres must not be used in marine environments, or where there is risk of fibres escaping into the environment, without approved controls to capture loose polyfibre strands.

Weepholes shall be provided in the concrete at intervals of 2 m spacing with non-horizontal elements or as determined by the Superintendent.

Contraction joints in concrete lining, consisting of narrow transverse and vertical grooves, 5-10 mm in width, 20 mm deep, shall be formed neatly in the surface of the freshly placed concrete at intervals of 3 m unless otherwise specified by the Superintendent.

Expansion joints shall be placed at intervals not more than 15 m with a minimum width of 15 mm and shall consist of preformed jointing material of bituminous fibreboard or alternate approved material and shall be of sufficient depth to fill the joint.

(3) Stone pitching

Stone pitching shall consist of sound durable rock not less than 100 mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface. The exposed surface of each stone or block shall be generally flat and not less than 0.05 square metres in area. Spaces between adjacent stones or blocks shall not exceed 20 mm in width.

(4) Batter drains

Batter drains shall be constructed using either half round steel pipes or precast nestable concrete units as shown and detailed on the drawings.

The units shall be installed in carefully excavated and template controlled trench to produce an even rim line of +0 mm to –50 mm from the batter line at the underside of topsoil.

Any over excavation and undulations in the batter line shall be backfilled and both sides of the drain compacted over the full length to form a firm shoulder against the rim of the batter drain.

When topsoil is placed it shall be tapered over a width of 1 m to zero thickness at the rim of the drain. Both sides of the drain shall then be turfed for minimum width of 1 m and pinned down as provided in SC6.4.6.26 Landscaping.

(5) Proprietary products

Unless shown on the drawings, proprietary products may only be used with the approval of the Superintendent. Where specified, they must be used strictly in accordance with the manufacturer’s instructions.

SC6.4.6.9.4 Rock filled wire mattresses and gabions general

(1) Prior to installation of rock filled wire mattress or gabion excavate so the mattresses finish flush and level with the surrounding ground. Rock-filled wire mattresses and gabions shall be placed at the locations shown on the drawings. Installation shall be in accordance with the manufacturer's instructions. A geotextile, as shown on the drawings, shall be placed between the wire cage and the material being protected.

Foundations of floors of gabions should ideally be within cut material, however if in fill areas or embankments then material must be compacted in layers not greater than 150 mm thick, to a relative compaction of 95 per cent when tested in accordance with AS 1289.5.4.1, for standard compactive effort.

(2) Materials

For wire mattresses and gabions, the galvanising requirements for wire of circular cross section cited in this Clause as "heavily galvanised", shall comply with the coating mass requirements for round wire, Class W10, in AS/NZS 4534. The contractor must submit for approval the type of mattress/gabion proposed along with confirmation of compliance to ASTM A975 and a schedule of installation locations.

(a) Gabions

The gabions shall be of the sizes shown on the drawings and fabricated of woven heavily galvanised wire mesh and PVC coated where specified on the drawings. Each gabion shall be divided by diaphragms into cells whose length shall not be greater than the width of the gabions plus 100 mm. Gabions shall have a nominal mesh size of 80 mm x 100 mm and body wire shall be a minimum diameter of 2.7 mm heavily galvanised with an additional thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 3.4 mm and 2.2 mm respectively.

(b) Wire mattresses

Unless specified otherwise, the wire mattresses shall be supplied in units having dimensions of 6 m x 2 m x 230 mm, and shall be cut to suit areas as shown on the drawings. The mattresses shall be divided by diaphragms into cells of length not exceeding 600 mm. Unless otherwise specified, they shall be fabricated of woven heavily galvanised wire and PVC coated where specified on the drawings.

Mattresses shall have a mesh size of 60 mm x 80 mm and body wire shall be a minimum diameter of 2.0 mm heavily galvanised with an additional minimum thickness of 0.4 mm PVC coating where specified on the drawings. The minimum core diameters of heavily galvanised selvedge wire and lacing wire shall be 2.7 mm and 2.2 mm respectively.

(c) Geotextile

A chemically and biologically stable geotextile with a minimum strength rating (G) of 1350 and minimum mass of 180 grams per square metre, in accordance with Guide to Pavement Technology Part 4G Geotextiles, shall be used.

Samples, manufacturer's specification and instructions on installation shall be submitted to the Superintendent seven days before the intended use of geotextile.

(d) Rock Fill Material

The rock fill shall consist of clean hard rock complying with the requirements of AS 2758.4.
Rock fill for gabions shall have particle sizes between 100 mm and 250 mm. Rock fill material should be placed by hand and only when approved by the superintendent shall they be placed using a suitable mechanical device to ensure fill is tightly packed with a minimum of voids. Fill material shall be levelled off 25 mm to 50 mm above the top of the mesh to allow for settlement.
When the mattress is on a slope, rock fill material shall be placed into the units starting from the low end. Units shall be filled slightly overfull by 25 mm to 50 mm to allow for settlement and to provide an even tight and smooth surface of the required contour.

(3) Assembly and erection

Before laying out the gabions or wire mattresses, geotextile shall be placed on the founding material and against any surface that will be in contact with either drainage course or earth backfill.

Adjust the position of the diaphragms so that the sides hinge up on the thicker wire woven in the mesh. Lace the gabion boxes along all diaphragm points and edges at to all adjacent boxes. Internal bracing wires 4 per metres at 330 mm centres to prevent distortion. Face bracing wires 4 per metres of face.

Ensure star pickets are either driven or cut off level with the top of the mattress.

After tying diaphragms and adjacent units of mattresses/gabions on all three adjacent corners(rear, floor and front face), leave top edge untied to allow for securing along with the lid section. The end corners of wire mattress/gabion tied sections shall be firmly tied after galvanised star pickets are driven and stretched in place a minimum of 900 mm into the surrounding ground in the final location at one end.

Carefully secure the opposite end of the gabions without damaging or distorting the dimensions of the units to a

suitable mechanical device and apply a stretching force to the assembled mattress/gabion section to be filled. Whilst under tension, secure each corner of each unit using galvanised star pickets driven into foundation ensuring each unit is stretched tight in all directions.

(4) Filling

Fill whilst the gabion boxes are under tension. Place the rocks at the front face and other exposed faces by hand to produce a neat face free of excessive bulges, depressions and voids.

Redistribute the filling materials by hand to ensure that all diaphragm compartments are fully filled to produce a neat and level top surface. Overfill by 25 to 50 mm to allow for subsequent settlement.

Mechanical filling equipment may be used with caution ensuring to protect any PVC or galvanized coatings from abrasion. Release the tension on the mattress/gabion boxes only when fully laced so as to prevent any slackening.

The upstream edge of wire mattresses shall be folded down into a trench of minimum depth 300 mm and filled with rock fill. This edge shall be tied to star pickets.

Final lacing should be undertaken as soon as practicable after filling particularly if there is a storm or flood expected. Stretch lids tightly over the filling and lace down securely. The works should be inspected upon completion of lacing.

SC6.4.6.9.5 Summary of limits and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.9.1 below.

Table SC6.4.6.9.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Open Drains - General**	Grade - QUDM 2013 Table 9.5.2	SC6.4.6.9.2(3)
	(a) Grading		
	(b) Depth	Based on hydraulic capacity of the channel	SC6.4.6.9.2
	(c) Freeboard	QUDM 2013 table 9.3.1 & Fig 9.8	SC6.4.6.9.2
	(d) Channel Side Slopes	QUDM 2013 Section 9.5.3	SC6.4.6.9.2(3)
	(e) Compaction	>95% (standard compaction)	SC6.4.6.9.2(3)
2.	**Open Drains - Lining**	>95% (standard compaction)	SC6.4.6.9.3(1)
	(a) Compaction of Foundation		
3.	**Stone Pitching**	>100mm thickness	SC6.4.6.9.3(3)
	(a) Rock Dimensions		
	(b) Exposed Surface Area	>0.05 sq m	SC6.4.6.9.3(3)
	(c) Spaces between Stones	<20mm width	SC6.4.6.9.3(3)
4.	**Batter Drains**	+0, -50 from batter line	SC6.4.6.9.3 (4)
	(a) Rim line		
5.	**Kerb and channel**		
	(a) Compaction of foundation	To AS 2876	SC6.4.6.9.3(6)
	(b) Level of gutter surface	Level ≤ ±6mm of design level	SC6.4.6.9.3(6)
	(c) Alignment	Level ≤ ±50mm of design alignment	
	(d) Surface uniformity	Deviation of kerb and channel surface from 3m straight edge ≤5mm	SC6.4.6.9.3(6)
	(e) Contraction Joints		
	(i) Area	≥50% of CS area	SC6.4.6.9.3(6)
	(ii) Groove Width	≥5mm	SC6.4.6.9.3(6)
	(f) Expansion Joint Interval	at all gully pits and associated structures	SC6.4.6.9.3(6)
	(g) Backfill behind Kerb		
	(i) Layer thickness	≤150mm	SC6.4.6.9.3(6)
	(ii) Compaction	>95% (standard compaction)	SC6.4.6.9.3(6)

Item	Activity	Limits/Tolerances	Clause
6.	**Rock Fill for Gabions and Wire Mattresses**	>100kN	SC6.4.6.9.4(2)(d)
	(a) Wet Strength		
	(b) Wet/Dry Strength variation	<35%	SC6.4.6.9.4(2)(d)
	(c) Particle size for Gabions	>100mm <250mm and preferably not greater than 200 mm	SC6.4.6.9.4(2)(d)
	(d) Fill Level	>25mm <50mm above top of mesh	SC6.4.6.9.4(2)(d)
	(e) Particle size for Wire Mattresses	Between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser	SC6.4.6.9.4(2)(d)
7.	**Erection of Gabions and Wire Mattresses**	Depth in ground >900mm Spacing <1m	SC6.4.6.9.4(3)
	(a) Star pickets for ties		
	(b) Trench Depth for upstream edge	Depth >300mm	SC6.4.6.9.4(3)

SC6.4.6.10 Earthworks (construction)

SC6.4.6.10.1 Introduction

(1) Scope

(a) This sub-section provides standards, advice and guidelines for earthworks and associated construction, including:

(i) removal of topsoil;

(ii) all activities and quality requirements associated with site regrading, the excavation of cuttings, the haulage of material and the construction of embankments to the extent defined in the drawings and sub-section;

(iii) removal and replacement of any unsuitable material;

(iv) any spoil or borrow activities associated with earthworks; and

(v) any additional processing of selected material for the selected material zone.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.30 Control of traffic
SC6.4.6.11 Clearing and grubbing
SC6.4.6.4 Stormwater drainage

(b) Australian Standards:

AS1141.11 - *Soil classification test – Determination of the particle size distribution of a soil – Standard method of analysis by sieving*
AS1289.3.3.1 - *Calculation of the plasticity index of a soil.*
AS1289.5.1.1 - *Determination of the dry density/moisture content relation of a soil using standard compactive effort.*
AS1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*
AS1289.5.7.1 - *Compaction Control Test Hilf density ratio and Hilf moisture variation (Rapid Method).*
AS1289.6.1.1 - *Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.*
AS1289.7.1.1 - *Soil reactivity tests – Determination of the shrinkage index of a soil*
AS2187.0 - *Explosives - Storage, transport and use - Terminology*
AS2187.1 - *Explosives - Storage, transport and use - Storage*
AS2187.1 - *Explosives - Storage, transport and use - Use of explosives*

(c) QLD Government Legislation:

Environmental Protection Act 1994
Environmental Protection (Noise) Policy 2008
Explosives Act 1999
Explosives Regulation 2003
Sustainable Planning Act 2009
Work Health and Safety Act 2011

(d) Other:

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

Workplace Relations Ministers' council, *Australian Code for the Transport of Explosives by Road and Rail*
MRTS55 Use of Explosives in Roadworks

(3) Natural surface and earthworks materials

(a) Natural surfaces

The Contractor must verify the accuracy of the model by field surveys. If the Contractor considers any areas of the model not to be representative of the approved plans, the Contractor shall give not less than seven days' notice, prior to commencement of Works to the Superintendent to allow checking. If the subsequent check survey reveals the ground model to be incorrect, any plans that are affected are to be resubmitted for approval.

(b) Earthworks materials

The Contractor shall be responsible for any assumptions made by the contractor in relation to the nature and types of the materials encountered in excavations and the bulking and compaction characteristics of materials incorporated in embankments.

The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.
Where material from excavations is acceptable for use in embankments, but the Contractor elects to:

(i) spoil it; or

(ii) use it for the Contractor's own purposes; or

(iii) use it as a source of pavement materials; or

(iv) construct embankments with dimensions in excess of those specified.

and a deficiency of material for embankment construction is thereby created, the Contractor shall make good that deficiency from sources of material meeting the quality requirements specified in clause SC6.4.6.10.6(2). The cost of making good such deficiency of material shall be borne by the Contractor.

(4) Protection of earthworks

The Contractor's responsibility for care of the Works shall include the protection of earthworks.
The Contractor shall install effective erosion and sedimentation control measures in accordance with accepted *Best Practice Erosion and Sediment Control* procedures, prior to commencing the earthworks, and shall maintain these control measures for the duration of the contract.

Details of the proposed sediment and erosion control measures and procedures are to be documented by a suitably qualified person in accordance with council's soil and sediment erosion control standards. The proposed measures and procedures are to be approved by council prior to implementation on site.

Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface.

Should insitu or stockpiled material become wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

(5) Setting out of earthworks

Before earthworks operations commence and after survey controls are in place, batter profiles shall be established by the Contractor and the necessary pegs driven at 25m intervals, at each cross section shown on the drawings or at each change in batter slope, whichever is the lesser. The chainage/station, offset from-control line and slope distance to finished surface level, shall be clearly marked on each peg.

The batter profiles shall be repositioned by the Contractor at each change in the slope of the batter and at

intervals of not more than 5m of vertical height.

All pegs and batter profiles shall be maintained in their correct positions. Additional pegs and profiles may be required to suit the Contractor. These shall not be painted with the same colours used for the specified setting out pegs and stakes.

The position and extent of all transitions from cuttings to embankments and foundations for shallow embankments shall be marked with clearly labelled stakes in accordance with Clauses SC6.4.6.10.3(5) and SC6.4.6.10.6(3).

(6) Stockpile sites

The Contractor shall obtain the written consent of the Superintendent to the use of any stockpile site which is not shown on the drawings. Proposals in this regard shall be submitted at least three working days before stockpiling is due to commence and shall specify the maximum dimensions of the proposed stockpile.

Any clearing and grubbing required for these sites shall be carried out in accordance with SC6.4.6.11 Clearing and grubbing. Temporary erosion and sedimentation control measures shall be taken in accordance with *Best Practice Erosion and Sediment Control.*

Restoration of stockpile sites following completion of the work shall be carried out in accordance with IECA *Best Practice Erosion and Sediment Control.*

SC6.4.6.10.2 Removal of topsoil

(1) Scope

Topsoil is surface soil which is reasonably free from subsoil, refuse, clay lumps and stones.

Removal of topsoil from any section of the Works shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the works in accordance with relevant parts of *Best Practice Erosion and Sediment Control* and SC6.4.6.11 Clearing and grubbing.

Topsoil throughout the length of the Work shall be removed and stockpiled separately clear of the Work with care taken to avoid contamination by other materials. The work shall include the following:

(a) Cuttings

Removal of the topsoil to a depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent.

(b) Embankments

Removal of topsoil over the base of embankments up to the depth below the natural surface quoted in SC6.4.6.10 Attachment A Earthworks supplementary information, or as directed by the Superintendent. For those embankments or sections of embankment where the height of embankment from natural surface to underside of pavement is less than two metres, topsoil which is deeper than the depth quoted in SC6.4.6.10 Attachment A Earthworks supplementary information shall be removed to its full depth as directed by the Superintendent.

(c) Other locations

Removal of topsoil as directed by the Superintendent.

(2) Topsoil stockpiles

The maximum height of stockpiles shall not exceed 2.5m and the maximum batter slope shall not exceed 2h:1v.

Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.

Keep topsoil and underburden stockpiles separate.

Stabilise stockpiles and batters that will remain bare for more than 28 days by covering with mulch or anchored

fabrics or seeding with sterile grass.

Establish sediment controls around unstabilised stockpiles and batters. Locate stockpiles away from drainage lines, at least 10m away from natural waterways and where they will be least susceptible to wind erosion.

To minimise erosion, stockpile batters shall be track rolled or stabilised by other means acceptable to the Superintendent.

Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with SC6.4.6.26 Landscaping.

SC6.4.6.10.3 Cuttings

(1) Scope

Construction of cuttings shall include all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

(2) Excavation

Materials encountered in cuttings shall be loosened and broken down as required so that they are acceptable for incorporation in the Works. In this regard, the Contractor's attention is drawn to clauses SC6.4.6.10.5 Unsuitable material, SC6.4.6.10.6(1) Scope and SC6.4.6.10.6(2) Embankment material.

Cuttings shall have batter slopes as shown on the drawings or as redetermined by the Superintendent on the basis of site inspection and investigation during the excavation.

The tops of all cuttings shall be neatly “rounded”.

In all cuttings, undulations in the general plane of the batter shall not be permitted except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material.

Cut faces shall be cleaned of loose or unstable material progressively as the excavation proceeds.

Where, after the removal of topsoil as specified in clause SC6.4.6.10.2(1) Scope, material of variable quality or moisture content is encountered, the Contractor shall adjust his excavation methods to ensure blending of the materials, to obtain material meeting the requirements of clause SC6.4.6.10.6(2) Embankment material.

(3) Batter tolerances

If the Contractor excavates the batter beyond the batter slope line and the tolerance applicable thereto, the Superintendent may authorise a minor change in the general slope of the batter to suit the convenience of

the Contractor, but such a change shall not be regarded as a redetermination of the batter slope under clause SC6.4.6.10.3(2) Excavation. Alternatively the Contractor shall submit details of the material and/or methods proposed to restore the specified slope and stability of the batter for the Superintendent's approval.

For batters steeper than 1:1, if any section of the batter up to a height of 3m above the table drain level has been over excavated beyond the tolerance limit specified, the Superintendent may direct that the batter be restored to the average batter slope using randomly mortared stone. The stone shall be similar to the sound rock in the cutting and the mortar shall be coloured to match the colour of the rock.

The tolerances for the excavation of batters, measured at right angles to the design grade line, are given in Table SC6.4.6.10.1 Excavation tolerances for batters.

Table SC6.4.6.10.1 Excavation tolerances for batters

Location	Tolerance (mm)	
	Slope 1:1 or flatter	Steeper than 1:1
Toe of batter and level of table drain	+ 0 - 150	+ 0 - 200
2m above table drain and higher	+ 300 - 300	+ 300 - 600
Between level of table drain and 2m above table drain	pro rata basis	pro rata basis

Note—tolerances are measured normal to the batter surface with (+) measured towards the roadway.

(4) Benching in cuttings

Cut batters shall be benched as shown on the drawings to provide drainage and erosion control. Notwithstanding the tolerances permitted under clause SC6.4.6.10.3(3) Batter tolerances, bench widths shall not be less than those shown on the drawings.

Benches shall be maintained and cleaned of loose stones and boulders regularly throughout the Contract period. The cost of such maintenance and cleaning of benches shall be borne by the Contractor.

(5) Subgrade of cuttings

The subgrade of cuttings shall be excavated, parallel to the designed grade line, to a designed subgrade level. The subgrade must then be trimmed to a level of not more than +0mm, -50mm from the designed subgrade level. Prior to ripping or removal of the cut material, the Contractor shall determine the CBR of the material in at the subgrade level in accordance with AS1289.6.1.1, Plasticity Index AS1289.3.3.1 and Shrink-Swell Index AS1289.7.1.1. Sufficient tests shall be taken to represent all the various materials which may exist within the subgrade.

Adequate sampling and testing shall be undertaken to satisfy all necessary requirements to verify the intended pavement design. Where the Superintendent considers that any underlying material is unsuitable for pavement support, the Superintendent may direct that it be removed in accordance with clause SC6.4.6.10.5 Unsuitable material.

The Contractor shall rip or loosen all material in the subgrade to a minimum depth of 200mm below the designed subgrade level for the width of the selected material zone (or subbase layer, where no selected material zone), including areas of rock. The maximum dimension of any particles in the ripped or loosened zone shall not exceed 150mm.

After recompaction, the subgrade within cuttings shall be re-trimmed parallel with the finished wearing surface so that their levels do not vary more than +0mm, -50mm from the designed subgrade level. It shall be recompacted in accordance with Clause SC6.4.6.10.7(1).

Horizontal tolerance – the width of the cutting at subgrade level for support of the pavement shall not be less than that specified.

Prior to placing any subsequent layers over the completed subgrade level, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects to relevant specifications.

In placing subsequent layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the subgrade surface.

(6) Transition from cut to fill

After the removal of topsoil and before the excavation of any cutting commences the contractor shall survey and mark the position of the intersection line between cutting and embankment occurring at the underside of

the selected material zone or pavement subbase.

The contractor is to ensure that the transition from cut to fill is undertaken in accordance with best practice geotechnical procedures and guidelines.

SC6.4.6.10.4 Blasting general

(1) When explosives are permitted to be used by council, the contractor shall obtain all necessary licences from the appropriate authorities, and shall comply with all government and council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS2187.1 and AS2187.2. The transport of explosives shall be in accordance with the *Australian Code for the Transport of Explosives by Rail and Road. The requirements of the Explosives Act 1999* and *Explosives Regulation 2003* and Local laws, if applicable, shall be complied with.

The contractor shall be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Before the start of blasting operations, the contractor, in the presence of the superintendent, shall conduct a dilapidation survey to determine and record the existing condition of all structures likely to be affected by any blast.

The survey shall include all structures including public utilities within 500m of any blast but shall be extended where the maximum instantaneous charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site. A written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, shall be submitted to the owner of each structure, to the superintendent and council before blasting commences.

The contractor shall advise the superintendent of the proposed maximum instantaneous charge and the contractor's validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. The superintendent may direct amendments to the scope of the survey as a result of blast monitoring during the work. All costs associated with the surveys and reports shall be borne by the contractor.

Before each blasting operation, the contractor shall submit to the Superintendent written details of the proposed blasting procedure including the quantity and type of explosive to be detonated, the blasting pattern to be used and measures proposed to limit noise and to ensure that vibration from blasting does not adversely affect nearby structures.

Ground vibration caused by blasting shall not exceed the values of peak particle velocity listed in Table SC6.4.6.10.2 Limiting peak particle velocity.

Table SC6.4.6.10.2 Limiting peak particle velocity

Point of Potential Damage (within 1 km of blasting site)	**Peak Particle Velocity**
Completed and cured bridge structures or sub‐structures (e.g. completed abutment).	25mm/sec
Bridgeworks and structural retaining walls under construction.	20mm/sec
Residential premises, schools, hospitals and other buildings.	5mm/sec (with 10% not to exceed 10 mm/sec)
Buildings or monuments of historical significance.	2mm/sec

The contractor shall advise all residents within a radius of 1km, by letter drop before blasting operations

commence, of the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result.

Unless otherwise approved, blasting operations shall be confined to the periods Mondays to Fridays (excluding public holidays), 9am to 3pm.

When blasting operations are being carried out, precautions shall be taken relating to the safety of persons and animals and the road shall be closed to traffic and the appropriate signs erected in accordance with the sub-section SC6.4.6.30 Control of traffic. A standard warning procedure such as that given in the AS2187.2 shall be established and observed at all times.

(2) Presplitting

Where presplitting is carried out the spacing of presplit drill holes shall not exceed 750mm centre to centre.

(3) Blasting records

The Contractor shall maintain accurate records of each blast showing the details listed below:

(a) date and time of blast;

(b) location, number and diameter of holes loaded;

(c) depth of each hole loaded;

(d) inclination of holes;

(e) maximum and minimum burden;

(f) types of explosives used;

(g) charge distribution in each hole;

(h) maximum instantaneous charge;

(i) delay periods and sequence;

(j) total amount of charges in the blast; and

(k) length and type of stemming in each hole.

The records shall be prepared as holes are loaded and signed by the Powder man. A copy shall be provided to the Superintendent on the day of the blast.

(4) Control of air blast over-pressure

This clause shall apply only where a noise sensitive location exists within 1km of the blasting site.

The Contractor's attention is drawn to the recommendations given in the *Environmental Protection (Noise) Policy 2008* or as amended - for the reduction of air blast over-pressure.

The noise emanating from blasting operations shall not exceed an over-pressure level of 115dB (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10 per cent of the total number of blasts may exceed this value provided a level of 120dB is not exceeded at any time.

The Contractor shall arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this sub-section. In general, a monitoring location will be near the perimeter of the noise sensitive location at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

In the event that the measured air blast over-pressure exceeds the specified limits, the Contractor shall suspend further blasting work and shall submit to the Superintendent proposals detailing any additional steps and precautions the Contractor shall take to ensure that for any future blast, the limiting over-pressure shall not be exceeded. The Contractor shall not resume any blasting until such proposals have been submitted.

(5) Control of ground vibration

The Contractor shall arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in Table SC6.4.6.10.2 Limiting peak particle velocity. All monitoring shall be carried out by personnel possessing current NATA registration for such monitoring. All test results shall be reported on NATA endorsed test certificates which shall include a clear statement as to compliance or non-compliance with the requirements of this part of the sub-section. In general a monitoring location shall be near the perimeter of the structure or building at the point closest to the maximum charge. The Contractor shall submit a copy of the monitoring record to the Superintendent.

To minimise the risk of peak particle velocity limits being exceeded, the Contractor shall develop a blasting site relationship between peak particle velocity, distance and blasting charge.

For the first blast, monitors shall be set up at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast shall not exceed that calculated from the following formula:

$$MIC = 0.5\left[\frac{D}{\left[\frac{PPV}{1140}\right]^{-0.625}}\right]^2$$

where MIC = Maximum Instantaneous Charge in kilograms
D = Distance in metres from charge to the point of potential damage
PPV = limiting peak particle velocity from Table SC6.4.6.10.2.

A log-log (base 10) graph of measured peak particle velocity (vertical axis) versus Scaled Distance (horizontal axis) shall be plotted, where

$$\text{Scaled Distance} = \frac{D}{\sqrt{MIC}}$$

The mean regression line shall be obtained by the least squares method.

For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded. The Contractor shall make the regression line plots available to the Superintendent, if so requested.

SC6.4.6.10.5 Unsuitable material

Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments, which the Superintendent deems to be unsuitable for embankment or pavement support in its present position. Unsuitable material also includes material in cuttings which the Superintendent deems to be unsuitable for embankment construction.

Such material shall be excavated to the extent directed by the Superintendent. Material removed as unsuitable, as directed by the Superintendent, shall be incorporated in embankments in accordance with SC6.4.6.10.6(2) Embankment material or spoiled in accordance with clause SC6.4.6.10.6(13) Spoil.

After removal of the unsuitable material, the floor of the excavation shall be re-presented to the Superintendent for inspection, prior to backfilling with replacement material, to determine whether a sufficient depth of unsuitable material has been removed. Prior to placing replacement material the excavated surface shall be compacted in accordance with SC6.4.6.10.8(1) Compaction and moisture requirements.

The unsuitable material which has been removed shall be replaced with material from cuttings, or with material borrowed in accordance with clause SC6.4.6.10.6(14) Borrow, of the quality specified in clause SC6.4.6.10.6(2).

Embankment materials. Replacement material is deemed to form part of embankment construction. It shall be placed in accordance with clause SC6.4.6.10.6(5) Placing Fill for embankment construction and compacted in accordance with clause SC6.4.6.10.8(1) Construction management.

Reworking or replacing any material which the Superintendent deems to have become unsuitable because of inappropriate construction activities shall be borne by the Contractor.

Excavate and dispose of all contaminated material in an environmentally responsible manner including the following:

(1) assay material uncovered on-site prior to disposal. If the wastes include putrescibles wastes, then also analyse leachate and landfill gases;

(2) excavate material in a manner which avoids off-site environmental problems;

(3) seal remaining contaminated material or wastes, where only part of the tip has been excavated, to ensure than there is no off-site effect now or in the future;

(4) transport odorous wastes in covered vehicles; and

(5) dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

SC6.4.6.10.6 Embankment construction

(1) Scope

Embankment construction includes all operations associated with the preparation of the foundation areas on which fill material is to be placed, the placing and compacting of approved material within areas from which unsuitable material has been removed in accordance with clause SC6.4.6.10.5 Unsuitable material, the placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works and all other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the drawings. It also includes any pre-treatment such as breaking down or blending material or drying out material containing excess moisture.

(2) Embankment material

Material for embankment construction shall be obtained from the cuttings within the Works in accordance with clause SC6.4.6.10.3(2) Excavation supplemented by borrow in accordance with clause SC6.4.6.10.6(14) Borrow and from other sources as approved by the Superintendent if necessary. The material shall be free of tree stumps and roots, clay, topsoil, steel, organic material and other contaminants and shall be capable of being compacted in accordance with clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The work shall be programmed so that material of the quality specified in clause SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.6(9) Selected material zone for the upper zones of the formation is available when required.

(3) Foundations for embankments

(a) Following removal of topsoil in accordance with clause SC6.4.6.10.2 Removal of top soil, the embankment foundation area shall be made available for inspection by the Superintendent.
Where the Superintendent considers that any underlying material is unsuitable, the Superintendent may direct that it be removed and replaced in accordance with clause SC6.4.6.10.5 Unsuitable material.

(b) Foundations for Shallow Embankments
Shallow embankments are those embankments of a depth less than 1.0m from the top of pavement to natural surface. After removal of topsoil the Contractor shall survey and work out the extent of the area of shallow embankments.

Material in the foundations for shallow embankments which does not meet the requirements specified in SC6.4.6.10 Attachment A Earthworks – supplementary information, shall be deemed unsuitable in

accordance with clause SC6.4.6.10.5 Unsuitable material and shall be replaced by material of the specified quality.

Foundations for shallow embankments shall be prepared for embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 200mm, adjusting the moisture content of the loosened material and compacting as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements. The Contractor shall use equipment and techniques to minimise surface heaving or other foundation damage.

(c) Other embankments

For all other embankments the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The bridging layer shall consist of free-draining granular material with or without geofabric interlayer as specified on the drawings. The granular material shall be end-dumped and spread in a single layer and in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements shall not apply to the bridging layer.

A bridging layer may also be employed, subject to the approval of the Superintendent, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in clause SC6.4.6.10.8(1) Compaction and moisture requirements. A bridging layer shall not be acceptable if its proximity to the pavement is likely to affect the pavement design. As an alternative to a bridging layer, approval of a working platform created by the chemical stabilisation of in situ material to conform with sub-section SC6.4.6.19 Stabilisation may be required.

(4) Hillside embankments

Where embankments are to be constructed on or against any natural slopes or the batters of existing embankments, the existing slope or batter, if it is steeper than 4 horizontal to 1 vertical in any direction, shall be cut in the form of horizontal terraces over the whole area to be covered by new filling. The existing slope or batter shall be stepped in successive terraces, each at least 1m in width, the terraces to be cut progressively as the embankment is placed. Wherever possible terraces shall coincide with natural discontinuities. Subsoil drainage may be required in some instances. Material thus excavated shall be compacted as part of the new embankment material.

(5) Placing fill for embankment construction

The methods of excavation, transport, depositing and spreading of the fill material shall be selected so as to ensure that the placed material is uniformly mixed.
The embankment shall be constructed so as to derive its stability from the adequate compaction of the fine material embedding the large rock pieces rather than mechanical interlock of the rock pieces. The fine material shall be compacted to meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

Fill material for embankment construction shall be placed in layers parallel to the grade line and compacted in accordance with clause SC6.4.6.10.8(1) Compaction and moisture requirements. The layers shall be of uniform compacted thickness not exceeding 200mm, except that where more than 25% by volume of the filling consists of rock with any dimension larger than 150mm, the Superintendent may approve an increase in the compacted layer thickness to 300mm, provided that the relative compaction specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements is attained.

The maximum dimension, measured in any direction, of rock pieces in the fill material for embankment construction shall not exceed two-thirds of the approved compacted layer thickness. Any larger rock pieces shall be reduced in size for incorporation in the embankment layers.

Rock material shall be broken down and evenly distributed through the fill material, and sufficient fine material

must be placed around the larger material as it is deposited to fill the voids and produce a dense, compact embankment. Where the Superintendent considers insufficient fine material is present to fill the voids, additional fine material shall be obtained from other places in the work or by a change in the method of winning fill material.
Stony patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended in to achieve a dense, compact layer.

In placing embankment layers, the Contractor shall use equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.
After compaction, embankment material in the zone(s) below the selected material zone (or subbase layer, where no selected material zone) shall have a CBR value not less than that quoted in and for the depth(s) specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information.

For the purpose of this clause, the CBR value of the material shall be determined by Test Method AS1289.6.1.1.

The Contractor shall be responsible for determining suitable sources of material and for any processing to satisfy these quality requirements.

(6) Embankment batters

The batter slopes shown on the drawings represent the estimated requirements for the expected types of materials, and may be subject to redetermination by the Superintendent according to the Superintendent's assessment of the materials encountered.

When completed, the slope of embankment batter shall conform to those shown on the drawings and conform to the following tolerances:

(a) for a vertical distance to 1m below the shoulder, no point on the completed batter to vary from the specified slope line by more than 150mm when measured at right angles to the slope line;

(b) at distances greater than 1m vertically below the shoulder, no point on the completed batter to vary from the specified slope line by more than 300mm when measured at right angles to the slope; and

(c) in no case is the edge of the formation at the underside of the pavement to be nearer to the roadway than shown on the drawings and the batter slope at no point be steeper than the specified slope.

However, in no case shall the edge of the formation at the underside of the pavement be nearer to the roadway than shown on the drawings.
Undulations in the general plane of the batter shall not be permitted.

(7) Rock facing of embankments

Where shown on the drawings, embankment batters (including embankments at bridge abutments) shall be provided with a facing of clean, hard, durable rock.

The rock facing shall be built up in layers ahead of each layer of filling. Rock may be placed by hand or plant but shall be placed in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs. Any rock deposited in the rock facing which has an excess of fine material surrounding it shall be removed together with the excess fine material and replaced.

The Contractor shall adjust its working methods and programme the work so as to obtain hard and durable rock of the specified dimensions as it is required. The space between larger batter rocks shall be filled with progressively smaller rocks to form a 'graded filter' which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Fine material shall not cover the outside of the rocks on the face of the batter.

The Contractor shall exercise extreme caution whilst placing the rock facing. Where embankment material is placed above other roads in use the outer rock layer shall be placed in such a manner as to prevent spillage down the batter.

The Contractor shall ensure that, under no circumstances, could any rock be dislodged and roll onto any adjacent roadway or track in use.

(8) Trimming tops of embankments

The tops of embankments shall be trimmed parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone.

The tops of embankments at these levels shall be compacted to meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements and trimmed so that they do not vary by more than ±50mm from the calculated level. The width of the embankment at subgrade level shall not be less than that specified.

Prior to placing any subsequent pavement layers over the completed top of embankment filling, the contractor shall present the completed surface to the superintendent for inspection. The contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of the relevant specifications.

(9) Selected material zone

A selected material zone must be provided in accordance with the following quality requirements:

(a) it shall be free from stone larger than 75mm maximum dimension and have no less than 50% passing the 19mm AS sieve;

(b) a CBR value not less than the specified in SC6.4.6.10 Attachment A Earthworks Supplementary Information for the fraction passing AS 19mm sieve; and

(c) Plasticity Index of 15 maximum.

If chemical stabilisation is specified these requirements must apply to the selected material immediately prior to incorporating the stabilising agent.

The Contractor shall use working methods to yield material for the selected material zone by breaking down oversize rock or by other means, including processing through a crusher, to ensure that the resulting material conforms to the requirements of this clause.

The Contractor shall ensure that any material encountered of the quality specified for the selected material zone shall be either placed directly in the selected material zone or stockpiled at locations approved by the Superintendent for future use by the Contractor in the selected material zone until at least sufficient material is reserved to complete the selected material zone over the whole work. Should the Contractor fail to conserve material of the specified quality, the Superintendent may direct that material of equivalent quality be provided.

The selected material zone shall be placed and compacted in layers with the compacted thickness of each layer not exceeding 150mm. The selected material shall be homogeneous and free from patches containing segregated stone or excess fines. There shall be no areas containing material which does not comply with the specified requirements of this clause and compaction shall be as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The top of the selected material zone shall be compacted and trimmed parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in SC6.4.6.10 Attachment A Earthworks – Supplementary Information.

Prior to placing any subsequent pavement layers over the completed select material zone surface, the Contractor shall present the completed surface to the Superintendent for inspection. The Contractor shall verify as part of the quality system that the completed surface has achieved full conformance with all respects of relevant Specification.

(10) Fill adjacent to structures

For the purpose of this clause, structures shall include bridges, precast and cast-in-situ box culverts and

retaining walls. Fill adjacent to other culverts and drainage structures to be provided in accordance with SC6.4.6.4 Stormwater Drainage, SC6.4.6.6 Pipe Drainage, SC6.4.6.7 Precast Box Culverts and SC6.4.6.5 Drainage Structures.

No filling shall be placed against structures, retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the contractor can demonstrate that 85% of the design strength of the concrete has been achieved. This includes concrete in bridge decks and fill placement that impacts the position, stability and serviceability of bridge deck member bearings.

(11) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50 mm to 10 mm such that:

(a) the maximum particle dimension shall not exceed 50mm; and

(b) no more than 5% by mass shall pass the 9.5mm A.S. sieve.

The broken stone or river gravel shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend from 200mm below to at least 450mm vertically above the level of the weepholes, where practicable.

Alternatively the Contractor may provide a synthetic membrane (geotextile) of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane (geotextile) shall be subject to the Superintendent's approval.

(12) Selected backfill

(a) Selected backfill shall be placed adjacent to structures in accordance with Table SC6.4.6.10.3 Selected backfill, width and height. The selected backfill shall consist of a granular material having a maximum dimension not exceeding 50mm and a Plasticity Index, determined by AS1289.3.3.1, neither less than 2 nor more than 12.

Table SC6.4.6.10.3 Select backfill, width and height

Structure Type	Selected Backfill	
	Width	Height
Bridge abutments	2m	H
Cast-in-situ Box Culverts and Precast Culverts	H/3	H + 300mm
Corrugated Steel Pipes and Arches	0.5m	H + 500mm
Retaining Walls	H/3	H

(Where H = height of structure)

The selected backfill shall be placed in layers, with a maximum compacted thickness of 150mm. Layers shall be placed simultaneously on both sides of box culverts to avoid differential loading. Compaction shall start at the wall and proceed away from it, and shall meet the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

The existing embankment slope behind the structure shall be cut in the form of successive horizontal terraces, each terrace being at least 1m in width, and the selected backfill shall be placed in accordance with clause SC6.4.6.10.6(5) Placing fill for embankment construction.

Where a bridge deck is being concreted adjacent to an abutment, no filling shall be placed against the abutment within 21 days after placing concrete in the bridge deck, unless approved by the Superintendent.

In the case of spill-through abutments, rocks shall not be dumped against the columns or retaining walls but shall be built up evenly by individual placement around or against such structures.

In the case of framed structures, embankments at both ends of the structure shall be brought up simultaneously, the difference between the levels of the embankments at the respective abutments, shall not exceed 500mm.

(13) Spoil

Spoil is surplus material from excavations which is not required to complete the Works as specified or other material from excavations whose quality the Superintendent deems to be unacceptable for incorporation in the Works.

Where there is surplus material the Superintendent may direct that flatter batter slopes be provided on embankments which have not been commenced, and/or direct that the excess material be used in the uniform widening of embankments, the surface of which shall be shaped so as to provide a tidy appearance and effective drainage. The surplus material shall be spread and compacted as specified in clauses SC6.4.6.10.6(5) Placing fill for embankment construction and SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments.

Alternatively, spoil shall be disposed of in the manner and at locations approved by the Superintendent within the specified working area for the Works or be removed and disposed of off site by the Contractor. Surplus material so deposited shall be compacted as specified in clause SC6.4.6.10.8(1) Compaction and moisture requirements for material in embankments or to such lesser extent as may be approved by the Superintendent.

(14) Borrow

Borrow will only be authorised by the Superintendent if, in constructing cuttings and embankments to the batter slopes specified or directed by the Superintendent or in providing materials of the quality specified, and not by reason of excess widening of embankments or wastage by the Contractor of material of the quality specified in clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock facing of embankments, SC6.4.6.10.6(8) Trimming tops of embankments or SC6.4.6.10.6(10) Fill adjacent to structures, there is an overall deficiency in either the quantity or the quality of material required to complete the Works.

Where borrow material is required to complete the Works as specified, the location of borrow sites shall be as approved by the Superintendent, and the quality of material shall be acceptable to the Superintendent in accordance with clauses SC6.4.6.10.6(2) Embankment material, SC6.4.6.10.6(7) Rock Facing of Embankments or SC6.4.6.10.6(10) Fill Adjacent to Structures as appropriate. The edges of borrow sites must be no closer than 3m from any fence line, or edge of excavation or embankment. Adequate clearance shall be provided for the construction of catch drains. Borrow sites shall have drainage outlets acceptable to the Superintendent, cut batter slopes not steeper than 4h to 1v, and shall be left by the Contractor in a tidy and safe condition (i.e. stabilising disturbed areas).

For borrow within the defined working area for the Works as specified, site preparation shall be in accordance with SC6.4.6.11 Clearing and grubbing and clause SC6.4.6.10.2 Removal of top soil. Restoration of borrow sites shall be carried out by Contractor in accordance with Best Practice Erosion and Sediment Control.

If borrow material is obtained by uniformly widening a cutting, the requirements of Clauses SC6.4.6.10.3(2) Excavation, SC6.4.6.10.3(3) Batter tolerances and SC6.4.6.10.3(5) Treatment of floors of cuttings as to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively shall apply to the borrow area.

The Contractor shall be responsible for obtaining any permits required for entry on land and for the payment of any royalty for such borrow material. The Contractor shall also comply with any requirements of the *Planning Act 2016* – as amended, Townsville City Plan, Local laws and land owners, as appropriate.

SC6.4.6.10.7 Acid sulfate soils

(1) Objective

To minimise disturbance to areas of potential acid sulphate soils (PASS) and/or actual acid sulphate soils (ASS). If disturbance of PASS/ASS cannot be avoided, appropriate treatment is required to minimise the

potential for environmental harm.

PASS and ASS are soils that have the potential to generate acid through oxidation of iron sulphides when exposed to air. ASS and PASS are generally found in coastal areas, and generally in soils at an elevation of 5m AHD or lower.

(2) References

Dept of Environment and Resource Management, *Nov 2002*
Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines
State Planning Policy
EF006: Daily Dredging Checklist Form
CE020: Regulated Waste Transport Procedure
QAF004 Incident, Hazard, Improvement reporting form

(3) Safety requirements

Works shall comply with provisions of the Work Health and Safety Act 2011 and subsequent regulations. Personnel are responsible for their own Personal Protective Equipment (PPE) and the safety of the surrounding workplace during works.

Care is to be taken when using hydrogen peroxide, including gloves and eye protection.

(4) Environmental Requirements

Compliance with Environmental Protection Act 1994 and subordinate legislation.
Compliance with *Queensland Acid Sulfate Soil Technical Manual Soil Management Guidelines*
Compliance with the State Planning Policy.
Compliance with all other environmental legislation.
Compliance with TCC Environmental Policy.

(5) Equipment and materials

Testing should be undertaken by a suitably qualified laboratory.

(6) Method

(a) Identifying ASS/PASS on site

The following points can assist in determining if soil has a likelihood of containing ASS/PASS. Affirmative answers to the following questions may indicate the presence of ASS/PASS. Field observations and tests should be complemented by laboratory testing.

(i) Is the site elevation 5m AHD or less?

(ii) Are mangroves, she-oaks or melalueca species (i.e. paper barks) present on site?

(iii) Is there other vegetation that is stunted or dying?

(iv) Does the soil have a dark grey to grey appearance?

(v) Is there a rotten egg smell (hydrogen sulphide) to disturbed soil?

(vi) Is there a mottled-yellow mineral present in the soil (Jarosite)?

(vii) Is there water bodies nearby that have a very clear blue-ish appearance, or does it appear to be reddish (rust) in colour?

(viii) Is the pH of the excavated sediment, or water, below 4?

(b) Managing and treating ASS and PASS

(i) Determine if works can be undertaken without disturbing ASS/PASS material.

(ii) If ASS/PASS is to be disturbed as a result of project activities then undertake testing to determine the severity of the potential acidification and extent of ASS/PASS material.

(iii) ASS/PASS material excavated on site must either be treated on site or transported to a treatment location. A treatment pad should be set up as per the *Queensland Acid Sulfate Soil Technical*

Manual, Soil Management Guidelines.

(iv) ASS material should be transported as regulated waste as it has the potential to be generating acid while exposed to the atmosphere.

(v) All treatment of PASS/ASS must be undertaken in compliance with the *Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines.*

(vi) ASS/PASS treatment must be undertaken as per the laboratory recommendations.

(c) Corrective/Emergency Actions

If PASS and/or ASS are identified through site inspection and confirmed through lab testing, follow procedure outline in (6) above.

If corrective actions are identified, an Incident, Hazard, Improvement Report is to be completed and subsequent review of this procedure undertaken in accordance with these guidelines.

(d) Waste Control

Treat PASS and ASS in accordance with guidelines (State Policy)

Ensure wastes generated as a result of field testing or work activities are disposed of correctly.

(e) Responsibilities

(i) Site foreperson/works controller is responsible for:

(A) monitoring and testing soils; and

(B) Minimising disturbance to PASS/ASS.

(ii) The Environmental Engineer is responsible for ensuring any environmental non-compliances are reported.

(iii) The Executive Manager Engineering Services is responsible for:

(A) notifying relevant personnel of changes to this procedure; and

(B) delivering training to personnel (if required).

(f) Monitoring and reporting

The foreperson will monitor and test soils prior to commencement of works and record results of field tests on daily dredging checklist.

SC6.4.6.10.8 Compaction and quality control

(1) Compaction and moisture requirements

In areas listed below, all layers shall be uniformly compacted to not less than the relative compaction specified before the next layer is commenced. Each layer of material shall be trimmed prior to and during compaction to avoid bridging over low areas. A smooth surface shall be presented at the top of each layer.

(a) The following areas shall be compacted to provide a relative compaction, determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort, of not less than 95%.

(i) each layer of material replacing unsuitable material as detailed in clause SC6.4.6.10.5 Unsuitable material

(ii) each layer of material placed in embankments, up to 300mm from the top of the sub-grade;

(iii) fill placed adjacent to structures up to 300mm from the top of sub-grade;

(iv) material in unsealed verges and within medians up to the level at which topsoil is placed;

(v) spoil (excluding unsuitable material); and

(vi) all other areas except those where a higher relative compaction is specified.

Unsuitable material shall be stockpiled as directed by the Superintendent and compacted by track rolling.

(b) The following areas shall be compacted to provide a relative compaction of not less than 97% as determined by AS1289.5.1.1 using AS1289.5.4.1 or AS1289.5.7.1 for standard compactive effort:

(i) foundations for shallow embankments;

(ii) foundations other than shallow embankments;

(iii) the whole area on the floors of cuttings;

(iv) each layer of the embankment or cutting within 300mm from the top of sub-grade;

(v) each layer of the selected material zone as specified in clause SC6.4.6.10.6(9) Selected material zone;

(vi) any areas of material of specified quality which may be shown on the drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements; and

(vii) the fill material placed adjacent to structures as specified in clauses SC6.4.6.10.6(10) Fill adjacent to structures and SC6.4.6.10.6(12) Selected backfill in each layer within 300mm from the top of the sub-grade.

Where the vertical alignment design is such that a substantial portion of the road is required to be built at or close to the natural surface, cut the prepared subgrade to a depth below natural surface of less than 0.5m. Approval is required when shallow cutting conditions occur, the specified transition from cut to fill may be modified such that the depth of terrace excavation at the transition from cut to fill is reduced from 900mm to 250mm.

Treat the floor of shallow cutting as specified in clause SC6.4.6.10.3(5) Treatment of floors of cuttings and clause SC6.4.6.10.3(6) Trasition from cut to fill and compact to provide a relative compaction of not less than 100% for a depth of 200mm determined by AS1289.5.4.1, for standard compactive effort.

At the time of compaction the moisture content of the material shall be adjusted so as to permit the specified compaction to be attained at a moisture content which, unless otherwise approved by the Superintendent, is within the range set out in SC6.4.6.10 Attachment A Earthworks Supplementary Information of the optimum moisture content as determined by AS1289.5.1.1 or AS1289.5.7.1. Material which becomes wetted up after placement shall not be compacted until it has dried out so that the moisture content is within this range. The drying process may be assisted by aeration, or where approved by the Superintendent, by the use of hydrated or quick lime. Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. The added water shall be applied uniformly and thoroughly mixed with the material until a homogeneous mixture is obtained.

Compaction shall be undertaken to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work. Compaction shall be completed promptly to minimise the possibility of rain damage.

Any material placed by the Contractor that has attained the specified relative compaction but subsequently becomes wetted up so that the moisture content is greater than the apparent optimum, determined by AS1289.5.4.1, shall be dried out and uniformly recompacted to the required relative compaction in accordance with this clause before the next layer of material is placed. Alternatively, the Contractor may remove the layer of wetted material to a stockpile site for drying and later re-use.

(2) Test locations

The specified compaction and moisture tests shall be taken at the random test locations established in each lot in accordance with the specified minimum testing frequency. Prior to testing the Contractor shall work the lot to ensure uniform moisture content and compaction of all material within the lot.

The test(s) then taken shall be considered to represent the total volume of material placed within the lot.

Where the Superintendent considers that the material which is present has not achieved uniformity required by this clause or clause SC6.4.6.10.6(5) Placing fill for embankment construction, the Superintendent may take or

direct further testing. The Superintendent shall nominate the area represented by the additional testing.

If such testing confirms that material not conforming to the Specification, the Contractor shall carry out remedial work as necessary to achieve conformance to the requirements of clause SC6.4.6.10.8(1) Compaction and moisture requirements.

(3) Deflection monitoring

Following completion of the formation to the underside of the selected material zone in accordance with clause SC6.4.6.10.6(3) Foundations for embankments and SC6.4.6.10.6(5) Placing fill for embankment construction, completion of the selected material zone in accordance with clause SC6.4.6.10.6(9) Selected material zone and SC6.4.6.10.3(5) Treatment of floors of cutting, the Contractor shall make the work available in lots, for the Superintendent or council to carry out deflection monitoring.

A lot for deflection testing shall consist of a continuous length of formation, in compliance with council requirements, and a single carriageway width which is generally homogeneous with respect to material and appearance. The contractor shall identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent.

Prior to the release of the lot, a proof roll is to be performed with a single drive axle truck with an axle load of 8.2 t covering all lanes of carriage way including parking bays having no evident movement.

(4) Widening of formation

Road shoulders and formation shall be widened to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the drawings.

(5) Subgrade testing and treatment

Refer to SC6.4.4.2.4

SC6.4.6.10.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.10.4 Summary of limits and tolerances below.

Table SC6.4.6.10.9 Summary of limits and tolerances

Item	Activity	Limits/Tolerances
1.	**Batter Slopes**	± 300mm
	a) Excavation	
	b) Embankment	± 300mm
2.	**Subgrade**	Parallel to designed grade line. Tolerance is to be within +0mm - 50mm of the levels specified.
	Vertical Tolerance	
	Horizontal Tolerance	The width of the cutting at subgrade level for support of the pavement shall not be less than that specified on the drawings or documentation.
3.	**Tops of Embankments**	Parallel to the designed grade line. Tolerance is to be within, ±50mm from the levels specified
	Vertical Tolerance	
	Horizontal Tolerance	The width of an embankment at subgrade shall not be less than that specified on the drawings or documentation.
4.	**Selected Material**	SC6.4.6.10 Attachment A: Earthworks – Supplementary Information

Note—tolerances are measured at right angles to design surfaces.

SC6.4.6.10.10 Attachment A: Earthworks - supplementary information

Clause	Description	Value
SC6.4.6.10.2(1)	The depth below natural surface up to which the removal and measurement of top soil shall apply: (a) Cutting area; and (b) Embankment area	75mm
SC6.4.6.10.3(5)	Minimum CBR value in cutting floors used for design of pavement	3%
SC6.4.6.10.6(3)	Requirements of material in foundations for shallow embankment Moisture Content - within the range of 60% to 90% of optimum	
SC6.4.6.10.6(5)	Upper Zones of Formation and SC6.4.6.10.6 (9) Select Material Zone Material within each zone shall have a CBR value of not less than the following, under the nominated test conditions:	

Location	Minimum CBR Value	Depth	Nominated Soaking Period (Days)
a. Select Material Zone	10	200	4
b. Material below Selected Material Zone to 1.5 metre from top of pavement	3	N/A	4

SC6.4.6.10.6(9) Construction tolerances for selected material zones is to be ±50mm of the designed grade and crossfall profile

SC6.4.6.10.8(1) Moisture content of material placed in embankments:

(a) Material in upper zones of formation - within the range of 60% to 90% of optimum

(b) All other embankment material - within the range of 60% to 90% of optimum

SC6.4.6.11 Clearing and grubbing

SC6.4.6.11.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the clearing of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards), all rubbish and other materials, including the chipping of the crowns of trees and the branches of shrubs, and the grubbing of trees stumps from the area. The work also includes the disposal, in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation and SC6.4.6.11.3(3) Disposal of materials, of all materials that have been cleared and grubbed.

(2) General requirements

Site works shall take all measures to prevent damage to existing underground and overhead utility services.

Before commencing earthworks, locate and mark existing underground services in the areas to be affected by the works including clearing, excavating and trenching.

All existing utilities, natural landscape features, including natural rock outcrops, natural vegetation, trees to be preserved, soil and watercourses are to remain undisturbed.

Explosives shall not be permitted to be used in clearing, grubbing or other demolition activities.

Editor's note—DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, through which underground pipes and cables are located (possible within two working days). For more information go to the Dial 1100 Before you Dig website.

SC6.4.6.11.2 Clearing

(1) Clearing operations

The area within the limits of clearing shall be cleared of all vegetation, both living and dead, all minor man-made structures (such as fences and livestock yards), all rubbish and other materials which, are unsuitable for use in the works with the exception of certain trees marked for preservation. The contractor shall plan clearing operations such that wherever possible, clearing is carried out progressively and only the minimum area of land is left disturbed at any time.

The contractor shall give the superintendent written notice of seven days of the intention to clear any area of the work. The superintendent shall mark or indicate to the contractor the trees that shall be preserved. The contractor shall arrange for an inspection by an authorised council officer and shall obtain council's approval to proceed with clearing and grubbing. The contractor must conform to the requirements of SC6.4.5.2(18) when protecting identified trees and bushland within or adjacent to the construction site.

The erection of structures, excavation and filling, changes to soil profiles, stockpiling of spoil, storage of other materials and driving or parking of any vehicle or machinery within 4m of the trunks of trees to be retained shall not be permitted unless they form part of the works as approved by the council.

The Contractor shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or directed by the Superintendent. No growing trees shall be destroyed or damaged by the Contractor other than those specified and those indicated by the Superintendent.

Any tree remaining within the road reserve but outside the limits of clearing which is, in the opinion of the Superintendent, unsound and likely to fall upon the roadway shall be cleared and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation, subject to prior approval of council.

If directed by the Superintendent, any branch, which overhangs the road formation, shall be cut back to within 0.5 m of the tree trunk and disposed of in accordance with clause SC6.4.6.11.3(2) Chipping of cleared vegetation.

(2) Fallen timber and tree damage

Every precaution shall be taken to prevent timber from falling onto private property. The Contractor shall dispose of any timber that has fallen onto private property or produce written consent from the property owner to its remaining there.

The cost of disposal of such fallen timber shall be borne by the Contractor. Prior to entering the private property, the Contractor shall obtain consent from the Superintendent and the property owner. Damage of any kind, including damage to trees, fencing, occurring during clearing operations shall be made good by the Contractor. The cost of making good such damage shall be borne by the Contractor. Any damage to trees or vegetation which in councils opinion, will require its removal, is to be in rectified in accordance with SC6.4.5.2.1(19)(d).

SC6.4.6.11.3 Grubbing

(1) Grubbing

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Contractor shall be removed by grubbing.

Grubbing operations shall be carried out to a depth of 0.5m below the natural surface or 1.5m below the finished surface level, whichever is the lower.

Holes remaining after trees and stumps have been grubbed shall be backfilled promptly with sound material to prevent the infiltration and ponding of water. The backfilling material shall be compacted to at least the relative density of the material existing in the adjacent ground.

(2) Chipping of cleared vegetation

The Contractor shall produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this sub-section. The wood-chip mulch produced shall be stockpiled for subsequent use or for use at other locations as appropriate.

The wood-chip mulch shall be produced from branches having a maximum diameter of 100mm and the chipped material produced shall not have two orthogonal dimensions exceeding 75mm and 50mm.

(3) Disposal of surplus materials

Unless otherwise specified elsewhere, all surplus materials cleared and grubbed in accordance with this sub-section shall either be removed from the site or used for landscaping within the site in accordance with the approved plans and any conditions set by council.

Unless otherwise approved by council in writing, disposal of timber and other combustible materials by burning shall not be permitted.

SC6.4.6.12 Flexible pavements

SC6.4.6.12.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply, spreading, compaction and trimming of base and subbase courses of flexible pavements.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Pavement structures

Flexible pavement material types and layer thicknesses must be as per design requirements.

(3) Activity plan

Prior to commencement of work, the Contractor must provide the Superintendent a Pavement construction plan and detail the following activities:

(a) allocation of plant and personnel for the contract period;

(b) work programming to meet the constraints of all inspection points; and

(c) prepare and submit a Pavement construction plan for the flexible base and subbase construction consistent with the drawings and subject to direction by the Superintendent. Include the following:

(i) a time based program;

(ii) a drawn sectional plan showing lots and sequence;

(iii) site availability, assumptions on weather, plant and materials;

(iv) a list of activities requiring approvals or notification of local authorities, statutory bodies, and local residents; and

(v) off-site storage of plant, personnel and maintenance facilities.

(4) Inspection, sampling and testing

Inspection, sampling and testing of the pavement must be undertaken by the Contractor in accordance with the requirements of this sub-section before, during and after the construction of the pavement. Testing must be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

The Contractor must provide the Superintendent with written notice when testing is being carried out and copies of all test reports for approval to proceed.

Field density tests must be carried out in accordance with AS 1289.5.3.1, or, with the Superintendent's concurrence, with a Nuclear Density Meter in accordance with Clause SC6.4.6.12.6(3).

(5) Terminology

Base material	materials designated as Base are of a suitable quality that form the uppermost structural element of a pavement and on which the surfacing may be placed.
Bound material	bound material incorporates binder/s to produce structural stiffness (UCS > 1.5MPa at 28 days in accordance with TMR Test Method Q115).

Flexible pavement	a flexible pavement consists of a base and a subbase constructed of unbound granular materials or modified material, obtaining its load spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
Modified material	modified material incorporates small amounts of stabilising binder to improve the properties of the material without significantly affecting structural stiffness. A modified material must have sufficient stabilising binder to achieve a UCS range of 0.8MPa - 1.5MPa at 28 days in accordance with TMR Test Method Q115.
Subbase material	materials designated as Subbase are laid on the subgrade (or selected material), below the base, either for the purpose of making up additional pavement thickness, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Unbound material	unbound materials are granular materials with no significant capacity to resist tensile stresses.

(6) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.16 - Sprayed bitumen surfacing
SC6.4.6.19 - Stabilisation
SC6.4.4.2 - Pavement design

(b) Queensland Department of Transport and Main Roads specifications:
MRTS05 - Unbound Pavement

(c) Queensland Department of Transport and Main Roads Test Methods:
Q142A - Dry Density - Moisture Relationship (Standard Compaction).
Q115 - Unconfined Compressive Strength of Compacted Materials.
Q701 - Benkelman Beam Deflections.

(d) Australian Standards:

AS 1141.14 *- Particle shape, by proportional calliper*
AS 1141.22 *- Wet/dry strength variation*
AS 1289.3.1.1 *- Determination of the liquid limit of a soil - Four point Casagrande method*
AS 1289.3.3.1 *- Calculation of the plasticity index of a soil*
AS 1289.3.6.1 *- Determination of the particle size distribution of a soil - Standard method of analysis by sieving*
AS 1289.3.6.3 *- Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer*
AS 1289.5.1.1 *- Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS 1289.5.3.1 *- Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus*
AS 1289.5.4.1 *- Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1289.5.8.1 *- Determination of field density and field moisture content of a soil using a nuclear surface moisture - density gauge - Direct transmission mode*
AS 1289.6.1.1 *- Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 5101.4 *- Methods for preparation and testing of stabilized materials. Method 4: Unconfined compressive strength of compacted materials*

SC6.4.6.12.2 Materials

(1) General

The Contractor must submit details of all constituents of the proposed base and subbase materials, including sources of supply and the proposed type and proportion of any binder including targeted 28 days unconfined compressive strength (UCS). These details must be submitted to the Superintendent, supported with test results from a nominated NATA registered laboratory confirming that the constituents comply with the requirements of this sub-section.

If the proposed base or subbase is a bound material, the Contractor must submit a completed SC6.4.6.19 Attachment A Stabilisation mix design contained in the sub-section SC6.4.6.19 Stabilisation.

No material may be delivered until the Superintendent has approved the source of supply.

If, after the Contractor's proposals have been approved, the Contractor wishes to make changes in any of the material constituents the Contractor must inform the Superintendent in writing of the proposed changes. No delivery of material produced under the altered proposal must take place without the approval of the Superintendent.

At least 2 weeks before placement of the material on site, the Contractor must submit a Certificate from a laboratory with appropriate NATA registration demonstrating and stating that the unbound material or the mix and its constituents comply with the requirements of this sub section.

Ongoing testing of materials during delivery and construction must be undertaken on samples taken from the site.

(2) Unbound base and subbase

Base materials must comply with the requirements of type 2.1 materials as per clause 7.2 of MRTS05, grading B or C.

Sub-base materials must comply with the requirements of type 2.3 materials as per clause 7.2 of MRTS05, grading B or C.

Lower sub-base must comply with the requirements of type 2.4 materials as per clause 7.2 of MRTS05, grading B or C.

Unbound materials, including blends of two or more different materials, must consist of granular material which does not develop significant structural stiffness when compacted. Material produced by blending must be uniform in grading and physical characteristics.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the Contractor.

(b) **Layer Thickness**

Unbound pavement material must be laid at a minimum thickness of 125mm and a maximum thickness of 250mm.

(c) **Longitudinal Joins**

Longitudinal joins for paving runs for the top layer of the base courses must be aligned to coincide with the position of the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**

Segregation is the uneven distribution of particle sizes. The construction process must minimise segregation. There must be no visible signs of segregation on each lot. Samples must be taken from each lot to check that segregation of the material in the lot has not occurred. Additional samples must be taken from any areas which show visible signs of segregation. Each sample must be tested in accordance with Test Method Q103A.

(3) Lime modified base and subbase materials

Modification of unbound base and subbase materials to meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase by the addition of hydrated lime or quicklime is subject to approval by the Superintendent and to the additional requirements of this clause. After modification, the material must meet the requirements of clause SC6.4.6.12.2(2) Unbound base and subbase.

Modification of materials must be by means of blending either hydrated lime through a stationary mixing plant or by hydrated lime or quicklime utilising in-situ operations.

Material requirements of hydrated lime and quicklime must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The method of incorporating lime through the stationary mixing plant must ensure that the lime is mixed uniformly through the material.

In-situ operations must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The proportion of lime must be not less than 1.5% nor more than 4% by mass. The material prior to lime treatment must contain no added pozzolanic material.

The lime treated material must yield an unconfined compressive strength not exceeding 1MPa, when tested in accordance with Test Method Q115 where sampling is undertaken within 24 hours of adding the lime and testing is after 28 days curing.

(a) **Curing Final Layer**

Moist curing process has the potential to "wash" the cementitious paste from the upper surface, which leaves an unbound, non-cohesive, soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, wherever possible the completed pavement should not be moist cured within 48 hours of placing. Moist curing must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 48 hours.

(4) Bound base and subbase materials (Including Modified Material)

Bound material for a UCS>1.5MPa (28 days) to be used as subbase generally or base layer may be supplied as a pugmill quarry product with stabilising agent and laid using a paving machine or grader laid. Alternatively it may be produced by the in-situ stabilisation of natural or blended gravel where stabilisation is undertaken by mobile plant at the site.

Prior to stabilisation, the layer to be stabilised must meet the appropriate requirements for subbase material.

Material requirements for the stabilising agent must be in accordance with sub-section SC6.4.6.19 Stabilisation.

The stabilisation process must meet the requirements of sub-section SC6.4.6.19 Stabilisation.

The unconfined compressive strength (UCS) of the material after 28 days curing as determined by Test Method Q115 must be not less than 2.5MPa for stabilised pavements and not less than 0.8MPa for modified pavements. Sampling and test specimen compaction of the material must be undertaken within one hour of the incorporation of the stabilising agent.

The maximum period (working time) between mixing cement with the gravel material and the completion of compaction must be 3 hours. Council reserves the rights to reject the work if working time is not achieved and the material must be removed from site.

(a) **Surface Evenness**

Townsville City Council reserves the rights to carry out the necessary test procedure and supply results to the contractor.

(b) **Layer Thickness**
Bound pavement material (including Modified Material) must be laid at a minimum thickness of 150mm and a maximum thickness of 250mm. If bound layers are placed with a paving machine, Council may approve thinner layers.

(c) **Longitudinal Joins**
Longitudinal joins for paving runs for the top layer of the base courses must be aligned to coincide with the position with the traffic lane markings, except where approved otherwise in writing by the Superintendent.

(d) **Segregation**
Segregation is the uneven distribution of particle sizes. The construction process must minimise segregation. There must be no visible signs of segregation of the material in the lot has not occurred. Additional samples must be taken from any areas which show visible signs of segregation. Given the presence of cement additive in the material, the relevant test for segregation must be as specified in AS 1289.3.6.1.

(e) **Curing Final Layer**
Moist curing process has the potential to “wash” the cementitious paste from the upper surface, which leaves an unbound, non-cohesive soft pavement matrix with high embedment potential for the subsequent sealing aggregate. Therefore, the completed pavement must not be moist cured within 48 hours of placing. After 48 hours, moist curing must be carried out using equipment fitted with spray jets that deliver water to the pavement as a fine mist. The use of conventional spray bars or high pressure water nozzles with large aperture sprays holes will not be permitted. Conventional bituminous surface curing may be used within 48 hours.

SC6.4.6.12.3 Delivery, stockpiling and processing of pavement material

(1) Delivery to site
Materials must be supplied sufficiently damp to avoid segregation and loss of fines during transit.

(2) Stockpiling of unbound materials
Stockpile sites must be located as shown on the drawings or as approved by the Superintendent.

Stockpile sites, which must be cleared of all vegetation and extraneous matter, must be shaped to form a crown so as to be free draining and compacted over the whole area to provide a relative compaction, determined by AS1289.5.4.1 for standard compactive effort, of not less than 95%.

Stockpiles and stockpile sites must be maintained so as to prevent the stockpiled materials from becoming intermixed or contaminated with foreign material.

The total height of any stockpile must not exceed 3m.

Stockpiles must be of uniform shape with side slopes neither steeper than 1.5h to 1v nor flatter than 3h to 1v.

The worked face of any stockpile must be the full face of the stockpile. The stockpiled material must be maintained at a moisture content sufficiently damp to avoid loss of fines.

At the completion of the works, stockpile sites must be cleared of all surplus material and left in a clean and tidy condition.

(3) Delivery of modified or bound materials
Modified or bound materials must be delivered in vehicles fitted with covers of canvas or other suitable material to prevent loss of moisture during transport.

The time between mixing and conveyance by delivery trucks to the site, must be such as to allow incorporation into the works including trimming and compaction within the nominated field working period.

Each truck load of bound material must be identified by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck, and such dockets must be made available to the Superintendent at the point of delivery.

Bound materials must comply with the requirements of sub-section SC6.4.6.19 Stabilisation.

SC6.4.6.12.4 Spreading pavement materials

The contractor must present the underlying layer to the Superintendent prior to placement of subsequent layers and must ensure that moisture content of the underlying layer does not exceed 90% of the laboratory optimum moisture content as determined by AS1289.5.1.1. If the underlying layer has become rutted or mixed with foreign matter, it must be corrected to comply with this Sub-section before spreading of the next layer of pavement.

Where the underlying layer was constructed by the Contractor, or where the Contractor's activities caused the underlying layer constructed by others to become non-complying with this sub-section, correcting the underlying layer to comply is the responsibility of the Contractor.

Each layer of material must be deposited and spread in a concurrent operation and, after compaction, the finished surface levels on the base and subbase courses must be within the permitted tolerances stated in Clause SC6.4.6.12.6(6)(c) Levels and surface trim without subsequent addition of material. The thickness of each compacted layer must be neither less than 125mm nor more than 250mm for all pavement layer types, unless otherwise approved by the Superintendent.

At all work boundaries in bound materials the Contractor must provide vertical faces to provide for transverse and longitudinal joints.

When spread for compaction processes the moisture content of the unbound and bound base materials must be in the range of 60-90% and subbase materials must be in the range of 75-100% of laboratory optimum moisture content in accordance with AS1289.5.1.1.

Bound materials with UCS > 1.5MPa (28 days) must not be spread with a self-propelled paver when the ambient air temperature in shade is either below 5°C or above 35°C. Where the materials are to be spread outside the required ambient air temperature range, the Contractor must submit a work proposal to the Superintendent for approval.

SC6.4.6.12.5 Compaction

(1) General requirements

Each layer of the base and subbase courses must be uniformly compacted over its entire area and depth to satisfy the requirements of relative compaction set out in clauses SC6.4.6.12.6(3) Relative compaction and SC6.4.6.12.6(4) Compaction requirements and acceptance.

On sections of pavement with one way crossfall, compaction must begin at the low side of the pavement and progress to the high side. On crowned sections, compaction must begin at the sides of the pavement and progress towards the crown. Each pass of the rollers must be parallel with the centreline of the roadway and uniformly overlap each preceding pass. The outer metre of both sides of the pavement must receive at least two more passes by the compaction plant than the remainder of the pavement.

At locations where it would be impracticable to use self propelled compaction plant, the pavement material must be compacted by alternative hand operated plant approved by the Superintendent.

Watering and compaction plant must not be allowed to stand on the pavement being compacted.
If any unstable areas develop during rolling, the unstable material must be rejected. The rejected material must be removed for the full depth of the layer, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. This operation will be at cost to the Contractor.

The placement of subsequent layers must not be allowed until the requisite testing has been completed and the test results for each layer have been accepted by the Superintendent and correct curing times for bound

layers has been attained.

Any unbound material in a layer that has attained the specified relative compaction but subsequently becomes wetted up must be dried out and, if necessary, uniformly recompacted and trimmed to meet the specified density requirements and level tolerances.

(2) Curing of bound materials
The curing of the surface layer of a lot must commence after compaction is completed and must be in accordance with the SC6.4.6.19 Attachment A Stabilisation mix design.

The stabilised work must be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal. Also refers to the requirements of SC6.4.12.2 (5) (e) Curing of final layer.

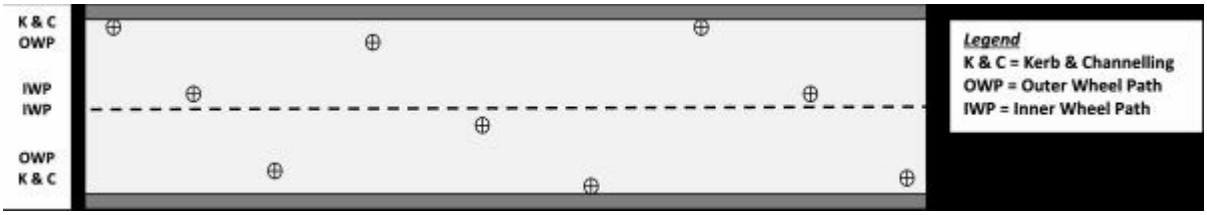
SC6.4.6.12.6 Acceptance of compaction

(1) Lots for acceptance
Acceptance of work, as far as compaction is concerned, must be based on density testing of the work in lots. A lot must be nominated by the Contractor, but must conform to the following:

(a) cover only a single layer of work which has been constructed under uniform conditions in a continuous operation and not crossing any transverse construction joints; and

(b) for unbound materials, it may equal a day's output using the same material.

(2) Compaction assessment
The Superintendent must assess compaction for each lot based on arranged test locations for in-situ dry density testing in line with the following diagram. The intention is that one in every three density tests must be positioned against the inner line of the kerb and channel on either side. This arrangement must be repeated or truncated as appropriate depending on the number of tests required per lot.



Similar arrangement must be adopted for roads with no kerb and channel or edge constraint, with the test locations at the edge shifted to the OWP position. A random arrangement for test locations at intersection is acceptable, provided that one in every three density test is positioned along the inner kerb and channel / edge line.

The Contractor must arrange for testing to assess compaction on the basis of a pro rata testing frequency of 10 tests per 5,000sqm with a minimum of three tests per lot.

The elastic rebound deflection must be taken as the maximum deflection in accordance with Test Method Q701 utilising the Benkelman Beam or equivalent. The average maximum deflection for any lot must not exceed 1mm, and the co-efficient of variation (CV) in recorded deflections must not exceed 30%.

Measurements must be taken at the rate of 4 per 1,000sqm, with a minimum of ten measurements per lot.

Proof rolling must be undertaken with the use of a single drive axle truck with a rear single axle/dual wheels load of 8.2t or tandem rear axle/dual wheels carrying a load of 13.8t. Proof rolling cover all lanes of the carriage way including parking bays and must show no evident movement.

(3) Relative compaction
The relative compaction of pavement material at each location tested for in-situ dry density must be calculated

in accordance with AS 1289.5.4.1 as follows:

Relative Compaction (per cent) = $\frac{\text{In-situ dry density}}{\text{Comparative dry density}} \times 100$

Note—the comparative dry density must be the maximum dry density determined in the laboratory.

The council Superintendent may approve some or all of the in-situ dry density testing to be carried out with a single probe Nuclear Density Meter in the direct transmission mode in accordance with AS 1289.5.8.1. Council reserves the right to request additional testing at the discretion of the Inspector.

Each day that material is produced for placement in a layer or layers, a sample of the material must be taken by the Contractor for maximum dry density testing to represent that day's production.

For unbound layers, the sample must be tested in accordance with AS 1289.5.1.1 to determine the maximum dry density (standard compactive effort) for the material.

For bound layers the sample must be tested within two hours after the addition of stabilising agent to the mix in accordance with Test Method Q142A to determine the maximum dry density (standard compactive effort) for the material. This test method must also be used to determine the standard optimum moisture content.

The maximum dry density so determined must be used as the comparative dry density in relative compaction calculations for all like material from that lot or day's production placed in a single layer of work whichever is the lesser.

(4) Compaction requirements and acceptance

All compaction test results must exceed the minimum requirements in accordance with:

(a)	Unbound pavement	MRTS05
(b)	Insitu stabilised subgrade using lime	MRTS07A
(c)	Insitu stabilised pavement using cement	MRTS07B
(d)	Insitu stablised pavement using foam bitumen	MRTS07C
(e)	Plant mixed stabilised pavement	MRTS08

(5) Reworking of rejected unbound layers

Lots or areas of pavement that have been rejected in regard to compaction must be reworked before resubmission for compaction assessment.

Material that has become degraded, segregated or otherwise reduced in quality by reworking must be rejected. The rejected material must be removed, disposed of and replaced with fresh material complying with this Sub-section in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses. When a lot or area of pavement is resubmitted for compaction assessment, testing must be carried out in accordance with clauses SC6.4.6.12.6(2) Compaction assessment and SC6.4.6.12.6(3) Relative compaction.

All corrective work must be carried out by the Contractor before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking. All costs associated with corrective work carried out before the resubmission of a lot for compaction assessment, including rewatering, rerolling, removal and replacement of material as well as reworking must be borne by the Contractor. Reworking of rejected modified or stabilised material is not accepted.

(6) Tolerances

(a) General

The tolerances stated are the acceptable limits of departure from the dimensions shown on the drawings, which may occur during construction.

Areas for assessment of conformity with tolerance requirements must be divided into lots and presented to the Superintendent together with survey reports covering line and level.

(b) Width

At any cross section without kerb and /or guttering channel or a dish drain, and for pavement layers extending under the kerb and channel or dish drain/or guttering , the horizontal dimension measured from the design centre line to the edge of the constructed pavement surface must be neither less than 50mm less than the dimension nor more than 300mm greater than the dimension shown on the drawings.
The average width of the layer determined from measurements at three sites selected at random by the Superintendent over any 200m road length, or part thereof, must be not less than the specified width.

(c) Levels and surface trim

The levels of the finished surface of the top of the unbound subbase course must not vary from the design levels by more than ±15mm.

Level tolerances at the top of the unbound base course must not exceed those stated above for subbase. In addition, where kerb and channel exists or is being constructed, the level of the top of the base course adjacent to the kerb and channel must not vary by more than ±5mm from the lip level of the gutter minus the design thickness of the wearing surface.

The design level of the top of the subbase course must be determined from the design level of the finished road surface less the thickness of the base course and the wearing course, including an allowance for any flush seal layer in the pavement design.

The pavement surface after trimming and immediately prior to sealing must be of a quality such that the deviation under a 3m straight edge placed in any direction does not exceed 12mm. Measurements for conformance must be taken in accordance with the maximum lot size and minimum test frequencies in SC6.4.5 Construction management.

(7) Action on rejection

(a) Unbound materials

A lot that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6)(c) Levels and surface trim respectively must be rejected except as otherwise provided in this clause. Rejected lots must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

Notwithstanding the above, where the rejected lot can be corrected by further trimming, the Superintendent may allow the surface to be corrected without complete removal and replacement with fresh material. Such trimming must be undertaken in a manner that produces a uniform, hard surface and must be achieved by cutting only without filling. After any such cutting, the level tolerances in clause SC6.4.6.12.6(6)(c) Levels and surface trim must apply.

The required surface correction or replacement work ordered in accordance with this clause including removal of material, disposal and supply and transport of replacement material, must be borne by the Contractor.

(b) Bound materials

An area of bound material that has not complied with the requirements for width or level tolerance as set out in clauses SC6.4.6.12.6(6)(b) Width and SC6.4.6.12.6(6) Levels and surface trim respectively must be rejected except as otherwise provided for in this clause. Rejected areas must be removed, disposed of and replaced with fresh material in accordance with clause SC6.4.6.12.6(8) Removal and replacement of rejected courses.

The removal and disposal of rejected material and its replacement with fresh material must be borne by the Contractor.

Notwithstanding the above, the Superintendent may allow the Contractor to rectify the area in the following cases:

(i) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far below the design level, the Contractor may increase the thickness of the base course to make up such deficiency in thickness.

(ii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a subbase course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course, to allow for its design thickness to be laid, up to a maximum of 20mm above the original design level. Approval by the Superintendent must be subject to the following requirements:

(A) the rate of change of grade from the original finished design surface level must be less than 3mm per metre;

(B) the regrading must not interfere with the proper design functioning of the drainage system;

(C) the regrading must not interfere with levels at the property boundary, or increase or decrease footpath or footpath crossover levels or grades beyond council's allowable design limits; and

(D) the regrading must not interfere with clearances.

(iii) Where the cause for rejection is under clause SC6.4.6.12.6(6)(c) Levels and surface trim, the course is a base course and rejection is due to departures from design level being too far above the design level, the Contractor may propose a regrading of the design level of the base course. Approval by the Superintendent is subject to the requirements of this clause in (ii) above.

(8) Removal and replacement of rejected courses
Sections of work that have been rejected by the superintendent are to be removed from the work site and replaced with fresh material.

Any rejected pavement sections are to be removed and replaced over the full length of the rejected lot for a minimum length of 20m of the pavement layer. Any damage to underlying or abutting layers or structures must be made good by the Contractor using methods approved by the Superintendent.

The Superintendent may approve removal for less than the full width as constructed if the cause of the rejection of the work can be isolated transversely to the Superintendent's satisfaction. In this case, the new longitudinal cold joint must be formed and located along the centreline of the road pavement.
After removal of rejected base or subbase course material, the section must be presented for inspection by the Superintendent before replacement work is commenced.

Materials used as replacement materials, and the subsequent spreading, compaction, trimming, curing and testing of the replacement materials, must comply with the requirements of this sub-section.

The removal, replacement and correction of base and subbase courses required under this clause must be the responsibility of the Contractor in respect of delays caused by such removals, replacements and corrections must be borne by the Contractor.

All costs associated with the corrective work must be borne by the Contractor.

(9) Maintenance before completion of wearing surface
Following the Superintendent's acceptance of any section of the work, the Contractor must maintain the prepared surface of the base in the condition specified for acceptance until the wearing surface is completed. The preparation work must be carried out in a manner which will promote the adhesion of the bituminous material to the surface of the pavement. Preparation work must include:

(a) Removal of all foreign and loose material from the surface; and

(b) Light watering on dry and dusty surface

Ball Penetration testing on inner and outer wheelpaths must be carried out on all pavements before application of bituminous material. Where a ball penetration result exceeds 4.0mm the surface must not be sprayed until Council is advised and approval to proceed granted.

The base course of sections of the accepted work must be covered with a primerseal over the full width of pavement in accordance with sub-section SC6.4.6.16 Sprayed bitumen surfacing within 7 days of the date of the acceptance of such sections, unless otherwise approved by the Superintendent.

Should the pavement condition deteriorate before the application of the primerseal and consent to proceed with the bitumen surfacing work is withdrawn by the Superintendent, the Contractor must re-prepare the pavement and re-present the pavement for inspection by the Superintendent.

The maintenance and re preparing areas of the deteriorated pavement is the responsibility of the Contractor.

The Contractor must maintain adequate drainage of the pavement, and remove any ponded water within 12 hours of its creation if free drainage cannot be achieved, prior to the completion of the wearing course.

SC6.4.6.12.7 Opening pavement to traffic

General requirements

For unbound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work must not be permitted to use the pavement until the primerseal has been applied, unless otherwise approved.

For bound pavement layers, construction plant and vehicles not involved in the current construction or testing of the work should not use the pavement until the primerseal has been applied and seven days have elapsed since placement of the base. In any case only vehicles registered for legal road usage and loaded within legal limits will be allowed to use the pavement.

SC6.4.6.12.8 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.12.1 below.

Table SC6.4.6.12.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Stockpile Sites**	(i) Relative Compaction >97% (ii) Stockpile height <3m (iii) Stockpile batter <1.5:1 and >3:1	SC6.4.6.12.3(2) SC6.4.6.12.3(2)
2.	**Spreading Pavement Materials**		
	(i) Compacted Layer Thickness	≥150mm (modified material) ≥125mm (unmodified material) ≤250mm (all material)	SC6.4.6.12.4
3.	**Compaction Acceptance**		
	Minimum value of all calculated relative compaction results	All compaction test results must exceed the minimum referenced requirements	SC6.4.6.12.6(4)
4.	**Width of Pavement**	-50mm to +300mm of dimensions on drawings	SC6.4.6.12.6(6)(b)
	(i) Design centre-line to edge of constructed pavement		
	(ii) Average Width	The average width determined from 3 random sites over any 200m road length, or part thereof, must be not less than the specified width.	SC6.4.6.12.6(6)(b)
5.	**Surface Level**		
	(i) Subbase levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)
	(ii) Base levels	<± 15mm from design level	SC6.4.6.12.6(6)(c)

(iii) Base levels adjacent to kerb and channel	<±5mm from the lip levels of adjacent gutter minus design thickness of wearing surface.	SC6.4.6.12.6(6)(c)
(iv) Shape	Deviation from a 3m long straightedge on base surface immediately prior to sealing must be less than 12mm	SC6.4.6.12.6(6)(c)
(v) Ball Penetration	>4.0mm	SC6.4.6.12.6(9)

SC6.4.6.13 Asphaltic concrete

SC6.4.6.13.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the production and placing of asphalt including the supply of materials, sampling, testing and any other operations necessary to provide asphalt. The extent of the policy sub-section includes:

(i) manufacture/supply of the production mix;

(ii) provision of a testing laboratory;

(iii) preparation of the surface on which asphalt is to be placed;

(iv) transport of asphalt;

(v) laying and compaction of asphalt; and

(vi) sampling and testing.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Plant

The Contractor must provide all the plant, equipment and labour necessary for carrying out the work in accordance with this sub-section.

All plant and equipment used on the work must be in accordance with the submitted quality documentation and kept in good operating condition. The Contractor must not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent.

All plant must be registered and insured as appropriate to its use on a public road and must comply with statutory environmental regulations.

(3) Protection of services and road fixtures

The Contractor must take all necessary precautions to prevent asphalt or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures. Immediately after the asphalt has been spread the Contractor must clean off or remove any such material as directed by the Superintendent and leave the services and road fixtures in a condition satisfactory to the Superintendent.

(4) Control of traffic

The Contractor must provide for traffic control in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the road users or employees.

(5) Work records

Particulars of the work performed must be recorded by the Contractor on the Asphalt Work Record at SC6.4.6.13 Attachment A Asphalt Work Record or as per the Contractor's own procedures where equivalent. The Contractor must complete the Asphalt Work Record, which must be countersigned by the Superintendent each day as a true record of the work performed.

Delivery dockets stating the mass of each truck load of asphalt must be attached to the Asphalt Work Record.

(6) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1141.11	*- Particle size distribution by dry sieving*
AS 1141.14	*- Particle shape, by proportional calliper*
AS 1141.17	*- Voids in dry compacted filler*
AS 1141.18	*- Crushed particles in coarse aggregate derived from gravel*
AS 1141.22	*- Wet/dry strength variation*
AS 1141.42	*- Pendulum friction test (PAFV)*
AS 1160	*- Bitumen emulsions for the construction and maintenance of pavements*
AS 2008	*- Residual bitumen for pavements*
AS 2150	*- Hot mix asphalt*
AS 2734	*- Asphalt (hot-mixed) paving - Guide to good practice*
AS 2758.5	*- Asphalt aggregates*
AS 2891.1	*- Sampling of Asphalt (AS2891.1.1 Methods of Sampling and testing asphalt Loose asphalt)*
AS 2891.3.1	*- Bitumen content and aggregate grading - Reflux method*
AS 2891.5	*- Determination of stability and flow - Marshall procedure*
AS 2891.8	*- Voids and density relationships for compacted asphalt mixes*
AS 2891.10	- Water and volatile oils content

(c) Queensland Department of Transport and Main Roads Specifications:

MRTS17	*- Bitumen*
MRTS18	*- Polymer Modified Binder*
MRTS21	*- Bituminous Emulsion*
MRTS30	*- Dense Graded and Open Graded Asphalt*

(d) Austroads:

AGPT03-2009 *Guide to Pavement Technology Part 3 – Pavement surfacings*
AGPT04B-2007 *Guide to Pavement Technology Part 4B - Asphalt*

SC6.4.6.13.2 Materials

Materials and mix ingredients must be in accordance with MRTS30. Binder must be in accordance with MRTS17 and polymer modified binder in accordance with MRTS18.

SC6.4.6.13.3 Asphalt mix design

(1) Approved mix

The supply only of an approved mix in accordance with MRTS 30.

The Contractor may not make any changes to the approved mix, or constituent materials without the prior written approval of the Superintendent.

Notwithstanding any approval given by the Superintendent to a proposed asphalt mix, the Contractor is responsible for producing asphalt which satisfies all requirements of this policy sub-section.

Asphalt produced in the plant and delivered to the site must be known as the "production mix".

(2) Production

(a) Asphalt production must comply with the requirements of MRTS30.
The Superintendent, upon provision of notice to the asphalt supplier or the supplier's representative, must have access to the mixing plant for purposes of inspection to verify production procedures and the supplier's compliance with the Contractor's Quality Management Manual and Project Quality Plan. The Superintendent must have the right to declare any non-conformance and be entitled to request correction

of either the Contractor's Quality Management Manual or the Project Quality Plan or both.

(b) Storage of asphalt
Asphalt may be stored in an insulated storage bin prior to delivery. Asphalt which has been stored for more than twenty four hours or is below the minimum temperature specified must not be used. Binder manufacturer's instructions must be followed when polymer modified asphalt is stored.

(c) Contractor's laboratory
The Contractor must maintain and operate an appropriately registered NATA testing laboratory at or near the mixing plant to control the quality of the asphalt produced.

The Contractor will make the laboratory available for inspection by the Superintendent at any time during the course of the works.

All documented test results must be submitted to the Superintendent for inspection and approval in a format and to a timetable suitable to the Superintendent.

The Contractor is responsible for taking samples and must supply all facilities, equipment and labour for that purpose. The samples must be taken by the Contractor.

(d) Frequency of sampling
For the purpose of testing production mix the Contractor must sample production lots at the minimum frequencies set in MRTS30. This testing frequency requirement must apply to each asphalt mix type. The test results must be related to production intervals with samples representing the full lot of production of the relevant mix for the production interval.

Test results from this production control sampling are acceptable as representative of deliveries made under this contract subject to the traceability of production from specific production intervals to the location at the paving site.

Such traceability shall include registration of lot number and time of production on the delivery docket system. The size of any production lot shall be limited to production from a 12 hour "shift".

Sampling shall be performed in accordance with Test Method Q301. Samples shall be identified so as to allow traceability of the mix to the paving site. Each sample or sample portion as appropriate sampled as a referee sample shall be stored in an airtight container labelled so as to be traceable to the job and paving site location.

Testing required shall be arranged by the Contractor at an appropriately registered NATA laboratory. Test reports will be made available to the Superintendent as soon as they are available and always within 7 days of delivery of material.

Dense graded asphalt that does not include modified bitumen may include a proportion of RAP up to but not exceeding 20% by mass. The resultant asphalt shall meet all requirements for the Nominated Mix.

The RAP to be utilised shall be nominated by source and/or stockpile. Testing of the Nominated Mix shall include RAP sampled from the stockpile and of similar physical properties as that to be utilised for the contract. Any change in RAP supply shall be brought to the attention of the Superintendent prior to proposed usage in asphalt under this contract.

(3) Delivery
The bodies of haulage trucks shall be kept clean and coated with a thin film of an approved release agent to prevent asphalt sticking to the body of the truck. Any surplus release agent shall be removed before loading.

During transport asphalt shall be covered with a canvas or other suitable cover which is held down securely.

When transported to site until delivery to the hopper, the mix must be covered with a heavy duty canvas or similar waterproof cover which shall overlap the sides of the truck body by at least 250mm and shall be tied down securely. The bodies of all trucks shall be suitably insulated.

Delivery of the asphalt shall be at a uniform rate within the capacity of the spreading and compacting equipment.

The mass of all truck loads of asphalt shall be measured on a registered weighbridge.

(4) Placing

Placing of asphalt shall not be permitted when the surface of the road is wet or while rain appears imminent, or when cold winds chill the asphalt to such an extent that, in the opinion of the Superintendent, spreading and compaction will be adversely affected. The Superintendent may order work to cease temporarily on account of adverse weather, unsatisfactory pavement surface condition, or other circumstance which the Superintendent feels may adversely affect the subsequent operations.

(5) Preparation of pavement

The existing surface shall be dry, clean and free from any loose stones, dirt and foreign matter. The surface shall be swept beyond the edge of the proposed asphalt layer by at least 300mm. Any foreign matter adhering to the pavement and not swept off shall be removed by other means. Any areas significantly affected by oil contamination shall be cleaned to the satisfaction of the Superintendent.

Surface preparation shall be in accordance with AS 2734. Thermoplastic linemarking or other linemarking, where indicated necessary by the Superintendent will be removed prior to paving. Raised pavement markers shall be removed prior to paving.

The Contractor, when paving over existing road pavement, shall be responsible for the recording of lane marking positions including the extent of barrier line. After paving the Contractor will mark up the pavement to re-establish such positions using conventions agreed with the Superintendent and to a standard adequate to allow accurate re-establishment of line marking.

The Contractor shall repair any damage to the existing pavement surface caused by the Contractor's activities. Affected areas designated by the Superintendent shall be removed and reinstated to the Superintendent’s satisfaction.

A corrector course shall be used to correct irregularities in an existing surface and/or modify the shape of an existing surface. Any surface depressions greater than 25mm in depth and any uneven surface shall be brought to the general level of the surrounding pavement/deck surface. Where a corrector course is used to modify the shape of an existing surface, the course shall be laid to the reduced levels and/or shape specified in the documents.

The Contractor shall mark out, in the presence of the Superintendent, the areas where corrector course is to be applied and shall not lay corrector course prior to receiving acceptance of the proposed areas from the Superintendent.
The asphalt in these patches shall be compacted to comply with the general level of the existing surface to the Superintendent’s satisfaction.
Back filling and stress absorbing fabric strips is to be carried out in accordance MRTS30 where indicated on the drawings or directed by the superintendent.
Preparation of the prepared surface is to be to the satisfaction of the Superintendent. Subsequent inspection and Superintendent’s approval of surface condition shall be required prior to the release of the hold point.

(6) Tack coat

Only on multiple courses shall tack coat be used between each course unless directed otherwise by the Superintendent. The whole of the area to be sheeted with asphalt shall be tack coated with a light and even coat of bitumen emulsion. Bitumen emulsion shall comply with the requirements of MRTS21.

The bitumen emulsion shall be applied at a rate of between 0.1 litres per square metre and 0.2 litres per square metre of undiluted bitumen unless otherwise specified.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar. Where the areas to be sprayed are small, irregular or inaccessible to mechanical sprayers, such areas shall be tack coated by hand spraying or brushing.

The bitumen emulsion may be warmed or diluted with water to facilitate spraying. Adequate time shall be allowed for the emulsion to break before asphalt is laid. Over application of tack coat, due to surface depressions, shall be removed or dispersed by brushing.

All contact surfaces of kerbs and other structures and all cold joints shall be coated with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat, any services or exposed fixtures including concrete kerbs, guardfence or bridge handrails. Appurtenances susceptible to overspray shall be protected with suitable paper.

When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the Superintendent may require that the finished surfaces be suitably protected from carryover of bituminous material.

In locations of heavy pedestrian traffic, such as shopping areas, the Contractor shall take appropriate precautions in accordance with sub-section SC6.4.6.30 Control of traffic to keep pedestrians off tack coated areas.

(7) Laying

(a) Paver
The paver(s) shall be expected to have a minimum spreading capacity of 50t of asphalt per hour and be capable of spreading a width of at least 3.7m to the requirements of this sub-section. It shall be expected to have automatic screed control operated from joint matching shoe, fixed line, travelling straight edge or levelling beam. The Contractor shall provide the Superintendent with notice of proposed pavers without these capabilities and obtain Superintendent's agreement to their use.

(b) Laying operations
The work shall be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

The paver shall operate at a uniform speed and the delivery of asphalt shall match the output of the paver such that continuous laying of asphalt is achieved.

When laying asphalt in echelon the distance between pavers shall be such that the temperature of the asphalt at the edge of the asphalt laid by the advance paver is not less than 80 °C by the time the following paver matches the longitudinal joint.

In the event of faulty operation of the paver causing irregularities in the spread asphalt, work shall cease until the fault is rectified.

Unless otherwise approved by the Superintendent, asphalt shall not be spread by hand behind the paver. Workers shall not stand or walk on the hot surface until compaction has been completed except where necessary for correction of the surface.

The Superintendent may approve spreading asphalt by hand for minor correction of the existing surface and in areas inaccessible to mechanical pavers.

Asphalt shall not be placed when the surface of the pavement is wet or while rain appears imminent.

AS 2734 shall constitute a valid reference of good practice for asphalt laying practice.

(c) Laying temperature

Weather restrictions and minimum asphalt temperatures at the time of discharge into the paver shall be in accordance with MRTS30. Measurement may be made by calibrated infra-red thermometers when accepted by both Contractor and Superintendent.

The Superintendent may reject that part of any truck load which contains lumps of cooled asphalt which are liable to affect the quality of the finished surface.

The laying temperature shall be measured in the paver hopper. A suitable stem type thermometer readable and accurate to within plus or minus 2 °C with a range from at least 0 °C to 200 °C shall be used. The stem shall be inserted into the asphalt to a depth of approximately 200mm at a location at least 300mm from the side of the paver. The average of two readings shall be adopted as the temperature of the mix. Measurements of asphalt and road surface temperatures and wind velocity to comply with this Clause shall be recorded on the Asphalt Work Record Sheet.

(d) Level control

The minimum controls for level set out below shall be used. Additional controls may be necessary to obtain the required finished pavement properties.

Corrective courses shall be automatically controlled by programmed computer control of the paver, joint matching shoe or stringline sensor. Where the correction is only minor, the Superintendent may allow the use of levelling beams at least 10m long.

Intermediate courses shall be automatically controlled by programmed computer control of the paver or a joint matching shoe.

The wearing course shall be controlled by levelling beams at least 10m long and, as required by the Superintendent or a joint matching shoe. When identified in the Project Quality Plan and/or approved in writing by the Superintendent, small areas (as defined) may be paved as wearing course without the use of levelling beam to achieve target levels.

(e) Layer thickness

The compacted thickness of each course shall be as shown on the drawings. A course may comprise one or more layers. The nominal compacted layer thickness shall be in accordance MRTS30.

(8) Joints

(a) General

The location of longitudinal and transverse joints shall be as approved by the Superintendent and at the spacing nominated in the drawings. All joints shall be compacted and finished with a smooth, planar surface coinciding with, and being of similar appearance to the remainder of the layer.

(b) Longitudinal joints

An automatically controlled joint matching device shall be used to control the levels of adjacent runs. Care shall be taken to provide positive bond between adjoining runs. Longitudinal joints shall be:

(i) continuous and parallel;

(ii) coincident within 150mm of line of change in crossfall;

(iii) offset by at least 150mm from joints in underlying layers;

(iv) located away from traffic wheel paths; and

(v) located beneath proposed traffic linemarkings in the case of a wearing course.

Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

When pavers are laying asphalt in echelon, the hot joint so produced shall be constructed by leaving an uncompacted strip approximately 150mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

A joint shall be considered “cold” when the temperature of the asphalt has dropped below 60ºC for dense graded mix. Cold joints will require tack coating.

(c) Transverse joints

When the end of the asphalt layer has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be at right angles to the direction of laying. They shall be staggered by at least 1m between successive layers and between adjacent runs.

Runs shall end either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, before continuing the run the feathered material shall be cut back to a line where the full layer thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut. The end of the previous run shall be lightly tack coated before the laying of the next run proceeds.

When the asphalt layer is required to join and match the level of an existing pavement surface, bridge deck or other fixture, sufficient of the existing material shall be cut out to achieve the minimum layer thicknesses requirements.

SC6.4.6.13.4 Compaction

(1) Plant and equipment

The proposed compaction fleet and rolling pattern shall be adequate to achieve the specified compaction and finish.

The minimum number of rollers used for compaction of asphalt laid at various rates should be as shown in Table SC6.4.6.13.1 Minimum roller combinations for compaction.

For compaction of confined areas or patching works a small vibrating roller, or hand operated vibrating compactor acceptable to the Superintendent shall be used.

Table SC6.4.6.13.1 Minimum roller combinations for compaction

ASPHALT OUTPUT	ALTERNATIVE ROLLER COMBINATION		
	Dense Graded Asphalt		
Tonnes per hour per paver	Static Steel	Steel Vibrating	Pneumatic Tyred
Up to 45	1	-	1
	-	1	1
45 to 85	1	-	2
	-	1	1
85 to 120	1	-	3
	2	-	2
	-	2	1
Above 120	As for 85 to 120 plus additional rollers as determined by Compaction Trials		

Note— 1. At the discretion of the Superintendent, the minimum number of rollers may be decreased for layer thicknesses in excess of 60mm.

2. Additional pneumatic tyred rollers to those specified may be required for backrolling asphalt.

(2) Dense graded asphalt

(a) Initial rolling

Initial rolling shall be carried out using steel rollers. Vibratory steel rollers may be used, but they shall be operated in the static mode for the first pass. On deep lift asphalt, pneumatic tyred rollers may be used.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver.

The transverse and longitudinal joints and edges shall be compacted first.

The minimum asphalt temperature at the commencement of rolling shall be as detailed in MRTS30.

(b) Secondary rolling
Secondary rolling shall immediately follow initial rolling. In secondary rolling, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic tyred rollers should equal or exceed 550 kilopascals.

Rolling shall commence at the longitudinal joint side of the run.

Secondary rolling shall be completed before the mix temperature falls below 80 °C.

(c) Final rolling
Final rolling shall be carried out by a pneumatic tyred roller to eliminate all roller marks and to produce a uniform finish. If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling instead of the pneumatic tyred roller specified.

Final rolling shall be completed before the asphalt temperature falls below 60 °C.

(3) Acceptance criteria for compaction
The acceptance for compaction shall be on a lot by lot basis where each day's work in one layer is generally one lot. Any defective areas which show cracking, bony material or exhibiting excessive binder shall be excluded from the lot and shall be rectified by the Contractor before being tested.

When directed by the Superintendent the Contractor shall arrange for the determination of the relative compaction of the lot by either of the following methods:

The acceptance for compaction on a lot shall be on the basis of characteristic value of relative compaction in accordance with MRTS30.

(4) Finished pavement properties
Each course of asphalt shall be finished parallel to the finished surface of the wearing course.

(5) Thickness
The thickness of asphalt shall be specified and/or measured in one of the following ways:

(a) No finished surface levels specified
When asphalt is placed over an existing pavement in one or more courses and no corrective course is applied, the calculated average compacted thickness of each course shall be in accordance with the course thickness specified in the Drawings and tolerances indicated in MRTS30.

(b) Finished surface levels specified
When asphalt is placed to specified levels, vertical tolerances and thicknesses shall be in accordance with MRTS30.

(6) Shape
The surface shall not deviate from the bottom of a 3m long straightedge laid in any direction by more than 5mm.

(7) Removal and replacement of rejected material
The sections of work that have been rejected under the preceding clauses of this sub-section or as otherwise determined by the Superintendent shall be removed within 15 days from the work and replaced with fresh asphalt mix material corresponding in grade and quality to that material specified in the Approved Mix unless otherwise approved by the Superintendent.

If removal of the single nonconforming pavement strata is impossible, the affected area as determined by the Superintendent shall be removed to subbase or subgrade depth as appropriate to provide a smooth level

surface on which to found the reinstated base and/or subbase course.

The perimeter of the nonconforming area shall be prepared in accordance with the practice pertaining to longitudinal and transverse cold joints (AS 2734).

In rejected sections the material is to be removed over the full length of the affected area except that a minimum length of 5m and a minimum width equal to the paver width shall be removed.

The Superintendent shall have the right to alter the constitution, quality, grading, or other parameters of the "reinstatement pavement" if it is felt that reconstruction of the affected area with the Approved Mix would produce nonconforming pavement as a result of non-continuous pavement structure.

After removal of the rejected base or subbase course the area shall be made available to the Superintendent for inspection and approval to proceed with the works. Superintendent inspection and approval is required prior to release of hold point.

All materials used in the reinstatement of the nonconforming area shall comply with the requirements of this sub-section unless otherwise directed by the Superintendent.

SC6.4.6.13.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.13.2 below:

Table SC6.4.6.13.2 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Materials and mix ingredients and manufacture	AC Asphalt - MRTS 30 and current TMR supplementary specifications. Bitumen - MRTS 17 Polymer modified binder - MRTS 18	SC6.4.6.13.2
2.	**Preparation of Pavement** (a) Cleaning of Surface	>300mm beyond the edge of proposed layer	SC6.4.6.13.3(1)
3.	**Tack Coat** (a) Bitumen Emulsion	Application Rate > 0.10 and < 0.20 litres per square metre	SC6.4.6.13.3(1)
4.	**Laying** (a) Paver Capacity	>50 tonnes asphalt per hour	
	(b) Spread Width	>3.7m	
	(c) Laying in Echelon	Distance between pavers is such that temperature of asphalt at edge (or laid by leading paver) is >80˚C when following paver matches the longitudinal joint.	
	(d) Laying Temperature		
	(i) Dense Grade AC	As per MRTS30	
	(e) Level Control	>10m length	SC6.4.6.13.3(7)(d)
	(i) Levelling Beam for Corrective Course		
	ii) Levelling Beam for Wearing Course	>10m length	SC6.4.6.13.3(7)(d)
	(f) Course and Layer Thickness	Nominal size mix and compacted layer thickness as per MRTS30.	
5.	**Longitudinal Jointing** (a) Change in Crossfall	Within 150mm of line of change.	
	(b) Where Underlying Layers	Offset at least 150mm from joints in underlying layers.	
6.	**Transverse Jointing** (a) Where Underlying Layers	Stagger to be >1m between successive layers and adjacent runs.	

Item	Activity	Limits/Tolerances	Clause
7.	**Compaction**	Initial Rolling:	SC6.4.6.13.3(2)(c)
	(a) Dense Graded Asphalt	To be commenced before asphalt temperature falls below 115ºC for layer ≤40mm. Refer to MRTS30	
		Secondary Rolling:	SC6.4.6.13.3(2)(d)
		Tyre pressures on pneumatic rollers to be≥550kPa.	
		Rolling to be completed before the asphalt temperature falls below 80ºC.	
		Final Rolling:	SC6.4.6.13.3(2)(d)
		Rolling to be completed before asphalt temperature falls below 60ºC.	
	(b) Acceptance Criteria for Compaction	On bases of characteristic value of relative compaction as per MRTS30 AC7 90% AC10 90% AC14 91% (92% > 50mm) AC20 93%	SC6.4.6.13.3(4)
8.	**Finished Pavement**	Max. compacted thickness tolerance as for	
	(a) Thickness	Table 12.3.3.2 of MRTS30 AC7 ± 5mm AC10 ± 5mm AC14 ± 7mm Where finished surface levels are specified, thickness and level shall comply with requirements of MRTS30. Reduced level primary tolerance ± 10mm.	
	(b) Shape	Shall not deviate from bottom of 3m straight edge by more than 5mm	SC6.4.6.3(6)

SC6.4.6.13 Asphalt Work Record

Click here to obtain a copy of the following form.

SC6.4.6.14 Mass concrete sub-base

SC6.4.6.14.1 Introduction

(1) Scope

This policy sub-section provides standards advice and guidelines for the construction, by mechanical or hand placement of mass concrete sub-base including trial sections and sub-grade beams.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note—A reference to drawings is a reference to construction drawings.

(2) Thickness and levels of subbase

The sub-base thickness and levels shall be as per design requirement.

(3) Provision for base slab anchors

During construction of the sub-base, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the design. Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with sub-sectionSC6.4.6.15 Plain and reinforced concrete base as part of the concrete base construction.

(4) Reference and source documents

Documents referenced in this Sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:

SC6.4.6.15 - Plain and reinforced concrete base

SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:

AS1012.1 - *Sampling of fresh concrete*

AS1012.3.1 - *Determination of properties related to the consistence of concrete - Slump test*

AS1012.4.2 - *Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete*

AS1012.8 - *Method of making and curing concrete – Compression and indirect tensile test specimens*

AS1012.8 - *Method of making and curing concrete – Flexure test specimens*

AS1012.9 - *Determination of the compressive strength of concrete specimens*

AS1012.13 - *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*

AS1012.14 - *Securing and testing cores from hardened concrete for compressive strength*

AS1141.11.1 - *Particle size distribution – Sieving method*

AS1141.14 - *Particle shape, by proportional calliper*

AS1141.22 - *Wet/dry strength variation*

AS1160 - *Bitumen emulsions for the construction and maintenance of pavements*

AS1379 - *Specification and manufacture of concrete*

AS1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*

AS2758.1 - *Concrete aggregates*

AS3582.1 - *Supplementary cementitious materials for use with portland and blended cement - Flyash*

AS3799 - *Liquid membrane-forming curing compounds for concrete*

AS3972 - *General purpose and blended cements*

(c) Other:

Austroads, *Guide to Pavement Technology Part 4G: Geotextiles and Geogrids*

SC6.4.6.14.2 Materials for concrete

(1) Cement

Cement shall be Type GP Portland cement or Type GB blended cement complying with AS3972. Cement shall be from a source approved under the Queensland Government's State Purchasing Policy.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the Superintendent, the contractor shall use only the nominated cement in the work.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent may require a retest to ensure the cement complies with AS3972, before the cement is used in the work.

Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash

Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and the quality of flyash shall comply with AS3582.1.

When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the Superintendent, the Contractor shall use only flyash from the nominated powerhouse.

Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(3) Water

Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures

Chemical admixtures and their uses shall comply with AS1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below shall not be used. An air entraining agent may be included in the mix. If an air entrainer is used, the air content of the fresh concrete shall comply with Clause SC6.4.6.14.3(5) Air content.

Fresh concrete with an air content not complying with Clause SC6.4.6.14.3(5) Air content shall be rejected.

During the warm season (October to March inclusive), a lignin or lignin based ("ligpol") set retarding admixture approved by the Superintendent, shall be used to control slump within the limits stated in Clause SC6.4.6.14.3(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS1478.1 shall be submitted to the Superintendent, together with the proposed `dosage chart' in accordance with SC6.4.6.14.4(1) General.

If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause SC6.4.6.14.4(2) Variations to approved mixes.

When submitting details of the nominated mix in accordance with Clause SC6.4.6.14.4(1) General, the Contractor shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) When submitting details of the nominated mix in accordance with clause SC6.4.6.14.4(1) General, the Contractor shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate.

(ii) Aggregates shall all pass the 37.5mm AS sieve and shall comply with AS2758.1 in respect of bulk density, water absorption (maximum 5%), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS1141.14 shall not exceed 35%.

(iii) When submitting details of the nominated mix, the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the "Proposed Grading".

(iv) If the Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

(b) Grading

(i) The grading of the combined aggregate used in the work, determined by AS1141.11, shall not deviate from that of the proposed grading by more than the amounts shown in Table SC6.4.6.14.1 Aggregate grading deviation limits.

Table SC6.4.6.14.1 Aggregate grading deviation limits

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5mm	-5
19.0mm	+ or -10
4.75mm	+ or -10
1.18mm	+ or -5
600mm	+ or -5
150mm	+ or -2

(c) Durability

Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:

(i) Wet Strength AS1141.22 Shall not be less than 50kN; and

(ii) 10 per cent Fines Wet/Dry Variation AS1141.22 Shall not exceed 35%.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the

Superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Superintendent.

SC6.4.6.14.3 Quality requirements of concrete

(1) Cement and flyash content
When a cement and flyash blend is nominated the minimum acceptable range is 40 – 75% by mass of the total cementitious material (cement and fly ash) in accordance with AS3582.1.

(2) Compressive strength
The compressive strength of concrete shall be determined in accordance with AS1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted.

(3) Shrinkage
The drying shrinkage of the nominated mix, determined by AS1012.13 shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10mm shall be taken as the average of the reading or readings within 5% of the median of the three readings obtained in accordance with AS1012.13.

(4) Consistency
The Contractor's nominated slump, determined in accordance with AS1012.3.1, shall be neither less than 25mm nor more than 40mm for mechanically placed concrete and shall be neither less than 50mm nor more than 65mm for hand placed concrete. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4.

(5) Air content
If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS1012.4.2, shall be neither less than 3% nor more than 7% when discharged from the transport vehicle ready for placement.

SC6.4.6.14.4 Design and control of concrete mixes

(1) General
The Contractor shall submit, for approval by the Superintendent, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

The Contractor shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the Superintendent.

In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1MPa of the median.

These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes
The Contractor shall not make any changes to the approved mix, its method of production or source of supply

of constituents without the prior written approval of the Superintendent.

Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.14.4(1) General. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10kg for Portland cement, 20kg for other cementitious material and 5% by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

Notwithstanding these tolerances, the minimum cement content shall be 90kg per yielded cubic metre of concrete, the minimum flyash content shall be 100kg per yielded cubic metre of concrete.

SC6.4.6.14.5 Conformance for concrete strength and thickness

(1) Concrete cylinders

(a) Test specimens

Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS1012.8.1. The Contractor shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Superintendent.

Samples of concrete for testing shall be taken in accordance with AS1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

The method of making and curing specimens shall be in accordance with AS1012.8.1 with compaction by internal vibration.

The Contractor shall mark the specimens for identification purposes.

Specimens shall be inspected, capped and crushed in accordance with AS1012.8.1 and AS1012.9.

(b) Frequency of moulding of test specimens

Test specimens shall be moulded as follows:

(i) For the determination of the compressive strength at twenty eight days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(ii) For the determination of the compressive strength at seven days:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Contractor:

- For each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens.
At the time of approving the mix design, the Superintendent shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.14.2 - Concrete age conversion factors.

For intermediate ages the factor shall be determined on a pro rata basis.

Table SC6.4.6.14.2 Concrete age conversion factors

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for compressive strength
If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause SC6.4.6.14.3(2) Compressive strength, the lot represented by the test cylinders shall be removed and replaced.

In case of non-conformance the Contractor may request permission of the Superintendent to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Contractor. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.

(3) Specimens cut from the work

(a) Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS1012.14 with the following amendments:

(i) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.

(ii) The preferred dimension for cores shall be 100mm diameter but in no case shall the diameter be less than 75mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.

(iii) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5mm from the mean diameter.

(iv) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table SC6.4.6.14.3 Core strength factor.

(v) Wet Conditioning only shall be used.

Table SC6.4.6.14.3 Core strength factor

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

Note—for intermediate form ratios, the factor shall be determined by interpolation.

Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor at the time of sampling and duly recorded prior to testing.

Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores.

The cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be the responsibility of the Contractor. The method of restoration shall be approved by the Superintendent.

(4) Acceptance of cored concrete for compressive strength
Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement.
If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed.

(5) Conformance for thickness

(a) General
No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in Clause SC6.4.6.14.7(5)(b) Surface tolerances.
If scabbling is required to achieve the level tolerance limits, the Superintendent may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5m grid on the plan area. Alternatively, the Superintendent may authorise coring and measurement at the edges of the layer. Thickness measurements shall be rounded off to the nearest 5mm.

(b) Thickness below specification
After making due allowance for the tolerances, subbase which is more than 20mm below the theoretical thickness shall be rejected and removed from the site. The removal and disposal from the site shall be the responsibility of the Contractor.

Subbase which is 20mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot.

SC6.4.6.14.6 Productions, transport and consistency of concrete

(1) Production and transport of concrete
At least 3 weeks before commencing work under this sub-section, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(2) Handling, storage and batching materials
The methods of handling, storing and batching materials for concrete shall be in accordance with AS1379, with

the following additional requirements:

(a) certificates of calibration issued by a recognised authority shall be made available for inspection by the Superintendent, as evidence of the accuracy of the scales;

(b) cementatious material shall be weighed in an individual hopper, with the cement weighed first;

(c) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water; and

(d) where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Superintendent, except for liquids which may be measured by volume or flow rate meter.

(3) Mixers and agitation equipment

Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS1379, with the following additional requirement that in Appendix A of AS1379 the maximum permissible difference in slump shall be 10mm.

(4) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS1379, with the following additional requirements:

(a) The mixer shall be charged in accordance with the manufacturer's instructions.

(b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15% and 85% along the length of the tray.

(c) For truck mixed concrete, addition of water in accordance with the batch production section of AS1379 shall be permitted only within ten minutes of completion of batching and within 200m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

(d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non agitating trucks.

Means of verification, satisfactory to the Superintendent, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Superintendent considers the prevailing weather, mix type, or materials being used warrant such a change.

(e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80% of the gross volume of the drum of the mixer.

(5) Maximum mixing time

Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of 10 minutes except for split drum mixers where the maximum shall be 5 minutes.

For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(6) Consistency

The consistency of the concrete shall be such as to allow the production of a dense, non segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its

shape and shall not sag or tear.

The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent.

The consistency of the concrete shall be checked by use of a slump cone in accordance with AS1012.3.1. The test shall be made on concrete samples obtained in accordance with AS1012.1. The compactibility index range shall be between 60 and 80 in accordance with AS1012.3.4. Check tests shall be done on each truckload of concrete or as directed by the Superintendent.

SC6.4.6.14.7 Placing and finishing concrete subbase

(1) General

At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of the Superintendent, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

The Contractor shall give the Superintendent 7 days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause SC6.4.6.14.11.

The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.

Submit the work-as-executed survey of the subgrade to the full extent of the works to the Superintendent for confirmation, and highlight any locations where the actual level is higher than the design levels. If the underlying layer is required to be spray sealed, take levels on the top of the seal and after removal of foreign or loose material such as aggregate. Report levels to the nearest millimetre and survey on 5.0m grid on a plan area. In the case of non conforming levels, locally redesign the pavement levels as directed by the Superintendent.

Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.

The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C.

(2) Rate of evaporation

When the value of Rate of Evaporation, determined from the graph in Figure SC6.4.6.14.1 Rate of evaporation, exceeds 0.5kg per square metre per hour the Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50kg per square metre per hour.

Should the Contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull floating, are complete.

The Contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity daily, at the site throughout the course of the work. The Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording.

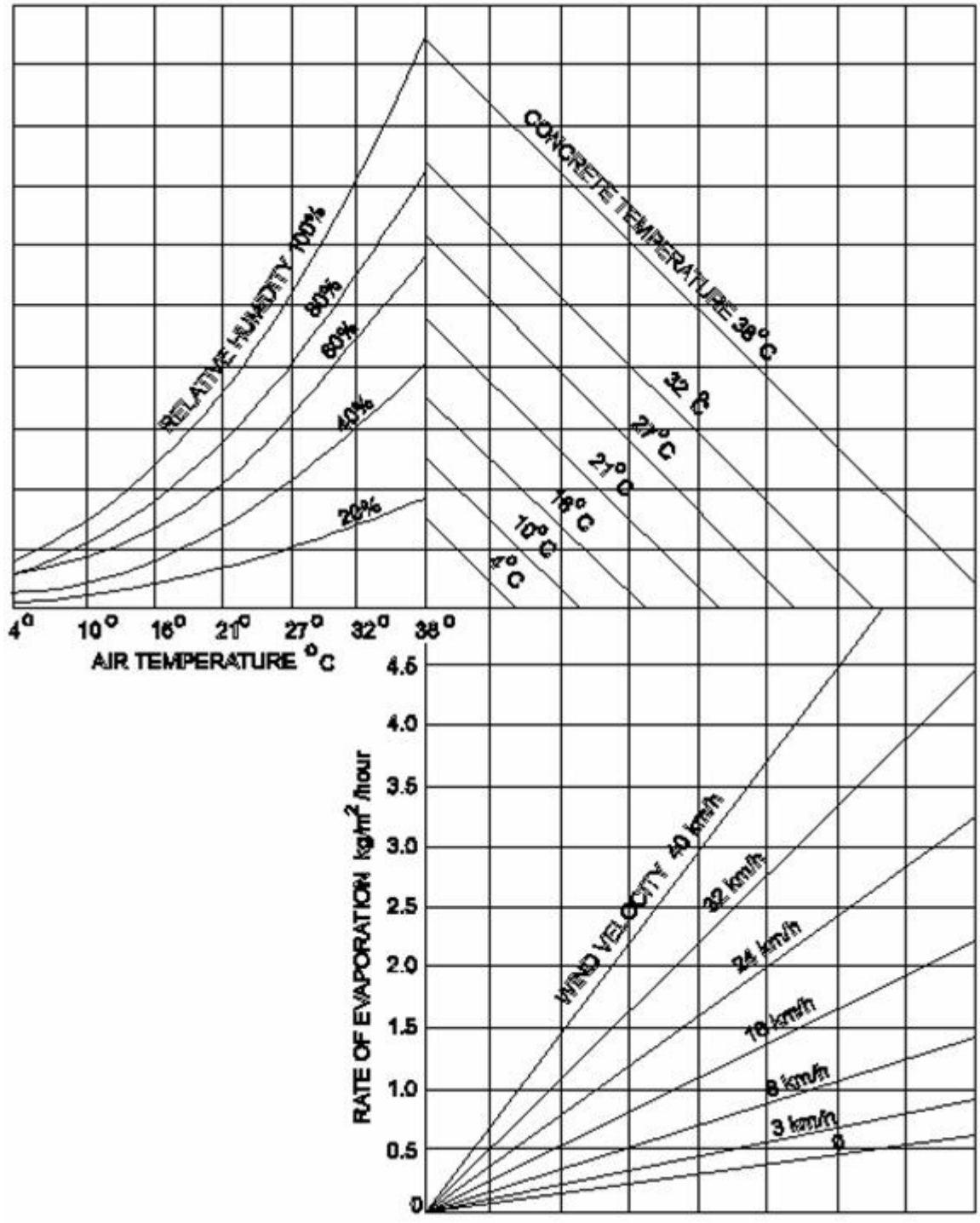


Figure SC6.4.6.14.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

The mechanical paver shall be a self propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(a) an automatic control system with a sensing device to control line and level to the specified tolerances;

(b) means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components;

(c) internal vibrators capable of compacting the full depth of the concrete;

(d) adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(e) capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(4) Hand placing

Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non adhesion of concrete to the forms.

Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented.

If disruptions occur for any reason, the Superintendent may direct that a construction joint be formed before the recommencement of paving operations.

A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.

Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of 25mm.

Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with clause SC6.4.6.14.8(2) Longitudinal construction joints.

(b) Surface tolerances

The level at any point on the top of the subbase shall not vary by more than 0mm above or 20mm below

that shown on the drawings or as directed by the Superintendent. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete.

The top surface of the subbase shall also not deviate from a 3m straightedge, laid in any direction, by more than 5mm.

(6) Curing

The subbase shall be cured by the use of one of the following:

(a) chlorinated rubber curing compound complying with AS3799 Class C Type 1D or resin-based curing compound complying with AS3799 Class B, Type 1D or Type 2, if an asphalt base is used; or

(b) white pigmented wax emulsion curing compound complying with AS3799 Class A Type 2, if a concrete base is used; or

(c) bitumen emulsion Grade CRS/170 complying with AS1160 for either asphalt or concrete base.

The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90% when tested in accordance with Appendix B of AS3799.

The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.35 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25%.

The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent.

The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(7) Protection of work

The Contractor shall ensure that the temperature of the concrete does not fall below 5ºC during the first twenty four hours after placing. The Contractor shall provide, for the information of the Superintendent, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Contractor fails to maintain the temperature of the concrete at or above 5ºC and if, in the opinion of the Superintendent, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals for procedures and equipment to be used for such protection.

Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4.0MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:

(a) bond-breaker and spall treatment;

(b) concrete or asphalt paving; and

(c) Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction.

SC6.4.6.14.8 Joints

(1) Transverse construction joints

Transverse construction joints shall:

(a) be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations;

(b) be constructed normal to the edge line and to the dimensions shown on the drawings;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm; and

(d) cut back the edge of the previously placed concrete by sawing the concrete, to at least 1/3 the slab depth to expose an even, clean, sound, vertical surface, without disturbing the concrete that is to remain in place.

(2) Longitudinal construction joints
Longitudinal construction joints shall:

(a) be formed no closer than 300mm of the base longitudinal joints as shown in the drawings, unless directed otherwise by the Superintendent;

(b) not deviate from the plan or nominated position at any point by more than 20mm;

(c) not deviate from a 3m straightedge placed along the joint by more than 10mm, having made due allowances for any planned curvature; and

(d) be smooth across the joint.

SC6.4.6.14.9 Bond breaker and spall treatment

(1) General
Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS3799 Class A Type 2.

Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted.

Subbase with spalled areas shall be treated, where directed by the Superintendent, prior to application of the bond breaker or asphaltic concrete.

(2) Preparation of subbase
Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Superintendent of all loose, foreign and deleterious material.

(3) Treatment of spalling
Where directed by the Superintendent, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches.

A spalled area, if directed to be treated, shall have such treatment completed no earlier than five working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor.

(4) Application of bond breaker
The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete.

The method of application shall conform to the requirements of Clause SC6.4.6.14.10(6) Curing.

(5) Treatment of unplanned cracks
The Superintendent shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width geotextile backed polymer modified bitumen strip

(reference Guide to Pavement Technology Part 4G: Geotextiles and Geogrids) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.

The Contractor shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

SC6.4.6.14.10 Subgrade beams

(1) General
Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the drawings.

(2) Excavation
Excavation for subgrade beams shall be to the dimensions shown on the drawings. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. Excavated material shall be legally disposed of by the Contractor.

(3) Concrete
Concrete in subgrade beams shall comply with the requirements of sub-section SC6.4.6.28 Minor concrete works. The minimum compressive strength at 28 days shall be 32MPa.

(4) Steel reinforcement
Steel reinforcement shall be of the type and size shown on the drawings and shall be supplied and installed in accordance with sub-section SC6.4.6.15 Plain and reinforced concrete base.

(5) Construction and protection
Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompacted to the correct level. If the contractor elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade.

A steel float shall be used to produce a smooth surface finish, free of any texture.

The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Contractor.

(6) Curing
The top surface of the subgrade beam shall be cured in accordance with clause SC6.4.6.14.7 Curing before placing the subbase.

(7) Bond breaker
The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty four hours nor more than seventy two hours before placing of subbase concrete.

SC6.4.6.14.11 Trial concrete subbase

Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the sub-section. This section shall be constructed so that it may be incorporated in the finished work.

The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints.

The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

A trial length of between 100m and 200m or lesser length in compliance with council requirements for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation.

Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this sub-section, the Contractor may proceed with placing concrete subbase from a time five working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this sub-section.

SC6.4.6.14.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.14.4 below:

Item	Activity	Limits/Tolerances	Clause
1.	**Materials for Concrete**		
	a. Misshapen Particles	2 : 1 ratio < 35%	SC6.4.6.14.3(5)(a)
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	SC6.4.6.14.2(5)(b)
	c. Durability	Wet Strength > 50kN 10% Fines < 35%	SC6.4.6.14.2(5)(c)
2.	**Concrete**	Drying Shrinkage <450 microstrain	SC6.4.6.14.3(3)
	a. Shrinkage		
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	SC6.4.6.14.3(4)
	c. Air Content	≥3, ≤7%	SC6.4.6.14.3(5)
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	SC6.4.6.14.5(5)
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non agitating trucks.	SC6.4.6.14.6(4)

Item	Activity	Limits/Tolerances	Clause
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5ºC or >38ºC. Temperature of concrete shall be >10ºC but <32ºC.	SC6.4.6.14.7(1)
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	SC6.4.6.14.7(2)
3.	**Alignment and Surface Tolerances** a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	SC6.4.6.14.7(5)
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	SC6.4.6.14.7(5)
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	SC6.4.6.14.7(5)
4.	**Joints** a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	SC6.4.6.14.8(1)
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm. (ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	SC6.4.6.14.8(2)
5.	**Bond Breaker** a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	SC6.4.6.14.9(4)

SC6.4.6.15 Plain and reinforced concrete base

SC6.4.6.15.1 Introduction

(1) Scope

(a) This policy sub-section provides standards, advice and guidelines for the construction, by mechanical or hand placement of plain or reinforced concrete, including trial sections, slab anchors and terminal slabs.

(b) The work also includes the construction of reinforced concrete approach slabs for bridge abutments and traffic signal approach slabs.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Thickness and levels of slab

The base thickness and levels shall be detailed on design and construction drawings.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.9 - Open drains - kerb and channel
SC6.4.6.20 - Subsoil, foundation and pavement drains
SC6.4.6.14 - Mass concrete sub-base

(b) Australian Standards:
AS 1012.1 - *Sampling of fresh concrete*
AS 1012.3.1 - *Determination of properties related to the consistence of concrete - Slump test*
AS 1012.4.2 - *Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete*
AS 1012.8 – *Method of making and curing concrete*
AS 1012.9 - *Determination of the compressive strength of concrete specimens*
AS 1012.12.2 - *Determination of mass per unit volume of hardened concrete - Water displacement method*
AS 1012.13 - *Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory*
AS 1012.14 – *Method for securing and testing cores from hardened concrete for compressive strength*
AS 1141.11.1 - *Particle size distribution – Sieving method*
AS 1141.14 - *Particle shape, by proportional calliper*
AS 1141.18 - *Crushed particles in coarse aggregate derived from gravel*
AS 1141.22 - *Wet/dry strength variation*
AS 1141.24 – *Aggregate soundness – Evaluation by exposure to sodium sulphate solution*
AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*
AS 1379 - *Specification and supply of concrete*
AS 1478.1 - *Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS/NZS 1554.3 - *Welding of reinforcing steel*
AS 2758.1 - *Concrete aggregates*
AS 3582.1 - *Supplementary cementitious materials for use with Portland and blended cenemt – Fly ash*
AS 3799 - *Liquid membrane-forming curing compounds for concrete*
AS 3972 – *General purpose and blended cements*
AS/NZS 4671 - Steel reinforcing materials.

(c) Queensland Department of Transport and Main Roads technical standard:
MRTS40 - *Concrete Base in Pavements: Jointed unreinforced, Jointed Reinforced, Continuously Reinforced and Steel Fibre Reinforced Pavements (10/10).*

(d) Queensland Department of Transport and Main Roads Materials Testing Manual:

Q461 - *Durability of Sealant*
Q462 - *Resistance of Vulcanised Rubber to the Absorption of Oil*
Q463A - *High Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals*
Q463B - *Low Temperature Recovery of Preformed Polychloroprene Elastomeric Joint Seals*

(e) ASTM Standards:
D792 – *Standard test methods for density and specific gravity (relative density) of plastics by displacement*
C793 – *Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants*
C794 – *Standard test method for adhesion-in-peel of elastomeric joint sealants*
D2240 – *Standard test method for rubber property - durometer hardness*
D2628 – *Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements*
D2835 – *Standard specification for lubricant for installation of preformed compression seals in concrete pavements.*

(f) US Military Specification:
MIL-S-8802 - *Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion*

SC6.4.6.15.2 Design and control of concrete mixes

(1) General - design and control of concrete mixes

(a) Details of the concrete mix (or mixes) and the materials, including source, to be used for each of any mechanically placed and/or hand placed base, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a “nominated mix”.

(b) Also, a certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this specification. All relevant test results shall accompany the certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve month period before the date of submission to the superintendent.

(c) In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS 1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 2.0 MPa of the median. The compressive strength for 28 days shall not be less than 36.0 MPa.

(d) These details shall be submitted at least 21 days before using the nominated mix in the work.

(2) Variations to approved mixes

(a) The contractor shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the superintendent.

(b) Where changes to an approved mix are proposed, the contractor shall provide details of the nominated mix and materials, in accordance with clause SC6.4.6.15.2(1) General – design and control of concrete mixes. If the variations to the quantities, qualities or sources of the constituents in the approved mix are less than 10 kg for portland cement and flyash and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the superintendent may approve the changes without new trials being carried out.

(c) Notwithstanding these tolerances the minimum portland cement content shall be 270 kilograms per yielded cubic metre of concrete and the maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

SC6.4.6.15.3 Materials for concrete

(1) Cement

(a) Cement shall be Type GP Portland cement complying with AS 3972 and shall be from a source approved under the Queensland Government’s State Purchasing Policy.

(b) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1) General – design and control of concrete mixes the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the superintendent, the contractor shall use only the nominated cement in the work.

(c) Documentary evidence of the quality and source of the cement shall be furnished by the contractor to the superintendent upon request at any stage of the work.

(d) If the contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, a re-test shall be required to ensure the cement still complies with AS 3972, before the cement is used in the work.

(e) Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Flyash

(a) Flyash shall be from a source approved under the Queensland Government's State Purchasing Policy. The use and quality of flyash shall comply with AS 3582.1.

(b) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the Contractor shall nominate the powerhouse source of the flyash. The Contractor shall use only flyash from the nominated powerhouse.

(c) Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent.

(3) Water

Water used in the production of concrete shall be potable, free from materials that may be deterimental to the production of concrete or reinforcement, and be neither salty nor brackish.

(4) Admixtures

(a) Chemical admixtures and their use shall comply with AS 1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used. An air entraining agent shall be included in the mix and the air content of the concrete shall comply with clause SC6.4.6.15.4(5) Air content. Fresh concrete with an air content not complying with clause SC6.4.6.15.4(5) will be rejected.

(b) The dosage of admixtures shall be varied to account for air temperature and haulage times in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS 1478.1 shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with clause SC6.4.6.15.2(1).

(c) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the contractor shall nominate the proprietary source, type and name for each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

(5) Aggregates

(a) General

(i) At least 40 per cent by mass of the total aggregates in the concrete mix shall be quartz sand. Quartz sand is aggregate having a nominal size of less than 5 mm and shall contain at least 70 per cent quartz, by mass. Where present, chert fragments will be regarded as "quartz" for the purpose of this specification, but the ratio of chert to quartz shall not exceed unity.

(ii) When submitting details of the nominated mix in accordance with clause SC6.4.6.15.2(1), the contractor shall nominate the sources of aggregate to be used in the concrete and shall submit details of the geological type of each aggregate.

(b) Fine aggregate

(i) Fine aggregate shall consist of clean, hard, tough, durable, uncoated grains uniform in quality.

Fine aggregate shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), with material finer than 2 micrometres and impurities and reactive materials. The sodium sulphate soundness, determined by AS 1141.24, shall not exceed the limits in Table SC6.4.6.15.1 Sodium sulphate soundness limits

Table SC6.4.6.15.1 Sodium sulphate soundness limits

Australian Standard Sieve	Per Cent Loss by Mass
4.75mm to 2.36mm	4
2.36mm to 1.18mm	6
1.18mm to 600µm	8
600µm to 300µm	12

(ii) In the case of a blend of two or more fine aggregates, the above limits shall apply to each constituent material.

(iii) The grading of the fine aggregate, determined by AS 1141.11, shall be within the limits given in Table SC6.4.6.15.2 Fine aggregate grading.

(iv) When submitting details of the nominated mix the contractor shall submit to the superintendent a NATA certified laboratory test report on the quality and grading of the fine aggregate proposed to be used. The grading shall be known as the "proposed fine aggregate grading".

(v) If the contractor proposes to blend two or more fine aggregates to provide the proposed grading then test reports for each constituent material shall be submitted separately and the superintendent advised of the proportions in which the various sizes and constituents are to be combined. The fine aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(vi) The grading of the fine aggregate used in the work shall not deviate from that of the proposed grading by more than the amounts in Table SC6.4.6.15.2 Fine aggregate grading.

(vii) Notwithstanding these tolerances, the fine aggregate used in the work shall comply with the limits shown in Table SC6.4.6.15.2 Fine aggregate grading.

Table SC6.4.6.15.2 Fine aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	± 3
4.75mm	90 - 100	± 10
2.36mm	65 - 95	± 10
1.18mm	40 - 80	± 10
600µm	24 - 52	± 5
300µm	8 - 25	± 2
150µm	1 - 8	
75µm	0 - 3	

(c) Coarse aggregate

(i) Coarse aggregate shall consist of clean, crushed, hard durable rock, metallurgical furnace slag or gravel. Coarse aggregate shall comply with AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5 per cent), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this sub-section. If required, coarse aggregate shall be washed to satisfy these requirements.

(ii) The grading of the coarse aggregate, determined by AS 1141.11, shall be within the limits given in Table SC6.4.6.15.3 Coarse aggregate grading.

(iii) When submitting details of the nominated mix the Contractor shall submit to the Superintendent a NATA Certified Laboratory Test Report on the quality and grading of the coarse aggregate proposed to be used. The grading shall be known as the "proposed coarse aggregate grading".

(iv) If the contractor proposes to blend two or more coarse aggregates to provide the proposed grading

then test reports for each constituent material shall be submitted separately and the superintendent advised of the proportions in which the various sizes and constituents are to be combined. The coarse aggregate from each source and the combined aggregate shall comply with the requirements of this clause.

(v) The grading of the coarse aggregate used in the work shall not deviate from that of the proposed grading by more than the amounts in Table SC6.4.6.15.3 Coarse aggregate grading.

Table SC6.4.6.15.3 Coarse aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass of Sample)	Deviation from Proposed Grading (% of Mass of Sample)
26.50 mm	100	± 2
19.00 mm	95 - 100	± 5
13.20 mm	(accepted design mix)	± 5
9.50 mm	25 - 55	± 3
4.75 mm	0 - 10	
2.36 mm	0 - 2	

(vi) Notwithstanding these tolerances, the coarse aggregate used in the work shall comply with the limits shown in Table SC6.4.6.15.3.

(vii) The coarse aggregate shall also conform to the following requirements:

(A) Wet Strength - AS 1141.22.
Shall not be less than 80 kN for any fraction and/or constituent;

(B) 10 per cent Fines Wet/Dry Variation - AS 1141.22.
Shall not exceed 35 per cent for any fraction and/or constituent;

(C) Soundness - AS 1141.24
The loss in mass when tested with sodium sulphate shall not exceed 9 per cent for any constituent;

(D) Particle Shape - AS 1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35 per cent;

(E) Fractured Faces - AS 1141.18.
At least 80 per cent by mass of the particles shall have two or more fractured faces; and

(F) Material finer than 75 micrometres – AS 1141.12
Shall not exceed 1 per cent for any fraction and/or constituent.

(d) Storage

(i) Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring.

(ii) The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the superintendent, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the superintendent.

SC6.4.6.15.4 Quality requirements of concrete

(1) Cement and flyash content
The minimum Portland cement content shall be 270 kilograms per yielded cubic metre of concrete. The maximum flyash content shall be 50 kilograms per yielded cubic metre of concrete.

(2) Compressive strength
The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at 28 days shall be 36 MPa.

(3) Shrinkage

The drying shrinkage of the nominated mix, determined by AS 1012.13, shall not exceed 450 microstrain after 21 days air drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS 1012.13.

(4) Consistency

The Contractor's nominated slump, determined in accordance with AS 1012.3.1, shall be neither less than 30 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 55 mm nor more than 65 mm for hand placed concrete.

(5) Air content

The air content of the concrete, determined in accordance with AS 1012.4.2, shall be neither less than 4 per cent nor more than 7 per cent, when discharged from the transport vehicle ready for placement.

(6) Relative compaction

The minimum relative compaction, determined in accordance with AS 1012.12.2, shall be 98 per cent.

SC6.4.6.15.5 Steel reinforcement

(1) Material

(a) The type and size of bars shall be as shown on the drawings.

(b) Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but is not to be brought to a smooth polished condition.

(c) The Contractor shall supply evidence satisfactory to the superintendent that steel reinforcement complies with AS 4671 *Steel reinforcing materials*. Test certificates shall show the results of mechanical tests and chemical analysis of the reinforcing steel to be used.

(d) Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length.

(e) Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for 1 hour at 23 ± 5ºC without malfunction. The Contractor shall demonstrate that the proposed chairs conform with these requirements.

(2) Bending

Reinforcement shall be formed to the dimensions and shapes shown on the drawings. Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the drawings shall not be used. Heating of reinforcement for the purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450 ºC and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

(3) Splicing

(a) All reinforcement shall be furnished in the lengths indicated on the drawings. splicing of bars shall only be permitted with the approval of the superintendent and as shown on the drawings. The information shown on the drawings is to detail the location and method of splicing.

(b) The length of lapped splices not shown on the drawings shall be as follows for unhooked bars:

Plain bars, Grade 250	40 bar diameters;
Deformed bars, Grade 400	35 bar diameters; and
Hard-drawn wire	50 bar diameters.

(c) Splices in reinforcing fabric shall be measured as the overlap between the outermost wire in each sheet of fabric transverse to the direction of splice. This overlap shall not be less than the pitch of the transverse wires plus 25 mm.

(d) In welded splices, bars shall only be welded by an approved electrical method. Grade 400 deformed bars

shall not be welded.

(e) Welding shall comply with AS 1554.3. The welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

(4) Storage

Reinforcement, unless promptly incorporated into the concrete, shall be stored under a waterproof cover and supported clear of the ground, and shall be protected from damage and from deterioration due to exposure.

(5) Placing

(a) Reinforcing bars and wire reinforcing fabric shall be accurately placed to the dimensions and details shown on the drawings. They shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs or metal hangers, as approved by the superintendent, and by wiring together where required using annealed iron wire not less than 1.25 mm diameter. These supports shall be in a regular grid not exceeding 1 m and steel shall not be supported on metal supports which extend to any surface of the concrete, on wooden supports, nor on pieces of aggregate.

(b) Tack welding instead of wire ties may be used on reinforcing steel. Cold worked reinforcing bars shall not be tack welded. Tack welding must conform to AS 1554.3.

(c) The minimum cover of any bar to the nearest concrete surface shall be 50 mm unless otherwise shown on the drawings.

(d) Tie bars shall be placed in the pavement such that after placement they remain in their specified location. Tie bars shall not be placed through the finished upper surface of the pavement. Tie bars shall be placed either ahead of paving or by a bar vibrator into the edge of the joint or by an automatic tie bar inserter on the mechanical paver. Irrespective of the method of placement, tie bars extending from any side face of base concrete or gutter shall be anchored in a manner which will develop 85 per cent of the yield strength of the bar in tension.

(e) Placing and fastening of all reinforcement in the work shall be approved by the superintendent before concrete is placed and adequate time shall be allowed for inspections and any corrective work which the superintendent may require. Notice for the superintendent's inspection shall not be less than four working hours before the intended time of commencement of concrete pour or such time as determined by the superintendent. Council is to be advised no later than (48) hours before hand.

(f) Dowelled joints shall be provided as directed by the superintendent, parallel to the pavement surface and normal to the line of the joint, or as shown on the drawings. The dowels are to be installed ahead of paving by an approved dowel support assembly. One end of the dowel is to be sleeved which is to be placed on the same side of the joint for a distance of (L/2 + 25 mm) to make sure free movement of the concrete base slab (including temperature variations). The contractor is to check each dowels before placement and make sure the dowels are straight and free of irregularities including burrs and protrusions.

SC6.4.6.15.6 Production, transport and consistency of concrete

(1) Production and handling of concrete

(a) At least 4 weeks before commencing work, the Contractor shall submit, for the information of the superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport.

(b) The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:

(i) certificates of calibration issued by a recognised authority shall be made available for inspection by the superintendent, as evidence of the accuracy of the scales;

(ii) cementitious material shall be weighed in an individual hopper, with the Portland cement weighed first; and

(iii) the moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.

(c) Details of the proposed mixers and agitation methods shall be in accordance with the plant and

equipment sections of AS 1379, with the additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10 mm.

(2) Mixing and transport

Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:

(a) the mixer shall be charged in accordance with the manufacturer's instructions;

(b) for the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray;

(c) for truck mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten minutes of completion of batching and within 200 m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water:cement ratio be exceeded. Mixing of the concrete shall be completed at that location;

(d) admixtures shall be separately pre-diluted with mixing water and shall be incorporated by a method which ensures that no adverse interaction occurs;

(e) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:

(i) one and a half hours, where transported by truck mixer or agitator; and

(ii) one hour, where transported by non-agitating trucks.

(f) the size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity for the vehicle nor shall it exceed 80 per cent of the gross volume of the drum of the mixer; and

(g) concrete delivery dockets must be provided for each batch of mix. The docket must record the following delivery information:

(i) supplier name and location;

(ii) volume of material supplied;

(iii) product constituents; and

(iv) dispatch time and date.

(3) Mixing time

(a) Minimum mixing time will be as determined for the approved mix and verified when trial concrete base is constructed.

(b) Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten minutes except for split drum mixers where the maximum time shall be five minutes.

(c) For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded.

(4) Consistency

(a) At all times between mixing and discharge, the slump of the concrete is to be within 10 mm for mechanically placed concrete and is to be within 15 mm for hand placed concrete.

(b) The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1. The test shall be made on concrete samples obtained in accordance with AS 1012.1.

(c) The consistency of the concrete shall be checked within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, the consistency shall also be checked immediately prior to discharge. Concrete which is non-conforming in relation to consistency shall not be incorporated into the work. Check tests shall be done on each truck load of concrete.

SC6.4.6.15.7 Placing and finishing concrete base

(1) General

(a) At least 4 weeks before commencing work, the Contractor shall submit as part of the quality plan, to the superintendent, full details of the equipment and methods proposed for placing and finishing the concrete base together with a paving plan showing proposed paving widths, sequence, proposed jointing locations and estimated daily outputs.

(b) The Contractor shall give the superintendent seven days written notice of the intention to commence construction of the base on any section of work (including the placement of the trial concrete base in accordance with clause SC6.4.6.15.7(11) Trial concrete base. Submit work-as-executed survey details of the sub-base to the full extent of the works to the superintendent for confirmation of the constructed based. The survey should detail the locations where the constructed level is higher than the design levels. If the underlying layer is required to be spray sealed, the surveyor is to take levels on the top of the seal and after removal of foreign or loose material such as aggregate. The survey is to report as constructed levels to the nearest millimetre and survey on 5.0 m grid on a plan area that has been certified by a licensed surveyor. In the case of non-conforming locations and levels, the contractor is to locally reconstruct the pavement levels as directed by the superintendent and to the satisfaction of council.

(c) The sub-base surface shall be clean and free of loose or foreign or vegetative matter and is to be prepared in accordance with sub-section SC6.4.6.14 Mass concrete sub-base.

(d) Concrete shall not be placed either during rain or when the air temperature in the shade is below 5 ºC or above 38 ºC.

(e) The temperature of the concrete at the point of discharge from the transport vehicle shall be neither less than 10 ºC nor more than 32 ºC.

(f) Where required, slab anchors shall be constructed prior to construction of the base.

(2) Rate of evaporation

(a) When the value of rate of evaporation, determined from the graph in Figure SC6.4.6.15.1 Rate of evaporation, exceeds 0.50 kilograms per square metre per hour the contractor shall take precautionary measures to the superintendent's satisfaction, for the prevention of excessive moisture loss. If, in the opinion of the superintendent, such precautionary measures prove to be unsatisfactory, the contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour.

(b) Should the contractor elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except for minor manual bull floating.

(c) The contractor shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement and for continuously measuring and recording air temperature and relative humidity at the site throughout the course of the work. The contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording to accurately take place.

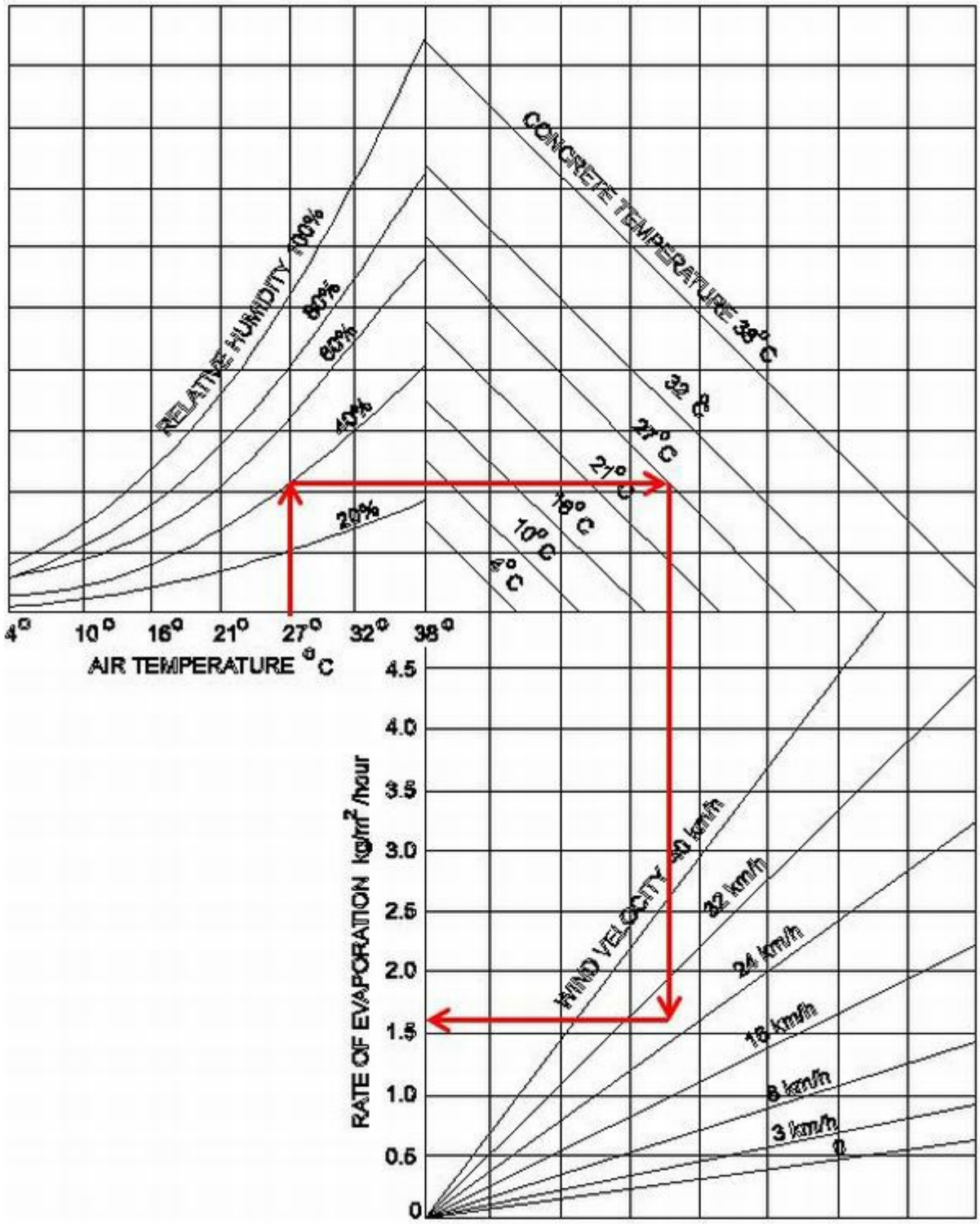


Figure SC6.4.6.15.1 Rate of evaporation

Note—the graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together with the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27ºC
- with relative humidity at 40%
- with concrete temperature at 27ºC
- with a wind velocity of 26 km/h

the rate of evaporation would be 1.6 kg/m/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27ºC), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27ºC. Move vertically down to the respective wind velocity curve - in this case interpolating for 26 km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

(3) Mechanical paving

(a) The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:

(i) an automatic control system with a sensing device to identify the control line and level – within the specified tolerances;

(ii) can spread the concrete mix uniformly and can regulate the flow of mix to the vibrators without segregation of the components;

(iii) has internal vibrators capable of compacting the full depth of the concrete;

(iv) has adjustable extrusion screeing and/or conforming plate to form the slab profile and produce the required finish on all surfaces; and

(v) has the capability of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

(b) The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that any finishing by hand is kept to a minimum. A dense and homogeneous concrete with a surface exhibiting low permeability is to be provided. It shall be textured in accordance with clause SC6.4.6.15.7(6) Texturing of surface.

(c) The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.

(d) Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the superintendent may direct that a construction joint be formed before the recommencement of paving operations.

(e) Where an interruption to paving occurs, which is likely to result in a non-monolithic concrete mass, the contractor shall form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(f) Should subsequent testing at the location of an interruption indicate the presence of non-monolithic concrete, such concrete shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(4) Hand placing

(a) Hand placement shall only be used in areas where mechanical placement is impracticable or where it has been approved by the superintendent prior to commencement of work.

(b) Forms shall be so designed and constructed so that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and de-bonded to ensure non adhesion of concrete to the forms.

(c) Concrete shall be delivered in agitator vehicles and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two passes of a hand guided vibratory screed traversing the full width of the slab on each pass. Any build-up of concrete between the forms and vibratory screed shall be removed.

(d) If disruptions occur for any reason, the superintendent may direct that a construction joint to be formed before the recommencement of paving operations. The cost of forming such construction joints shall be borne by the Contractor.

(e) A dense and homogeneous concrete with a surface exhibiting low permeability, shall be provided. It shall be textured in accordance with clause SC6.4.6.15.7(6) Texturing of surface.

(f) Where an interruption to placing of concrete occurs, which is likely to result in a non-monolithic concrete mass, the contractor shall form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(g) Should subsequent testing at the location of an interruption indicate the presence of non-monolithic

concrete, such concrete shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(5) Alignment and surface tolerances

(a) Horizontal alignment tolerance

(i) The outer edges of the concrete base shall be square to the sub-base and shall not deviate from the plan position at any point by more than 10 mm.

(ii) Where an edge of a slab is to form a longitudinal joint line, the allowable horizontal alignment tolerances shall comply with clause SC6.4.6.15.8(7) longitudinal isolation joints.

(b) Tolerances and ride-ability

(i) The tolerance on thickness of the concrete base shall be zero below the specified thickness and in accordance with clause SC6.4.6.14.7(5)(b) for excess thickness.

(ii) The top surface of the base shall also not deviate at any measurement from a 3 m straightedge, laid in any direction, by more than 5 mm. Measurements for conformance shall be taken in accordance with the maximum lot size and minimum test frequencies in accordance with SC6.4.5 Construction management. Notwithstanding this requirement, the surface shall not pond water.

(6) Texturing of surface

Texturing of the concrete surface may be effected by use of a fine broom or hessian drag. The contractor shall submit to the superintendent details of the proposed texturing method and equipment.

(7) Curing

(a) The base shall be cured by the use of one of the following:

(i) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt wearing surface is used, or

(ii) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if no asphalt wearing surface is used, or

(iii) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt wearing or no asphalt wearing surface.

(b) The contractor shall submit, for the information of the superintendent, a current certificate of compliance from an Australian laboratory, approved by the superintendent, showing an efficiency index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.

(c) The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the certificate of compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.5 litres per square metre. When applied with a hand lance the rates shall be increased by 25 per cent.

(d) The average application rate shall be checked by the contractor and certified to the superintendent by calculating the amount of curing compound applied to a measured area which is representative of a lot - and nominated by the Superintendent.

(e) The curing membrane shall be maintained intact for 7 days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.

(f) Equipment and materials for curing operations shall be kept on site at all times during concrete pours.

(8) Protection of work

(a) The Contractor shall protect the work from rain damage and shall provide, for the information of the superintendent, detailed proposals for procedures and equipment to be used for such protection.

(b) Neither traffic nor construction equipment, other than that associated with testing, sawcutting, groove cleaning or joint sealing, shall be allowed on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached a

compressive strength of at least 20 MPa.

(9) Odd-shaped and mismatched slabs

(a) A slab is a portion of concrete base bounded by joints or free edges. A slab shall be considered to be odd shaped if the ratio of the longer dimension to the shorter dimension exceeds 1.6 or if the joint pattern produces an angle of less than 80 degrees between two adjacent sides. Slab dimensions shall be taken as the average dimension measured normal and parallel to the longitudinal joints. Slabs containing block-outs for drainage structures shall be considered as odd shaped.

(b) Where any joint meets a slab and is not continued across that slab, that slab shall be considered a mismatched slab.

(c) Unless otherwise shown on the drawings, odd shaped and mismatched slabs shall be reinforced with F82 reinforcing fabric placed with 50 mm to 60 mm cover to the surface of the base. Fabric shall be clear of all transverse and longitudinal joints by 50 mm to 100 mm.

(10) Terminal slabs

Terminal slabs shall be constructed adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Terminal slabs shall be constructed to the dimensions and details shown on the drawings.

(11) Trial concrete base

(a) Before the commencement of paving, the contractor shall construct a trial section of concrete base on the carriageway to demonstrate to the superintendent the contractor's capability of constructing the concrete base in accordance with the specifications. This section shall be constructed so that it may be incorporated in the finished work.

(b) The trial base shall be constructed using the same materials, concrete mix, equipment and methods the contractor intends to use for the remaining base work. The contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound, the construction and sawing of joints and the placement of tie bars and dowels.

(c) The trial shall also be used to demonstrate that the contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum requirements specified.

(d) A trial length of between 20 m and 100 m for mechanical paving equipment or between 10 m and 30 m for hand placement is required. The maximum width proposed to be laid, shall be constructed in one continuous operation.

(e) Unless advised by the superintendent of any deficiencies in the trial concrete base, due to failure to comply with this sub-section, the contractor may proceed with placing the concrete base from a time ten working days after the completion of the trial concrete base or such earlier time as the superintendent may allow. In the event of deficiencies in the trial concrete base, the superintendent may order the contractor to construct a further length of trial concrete base which shall be treated as the first. If, after three trials, the base still is deficient in some way, the superintendent may require the contractor to justify to the satisfaction of the superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel.

(f) The superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the contractor in the equipment, materials, mix, plant or rate of paving are deemed by the superintendent to warrant such a trial or when concrete as placed does not comply with this sub-section.

SC6.4.6.15.8 Joints

(1) General - joints

Joints shall be provided at locations indicated on the drawings or as approved by the superintendent.

(2) Transverse construction joints

(a) Transverse construction joints shall:

(i) be provided only at discontinuities in the placement of concrete determined by the contractor's paving operations;

(ii) not be placed closer than 1.5 m to a transverse contraction joint. Where necessary, the superintendent shall authorise a change in the spacing and/or skew of transverse contraction joints to ensure that sufficient clearance is obtained;

(iii) be constructed normal to the control line and to the dimensions and details shown on the drawings. The tie bars shall comply with clauses SC6.4.6.15.5(1) Material and SC6.4.6.15.5(5) Placing;

(iv) be smooth across the joint before texturing; and

(v) not deviate from a 3 m straightedge placed along the joint by more than 10 mm.

(b) Prior to the placement of adjacent concrete, the surface of the concrete shall be roughened to expose coarse aggregate. The roughened surface and the projecting reinforcement shall be washed clean and all excess water and loose material removed.

(3) Transverse contraction joints

(a) General

(i) Transverse contraction joints shall be continuous across the full width of the concrete base and shall be sawn unless otherwise approved by the superintendent.

(ii) Where the concrete base is to be overlaid with asphalt wearing course, the superintendent may approve the joint to be formed with a suitable plastic joint inducing system.

(iii) Transverse contraction joints shall be constructed normal to the control line and to the dimensions and details shown on the drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.

(b) Saw-cutting

(i) The Contractor shall ensure that saw-cutting be conducted between 6 and 24 hours after initial paving so as not to cause excessive ravelling of aggregate adjacent to the cut and so as to prevent cracking of the concrete baseother than at the bottom of the 3 mm saw-cut. The contractor shall use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn and shall have sufficient standby equipment available on site to maintain continuity of sawing.

(ii) The line of the transverse contraction joint shall be without any discontinuities. No edge shall deviate from a 3 m straight edge by more than 10 mm.

(iii) The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300 mm in any 1m length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

(iv) Saw-cuts, which do not conform to the requirements of this clause, shall be rejected by the superintendent. Rejected saw-cuts may be repaired by a method approved by the superintendent.

(c) Cleaning

Immediately after any sawing, the saw-cut shall be cleaned of all debris. The cleaning method used shall not damage the saw-cut nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants. The method shall incorporate a pressurised liquid or liquid/air jet. Cleaning liquid shall not be gravity fed from tanks.

(d) Temporary sealing

(i) Immediately after cleaning following the second saw-cut, if the transverse contraction joint is produced by a two cut operation, the joint shall be temporarily sealed by a continuous closed cell polyethylene backer rod of diameter shown on the drawings or as required by the superintendent.

(ii) The top of the sealant shall be neither higher than nor more than 10 mm below the concrete surface. The backer rod shall pass over any longitudinal joint seal already in place.

(iii) The temporary sealant shall be maintained by the contractor until the joint is sealed permanently.

Damaged or disturbed temporary sealants shall be removed, the transverse contraction joint is to be re-cleaned to the satisfaction of the superintendent and a new temporary sealant inserted.

(e) Permanent sealing

(i) General – permanent sealing

(A) Within 10 days of initial sawing and immediately on removal of the temporary sealant, the permanent sealant shall be placed in the joint.

(B) The permanent sealant shall be either a neoprene compression seal or an in situ cast silicone sealant. The contractor shall submit for the approval of the superintendent, a full technical description of the proposed sealant, including its operating parameters and the method of installation recommended by its manufacturer.

(ii) Neoprene compression sealants

(A) Neoprene compression sealants shall comply with all the requirements of ASTM 2628. Test methods used to determine compliance with these requirements shall include test methods Q462, Q463A and Q463B.

(B) At least four weeks before installation of the sealant, the contractor shall submit to the superintendent a certificate of compliance from a NATA registered laboratory showing that the sealant meets all the requirements of ASTM 2628.

(C) At the time of installation, the sides of the neoprene sealant shall be coated with a clear or concrete coloured lubricant compound approved by the superintendent and complying with ASTM D 2835. The sealant shall be inserted into the joint by using appropriate equipment and procedures which shall not damage the sealant during its insertion. The maximum increase in length of the sealant after installation shall be 5 per cent of original length. Any sealant exceeding 5 per cent extension shall be rejected. The sealant shall be located in the transverse contraction joint in the design orientation without twist or buckle.

(D) The sealant shall be continuous between formed longitudinal joints. Where such a discontinuity occurs, the sealant shall be angle butt jointed by a method approved by the superintendent. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the base and shall overlay any longitudinal sealants.

(iii) Silicone Sealants

(A) Silicone sealants shall be formed using a silicone joint sealant complying with the requirements listed in Table SC6.4.6.15.4 Silicone joint sealant requirements. At least 4 weeks before the installation of the sealant, the contractor shall submit to the superintendent a certificate of compliance, from a NATA registered laboratory, showing that the sealant meets all the requirements of Table SC6.4.6.15.4.

(B) The silicone joint sealant shall be grey in colour and shall be stored and installed in accordance with the manufacturer's written instructions. Installation of a silicone sealant shall take place only when the side walls of the groove have been grit blasted and are surface dry.

(C) Immediately before introducing the silicone sealant into the groove, any foreign or disturbed material shall be cleaned from the joint and from the top of the backer rod by dry air jet. The backer rod shall then be depressed to the depth such that the bottom of the silicone sealant shall be at the planned location and of the correct shape.

(D) If the backer rod is damaged in any way it shall be replaced for the full length of the joint.

(E) The method to be used for permanent sealing with silicone sealant shall be approved by the superintendent before permanent sealing commences. Notwithstanding any approval given by the Superintendent to a proposed method, the contractor shall be responsible for producing a permanent seal complying with all requirements of this specification.

Table SC6.4.6.15.4 Silicone joint sealant requirements

Test Method	Test	Requirements
ASTM-D-792	Specific Gravity	1.1 to 1.55
MIL-S-8802	Extrusion Rate	90 to 250 g per min
MIL-S-8802	Tack Free Time	30 to 70 min
ASTM D 2240	Durometer	10 to 25
Q461	Durability	Extension to 70% Compression to 50%
ASTM C794	Adhesion to Concrete	35N minimum average peel strength
ASTM C 793-7	Accelerated Weathering at 5,000 hours	No cracks, blisters or bond loss

(4) Transverse isolation joints

(a) Transverse isolation joints shall be provided at bridge approach slabs and at slab anchors where shown on the drawings and where directed by the superintendent.

(b) Transverse isolation joints shall be continuous across the full width of the concrete base normal to the control line and shall be constructed in accordance with the drawings.

(c) Transverse isolation joints shall not be placed closer than 2 m to other transverse joints. Where necessary, the superintendent shall authorise a change in the spacing and/or skew of adjacent transverse contraction joints to ensure that sufficient clearance is obtained.

(d) Joint filler shall consist of preformed jointing material of bituminous fibreboard and the joint sealant shall comply with the silicone sealant requirements of clause SC6.4.6.15.8(3) Transverse contraction joints. They shall be installed in accordance with the drawings and in a manner conforming to the manufacturers recommendations except that any reference to backer rods will not apply.

(e) The line of the isolation joint shall not deviate from a 3 m straightedge more than 10 mm.

(5) Longitudinal tied joints

(a) General – Longitudinal tied joints

(i) Longitudinal tied joints shall be provided at the locations shown on the drawings or where directed by the superintendent. The joints shall be parallel to the control line and/or to the dimensions and details shown on the drawings.

(ii) Longitudinal tied joints shall be formed or induced either by sawing or by machine insertion of a crack inducer ribbon.

(iii) The ties shall be 12 mm diameter deformed steel bars Grade 400Y, 1 m long and shall be inserted in accordance with clause SC6.4.6.15.5(5) Placing. Tie bars shall be located and spaced as shown on the drawings. All parts of any tie bar shall lie within 50 mm of its designed position. Tie bars shall be omitted within 500 mm of a transverse joint. The epoxy to be used when installing tie bars in existing concrete shall be hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar.

(iv) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10 mm. The line shall also not deviate from a 3 m straight edge by more than 10 mm having made due allowance for any planned curvature.

(v) Where the longitudinal tied joint is formed or slip-formed, the joint face shall be corrugated in accordance with the details shown on the drawings.

(vi) Where the multi-lane width is greater than 18 m, a longitudinal isolation joint shall be constructed at each location shown on the drawings and in accordance with clause SC6.4.6.15.8(7) Longitudinal isolation joints.

(b) Sawn-induced joints

(i) Sawn longitudinal tied joints shall be provided to the dimensions shown on the drawings. Saw-cutting shall comply with clause SC6.4.6.15.9(3)(b) Saw-cutting.

(ii) Within 24 hours of sawing, the longitudinal tied joint shall be thoroughly cleaned of all debris and a neoprene backing rod, shall be inserted in accordance with the details shown on the drawings.

(iii) The sealant shall be coated with a lubricant adhesive compound approved by the superintendent. The compound shall have a colour compatible with the pavement colour. The sealant shall be inserted into the groove by means of suitable equipment which shall not damage the sealant during insertion. The maximum increase in length of the sealant after installation shall be 10 per cent of the original length, otherwise the sealant shall be rejected.

(iv) Joints in the sealant shall be kept to a minimum and shall be cemented together by an adhesive recommended by the manufacturer. The top of the sealant shall be neither less than 5 mm nor more than 7 mm below the surface of the concrete base, except where the sealant is depressed to lie under the transverse joint sealant.

(c) Ribbon-Induced Joints

(i) Ribbon induced longitudinal tied joints shall be provided to the dimensions and details shown on the drawings. The inducer ribbon shall be machine inserted so that the top of the ribbon does not protrude above the surface of the base, nor shall it lie below the surface of the base by more than 3 mm.

(ii) The inducer ribbon shall be a minimum of 0.5 mm thick. When placed, it shall be within 5º of the vertical plane. Any inducer ribbon that curls on placement when cut into the concrete base and is found to be curved in the transverse section by more than 3 mm its straight alignment, will be rejected.

(iii) At transverse construction joints, the inducer ribbon shall be carried through the joint sufficiently to allow a connection using strong stapling, or another method as approved by the superintendent. When a join, during paving, is necessary within the inducer ribbon - the inducer ribbon on the new spool shall be similarly joined to the tail of the inducer ribbon on the old spool.

(d) Treatment of sawn longitudinal tied joints prior to asphalt overlay

Where asphalt surfacing over sawn longitudinal tied joints is specified, the sealant shall be depressed to a depth below the concrete surface of not less than 10 mm and, following thorough cleaning, the joint shall be sealed flush with the concrete surface with a bituminous rubber compound, approved by the superintendent, which is to be compatible with the narrow groove.

(6) Longitudinal joint with kerb and/or channel

(a) Where kerbs and/or channel are to be constructed within the shoulder of a concrete base, they shall be formed directly onto the concrete sub-base and they may be cast either integrally with the concrete base or separately.

(b) Where constructed separately, they shall be tied to the concrete base by 12 mm diameter deformed steel tie bars grade 250S or 400Y, 1000 mm long at 1 m centres.

(c) The longitudinal joint shall be constructed parallel to the control line (parallel to the centre line for kerb ramps) and to the dimensions shown on the drawings. The tie bars shall be inserted in accordance with the drawings and clause SC6.4.6.15.5(5) Placing.

(d) The face of the longitudinal joint need not be scabbled however the joint does not need to be sealed.

(e) The line of the longitudinal joint shall be constructed to the tolerances specified for longitudinal tied joints in accordance with clause SC6.4.6.15.8 Longitudinal tied joints.

(f) The construction of kerb and/or channel shall be in accordance with kerb and channel sub-section SC6.4.6.9 Open drains regardless of method of construction except that the strength of the concrete used in the kerb and/or channel shall be 36 MPa.

(7) Longitudinal isolation joints

(a) Longitudinal isolation joints shall be provided where shown on the drawings and where directed by the superintendent.

(b) The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10 mm. The line of the joint shall not deviate from a 3 m straight edge by more than 10mm.

(c) The joint filler shall consist of pre-formed jointing material of bituminous fibreboard and the joint sealant shall comply with the silicone sealant requirements of clause SC6.4.6.15.8(2) Transverse construction joints. They shall be installed in accordance with the drawings and in a manner conforming to the manufacturer's recommendations except any reference to backer rods will not apply.

SC6.4.6.15.9 Slab anchors

(1) General

(a) Slab anchors shall be constructed normal to the control line, to the dimensions and at the locations shown on the drawings.

(b) Slab anchors shall extend over the full width of the concrete base and the associated transverse expansion joint shall not be placed closer than 2 m to other transverse joints. Where necessary, the superintendent shall authorise a change in the spacing of transverse contraction joints to ensure that this minimum clearance is obtained.

(2) Excavation

(a) Excavation of trenches for slab anchors shall be to the dimensions and details shown on the drawings.

(b) All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be re-compacted, where required, to the degree of consolidation of the adjacent undisturbed material.

(c) The Contractor shall dispose of excavated material at locations approved by the superintendent.

(d) Where a slab anchor is required at the junction of an existing flexible pavement, a straight saw-cut to the full depth of the asphaltic concrete or bituminous seal shall be made in the flexible pavement along the joint line. Excavation of the trench shall then take place as described above without disturbance or damage to the existing flexible pavement. Any disturbance or damage to the flexible pavement shall be made good as directed by the superintendent.

(e) A subsoil drain shall be provided at the bottom of the trench, in accordance with subsection SC6.4.6.20 Subsoil, foundation and pavement drains and details shown on the drawings.

(3) Concrete

(a) Concrete for slab anchors shall be produced, transported and placed in accordance with the requirements for hand placed concrete base.

(b) Slab anchors shall be poured separately from the concrete base slabs and to the dimensions and details shown on the drawings - up to the top surface of the sub-base.

(c) A transverse isolation joint shall be provided on the downhill side of the slab anchor.

(d) Steel reinforcement in slab anchors shall be of the type and size shown on the drawings and shall be supplied and fixed in accordance with clauses SC6.4.6.15.5(1) Material and SC6.4.6.15.5(5) Placing.

(e) Bridge approach slabs, if not in the bridge contract, shall be constructed at bridge abutments to the dimensions and details shown on the drawings and in accordance with the requirements for the concrete base.

SC6.4.6.15.10 Conformance of concrete strength, compaction and thickness

(1) Concrete cylinders

(a) Test specimens

(i) Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The contractor shall supply a sufficient number of moulds to meet these requirements for the frequency of testing specified in this clause. The contractor will also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the superintendent.

(ii) Samples of concrete for testing shall be taken in accordance with AS 1012.1. The selection of the

batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.

(iii) The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.

(iv) The contractor shall mark the specimens for identification purposes.

(b) Frequency of moulding of test specimens

Test specimens shall be moulded at 7 days and 28 days or as directed by the superintendent - for the determination of the compressive strength. Each test specimen shall be moulded as follows:

(i) for each lot of up to 50 cubic metres of concrete placed at the one time - One pair of specimens;

A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed.

(c) Inspection, capping and crushing of specimens

(i) Specimens required by this sub-section shall be tested at the NATA registered laboratory nominated by the contractor.

(ii) Specimens shall be inspected, capped and crushed in accordance with AS 1012.9.

(iii) Before crushing, the mass per unit volume of the seven day specimens shall also be determined in accordance with AS 1012.12.2, so that the relative compaction of cores taken from the same lot of concrete base can be determined.

(2) Compressive strength of concrete

(a) General

The compressive strength of the concrete represented by a pair of specimens moulded from one sample shall be the average compressive strength of the two specimens unless the two results differ by more than 3 MPa, in which case the higher result shall be taken to represent the compressive strength of the lot of concrete.

(b) Adjustment of test compressive strength for age of specimen

Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table SC6.4.6.15.5 Concrete age conversion factors. For intermediate ages the factor shall be determined by interpolation.

Age of Specimen at time of test (days)	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 or greater	1.25

(c) Conformance for Compressive Strength

(i) If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa or greater than 45 MPa, the lot represented by the test cylinders shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1) General – Removal and replacement of base, SC6.4.6.15.11(2) Removal and disposal of base and SC6.4.6.15.11(3) Replacement of base.

(ii) In case of non-conformance the contractor may elect to core the in situ concrete base for testing

of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the superintendent. Such locations may be determined by the use of a nuclear density meter, or any alternative method approved by the Superintendent. Testing shall be carried out at the request of the contractor. Base concrete failing to reach the required in situ compressive strength shall not be re-tested for at least 72 hours after the determination of the value of the in situ compressive strength.

(iii) After testing for compressive strength of the sample concrete cores, as required, the superintendent shall consider the test results and shall, at his absolute discretion determine the compressive strength of the concrete to be either:

(A) The average of the 28 day compressive strength of the pair of specimens moulded at the time of placing; or

(B) The equivalent 28 day compressive strength of the core.

(iv) A lot is defined as a continuous pour of up to 50 cubic metres of base represented by a set of test specimens cast from a sample of the concrete used in its construction.

(v) Thickness measurements of the concrete base shall be determined and certified by a licensed surveyor. Measurements are to be taken at the edges or by coring. Audit checks using a suitable probe may be carried out whilst the concrete is being placed. The readings shall be rounded off to the nearest 5 mm.

(vi) Concrete base which is below the specified thickness shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3) .

(vii) Base which is thicker than the design thickness will be acceptable provided the finish satisfies the requirements of Clause SC6.4.6.15.7 Placing and Finishing Concrete Base and that the finished surface base level complies with clause SC6.4.6.14.7 (5) (b)

(3) Relative compaction of concrete

(a) Test specimens

(i) Test specimens for determining the relative compaction of the concrete placed in the work shall be cores cut from the work. Cores shall be cut from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions:

(A) the requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However concrete must be not less than 3 days old in the warm season and 6 days old in the cool season, before removal; and

(B) the nominal diameter of the cores shall not be less than 75 mm.

(ii) The location of coring shall be chosen to exclude joints, steel reinforcement or tie bars from the core. The locations are not intended to be random, but are intended to ensure that the whole of the concrete base conforms to the minimum requirements of this sub section. Cores shall be marked for identification by the contractor.

(iii) Cores shall be placed immediately either in a tank of lime saturated water or in an individual plastic bag and sealed to prevent water loss. Cores stored in plastic bags shall be kept in the shade.

(iv) Cores shall not be subjected to temperatures in excess of either ambient temperature or 23 ºC whichever is the higher and they shall not be subjected to temperature less than 10 ºC, until delivered to the testing laboratory.

(b) Frequency of coring

(i) The Contractor shall take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded in accordance with clause SC6.4.6.15.10(1) Concrete cylinders.

(ii) In the case of hand placed concrete base, two cores shall be taken to represent a section of work. A section of work shall be confined between construction joints. Hand worked or placed base that is cast with machine placed concrete and not separated from the machine placed concrete shall be deemed to be part of the machine placed concrete, and be cored and tested as part of the

machine placed concrete base.

(c) Repair of core holes

(i) The Contractor shall clean and restore all core holes taken in the base with non-shrink cementitious concrete having a compressive strength of not less than that in the base and a maximum nominal aggregate size of 10 mm.

(ii) The surface of the restored hole shall be similar to the surrounding surface in texture and colour.

(d) Testing of cores for compaction

(i) The core specimens shall be wet conditioned in accordance with AS 1012.14 for not less than 24 hours immediately prior to testing for compaction. Testing to determine mass per unit volume shall be carried out on specimens at age seven days.

(ii) The relative compaction of a core specimen shall be the ratio, expressed as a percentage, of the mass per unit volume of the core specimen to the average mass per unit volume of the standard cylinders used to determine the seven day compressive strength from the same lot of concrete base. The mass per unit volume of both standard cylinders and cores shall be determined in accordance with AS 1012.12.2.

(e) Conformance for Compaction

(i) If the relative compaction is less than 97 per cent, the lot represented by the core shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3).

(ii) Core specimens for compressive strength testing shall be wet conditioned, prepared and tested in accordance with AS 1012.14. Cores obtained for compaction shall not be re used for compressive strength testing.

(iii) The test strength shall be adjusted for age in accordance with clause SC6.4.6.15.10(2) Compressive strength and for length/diameter ratio in accordance with Table SC6.4.6.15.6 Correction factors by multiplying by the correction factor in Table SC6.4.6.15.6 Correction factors.

(iv) If the 28 day compressive strength of the core is less than 33 MPa, the lot represented by the compaction core shall be removed and replaced in accordance with clauses SC6.4.6.15.11(1), SC6.4.6.15.11(2) and SC6.4.6.15.11(3).

Table SC6.4.6.15.6 Correction factors

Length/Diameter Ratio	Correction Factor
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

SC6.4.6.15.11 Removal and replacement of base

(1) General – Removal and replacement of base

(a) Where directed by the superintendent, rejected base shall be removed and replaced in accordance with this clause. Rejected base, which extends more than 25 m longitudinally, shall be replaced by mechanical means unless the slabs are odd shaped or mismatched. Replacement shall be in full slab widths between longitudinal joints and/or external edges.

(b) At least 7 days before the commencement of concrete base removal, the contractor shall submit, for the approval of the superintendent, details of the proposed methods of carrying out the work which shall be such as to prevent damage to the adjoining concrete base and the underlying sub-base.

(2) Removal and disposal of base

(a) At each end of the section of concrete base to be removed, a transverse saw-cut shall be made for the full depth of the base layer. Such transverse saw-cut shall be normal to the control line and not closer

than 1.5 m to an existing contraction joint in the base. No over-sawing into the adjoining concrete base or underlying sub-base shall be permitted.

(b) Longitudinal saw-cuts shall be made along the existing longitudinal joints to define the edges of the base section to be removed. Such longitudinal saw-cuts shall not extend more than 250 mm past the transverse saw-cut at each end of the section to be removed and shall not extend into the underlying sub-base.

(c) No over-sawing shall be permitted on any internal saw-cuts made by the contractor to aid in the removal of the concrete base.

(d) The contractor shall dispose of the removed concrete base slabs at sites acceptable to the superintendent.

(e) Any slab, adjoining the removed slabs, damaged by the contractor's operations shall also be removed and replaced in accordance with this clause.

(3) Replacement of base

(a) Before construction of the replacement base, the sub-base shall be prepared and de-bonded in accordance with sub-section SC6.4.6.14 Mass concrete sub-base.

(b) All work involved in the replacement of the concrete base shall comply with this sub-section, including the following additional requirements:

(i) The joint faces on the adjoining slab at the transverse saw-cuts shall be deeply scabbled below the top 25 mm which shall be left smooth. Tie bars shall be provided to form a transverse construction joint in accordance with clause SC6.4.6.15.8(2) Transverse construction joints.

(ii) Transverse contraction joints shall be continuous across the full width of the base containing the replaced section. The length of the joint across the full width of the base shall be sealed with the same sealant as in adjacent work and in accordance with clause SC6.4.6.15.8(3) Transverse contraction joints.

(iii) The lower two thirds of the depth of the longitudinal joint faces shall be deeply scabbled and any concrete considered to be unsound by the superintendent shall be removed. A crack inducer ribbon shall be attached to the surface of any formed longitudinal joint in the replacement concrete base and tie bars provided to form a longitudinal tied joint in accordance with clause SC6.4.6.15.8(5) Longitudinal tied joints.

(iv) Tie bars placed into hardened concrete shall be set by the use of a hydrophilic epoxy resin. The setting system used shall develop an anchorage strength at least 85 per cent of the yield strength of the bar.

(v) Neither traffic nor construction equipment other than that associated with testing, saw-cutting, groove cleaning or joint sealing shall be allowed on the section of replaced concrete base until the joints have been permanently sealed and at least 10 days have elapsed since placing the replacement concrete base or it has reached a compressive strength of at least 20 MPa.

SC6.4.6.15.12 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.15.7 below:

Table SC6.4.6.15.7 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Aggregates** a. General	Mass of the total aggregates in concrete mix shall consist of at least 40% quartz sand	SC6.4.6.15.3(5)(a)
	b. Fine Aggregate (i) Grading	To be within the limits as per Table SC6.4.6.15.2 and shall not deviate from Proposed Grading by more than amounts in Table SC6.4.6.15.2	SC6.4.6.15.3(5)(b)

Item	Activity	Limits/Tolerances	Clause
	(ii) Wet Strength	Not less than 80kN for any fraction and/or constituent	SC6.4.6.15.3(5)(c)
	(iii) 10% Fines Wet/Dry Variation	Not to exceed 35% for any fraction and/or constituent	SC6.4.6.15.3(5)(c)
	(iv) Soundness	The loss in mass when tested with sodium sulphate to be less than 9% for any constituent	SC6.4.6.15.3(5)(c)
	(v) Particle Shape	The proportion of misshapen particles (2:1 ratio) to be less than 35%	SC6.4.6.15.3(5)(c)
	(vi) Fractured Faces	At least 80% by mass of the particles shall have two or more fractured faces	SC6.4.6.15.3(5)(c)
2.	**Concrete Quality** a. Cement Content	At least 270kg per yielded cubic metre of concrete	SC6.4.6.15.4(1)
	b. Flyash	Not greater than 50kg per yielded cubic metre of concrete	SC6.4.6.15.4(1)
	c.Compressive Strength	The minimum 28 day compressive strength shall be 36.0 Mpa	SC6.4.6.15.4(2)
	d. Shrinkage	Not to exceed 450 microstrain after 3 weeks of air drying	SC6.4.6.15.4(3)
	e. Consistency	Nominated slump shall be neither less than 30mm nor more than 40mm for mechanically placed concrete. It shall be neither less than 55mm nor more than 65mm for hand placed concrete.	SC6.4.6.15.4(4)
	f. Air content	Shall not be less than 4% nor more than 7% when discharged from the transport vehicle ready for placement	SC6.4.6.15.4(5)
3.	**Concrete Mixing and Transport**	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half hours where transported by truck mixer or agitator. (ii) One hour where transported by non-agitating trucks.	SC6.4.6.15.6(2)
4.	**Concrete Placing**	Concrete shall not be placed when the air temperature in the shade is above 38ºC. The temperature of the concrete shall be neither less than 10ºC nor more than 32ºC.	SC6.4.6.15.7(1)
		Where the value of Rate of Evaporation exceeds 0.50kg per square metre per hour, the Contractor shall cease work.	SC6.4.6.15.7(2)
5.	**Alignment and Surface** a. Horizontal Alignment	The outer edges of the base shall not deviate from the plan position at any point by more than 10mm.	SC6.4.6.15.7(5)(a)

Item	Activity	Limits/Tolerances	Clause
	b. Surface Level	The level at any point on the top of the base shall not vary by more than +10mm or -0mm from that shown on the drawings or as directed by the superintendent. The top surface of the base shall not deviate from a 3m straight edge, laid in any direction, by more than 5mm.	SC6.4.6.15.7(5)(b)
6.	**Joints** a. Transverse Construction	The line of the transverse construction joints shall not deviate from a 3m straight edge placed along the joint by more than 10mm.	SC6.4.6.15.8(2)
	b. Transverse Contraction	(i) May be reduced locally to a skew of 1 in 12 to accommodate construction joints and slab anchors. (ii) No edge shall deviate from a 3m straight edge by more than 10mm. (iii) The surface of the transverse contraction joint shall not exhibit more than 5mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300mm in any 1m length of joint on each edge. (iv) Temporary sealing - the top of the sealant shall be neither higher than nor more than 10mm below the concrete surface. (v) Permanent Sealing The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base.	SC6.4.6.15.8(3)
	c. Transverse Isolation	The line of the transverse expansion joint shall not deviate from a 3m straight edge more than 10mm.	SC6.4.6.15.8(4)
	d. Longitudinal Tied Joints	(i) All parts of any tie bar shall be within 50mm of its designed position. (ii) The line of longitudinal tied joints shall not deviate from the designed position at any point by more than 10mm. The line shall also not deviate from a 3m straight edge by more than 10mm having made due allowance for any planned curvature. (iii) For sawn-induced joints, the maximum increase in length of the sealant after installation shall be 10% of the original length. The top of the sealant shall be neither less than 5mm nor more than 7mm below the surface of the base. (iv) For ribbon-induced joints, the inducer ribbon shall be a minimum of 0.5mm thick and when placed it shall be within 5 of the vertical plane.	SC6.4.6.15.8(5)

Item	Activity	Limits/Tolerances	Clause
	e. Longitudinal Isolation Joints	The line of the longitudinal isolation joint shall not deviate from the specified position by more than 10mm. The line of the joint shall not deviate from a 3m straight edge by more than 10mm.	SC6.4.6.15.8(7)
7.	**Slab Anchors**	Not placed closer than 2.0m to transverse joints (other than associated transverse expansion joints).	SC6.4.6.15.9(1)

SC6.4.6.16 Sprayed bituminous surfacing

SC6.4.6.16.1 Introduction

(1) Scope

This policy sub-section provides standards, advice and guidelines for the supply of all materials and the application of any or all of the following types of sprayed bituminous surfacing:

(a) prime
The application of a primer of field or refinery prepared cutback bitumen without aggregate to provide penetration of the surface (preferably from 5 to 10mm) and waterproofing;

(b) primerseal
The application of a primerbinder of field or refinery prepared cutback bitumen to provide surface penetration (preferably from 2mm to 5mm) and incorporation of a light cover of aggregate to provide a temporary wearing surface;

(c) seal or reseal
The application of a bituminous binder into which aggregate is incorporated to provide a durable wearing surface (including bitumen emulsion or polymer modified seals); and

(d) slurry surfacing
The application of a bituminous emulsion binder with or without polymer modifier and with or without continuous aggregate, mineral fillers, additives and water, properly proportioned to enrich the binder content and refresh the existing wearing course material. This is a preventive maintenance treatment and shall not be used in new construction.

The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, shall be as shown on the construction drawings and/or as detailed in SC6.4.6.16 Attachment A Details of work.

For multiple application treatments, the binder and aggregate may be required to be laid in one or more separate applications indicated in SC6.4.6.16 Attachment B.

Requirements for adhesion agent in the bitumen and tolerances for binder application rates are set out in SC6.4.6.16 Attachment B Binder details.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:
SC6.4.6.30 - Control of traffic

(b) Australian Standards:
AS 1160 - *Bituminous emulsions for the construction and maintenance of pavements*
AS 2008 - *Residual bitumen for pavements*
AS 2157 - *Cutback bitumen*
AS 2758.2 - *Aggregate for sprayed bituminous surfacing*
AS 3568 - *Oils for reducing the viscosity of residual bitumen for pavements*

(c) Queensland Department of Transport and Main Roads Technical Standards:
MRTS11 - *Sprayed Bituminous Surfacing (excluding Emulsion)*
MRTS12 - *Sprayed Bituminous Emulsion Surfacing*
MRTS13 - Bituminous Slurry Surfacing
MRTS17 - *Bitumen*

MRTS18 - *Polymer Modified Binder*
MRTS19 - *Cutter and Flux Oils*
MRTS20 - *Cutback Bitumen*
MRTS21 - *Bituminous Emulsion*
MRTS22 - *Supply of Cover Aggregate*

(d) Queensland state legislation:
Fire and Rescue Service Act 1990

(e) Other:
Austroads, *Guide to Pavement Technology Part 4K: Seals*
Austroads, *Bituminous Materials Sealing Safety Guide*

(3) Control of traffic
The Contractor shall provide for the control of traffic in accordance with the requirements of policy sub-section SC6.4.6.30 Control of traffic while undertaking the work and shall take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate.

Where early use of the new seal is required to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no lateral displacement of aggregate occurs. Where necessary, the Contractor shall use patrol vehicles to ensure that traffic travels at an acceptable speed.

The Contractor shall take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic shall be temporarily diverted while the work is in progress.

If facilities for the diversion of traffic are not available, the Contractor may spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway, except during the actual spraying operation when all traffic movement through the work shall cease. Traffic shall not be permitted to encroach upon the edge of the sprayed bituminous material until such time as it is covered with aggregate.

SC6.4.6.16.2 Materials

(1) Sampling and testing of materials
Sampling and testing of materials shall be arranged by the Contractor and carried out by a laboratory with appropriate NATA registration in accordance with the requirements of the relevant Queensland Department of Transport and Main Roads (DTMR) Specification.

(2) Bituminous materials and additives
Bituminous materials shall be in accordance with the relevant DTMR Specifications.

(3) Bitumen adhesion agent

(a) Bitumen adhesion agents.
Adhesion agents must conform to the following requirements:

(i) adhesion agent is to be added to bitumen at the rate of 5kg for every 1,000 Litres of bitumen CL170 and 10kg for every 1,000 litres of polymer modified bitumen; and

(ii) adhesion agents approved for use are Diamintol, or Bitumite EXP3995 if Diamintol is unavailable.

(4) Oils for reducing viscosity of bitumen
Cutter Oil shall conform to MRTS 19.

Delivery and storage procedures for cutter oil delivered in drums or in bulk shall ensure that all containers are free from any deleterious material prior to filling with cutter oil, and all drums are stored to ensure that entry of water through seals or welds in the drums is prevented.

(5) Aggregate

Aggregate shall conform to MRS22.

The Contractor shall obtain test results for each lot/stockpile of aggregate and certification of compliance from a laboratory with appropriate NATA accreditation, before aggregate from the lot is incorporated in the works.

SC6.4.6.16.3 Design of bituminous surfacing

(1) Before commencing sprayed bituminous surfacing work, the Superintendent will confirm the approved details of the proposed bituminous surfacing design for the work. Additional details are required to be submitted to the Superintendent prior to carrying out the work for check with the proposed bituminous surfacing design. These additional details include:

(a) test results for all nominated materials;

(b) aggregates source, geological type, nominated grading, average least dimension (ALD);

(c) pre-coating agent and bitumen adhesion agent types, proportions and manufacturer (if applicable);

(d) bitumen refinery source and certification of compliance;

(e) cutback bitumen refinery source of bitumen, type of cutter, source of cutter, cutter oil fraction, certification of compliance;

(f) polymer modified bitumen – refinery source of bitumen and manufacturer, class of polymer and fraction, certificate of compliance; and

(g) bitumen emulsion – refinery source of bitumen and manufacturer, grade of emulsion, certificate of compliance.

Design rates of application of binder and aggregate for bituminous surfacing shall be in accordance with *Guide to Pavement Technology Part 4K: Seals*. Design application rates shall be known as “nominated application rates” and materials as “nominated materials”.

SC6.4.6.16.4 Pre-coating of aggregate general

The aggregate pre-coating agent shall be applied to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

Pre-coating of aggregate shall not be carried out when rain is imminent. If aggregate has been pre-coated and rain appears imminent, the aggregate shall be adequately covered to prevent the pre-coating material being washed from the aggregate particles.

The Contractor shall take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the pre-coating agent on the stockpiled aggregate.

Stockpiles pre-coated more than 14 days in advance of use shall be retreated unless otherwise approved by the Superintendent and shall not be used if less than 3 days old.

SC6.4.6.16.5 Application of sprayed bituminous surfacing

(1) General

The Contractor shall carry out sprayed bituminous surfacing to:

(a) provide a uniform application of binder with adequate adhesion to the underlying surface;

(b) provide a complete cover of interlocking aggregate particles; and

(c) achieve effective bond between binder and aggregate.

Details of equipment and methods to be used for sprayed bituminous surfacing shall be submitted to the Superintendent for approval prior to their use on the works.

(2) Plant

A mechanical sprayer shall be used to apply primer, primerbinder and binder. The sprayer shall have a current Sprayer Certificate issued by the Queensland Department of Transport and Main Roads.

The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times.

Mechanical spreading equipment shall be used to spread aggregate and shall be capable of achieving a uniform and accurate spreading rate.

Rollers shall be utilised in accordance with Clause SC6.4.6.16.4(9) Application and rolling of aggregate.

The Contractor shall remove from the site any plant or equipment considered by the Superintendent to be not fully operational or not in a satisfactory condition for carrying out work in accordance with this sub-section.

(3) Preparation of pavement surface

Before the application of primer, primerbinder or binder, the pavement surface shall be swept by the use of a mechanically operated rotary road broom or suction broom to provide a uniformly clean surface. If necessary, additional sweeping shall be done by hand, using stiff brooms. Sweeping shall, where possible, extend at least 300mm beyond each edge of the area to be sprayed.

Adherent patches of foreign material shall be removed from the surface of the pavement.

For the spraying of primer or primerbinder, the pavement surface shall be slightly damp to impede dust interfering with initial adhesion except where explicit instructions are provided with the seal design.

(4) Surface defects must be repaired prior to laying the wearing course. This may include crack filling, pothole repairs and repair of failed pavements.

Rut-filling and corrector must be applied where necessary to rectify any ruts and uneven surfaces prior to placing the wearing course.

Review of nominated application rates

The Contractor shall select the locations where each lot of aggregate is to be incorporated in the works.

The Superintendent shall review the bituminous surfacing design at each location based on the actual average least dimension (ALD) test result for the lot of aggregate instead of the nominated ALD value of the aggregate adopted at design. Due consideration must also be given to the surface texture of the prepared pavement surface and the likely degree of stone embedment, to establish if any additional minor adjustments to bitumen spray rates should be applied. The revised application rates shall be known as "target application rates".

The Contractor shall give the Superintendent notice of the Contractor's intention to commence sprayed bituminous surfacing. This notice shall confirm spray rates, aggregate size and ALD.

(5) Bitumen temperature requirements

Bitumen temperature requirements are as per MRTS 17, 18, 19, 20 and 21.

Table SC6.4.6.16.2 Cutback bitumen spraying temperatures

Grade	Temperature Range (ºC)
AMC 00	10 - 35
AMC 0	35 - 55
AMC 1	60 - 80
AMC 2	75 - 100
AMC 3	95 - 115
AMC 4	110 - 135
AMC 5	120 - 150
AMC 6	135 - 160
AMC 7	150 - 175

(6) Pavement temperature and weather conditions

The Contractor shall measure and record pavement temperatures at regular intervals during the course of the work. For this purpose, a spirit or mercury in glass thermometer or other suitable type of thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. When a spirit or mercury in glass thermometer is used to measure pavement temperature, the bulb of the thermometer shall be covered from direct sunlight with a small heap of grit or similar material. Suitably calibrated infra-red thermometers may be used.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

Spraying primers, primerbinders and binders shall be undertaken only if the pavement temperature has been at or above 20ºC, 25ºC for PMB, 10ºC for emulsion for spraying for at least one hour before commencement of spraying and does not fall below 20ºC, 25ºC for PMB, 10ºC for emulsion for spraying during the period of spraying.

Spraying shall not be carried out on a wet pavement, while rain appears imminent or during high winds or dust storms.

(7) Incorporation of cutter oil, flux oil and adhesion agent

(a) Cutting back bitumen

The Contractor shall determine and record the proportion of cutter oil added to each sprayer load, using MRTS11 and based on the measured pavement temperatures.
The cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of cutback bitumen shall be circulated at a rate of at least 700 litres per minute for 20 minutes to ensure that the mixture is homogeneous.

If a part sprayer load of field cutback bitumen is unused on the date of mixing, and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter shall be added to the returned cutback bitumen unless the tank is fitted with an effective mechanical mixing system. When the returned cutback bitumen is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned cutback bitumen.

(b) Fluxing bitumen

Where flux oil is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres per minute for at least 20 minutes before spraying.

(c) Bitumen adhesion agent

Where bitumen adhesion agent is to be included, it shall be added to the bitumen in the sprayer and the mixture circulated twice at a rate of at least 1,000 litres per minute for at least twenty minutes before spraying. Spraying shall occur within 4 hours.

(8) Application of primer, primerbinder and binder

(a) General
The area to be sprayed with primerbinder or binder shall be limited to the area which can be covered with aggregate at the target application rate within ten minutes of spraying bitumen or cutback bitumen.

(b) Primer and primerbinder
Nominated and target application rates and quantities of primer and primerbinder shall apply to the whole material, including cutter oil, measured at 15ºC. Primer, Primerbinder and Binder application rates outside the tolerances indicated in SC6.4.6.16 Attachment B Binder details constitute a non-conformance.
After application of a primer, a period of at least forty eight hours, or such longer period as determined to be necessary for the primer to become completely dry, shall elapse before the binder for a seal is applied. All traffic shall be kept off the primed surface.

After application of a primerbinder, a period of at least fourteen days shall elapse before the binder for a seal is applied.

(c) Binder
The class of bitumen or grade of cutback bitumen shall be as specified in SC6.4.6.16 Attachment A Details of work.

Nominated and target application rates and quantities of binder shall be based on the volumes of bitumen measured at a temperature of 15ºC and shall not include any bitumen adhesion agent and/or cutter oil. If flux oil has been added to the bitumen, the quantity of flux oil shall be included as part of the binder. Binder application rates outside the tolerances provided in SC6.4.6.16 Attachment B Binder details shall constitute a non conformance.

Where bitumen adhesion agent and/or cutter oil have been added to the binder, the application rate of the total binder at 15ºC shall be adjusted to allow for the quantities of bitumen adhesion agent and/or cutter oil in the mixture.

The Contractor shall determine the hot application rate of total binder, including bitumen adhesion agent and/or cutter oil, using MRTS11.

Where refinery cutback bitumen is used as the binder, the target application rate of binder shall be increased by the Contractor to allow for the cutter oil in the mixture.

(d) Operation of the sprayer
Where the longitudinal edges of spray runs are not required to overlap, special type end nozzles must be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs shall be in the range 50-100mm for special type end nozzles. If intermediate nozzles are to be used to overlap adjacent longitudinal sprays the nozzles shall be set in the normal manner for intermediate nozzles and the overlap shall be in the range 250-350mm.

The spraying of primer, primerbinder or binder for each run of the sprayer shall commence on a protective strip of heavy paper weighing not less than 120g per square metre laid across and held securely to the pavement surface beforehand by addition of cover aggregate. The sprayer shall commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application and correct alignment is attained at the commencement of spraying.

The sprayer shall maintain a uniform rate of application throughout the length of each sprayer run.

The spraying for each run shall terminate on a protective strip of paper laid across and held securely to the pavement surface beforehand. The width of paper at the commencement and/or termination of each run shall not be less than that endorsed on the Sprayer Certificate.
Spraying shall cease immediately if any defect develops in the spraying equipment and spraying shall not recommence until the fault has been rectified.

Where any blockage or partial blockage of nozzles occurs, spraying shall cease immediately. If the blockage is due to the condition of the binder being sprayed and is likely to re-occur, that load together with any binder from the same bulk tanker or supply unit shall not be used in the works.

Where a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, such areas shall be sprayed by means of the hand spray equipment attached to the sprayer. The work shall be planned to minimise the area sprayed by hand spray equipment.

After each sprayer run, the quantity of binder sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the target application rate is achieved in subsequent runs. If the actual application rate of binder after three runs differs by more than 5% from the target application rate, the sprayer shall not be used until a new Sprayer Certificate has been obtained.

Areas not within 5% of the target application rate of primer, primerbinder or binder shall constitute a “non-conformance”.

(9) Application and rolling of aggregate

The application of aggregate shall proceed immediately after spraying is commenced and shall be completed within ten minutes of spraying bitumen or cutback bitumen. For polymer modified binder spreading and rolling shall start immediately after spraying and continue until adhesion is complete.
Wet aggregate shall not be used.

The Contractor shall apply the aggregate of the specified nominal size and at the target aggregate application rate. Sufficient loaded and measured trucks of dry aggregate shall be at the site to provide full cover for the area sprayed.
The aggregate shall be spread uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Any bare or insufficiently covered areas shall be re run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Any aggregate spread in excess of the target aggregate application rate shall be removed before rolling is commenced if it is localised and can be efficiently removed by hand brooming.
After the aggregate has been applied to each section of the work, initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi wheel rollers of minimum load of 1t per tyre and minimum tyre pressure of 550 kPa. A roller with a rubber surface drum providing equivalent compactive effort may be used in lieu of a multi-wheeled roller. Initial rolling shall continue until the aggregate is firmly embedded in the primerbinder or binder. Roller speed shall be 15-25 km/h subject to safe working conditions.

If the aggregate is not evenly distributed over the surface of the pavement, the surface shall be traversed with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primerbinder or binder, the Contractor shall defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor shall substitute light hand brooming.

Backrolling shall then be carried out for a minimum period of 1 hour per 1,000 square metres sprayed for roads having a traffic volume of less than 500 vehicles per lane per day and 1 hour per 1,500 square metres sprayed for other roads, up to a maximum of 24 hours after the aggregate has been applied.

Where a bituminous surfacing is specified with separate applications of coarse and fine aggregate on a single application of binder, the coarse aggregate shall be applied first, rolled and any necessary brooming carried out as described above, before application of the fine aggregate and its subsequent rolling and brooming. In this case, the time limits for incorporation of aggregate shall apply only to the application of the coarse aggregate.

After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10mm, or larger, aggregates not to exceed the values specified in Table SC6.4.6.16.3.

Table SC6.4.6.16.3 Maximum loose aggregate particles

Road type	Loose stones (particles/m²) max
Urban areas	20
Other medium to high traffic (> 250v/l/d)	30
Low traffic (< 250v/l/d)	40

Any remaining loose particles of aggregate shall be removed by light sweeping and/or vacuumed from the pavement and disposed of responsibly by the Contractor as per Table SC6.4.6.16.4 below or as directed to by the Superintendent.

Table SC6.4.6.16.4 Maximum time limits for sweeping or vacuuming

Traffic volume (vehicles/lane/day)	Maximum time limits
> 2,000	Within 8 hours of sealing
1,000 to 2,000	Within 24 hours of sealing
250 to 1,000	Within 48 hours of sealing
< 250	Within 5 days of sealing

Prior to leaving the work site, ensure that all services are uncovered and cleaned, if necessary. Remove from site all waste paper and rubbish arising from the sprayed sealing operations. Clean the stockpile site and store any excess material in a tidy heap or remove, depending on the requirements of the Superintendent.

(10) Work records

Particulars of the work performed shall be recorded by the Contractor on a spray record sheet. Details of primer, primerbinder, binder and aggregate applied shall be recorded immediately after every sprayer run. Each form shall be signed by the Contractor's representative as a true record of the work performed. The Contractor shall supply to the Superintendent a copy of each completed form.

(11) Protection

(a) New work

Protect the new work by providing warning signs as follows:

(i) provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers;

(ii) maintain signs until loose aggregate has been removed and linemarking reinstated; and

(iii) if linemarking is to be undertaken by others, erect warning signs indicating the absence of linemarking to be maintained by the organisation responsible for linemarking.

(b) Services and road fixtures

The Contractor shall take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, access chamber covers, bridge or culvert decks and other road fixtures.

Immediately after aggregate has been spread over the binder, the Contractor shall clean off or remove any sprayed surfacing material and leave the services and road fixtures in a condition equivalent to that existing when the Contractor commenced the sprayed surfacing work.

SC6.4.6.16.6 Nonconformance of materials and work

If any materials supplied or any section of sprayed bituminous surfacing work fail to conform to the requirements whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted, or any other cause then such failure or failures shall constitute a “non-conformance”.

The nonconforming section of sprayed bituminous surfacing work shall be either replaced or corrected as proposed by the Contractor, subject to the approval being obtained.

The rectified nonconformances, including any restoration work to any underlying or adjacent surface or structure,

which becomes necessary as a result of such replacement or correction, shall be the responsibility of the Contractor. Materials removed from the site by the Contractor shall be replaced with materials which conform to this sub-section.

SC6.4.6.16.7 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.16.5 below.

Table SC6.4.6.16.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Design of Bituminous Surfacing**	Contractor to provide details of design to Superintendent before proposed commencement of work.	SC6.4.6.16.3
2.	**Commencement of Work**	Contractor to give notice to the Superintendent of intention to commence work.	SC6.4.6.16.5(1)
3.	**Sweeping of Pavement Surface**	Sweeping shall extend at least 300mm beyond each edge of the area to be sprayed.	SC6.4.6.16.5(3)
4.	**Bitumen Heating** (a) Bitumen Temperature	When incorporated with cutter oil, bitumen shall be in temperature ranges as per MRTS.17 and 18 (06/09).	SC6.4.6.16.5(5)
	(b) Refinery Cutback Bitumen Temperature	At the time of spraying shall be in temperature range as per MRTS 20 (06/09).	SC6.4.6.16.5(5)
	(c) Retention of Temperature	Bituminous materials shall not be held at temperatures within the ranges of MRTS17,18 and 20 for periods in excess of 10 hours.	SC6.4.6.16.5(5)
5.	**Spraying Temperature** (a) Pavement Temperature	Bituminous surfacing shall not be undertaken if the pavement temperature has not been at or above 20°C, 25°C for PMB, 10°C for emulsion for at least one hour before commencement of spraying or if the pavement temperature falls below 20°C, 25°C for PMB, 10°C for emulsion during the period of spraying.	SC6.4.6.16.5(6)
6.	Cutting Back Bitumen	Circulation of hot bitumen and cutter oil mixture in the sprayer shall be at the rate of at least 700 litres per minute for 20 minutes.	SC6.4.6.16.5(7)
7.	Fluxing Bitumen or adding Bituminous Adhesion Agent	Circulation of fluxing oil or bituminous adhesion agent with hot bitumen shall be at the rate of at least 1,000 litres per minute for 20 minutes. Spraying to occur within 4 hours.	SC6.4.6.16.5(7)
8.	**Application of Bituminous Material** (a) Spray Area	Area to be sprayed shall be limited to area which can be covered by aggregate at target application rate within 10 minutes of spraying.	SC6.4.6.16.5(8)
	(b) Application Rates	Application rates and quantities shall apply to a temperature of 15ºC and have T1 tolerances of ±5% as set out in clause SC6.4.6.16.6 and T2 tolerances as set out in SC6.4.6.16 Attachment B.	SC6.4.6.16.5(8)
	(c) Primer	At least a 48 hour period shall elapse after spraying of primer before binder for a seal is applied.	SC6.4.6.16.5(8)
	(d) Primerbinder	At least a 14 day period shall elapse after spraying of primerbinder before application of binder.	SC6.4.6.16.5(8)

Item	Activity	Limits/Tolerances	Clause
9.	**Application of Aggregate** (a) Spreading Time	Application of aggregate shall be completed within 10 minutes of spraying bitumen or cutback bitumen on each section.	SC6.4.6.16.5(9)
10.	**Rolling** (a) Roller Numbers and Type	Initial rolling shall be carried out with two or more dual axle smooth pneumatic tyred multi-wheeled rollers. Minimum load of 1t per tyre and minimum tyre pressure 550KPa.	SC6.4.6.16.5(9)
	(b) Backrolling	(i) For traffic volume of <500 vehicles per lane per day, backrolling for minimum of one hour per 1,000 square metres sprayed.	SC6.4.6.16.5(9)
		(ii) For traffic volume >500 vehicles per lane per day, backrolling for minimum of one hour per 1,500 square metres sprayed.	SC6.4.6.16.5(9)

SC6.4.6.16 Attachment A: Details of work

Section Road Name From To	Prime Binder Type	Primer Seal		Seal or Reseal	
		Binder Type	Aggregate Nom. Size	Binder Type	Aggregate Nom. Size

Note —prime and primer seal binder type shall be indicated in this Attachment using the descriptive terms as follows:

Very Light Prime or Primer - equivalent cut back bitumen to grade AMCOO.
Light/Medium Prime or Primer - equivalent cutback bitumen to grade AMCO or AMC1.
Heavy Prime or Primer - equivalent cut back bitumen to grade AMC1 or AMC2.

Click here to obtain a copy of the following form.

SC6.4.6.16 Attachment B: Binder details

BINDER TYPE	**ADHESION AGENT** (At 0.5% of binder) **(YES/NO)**

Primer, Primerbinder and Binder Application Tolerance Thresholds T2

(Refer to clause SC6.4.6.16.6)

Nominal Aggregate Size (mm)	**Tolerance Thresholds T2 expressed as ± percentages**

SC6.4.6.17 Bituminous micro-surfacing

SC6.4.6.17.1 Introduction

(1) Scope

The work to be executed under this sub-section consists of the design, supply, mixing and placement of bituminous microsurfacing for surface correction and wearing surface applications on road pavements, carparks, cycleways and footpaths; or as a preventative maintenance treatment on roads with the objective of enriching the existing wearing course. The treatment must not be used in new road construction.

Bituminous microsurfacing must consist of a mixture of emulsified polymer modified bitumen binder, mineral aggregate, mineral filler, additives and water proportioned and mixed to form a slurry which is placed and spread evenly on the road surface. It must be capable of being spread in variably thick layers for surface correction and for wearing surface applications.

The size, nominal thickness, and extent of bituminous microsurfacing must be as shown on the drawings or as directed by the Superintendent.

For all new works on road and carpark pavements, this sub-section should be read in conjunction with sub-section SC6.4.6.16 Sprayed bitumen surfacing. For new works on road and carpark pavements, bituminous mircrosurfacing must be preceded by the application of a sprayed bituminous seal a minimum of 2 weeks prior to the application of the bituminous microsurfacing wearing course.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Terminology

Users of this specification should be aware that where terms are not specifically defined in the following section, AS1348 should be the default standard.

Bituminous microsurfacing	Is one of two types of bituminous slurry surfacing. It is distinguished from the other type, slurry seals, by the incorporation of polymer and other additives to the bituminous binder to improve the performance of the slurry surfacing. Bituminous microsurfacing is also commonly known under various proprietary names such as “cold overlay”, “microsealing”, “paveseal”, “microasphalt”, etc. The size of the bituminous microsurfacing is based on the nominal largest stone size in the mix. For the purpose of this sub-section, the size must be either Size 5 or Size 7.

(3) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy subsections to be read and applied in conjunction with this subsection are as follows:

SC6.4.6.16 Sprayed bitumen surfacing

SC6.4.5 Construction management

(b) Australian Standards:

AS1141.11.1	*Particle size distribution – Sieving method*
AS1141.12	*Material finer than 75 micrometre in aggregates (by washing)*
AS1141.22	*Wet/dry strength variation*
AS1141.23	*Los Angeles value*
AS1141.25.1	*Methods for sampling and testing aggregates - Degradation factor - Source rock*
AS1141.25.2	*Methods for sampling and testing aggregates - Degradation factor - Coarse aggregate*
AS1141.25.3	*Methods for sampling and testing aggregates - Degradation factor - Fine aggregate*

AS1141.42	*Pendulum friction test*
AS1160	*Bitumen emulsions for the construction and maintenance of pavements*
AS1289.3.7.1	*Determination of the sand equivalent of a soil using a power-operated shaker*
AS1348	*Glossary of terms - Roads and traffic engineering*
AS2008	*Residual bitumen for pavements*
AS2350	*Methods of testing Portland and blended cements*
AS2891.3.1	*Binder content and aggregate grading - Reflux method*

(c) International Slurry Surfacing Association Tests:
ISSA TB 100 - *Test method for wet track abrasion of slurry surfaces*
ISSA TB 109 - *Test Method for Measurement of Excess Asphalt in Bituminous Mixtures by Use of a Loaded Wheel Tester*
ISSA TB 114 - *Wet stripping test for cured slurry seal mixes*
ISSA TB 139 - *Method of classified emulsified asphalt/aggregate mixtures by modified cohesion test measurement of set and cure characteristics*
ISSA TB 144 - *Classification compatibility by Schulze-Breuer and ruck procedure*

SC6.4.6.17.2 Materials

(1) Sampling and testing of materials
Sampling and testing of materials must be arranged by the Contractor and carried out by a NATA registered laboratory for the nominated test methods.

(2) Binder
The binder supplied and used in the works must be an emulsified polymer modified bitumen, formulated to meet the performance requirements of the mix specified in clauses SC6.4.6.17.3(1) Mix properties and SC6.4.6.17.4(6) Surface texture.

Prior to emulsification, incorporation of polymer and additives, the bitumen must comply with AS2008.

The Contractor must provide the Superintendent with sufficient information to verify that the binder supplied is the same as that nominated in the mix design.

(3) Mineral aggregates
Mineral aggregates must consist of crushed rock or crushed gravel, or a mixture of crushed rock or crushed gravel and natural sand. It must consist of clean, hard, angular, durable particles, and free form clay, dirt, organic material or other deleterious matter.

The aggregate from each source must comply with the requirements given in Table SC6.4.6.17.1 Aggregate properties.

Table SC6.4.6.17.1 Aggregate properties

Property	Test Method	Requirement
Degradation Factor	AS1141. 25.1	50 minimum
Los Angeles Value	AS1141.23	30 maximum
Aggregate Wet Strength	AS1141.22	150kN minimum
Wet/Dry Strength Variation	AS1141.22	30% maximum
Polished Aggregate Friction Value	AS1141.42	45 minimum
Sand Equivalent	AS1289.3.7.1	60 minimum

When tested in accordance with AS1141.11 and AS1141.12, the aggregate (including mineral filler) must conform with the grading limits given in Table SC6.4.6.17.2 Grading limits for combined aggregate/filler.

Table SC6.4.6.17.2 Grading limits for combined aggregate/filler

Sieve Size	Percent Passing by Mass	
	Size 5	Size 7
13.2mm	100	100
9.5mm	100	100
6.7mm	100	85-100
4.75mm	90-100	70-90
2.36mm	50-70	45-70
1.18mm	30-50	28-50
600µm	20-35	19-34
300µm	12-25	12-25
150µm	7-18	7-18
75µm	4-10	5-15

The Contractor must nominate the source/s of aggregates to the Superintendent, and must submit NATA certified test reports on the quality and grading of the combined aggregate proposed to be used.

The Contractor must submit test results to the Superintendent for each lot/stockpile of aggregate a minimum of seven days prior to incorporation in the works.

(4) Mineral filler

Mineral filler must consist of hydrated lime, flyash, portland cement, or other material approved by the Superintendent.

The mineral filler must be dry, free from lumps and any deleterious material, with a minimum of 85% passing a 75µm sieve. In all other respects, the mineral filler must comply with the requirements of AS2350.

The quantity of filler added to the bituminous microsurfacing during placement must not vary by more than 1% of the total aggregate (by mass) from the filler content nominated in the mix design.

(5) Water

Water added to the bituminous microsurfacing must be potable and must be compatible with the component materials.

(6) Additives

Details of the type, source and nominal proportions of additives must be submitted to the Superintendent with the mix design.

SC6.4.6.17.3 Mix design

(1) Mix properties

The nominated mix design must satisfy the properties given in Table SC6.4.6.17.3 Mix properties.

Table SC6.4.6.17.3 Mix properties

Mix Property	Test Method	Requirement
Wear Loss	ISSA TB 100 6 day	800 g/m^2 maximum
Traffic Time	ISSA TB 139 30 minutes 60 minutes	12kg.cm minimum 20kg.cm minimum
Adhesion	ISSA TB 114 or ISSA TB 144	≥90% or 11 grade points minimum (AAA, BAA)

(2) Nominated mix

At least 7 days before commencing bituminous microsurfacing work, the Contractor must submit to the Superintendent for approval, details of the nominated bituminous mircrosurfacing mix design for the work including the target application rate (m^3 of mix/m^2 of road surface) and the corresponding nominal layer thickness, together with NATA certification and test results demonstrating that the nominated mix and its constituents meet the requirements of the specification.

The details of the nominated mix design must include the following:

(a) bitumen emulsion content of the mix, and the residual binder content of the emulsion;

(b) target combined aggregate/filler grading;

(c) proportions of constituent materials used;

(d) type and sources of aggregates, filler and binder; and

(e) all relevant compliance certificates.

(3) Approved mix

When a nominated mix has been approved by the Superintendent, it must be known as the “approved mix”. Work must not commence until a bituminous microsurfacing mix has been approved.

The combined aggregate/filler grading and the binder content of the approved mix will be termed the "approved grading" and the "approved binder content" respectively.

Any changes to the approved mix, its method of production or source of supply of constituents require written approval 21 days prior to proposed implementation.

SC6.4.6.17.4 Production and paving

(1) Requirements of production mix

Bituminous microsurfacing produced in the paving unit at the site must be known as the "production mix".

The production mix must comply with the requirements given in Table SC6.4.6.17.4 Maximum permitted variations from approved mix and must be confirmed by the Contractor as required in SC6.4.6.17.4(2) Sampling and testing of production mix.

The Contractor is responsible for taking samples for testing at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4.

Table SC6.4.6.17.4 Maximum permitted variations from approved mix

Production Mix Properties	Maximum Permitted Variations from Approved Mix (by mass)	
	Size 5	Size 7
Grading*	Nil	Nil
Passing 9.50mm AS sieve and larger	Nil	± 7%
Passing 6.70mm	± 6%	± 6%
Passing 4.75mm	± 5%	± 5%
Passing 2.36mm and 1.18mm	± 4%	± 4%
Passing 0.600mm	± 3%	± 3%
Passing 0.300mm	± 2%	± 2%
Passing 0.150mm	± 1.5%	± 1.5%
Passing 0.075mm		
Residual Binder Content	- 0.5% + 1.0%	- 0.5% + 1.0%

Note—*these allowable variations must not fall outside the limits for design of nominated mix as given in Table SC6.4.6.17.2 Grading limits for combined aggregate/filler.

(2) Sampling and testing of production mix

(a) Lot definition

Compliance sampling and testing of bituminous microsurfacing must be undertaken on a lot by lot basis. For this purpose, 50m^3 or one day's production (whichever is the lesser), or such smaller quantity which is considered as representative of consistent production of the paving unit, will be considered as representative of consistent production of the paving unit.

(b) Responsibility of sampling

The Contractor is responsible for taking samples and must supply all facilities, equipment and labour for that purpose.

(c) Frequency of Sampling

For the testing of production mix, two 1.5kg representative samples of bituminous microsurfacing mustbe taken from each lot at random intervals. The samples must be taken from the discharge of the paving unit and the sample containers immediately sealed.

For the testing of the binder, two 2L samples of bitumen emulsion must be taken from each bulk delivery in accordance with AS1160.

(d) Testing

The samples of bituminous microsurfacing must be treated and tested at a NATA registered laboratory to confirm compliance with Table SC6.4.6.17.4 Maximum permitted variations from approved mix. Prior to testing for Residual Binder Content and Aggregate Gradation, as determined by AS2891.3.1, the samples must be dried to constant weight in an oven at 60ºC for a minimum of 15 hours.

Each delivery of emulsion must be tested for residual binder content in accordance with AS1160 Appendix D and accompanied by a certification of specification compliance traceable to the relevant batch at the supplier's storage tank.

The paving unit to be used must be calibrated for the component materials of the approved mix prior to the commencement of paving. Previous calibration documentation covering the same materials and approved mix must be acceptable provided that calibration has been carried out within the previous 12 months.

The documentation must include an individual calibration for each component material at various settings which can be related to the paving unit's metering devices.

No paving unit must be allowed on the work until the calibration has been verified and approved by the Superintendent.

(3) Preparation of pavement

The existing surface must be clean and free from any loose stones, dirt, dust and foreign matter. The surface must be swept beyond the edge of the area to be surfaced by at least 300mm. Any foreign matter adhering to the pavement and not swept off must be removed by other means. Any areas significantly affected by oil contamination must be cleaned to the satisfaction of the Superintendent.

The Contractor must take all necessary precautions to prevent the bituminous microsurfacing or other materials used on the work from entering or adhering to kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, bridge or culvert decks or other road fixtures. After the bituminous microsurfacing has been spread the Contractor must clean off any such material and leave such gratings, access chamber covers and other road fixtures, in a clean and satisfactory condition.

(4) Weather limitations

Bituminous microsurfacing must not commence if either the pavement or air temperature is below 10ºC and falling.

Bituminous slurry may be applied when both pavement and air temperatures are above 7ºC and rising, or above 10ºC.

Spreading must not proceed during rain or when rain appears imminent.

The Superintendent must require cease of works, if weather conditions are not appropriate.

(5) Spreading

The surface may be pre-dampened if necessary by fogging ahead of the spreader box. Water used for pre-wetting the surface must be applied so that the entire surface is damp with no apparent flowing water ahead of the spreader box. The application rate of the fog spray must be adjusted to suit temperature, surface texture, humidity and dryness of the surface being covered.

Bituminous microsurfacing must be mixed and applied using a purpose built paver. The mix must be of the desired consistency when deposited in the spreader box, and nothing more may be added other than minor amounts of water for the purpose of overcoming temporary build-up of microsurfacing in the corners of the spreader box.

The mixing time must be sufficient to produce a complete and uniform coating of the aggregate and the resulting mixture must be conveyed into the moving spreader box at a sufficient rate to always maintain an ample supply across the full width of the strike-off.

The strike-off must be adjusted to provide an application rate which will completely fill the surface voids and provide the nominal application rate of bituminous microsurfacing as scheduled.

After the bituminous microsurfacing has been spread, the Contractor must ensure that all kerbs, gutters, driveways, gratings, hydrants, valve boxes, access chamber covers, etc. are uncovered and left in a clean and satisfactory condition.

After the emulsion has broken and the mix is sufficiently stable, rolling must be carried out using pneumatic tyred rollers to produce a dense, even, homogeneous compacted surface where there is insufficient local traffic to achieve satisfactory compaction across the mat.

Bituminous microsurfacing must be capable of carrying slow moving traffic (<40 km/h) within 1 hour of application without permanent damage occurring, such as rutting or ravelling. When the time before the microsurfacing is capable of carrying traffic exceeds 1 hour, work must cease unless specifically approved by the Superintendent.

(6) Surface texture

The resulting surface after spreading must be uniform in appearance, and free of areas exhibiting segregation or

excessive or insufficient binder.

The surface texture must be demonstrated on a short test run for approval by the Superintendent. If the surface texture is acceptable to the Superintendent, then all subsequent work must be finished to an equivalent surface texture.

Where increased surface texture is required, a fabric skirt may be trailed behind the spreader box.

(7) Joints

Longitudinal joints in the wearing course must be straight and placed at either the edge or the centre of a traffic lane. If necessary, the edges and joints must be lightly screeded with a hand squeegee to achieve a smooth uniform appearance and to remove excess build-up of material.

(8) Shape and levels

Where a correction and wearing course have been placed, the finished surface level may not vary from the design level at any point by more than ±10mm. Additionally immediately adjacent to any kerb and/or gutter the finished surface level is not be below nor more than 10mm above the level of the lip of the adjacent gutter.

Notwithstanding the above, the deviation from a 3m long straight edge placed anywhere on the top of the finished surface may not exceed 10mm when assessed within 24 hours of work completion.

(9) Non-conformance of materials and finished surfacing

If any materials supplied fail to conform to the requirements in this sub-section or if any section of bituminous microsurfacing fails to conform to the requirements of this sub-section - whether failure of the work is due to bad workmanship, defective materials supplied by the Contractor or materials made defective by the method of operation adopted - then such failure or failures will constitute a “Notice of Non Conformance”. Such non-conforming sections of bituminous microsurfacing work must be either replaced or corrected.

The rectification of nonconformances, including any restoration work to any underlying or adjacent surface or structure, which becomes necessary as a result of such replacement or correction, is the Contractor’s responsibility. Materials removed from the site by the Contractor must be replaced with materials which conform to this sub-section.

(10) Control of traffic

The Contractor must provide for traffic in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work and must take all necessary precautions to protect the work from damage until such time as the new work has developed sufficient strength to carry normal traffic without damage.

The Contractor must take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the Contract or are otherwise available, traffic must be temporarily diverted while the work is in progress.

SC6.4.6.17.5 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.17.5 below.

Table SC6.4.6.17.5 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Spec Clause
1.	**Mineral Aggregate**	As per Table SC6.4.6.17.1	SC6.4.6.17.2(3)
2.	**Combined Aggregate/filler**	As per Table SC6.4.6.17.2	SC6.4.6.17.2(3)
3.	**Mineral Filler**	> 85% passing a 75 µm Sieve	SC6.4.6.17.2(4)
4.	**Mix Properties**		
	(a) Design properties	As per Table SC6.4.6.17.3	SC6.4.6.17.3(1)
	(b) Permitted variations	As per Table SC6.4.6.17.4	SC6.4.6.17.4(1)
5.	**Surface Preparation**	Sweeping must extend at least 300mm beyond edge of area to be surfaced	SC6.4.6.17.4(3)
6.	**Weather Limitations**	Microsurfacing must not commence if either air or pavement temperature is below 10°C and falling, and may only commence if both air and surface temperature is above 7°C and rising or above 10°C	SC6.4.6.17.4)4)
7.	**Shape and Levels**		
	(a) Finished Levels	Must not vary at any point by more than ± 10mm from design levels. Immediately adjacent to kerb and/or gutters, levels must not be below nor more than 10mm above design level	SC6.4.6.17.4(8)
	(b) Finished Shape	Deviation from the bottom of a 3m straight edge must not vary by more than 10mm	SC6.4.6.17.4(8)

SC6.4.6.18 Segmental paving

SC6.4.6.18.1 Introduction

(1) Scope

(a) This sub-section covers the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.

(b) The work covered under this sub-section consists of the supply, placement and compaction of segmental pavers including the provision of a sand or crusher dust bedding course and joint filling sand, over bound or unbound base and/or subbase layer/s.

(c) This sub-section should be read in conjunction with the appropriate specifications for the construction of the base and subbase layers beneath the segmental paving, ie. SC6.4.6.12 Flexible pavements, SC6.4.6.14 Mass concrete subbase.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

Editor's note - A reference to drawings is a reference to construction drawings.

(2) Choice of paver type, shape, class and laying pattern

(a) The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern must be as per decision requirement for each area of application.

(b) Unless otherwise specified, concrete pavers for road pavements must be placed in herringbone laying pattern and must be in accordance with the requirements for the appropriate road application shown in Table SC6.4.6.18.1.

(c) Unless otherwise specified, clay pavers for road pavements must be Class 4, minimum 65 mm nominal thickness, and placed in a herringbone laying pattern.

(d) Paving for cycleways and other pedestrian areas must be carried out in accordance with SC6.4.3.3 Footpath treatment and SC6.4.4.7 Pathways and cycleways.

(e) Paving for road pavements, medians and traffic islands must be carried out in accordance with SC6.4.4.1 Geometric road design and SC6.4.4.2 Pavement design.

(f) Paving for driveways must be carried out in accordance with SC6.4.3.5 Driveways and SC6.4.4.8 Standard drawings.

(3) Terminology

Concrete segmental pavers are units of not more than 0.1sqm in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges. Concrete pavers are identified by shape as being one of the following types:

(a) **Shape Type A** - Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units; or

(b) **Shape Type B** - Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces; or

(c) **Shape Type C** - Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

Clay pavers are manufactured from clay, shale or argillaceous materials which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.

Laying patterns of pavers are identified as being either Herringbone, Basket-weave, or Stretcher as shown in SC6.4.6.18 Attachment A Laying patterns. Each of these may be laid at either 90º or 45º to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in SC6.4.6.18 Attachment A.

(4) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.9 - Open drains kerb and channel
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.14 - Mass concrete subbase
SC6.4.6.19 - Stabilisation
SC6.4.6.28 - Minor concrete works.

(b) Australian Standards:
AS1141.11.1 - *Particle size distribution - Sieving method*
AS/NZS4455 - *Masonry units, pavers, flags and segmental retaining wall units*
AS/NZS4456.0 - *Methods of test - General introduction and list of methods*
AS/NZS4456.3 – *Methods of test - Determining dimensions*
AS/NZS4456.5 – *Methods of test - Determining the breaking load of segmental pavers and flags*
AS/NZS4456.9 – *Methods of test - Determining abrasion resistance*
AS/NZS4586 - *Slip resistance classification of new pedestrian surface materials.*

(c) Concrete Masonry Association of Australia specifications:
CMAA MA56-2010 - *Guide to permeable interlocking concrete pavements*
CMAA MA57-2010 - *Concrete segmental and flag pavements - guide to specifying*
CMAA T45-1997 - *Concrete segmental pavements - Design guide for residential access ways and roads*
CMAA T46-1997 - *Concrete segmental pavements - Detailing guide.*

(d) Clay Brick and Paver Institute specification:
CBPI Manual 1: 2003 - *Clay Paving Design and Construction.*

SC6.4.6.18.2 Materials

(1) General

(a) The Contractor must submit details of all proposed segmental paving materials, including bedding sand or crusher dust and joint filling sand. These details must be submitted to the Superintendent for approval supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this sub-section.

(b) No pavers may be delivered until the Superintendent has approved the type and quality of the pavers and noted the source of supply as compliant to the requirements of this sub-section.

(c) All pavers must have suitable “slip resistance” for pedestrian traffic and vehicular traffic with a classification “W” according to AS/NZS4586 for the Wet Pendulum Test. Where specific localities or levels of usage require a higher slip resistance classification, this classification must be indicated on the drawings. Such approval does not relieve the Contractor of any responsibility for supplying materials that comply with this sub-section.

(2) Concrete segmental pavers

(a) Concrete segmental pavers must comply with the requirements of relevant Concrete Masonry Association of Australia Specifications and AS/NZS4455 for each area of application.

(b) The material requirements for concrete pavers for each application, derived from CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying*, are shown in Table SC6.4.6.18.1.

Table SC6.4.6.18.1 Material requirements for concrete segmental pavers

Pavement application		Minimum characteristic breaking load *kN	Work size minimum thickness mm	Dimensional deviation category (See Table SC6.4.6.18.3)	Maximum abrasion resistance (mean abrasion index) †		
Relevant Australian Standard		AS/NZS 4455.2 AS/NZS 4456.5	AS/NZS 4455.2	AS/NZS 4455.2 AS/NZS 4456.3	AS/NZS 4455.2 AS/NZS 4456.9		
Residential	Pedestrians only (eg paths, patios and outdoor areas)	2	40	DP0	§		
	Pedestrian and light vehicles only (eg driveways, parking spaces and the like)	3	40	DPB1	§		
	Pedestrian and commercial vehicles	5	60	DPB1	§		
					Pedestrian traffic volume		
					Low	Medium	High
Public space	Pedestrian only**	2	40	DPB1	7‡	5.5	3.5
	Pedestrian and light vehicles only	3	50	DPB2	7‡	5.5	3.5
	Pedestrian and commercial vehicles	5	60	DPB2	7‡	5.5	3.5
Trafficked segmental pavers	Minor and residential	6	60	DPB2	NA		
	Local access	6	60	DPB2	NA		
	Collector M	6	76	DPB2	NA		
Industrial	M	10	80	DPB2 or DPB3	7		

(Source: CMAA MA57-2010 *Concrete segmental and flag pavements - guide to specifying* - Table 1: Minimum Requirements for Dimensions, Breaking Load and Abrasion Resistance).

Note—

* At 28 days

† At 90 days

** where cleaning of pavers and flags is undertaken by mechanical means or where prevention of vehicle entry cannot be guaranteed, the minimum recommended pavers and flags are the 'Pedestrian and light vehicles only' for such pavement applications.

§ No abrasion criteria are specified for residential pavers. Abrasion resistance requirements for aesthetic or other purposes must be specified to the supplier/manufacturer.

NA Not applicable.

* Shape Type A pavers – dentated pavers that key into each other and by their plan generally interlock and resist relative movement of joints parallel to both the longitudinal and transverse axes of the pavers.
Examples of Type A shapes

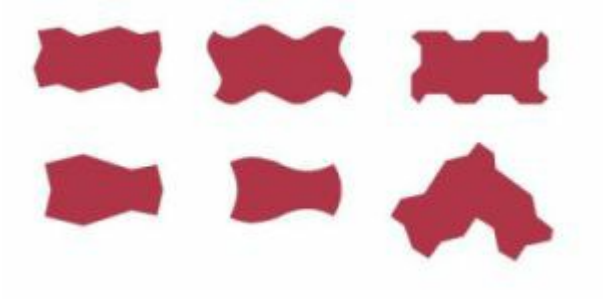


Table SC6.4.6.18.2 Maximum dimensional deviations determined by individual measurement

Category	Work Size dimensions, mm			
	Plan		Height	
	Standard deviation	Mean	Standard deviation	Mean
DP0	No requirement			
DPB1	2.0	± 3.0	3.0	± 2.5
DPB2	2.0	± 2.5	3.0	± 2.0
DPB3	Values declared by the supplier or by agreement between supplier and purchaser			
DPB4	1.5	± 2.0	2.0	± 2.0

Source: CMAA MA57-2010 Concrete segmental and flag pavements - guide to specifying - Table 2: Maximum Dimensional Deviations Determined for Pavers and Flags by Individual Measurement).

Note—all paving units will be categorised in accordance with AS/NZS4455.3 Method for Determining Dimensions.

(3) Clay segmental pavers
Clay segmental pavers must comply with the requirements of CBPI Manual 1:, *Clay paving design and construction* (chapter 3, Specifying clay pavers), and with the requirements of AS/NZS4455.

(4) Bedding sand or crusher dust

(a) The bedding material must be well-graded, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75 mm sieve. The bedding material must be from a single source or blended to achieve, when tested in accordance with AS1141.11, the following grading:

AS Sieve	**% Passing**
9.52mm	**100**
4.75	**95 - 100**
2.36	**80 - 100**
1.18	**50 - 85**

600µm	**25 - 60**
300	**10 - 30**
150	**5 - 15**
75	**0 - 10**

(b) The material must be of uniform moisture content when spread. It must be covered when stored on site to protect it from rain penetration.

(c) The bedding material must be free of deleterious soluble salts or other contaminants which may cause, or contribute to, efflorescence.

(5) Joint filling sand

(a) The joint filling sand must be well graded passing a 2.36mm sieve, and when tested in accordance with AS1141.11, having the following grading:

AS Sieve	**% Passing**
2.36mm	**100**
1.18	**90 - 100**
600µm	**60 - 90**
300	**30 - 60**
150	**15 - 30**
75	**5 - 10**

(b) The sand must be dry when spread. It must be covered when stored on site to protect it from rain penetration.

(c) The sand must be free of deleterious soluble salts or other contaminants.

(d) Material used for bedding is not suitable for joint filling.

(6) Concrete for edge restraints

(a) Concrete supplied and placed for the construction of edge strips must comply with sub-section SC6.4.6.28 Minor concrete works.

(b) Unless otherwise indicated on the drawings, or where the edge restraint is provided by kerb and/or gutter, the concrete used for edge restraints must have a minimum 28 day characteristic compressive strength of 32MPa for edge restraints to pavers on road pavements and 25MPa for edge restraints to pavers on footpaths, cycleways, medians and driveways.

SC6.4.6.18.3 Construction

(1) Subgrade preparation

(a) The subgrade must be formed to the required depth below finished surface level as shown on the drawings in accordance with SC6.4.6.10 Earthworks (construction).

(b) The finished subgrade foundation for the provision of subbase and/or base is subject to the approval of the Superintendent.

(2) Subbase

(a) As shown on the drawings, a subbase or working platform must be constructed in accordance with SC6.4.6.14.10 Subgrade Beams.

(b) The subbase must be constructed to the specified thickness, compaction and depth below finished surface level and to the design grade and crossfalls of the finished surface.

(c) The finished subbase is subject to the approval of the Superintendent.

(3) Base

(a) The base must be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the drawings in accordance with sub-section SC6.4.6.12 Flexible pavements.

(b) The base course must extend in width to at least the rear face of all new edge restraints.

(c) Notwithstanding the finished level tolerances contained within sub-section SC6.4.6.12 Flexible pavements for base of ±10mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving must be trimmed to within + 10mm or – 0mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving must not exceed 10mm. Bedding material must not be used as a levelling material to compensate for base finishing outside the above tolerances.

(d) The finished surface of the base must drain freely without ponding.

(e) The finished base is subject to the approval of the Superintendent.

(4) Edge restraints

(a) Edge restraints in the form of kerb and/or gutter or edge strips must be constructed along the perimeter of all segmental paving as shown on the drawings. Concrete kerb and/or gutter and edge strips must be constructed in accordance with sub-section SC6.4.6.9 Open drains and SC6.4.6.28 Minor concrete works.

(b) Faces of edge restraints abutting pavers must be vertical.

(c) Edge restraints must be supported on compacted base and/or subbase of the thickness as shown on the drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints must be 100mm adjacent to road pavements and medians, and 50mm adjacent to footpaths, cycleways and driveways.

(d) Unless otherwise shown on the drawings, contraction joints, 20mm depth must be formed every 5m of edge restraint length.

(e) After the concrete has hardened and not earlier than 3 days after placing, unless otherwise directed by the Superintendent the spaces at the back of the edge restraint must be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding design levels.

(5) Bedding

(a) The bedding course must be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and level. The bedding course must be laid such that a uniformly thick nominal 20-25mm layer is achieved following final compaction of the segmental paving.

(b) Any depressions in the screeding material exceeding 5mm must be loosened, raked and rescreeded before laying pavers.

(c) For the manual placing of paving units, the bedding material must be maintained at a uniform loose density. For mechanised laying, the bedding material must be uniformly and firmly, but not fully, compacted.

(d) Screeded material left overnight of subject to rain must be checked for level and rescreeded where necessary before pavers are placed. The material must not be screeded more than 2m in advance of the laying face at the completion of work on any day.

(6) Laying pavers

(a) Pavers must be uniformly placed on the screeded bedding to the nominated laying pattern. Pavers must be placed so that they are not in direct contact with each other and must have uniform 3mm nominal joint widths. The pavers must be mixed between various pallets to ensure that any colour variation from one pallet of pavers to the next is evenly distributed over the entire paved area.

(b) The first row must be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.

(c) In each row, full units must be laid first. Edge or closer units must be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in

size than one quarter of a full block must not be used.

(d) Access chambers, drainage gullies and similar penetrations through the pavement must be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

(e) Where pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, a joint must be provided in the pavers. The joint must consist of 10mm thick preformed jointing material of bituminous fibreboard.

(f) Any foot or barrow traffic must use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic is allowed on the pavement prior to compaction and provision of joint filling sand.

(g) On completion of subsequent bedding compaction and joint filling operations, all joints must have widths within the range 2-4mm.

(7) Bedding compaction

(a) After laying the pavers the bedding must be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units. Compaction must continue until all pavers form a smooth surface with adjacent paver edges matching. The level difference between adjoining edges of any two pavers must be a maximum of 2mm, to avoid trip hazards, unless approved otherwise by the Superintendent for rough textured pavers.

(b) Any units which are structurally damaged during bedding compaction must be removed and replaced. The pavement must then be recompacted for at least 1m surrounding each replacement unit.

(c) The paving operations must be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction must not be attempted within 1m of the laying face except on completion of the pavement against an edge restraint.

(d) The finished surface level must not vary from the design level at any point laid in any direction, by more than 6mm for all areas with Class 4 segmental pavements and 8mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, must not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8mm for all other areas of segmental paving.

(e) The channels formed between abutting chamfered units must finish with their inverts not less than 5mm nor more than 10mm above adjacent drainage inlets.

(f) All compaction must be complete and the pavement must be brought to design profiles before spreading or placing sand filling in the joints.

(8) Filling joints

(a) As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling must be spread over the pavement and the joints filled by brooming.

(b) To ensure complete filling of the joints, both the filling sand and pavers must be as dry as practicable when sand is spread and broomed into the joints.

(c) The pavement must then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

(9) Protection of work

Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic may not use the pavement until bedding compaction and joint filling operations have been completed.

(10) Opening to traffic

(a) As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should

be encouraged to traverse the greatest possible area of pavement to assist in the development of "lock-up".

(b) Excess joint filling sand must be removed prior to opening to traffic.

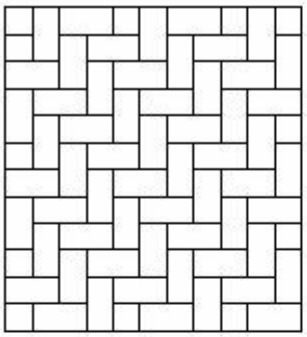
(c) The pavement must then be inspected by the Contractor at regular intervals up until the expiration of the defects liability period to ensure that all joints remain completely filled.

SC6.4.6.18.4 Limits and tolerances

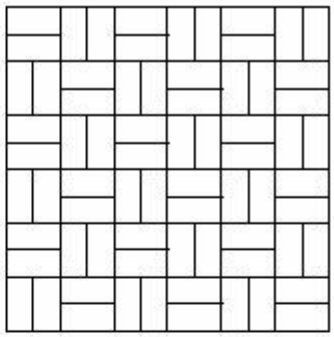
The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.18.3 below:

Table SC6.4.6.18.3 Summary of limits and tolerances

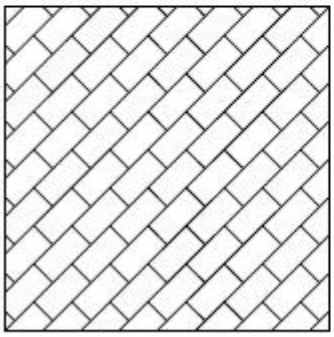
Item	Activity	Limits/Tolerances	Clause
1.	**Base**		
	(a) Surface Level	Finished level of base for road pavements to be within +10mm or -0mm of design levels.	SC6.4.6.18.3(3)
		Finished level of base other than for road pavements, to be within ±10mm of design levels.	SC6.4.6.18.3(3)
		The top surface of the base for all segmental paving must not deviate from a 3m straight edge, laid in any direction, by more than 10mm.	SC6.4.6.18.3(3)
2.	**Laying Paving Units**		
	(a) Joint widths	Within the range 2 -4mm.	SC6.4.6.18.3(6)
3.	**Completed Segmental Paving** (a) Surface level	Finished surface level of pavers must not vary from design levels by more than ±6mm for road pavements and ±8mm for other than road pavements.	SC6.4.6.18.3(7)
		Finished surface of pavers must not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other than road pavements.	SC6.4.6.18.3(7)
	(b) Level adjacent to drainage inlets	Invert level of channels between abutting chamfered units must be not less than 5mm and not more than 10mm above the level of adjacent drainage inlets.	SC6.4.6.18.3(7)
	(c) Difference in level of adjacent pavers	≤2mm	SC6.4.6.18.3(7)



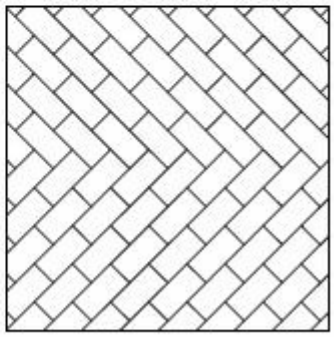
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond

SC6.4.6.19 Stabilisation

SC6.4.6.19.1 Introduction

(1) Scope

This sub-section identifies the materials requirements for stabilised materials provided by stationary plant production as well as materials and process requirements for in-situ stabilisation.

The work to be executed under this sub-section consists of the supply and incorporation of stabilising binders with material in a nominated pavement course or subgrade layer (including materials for the selected material zone, and selected backfill), at specified locations in the work and the spreading, compaction, trimming and curing of such materials.

This sub-section provides the requirements for stabilisation of the types of pavement courses and subgrade zones or layers as shown in Table SC6.4.6.19.1.

Table SC6.4.6.19.1 Types of pavement courses, subgrade zones or layers and stabilising binder

Pavement Course Or Subgrade Zone Or Layer	Stabilising Binder
PAVEMENT COURSE	
Base and Subbase	Cement Blended Stabilising Agent Hydrated Lime (pugmill) Quicklime (in-situ) Foam bitumen (MRTS07C)
SUBGRADE ZONE OR LAYER	
Selected Material Zone	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Other Subgrade Layers	Cement Blended Stabilising Agent Quicklime (in-situ) Hydrated Lime (pugmill)
Selected Backfill Zone	Cement Hydrated Lime (pugmill)

The pavement course or subgrade zone or layer to be stabilised shall be as specified in sub section SC6.4.6.12 Flexible pavements, or as indicated on the drawings.
Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) The Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:
SC6.4.6.4 Stormwater drainage
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1141.11.1	*Particle size distribution – Sieving method*
AS 1289	*Methods of testing soils for engineering purposes*
AS 1289.5.7.1	*Compaction control test – Hilf density ratio and Hilf moisture variation (rapid method)*

AS 1289.5.8.1	*Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode*
AS 1289.4.2.1	*Determination of the sulphate content of a natural soil and the sulphate content of the ground water - Normal method*
AS 1289.6.1.1	*Determination of the California bearing ratio of a soil - Standard laboratory method for a remoulded specimen*
AS 2350.4	*Methods of testing portland, blended and masonry cements -Setting time*
AS 2350.9	*Methods of testing portland, blended and masonry cements - Determination of residue on the 45 micrometre sieve*
AS 3582.1	*Fly ash*
AS 3582.2	*Slag - Ground granulated iron blast-furnace*
AS 3583.3	*Determination of loss on ignition*
AS 3583.6	*Determination of relative water requirement and relative strength*
AS 3583.12	*Determination of available alkali*
AS 3583.13	*Determination of chloride ion content*
AS 3583.14	*Determination of insoluble residue content*
AS 3972	*General purpose and blended cements*
AS 4489.6.1	*Test methods for limes and limestones – Lime index - Available lime*
AS 5101.4	*Methods for preparation and testing of stabilized materials – Unconfined compressive strength of compacted materials*

(c) Other publications:

Austroads

Guide to pavement technology Part 4D - Stabilised materials, AGPT04D-06.

The Glossary of Austroads Terms, AP-C87-10

NSW Roads and Maritime Services Test Methods

Test method T432: Rate of slaking of quicklime, 2012

SC6.4.6.19.2 Inspection, sampling and testing

(1) Pre-construction compliance

The Contractor shall provide a certificate from a laboratory with appropriate NATA registration stating that the stabilisation mix(es) submitted and the mix constituents comply with the mix nominated in approved stabilisation mix design approved as part of the pavement design and that the stabilised material meets the requirements of sub section SC6.4.6.12 Flexible pavements if incorporated into the works as a pavement layer or alternatively SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage.

(2) Construction compliance

Regular inspection, sampling and testing of pavement and subgrade materials shall be undertaken by the Contractor while stabilisation is in progress in accordance with this sub section.

SC6.4.6.19.3 Materials

(1) Unsuitable materials and shape correction

These shall be with unbound gravel of Type 1, Type 2, Type 3 or Type 4 in accordance with SC6.4.6.10 and SC6.4.6.12 New material shall not have a water soluble sulphate content exceeding 1.9 grams of sulphate per litre.

(2) Cement and stablising agent

The type of cement used as the stabilising agent or a constituent in a blended stabilising agent shall comply with AS3972.

Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any time.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the time of manufacture, the Contractor shall arrange a re-test, to ensure the cement still complies with AS3972, before the cement is used in the work. Test results shall be forwarded to the Superintendent for approval at least 2 days in advance of usage of the material.

The Contractor shall order gravel material with the cement content required to achieve the designed unconfined compressive strength (UCS) of the pavement. It is the Contractor's responsibility to ensure the material being used achieves the required UCS.

(3) Quicklime stabilising agent
Quicklime, consisting essentially of calcium oxide in a highly reactive form, shall have the following properties at the point of spread:

(a) available lime - the content of calcium oxide, determined by AS4489.6.1, shall not be less than 85%. Unless otherwise specified, the spread rate for quick lime shall be 20kg/m^3; and

(b) slaking rate - the active slaking time shall not be greater than 20 minutes and the temperature rise on slaking, determined from the average of four samples tested in accordance with Test Method T432, shall not be less than 40°C in 6 minutes.

The particle size distribution of the quick lime determined by AS1141.11 shall comply with the following requirements in Table SC6.4.6.19.2.

Table SC6.4.6.19.2 Particle size distribution of quicklime

AS Sieve	Per Cent Passing
13.2mm	100
9.5mm	96 - 100
4.75mm	70 - 100
2.36mm	0 - 90

(4) Hydrated lime stabilising agent

(a) Hydrated lime, consisting essentially of calcium hydroxide, whether used as the sole stabilising agent or blended with other additives, shall have the following properties:

(i) available lime - the content of calcium hydroxide, determined by AS 3583.12, shall not be less than 80%;

(ii) form - the material shall be in a dry powder form; and

(iii) residue on sieving - the residue on a 300 micron sieve, determined by (Particle Size) AS3583.14, shall not exceed 2%.

(b) The properties which characterise the particular hydrated lime to be used in the stabilising agent submitted as part of the mix design are:

(i) percentage of calcium hydroxide;

(ii) fineness percentage by mass passing the 45 micron sieve (AS 2350.9); and

(iii) source.

(5) Ground granulated blast furnace slag stabilising agent
The ground granulated blast furnace slag shall conform to AS3582.2.
The properties which characterise the particular ground blast furnace slag to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness percentage by mass passing the 45 micron sieve (AS2350.9);

(b) relative strength (28 days) (AS3583.6); and

(c) source.

(6) Flyash stabilising agent
Flyash shall conform to AS3582.1.

The properties which characterise the particular flyash to be used in the stabilising agent submitted as part of the mix design are:

(a) fineness - percentage by mass passing the 45 micron sieve (AS2350.9);

(b) loss on ignition (AS3583.3); and

(c) source.

(7) Blended stabilising agents

The Contractor may utilise a blended stabilising agent. The Contractor shall obtain mill and batch information which will make the blended stabilising agent traceable to the supplier's test results.

Handling and storage requirements of the Supplier shall be complied with by the Contractor who shall also arrange for sampling of the agent as required by the Superintendent.

The mass of components of the nominated blended stabilising agent shall not vary by more than ± 3% from the blend percentages nominated in the mix design described in approved stabilisation mix design.

When a blended stabilising agent is produced from a combined grinding of components the following properties will characterise the particular stabilising agent blend:

(a) source of each component;

(b) fineness percentage by mass passing the 45 micron sieve (AS2350.9); and

(c) setting time (AS2350.4).

(8) Water (for curing)

Water shall be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. The water shall not contain more than:

(a) 600 parts per million of chloride ion, determined by AS3583.13;

(b) 400 parts per million of sulphate ion, determined by AS1289.4.2.1; and

(c) 1% by mass of undissolved solids.

Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

(9) Foam bitumen

In accordance with MRTS07C.

SC6.4.6.19.4 Stabilisation processes

(1) General

The Contractor shall submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work 14 days prior to commencement of the work. This submission, hereafter called the work plan, is to include the following:

(a) the sequence of operations;

(b) widths of stabilisation passes;

(c) provision for traffic if appropriate;

(d) comply with statutory requirements for WHS;

(e) testing methods and frequency;

(f) comply with this specification;

(g) survey control methods; and

(h) curing methods.

Notwithstanding submission to the Superintendent of the Contractor's equipment and stabilisation procedures, the work shall meet all the sub-section requirements, and statutory requirements for work health and safety, and the Contractor shall perform such tests as specified as the work proceeds, to ensure compliance.

Stabilisation of pavement materials shall not proceed during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.

(2) Application of stabilising agent

(a) Stationary mixing plant

Application rate of stabilising agent shall be monitored at the pug mill or equivalent plant utilised as approved by the Superintendent.

Application rate measured in kg/t of product shall be monitored and recorded for every 100t of production.

The achieved accuracy of application rate shall be ±10% of the nominated rate nominated in approved pavement design's stabilisation mix design.

The application rate shall not be allowed to exceed the nominated rate by more than 10%.

(b) In-situ

For environmental reasons in urban areas the incorporation of stabilising agent is to be a closed system process where stabilising agent is added and mixed into the pavement within the bowl of the specialist mixing equipment.

Where approved in rural areas spreading shall be carried out using the mechanical spreader nominated in the work plan and subsequently approved by the Superintendent. The approved pavement design's stabilisation mix design nominates the spread rate.

The actual spread rate shall be within ±10% of the nominated rate. The Contractor shall verify this by testing the spread rate for each lot or 500m^2 of pavement treated (whichever is less) in each application of binder. Spread rate testing shall be performed by weighing the contents of a suitable four sided tray placed on the pavement and between the wheels of the closed system stabiliser. The rate of stabilising agent spread shall be calculated by dividing the mass collected (kg) by the area of the tray (m^2).

Where spreading/stabilising vehicles are fitted with load cells, the Contractor shall ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run. The Contractor shall record this data for each run and make it available to the Superintendent promptly. Such action will not cancel the Contractor's obligation to undertake prescribed testing of spread rate if required by the Superintendent.

Spreading shall not proceed during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property. Where open spreading is approved.

Traffic or equipment not involved in spreading or mixing of the stabilising agent shall not pass over the spread material until it has been mixed into the layer to be stabilised. Where open spreading is approved.

Any spillage of the stabilising agent on site or at any loading location related to the site shall be removed as soon as possible and within the same work shift of such spillage.

(3) Mixing

(a) Stationary mixing plant

The stationary mixing plant shall be purpose built for the process of mixing road making materials. All equipment shall be maintained and calibrated so as to provide a uniformly mixed product without segregation of the aggregate material.

The plant shall provide for the controlled and metered inclusion of water into the mix.

The stationary mixing equipment shall incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements. This performance shall be confirmed by monitoring of unconfined compressive strength of production, in accordance with AS1289.6.1.1, with a pair of test specimens tested for each 100 tonnes of production.

(b) In-situ

Mixing equipment shall be purpose built for the process of in-situ mixing of road making materials. It shall be capable of mixing to the depth specified for the layer to be stabilised and of distributing the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised. Where directed a minimum of two passes of the mixing equipment is required. As mixing blades or tynes wear they shall be replaced so as to maintain mixing efficiency consistent with that demonstrated during the trial section. The mixing equipment will be capable of supplying a calibrated amount of water to the mixing bowl in such a manner as to provide a uniformly moist mix to a target moisture content.

The resultant mix shall be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.

The procedure nominated in the Work Plan shall minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.

The Contractor shall carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Inspection results shall be recorded as cited in SC6.4.5 Construction management.

The Superintendent may require that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content.

(c) Paving equipment

For plant-mixed stabilising pavements, the mixture shall be placed by self-propelled paving machine purpose built for this work and with the capacity to place and spread the mixture in one pass at the required uncompacted thickness, width and shape. Other methods of paving may be considered by council where the use of a self-propelled paving machine is impractical.

(4) Field working period (allowable working time)

The time period from addition of water during the mixing process until the completion of compaction is nominated as the field working period.

The nominated field working period shall be provided in Stabilisation Mix Design for the stabilising agent approved as part of the pavement design. The Nominated field working period shall be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for standard compaction procedures decreases by more than 2 percentage points. This testing shall be undertaken utilising AS 1289.5.1.1 and samples of the materials representative of those to be utilised in the works. If the field working period is not specified as part of the pavement design, the maximum period between the commencement of mixing and the completion of compaction and trimming shall be 3 hours.

The Contractor will complete the compaction process within the Nominated field working period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions.

(5) Trimming and compaction

After mixing the layer shall be trimmed and compacted in accordance with sub-section SC6.4.6.12 Flexible pavements to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in clause SC6.4.6.19.4(7)(a) Levels and surface trim.

Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming shall involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurrying will not be accepted. The Contractor's survey control methods as stated in the work plan will be adequate to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent such that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified in clause SC6.4.6.19.4(7)(b) Layer thickness. When required by the Superintendent survey results shall be provided to confirm that the pavement layer thickness remains within tolerance after secondary

trimming.

Measurements with a 3m straight edge shall be taken at a minimum of ten randomly selected stations so as to represent each 200m lane length or part thereof. Deviation of the surface from the bottom of a 3m straight edge placed in any direction will meet the tolerance shown in clause SC6.4.6.19.4(7)(a). This testing will be undertaken immediately prior to sealing or prior to agreed practical completion for any work component.

The stabilised layer shall be compacted over the entire area and depth so that the relative compaction determined by AS 1289.5.1.1 is not less than as detailed in sub-sections SC6.4.6.12 Flexible pavements, SC6.4.6.10 Earthworks (construction) or SC6.4.6.4 Stormwater drainage as appropriate.

To provide true relative compaction assessments the lots shall be sampled and tested within the nominated field working period in accordance with AS1289.5.1.1.

The maximum wet density (standard compaction) will be determined by sampling immediately after the determination of field density and testing will be undertaken within 2 hours of sampling. A determination of maximum wet density (standard compaction) representing the full layer depth is required for each sampling location when calculation of relative compaction is undertaken.

The field density may be determined by in situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode in accordance with AS1289.5.8.1.

(6) Joints

Joints are defined in this sub-section to comprise interfaces between work episodes that are separated in time by more than the nominal field working period for the nominated stabilisation mix design. A longitudinal joint shall be considered to be a joint generally parallel to the road centreline. A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the nominated field working period.

All longitudinal and transverse joints shall be formed by cutting back into the previously stabilised and fully compacted sections. A minimum longitudinal overlap of mixing runs shall be 75mm. Transverse joints shall be overlapped by a minimum of 2m. The material disturbed during cutting back shall be remixed at full depth and incorporated into the new work. No longitudinal joints shall be allowed within 500mm of the centreline of a typical wheelpath.

The level and shape of the joints shall be within the limits specified in clause SC6.4.6.19.4(7) Tolerances.

(7) Tolerances

(a) Levels and surface trim

The surface level after primary trimming shall be within a tolerance of +30mm and +10mm of the levels shown on the drawings.

The surface level after secondary trimming shall be within a tolerance of +15mm and -15mm of the levels shown on the drawings.

The pavement surface after secondary trimming and immediately prior to sealing shall be of a quality such that deviation under a 3m straight edge does not exceed 12mm.

Ensure the final surface level is within ± 15mm of the design levels in the event only a single trim is carried out.

(b) Layer thickness

The final thickness of the stabilised layer at any point shall be within a tolerance of +20mm and 10mm of the nominated layer thickness.

The average thickness of the layer in a lot shall be determined from measurements of six randomly selected locations over any 200m length of a lot. The average thickness shall not be less than that

required to meet the specified final thickness tolerances after trimming.

The layer thickness shall be measured at the edges of the stabilising run after compaction commences. The layer thickness shall be measured relative to the finished design level.

(c) Width
The width measured at any point of the stabilised layer shall be not less than the specified width as shown in the drawings by more than 50mm.

The average width of the layer shall be determined from measurements at three sites selected at random by the Superintendent over any 200m length of a lot and shall be not less than the specified width.

(8) Curing
The Contractor shall submit to the Superintendent details of the proposed method of curing as part of the Work Plan.

The stabilised work shall be protected against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal.

Water curing shall consist of frequent light uniform spraying (using fine spray jets) that will not produce significant run off or flooding on sections of the area. Conventional spray bars and high pressure nozzles are not permitted. Slurrying of the surface or leaching of the stabilising agent shall be avoided.

Under this sub-section provision for curing up to the period indicated in the approved Stabilisation Mix Design shall be the responsibility of the Contractor.

(9) Trial section of stabilised earthworks
Prior to the commencement of works submit a trial section of stabilised earthworks to demonstrate the methods proposed to conform with this sub-section.

This trial section is constructed so that it may be incorporated in the finished work with a length of approximately 50m.

Construct the trial stabilisation using the materials, equipment and methods for placing and finishing the same as would be used for the entire stabilisation works. Demonstrate the methods proposed to be used for the construction of joints.

In the event of deficiencies in the stabilisation the trial section may not be approved. The method, equipment, materials and personnel will require to be reviewed and an explanation submitted. A further length of trial stabilisation may be requested. Non-conforming trial sections of stabilised earthworks must be removed to ensure preventing damage to the remaining stabilised earthworks and underlying materials. Dispose of the removed materials at an approved location.

(10) Insitu lime stabilisation of subgrade

Lime stabilisation of subgrade material shall be carried out as a two day operation to a minimum depth of 250mm, except for natural subgrades of CBR 0.5% where stabilisation depth shall be a minimum of 300mm. The stabilising agent shall be spread using a purpose built spreader and the stabilising agent and water shall be incorporated into the material using a reclaimer/stabiliser. Alternatively, a reclaimer/stabiliser with a calibrated integrated spreader/applicator may be used to incorporate the stabilising agent and water directly into the material to be stabilised. Where a reclaimer/stabiliser with calibrated integrated spreader/applicator is used, quicklime shall not be used as the stabilising agent.

Day 1: a single lime pass at a rate of up to half the required rate shall be applied. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the

requirements in this document. The depth of mixing shall not exceed 90% of the specified stabilisation thickness. The material shall be lightly rolled to seal the surface prior to the completion of work on that particular day.

Day 2: after the overnight amelioration period, the balance of the required lime shall be spread in accordance with the requirements in this document. Where quicklime is spread over the subgrade, it shall be slaked in accordance with the requirements in this document. In situations where hydrated lime is used, slaking is not required before mixing the stabilising agent into the soil. The hydrated lime or lime slurry formed from the slaking of quicklime shall then be mixed into the material in accordance with the requirements in this document. Notwithstanding this, a minimum of two mixing passes shall be completed.

Lime shall be spread at a maximum spread rate of 12kg/m2. The number of passes shall be calculated to comply with this requirement. The stabilising agent shall be uniformly spread over the insitu material at a controlled rate (mass per unit area, kg/m2). The total rate of spread shall be such that the stabilising agent spread rate for the compacted material is within the specified tolerances. Once the stabilising agent has been spread, no traffic, other than the construction plant employed for the stabilisation work, shall travel over it. After each spreading run at least one mixing run, and trimming and/or compaction as required, shall be completed. Further mixing operations between spreading runs shall comply with requirements in this document.

Quicklime shall be slaked with sufficient water to allow complete hydration such that the material remains friable after slaking and no further exothermic reaction occurs when further water is added to the lime. All through traffic shall be stopped during any slaking operation.

The entire stabilisation process shall not proceed in any of the following situations:

- during rainfall;
- when rainfall appears to be imminent;
- during periods when the wind is strong enough to cause particles of the stabilising agent to become airborne;
- during conditions that may result in the work causing nuisance or danger to people, property, the environment, or livestock;
- when the pavement temperature, measured 50mm below the surface, drops below 10°C; and
- when the air temperature, measured in the shade exceeds 40°C.

SC6.4.6.19.5 Limits and tolerances

The limits and tolerances applicable to the various clauses of this sub-section are summarised in Table SC6.4.6.19.3 Summary of limits and tolerances below.

Table SC6.4.6.19.3 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	Quicklime		
	a) Available Lime	>85% Calcium Oxide content	SC6.4.6.19.3(3) Quicklime
	b) Slaking Rate	Active Slaking time < 20 minutes, and temperature rise on slaking not less than 40ºC in 6 minutes (for an average of four samples).	SC6.4.6.19.3(3) Quicklime
	c) Particle Distribution	Fraction passing AS Sieve: 100% for 13.2mm Sieve 96-100% for 9.5mm Sieve 70-100% for 4.75mm Sieve 0-90% for 2.36mm Sieve	SC6.4.6.19.3(3) Quicklime
2.	Hydrated Lime		
	a) Available Lime	>80% Calcium Hydroxide	SC6.4.6.19.3(4) Hydrated Lime
	b) Particle Size	<2% residue on a 300 micron Sieve	SC6.4.6.19.3(4) Hydrated Lime

Item	Activity	Limits/Tolerances	Clause
3.	Blended Stabilising Agents	Blend percentages shall not vary by more than ±3% from those nominated in SC6.4.6.19 Attachment A (Stabilisation mix design)	SC6.4.6.19.3(7) Blended Stabilising Agents
4.	Water		
	a) Chloride ion content	<600 PPM Chloride ion	SC6.4.6.19.3(8) Water
	b) Sulphate ion content	<400 PPM Sulphate ion	SC6.4.6.19.3(8) Water
	c) Undissolved solids	<1% by mass of undissolved solids	SC6.4.6.19.3(8) Water
5.	Application of Stabilising Agent		
	a) Spread Rate or Incorporation Rate for in-situ plant.	Actual spread rate shall be within ±10% of the nominated rate	SC6.4.6.19.4(2) Application of Stabilising Agent
6.	Trimming and Compaction		
	a) Surface Level	After primary trimming be within +30mm and +10mm of levels shown on drawings After secondary trimming be within ±15mm of levels shown on drawings	SC6.4.6.19.4(7)(a) Tolerances
	b) Layer Thickness	Final thickness of layers shall not vary more than +20mm and -10mm of required thickness	SC6.4.6.19.4(7)(b) Tolerances
	c) Shape	Shall not deviate more than 12mm under a 3m straight edge immediately prior to first sealing	SC6.4.6.19.4(7)(a) Tolerances
7.	Joints		
	a) Longitudinal Overlap	> 75mm overlap of mixing runs	SC6.4.6.19.4(6) Joints
	b) Transverse Overlap	> 2m overlap of transverse joints	SC6.4.6.19.4(6) Joints
	c) Longitudinal Joints	Shall not be allowed within 0.5m of the centreline of a typical wheelpath	SC6.4.6.19.4(6) Joints
8.	Width		
	a) Width of Stabilised Layer	At any point, the width shall be not less than 50mm short of the width shown on the drawings with an average width always greater than that shown on the drawings.	SC6.4.6.19.4(7)(c) Tolerances

SC6.4.6.19 Attachment A: Stabilisation mix design

Click here to obtain a copy of the following form.

SC6.4.6.20 Subsoil, foundation and pavement drains

SC6.4.6.20.1 Introduction

(1) Scope

(a) The work to be executed under this sub-section covers the excavation, bedding, installation and backfilling of subsoil, sub-pavement, intra pavement, edge and foundation drains.

(b) Subsoil and foundation drains shall be constructed where and as shown on the drawings or as directed by the Superintendent.

(c) This sub-section should be read in conjunction with SC6.4.6.21 Subsurface drainage.

(d) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Order of construction

(a) Subsoil and sub-pavement drains
Subsoil drains shall be constructed as soon as possible after necessary earthworks are completed in the area of the drain. Where stabilisation of the subgrade is required, subsoil drains shall be constructed after completion of stabilisation, except where excessive ground water is encountered, they may be constructed prior to stabilisation of the subgrade.

Where a selected material zone is specified and excessive ground water is encountered, subsoil drains may be installed in two stages as follows:

(i) Stage 1: standard subsoil drains installed below the base of the cutting prior to placement of select material in the selected material zone; and

(ii) Stage 2: extension of subsoil drain to top of the selected material zone after placement of selected material.

(b) Intra-pavement drains
Intra-pavement drains shall be constructed after the completion of the layer below the pervious pavement material or 40mm open graded asphaltic concrete subbase and preceding the construction of the subsequent layers.

(c) Edge drains
Edge drains shall be constructed after the construction of the rigid pavement and before the placement and compaction of verge material.

(d) Foundation drains
Foundation drains shall be constructed after completion of clearing and stripping operations, and preceding the commencement of embankment construction.

(3) Terminology

Subsoil drains	are intended for the drainage of ground water and/or the pavement in cuttings.
Sub-Pavement Drains	are intended for the drainage of the pavement layers unless the subbase is open graded or pervious in nature in which case intra-pavement drains shall be provided.
Intra-Pavement Drains	are intended for the drainage of the pavement layers of a flexible pavement where the subbase comprises an open graded or pervious pavement material or open graded asphaltic concrete.
Edge Drains	are intended for the drainage of rigid pavements.
Foundation drains	are required for the drainage of seepage, springs and wet areas within and adjacent to the foundations.

(4) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with

this sub-section are as follows:
SC6.4.6.10 Earthworks (construction)
SC6.4.6.12 Flexible pavements
SC6.4.6.13 Asphaltic concrete
SC6.4.6.21 Subsurface drainage

(b) Australian Standards:

AS 1289.3.3.1	*Calculation of the plasticity index of a soil*
AS 1289.5.4.1	*Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 1289.5.6.1	(R2016) Methods of testing soils for engineering purposes Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

SC6.4.6.20.2 Construction

(1) Subsoil and sub-pavement drains

(a) Excavation

(i) Excavation shall be undertaken in accordance with the requirement of SC6.4.6.21 Subsurface drainage.

(ii) Trenches shall be trimmed to the required line and depth in accordance with the approved drain design specific to site conditions and as directed by the Superintendent.

(iii) The bottom of the trench shall be excavated to the same grade as the design pavement surface in the direction of the trench except where the grade of the design pavement surface in the direction of the trench is less than 0.25 per cent. In this case, the trench depth shall be increased to provide a minimum grade of fall in the trench of 0.25 per cent.

(iv) The bottom of the trench shall be excavated so that no localised ponding of water occurs. The bottom of the trench must not be more than 50 mm below the specified level of the invert of the pipe and ensure that the bottom and sides of the excavation are smooth with no protrusion that will damage the geotextile where required.

(v) If at any location the trench is excavated below the specified floor level, the trench shall be backfilled with non-porous subgrade material so that when the subgrade material is compacted to a relative compaction, determined by AS 1289.5.4.1, of at least 95 per cent (standard compaction), the bottom of the trench shall be at the specified floor level.

(vi) Where the drain is constructed in two stages, the excavation for Stage 2 shall be carried out after placement and compaction of the selected material zone or the stabilised subgrade layer. The Stage 2 trench shall be excavated to the same line and width as the Stage 1 trench and to a depth to provide a clean, full contact with the filter material placed in Stage 1. All excavated material shall be disposed to waste or incorporated into fills.

(vii) After the completion of excavation, the Contractor must present to the Superintendent the trench for inspection to ensure conformance with shape, grade line, filling and compaction and removal of any protrusions.

(b) Laying of pipe

(i) The 100mm diameter corrugated slotted plastic piping, complying with SC6.4.6.21 Subsurface drainage, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the specified line and grade. The pipe shall not deviate from the specified line by more than 100mm at any point

(ii) The type of filter material shall be shown on the drawings as per the requirements of SC6.4.6.21 Subsurface drainage and shall be confirmed by the Superintendent prior to placement of material.

(iii) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a cap.

(c) Backfilling

(i) The trench shall be backfilled with filter material to the level specified. The type of filter material shall be shown on the drawings as per the requirements of SC6.4.6.21 Subsurface drainage and shall be confirmed by the Superintendent prior to placement. The filter material shall be placed and

compacted in layers with a maximum compacted thickness of 300 mm. Tamping around and over the pipe shall be done in such a manner as to avoid damage or disturbance to the pipe.

(ii) The filter material shall be compacted for its full depth to a Density Index of not less than 70 per cent as determined by AS 1289.5.6.1.

(iii) The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with selected free draining backfill material, conforming to the requirements of SC6.4.6.10 Earthworks (construction), compacted for its full depth to a relative compaction of not less than 97 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iv) Where shown on the drawings or as directed by the Superintendent, a geotextile conforming with the requirements of SC6.4.6.21 Subsurface drainage, shall be provided at the interface between the filter material and adjoining materials. Cover the bottom and sides of the trench with sufficient free fabric to wrap around the completed drain. Conform to the shape of the trench with minimal wrinkles, folds or air voids between fabric and trench, but not stretched on the soil. Laps of 500mm shall be provided at joints in the fabric. The Contractor must take all reasonable care to ensure that the geotextile is not damaged during installation and backfilling operations. Ensure the period between initial laying out and final cover of the geotextile with drainage backfill layer does not exceed 14 days. Where possible place geotextiles just ahead of construction works and cover with materials within 48 hours. Any geotextile fabric exposed for longer than 14 days must be removed and replaced by the Contractor as directed by the Superintendent.

(v) Where the outlet section of pipes discharging through the fill batters, the trench shall be backfilled with the nominated filter material to a depth of 50mm above the pipe. The balance of trench shall be backfilled with earth backfill material of maximum particle size of 50mm and shall be compacted for the full depth to a relative compaction of 95 per cent (standard compaction) as determined by AS 1289.5.4.1.

(d) Outlets

(i) Outlets are to be provided at maximum intervals of 150m. Where possible, subsoil drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the drawings shall be constructed at the discharge end with appropriate treatment to address erosion of adjacent areas.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(e) Cleanouts

(i) Cleanouts are to be provided at the commencement of each run of subsoil drain line and at intervals of approximately 60m or as shown on the drawings.

(ii) Details of the required cleanout construction are shown on the drawings. The standard Cl caps as shown on the drawings shall be supplied by the Contractor.

(iii) Upon completion of backfilling, pump clean water into the cleanout at the commencement of each run until only clean water discharges at the outlet. The minimum rate of flow of flushing water at the inlet must be 100L/min.

(2) Intra-pavement drains

(a) Excavation

(i) A "V" shaped trench approximately 75mm deep shall be cut to the required line in the pavement layer immediately below the permeable pavement layer. No excavation is required below a 40mm open graded asphaltic concrete subbase layer.

(ii) The bottom of the trench is to be to the same grade as the roadway. The bottom of the trench shall be constructed so that localised ponding of water does not occur.

(iii) Where the pipe is to discharge through the fill batter a trench shall be constructed on a grade

suitable for the pipe to discharge its contents without scour. After laying the pipe the trench shall be backfilled with fill material and compacted for the full depth to a relative compaction of not less than 95 per cent (standard compaction) as determined by AS 1289.5.4.1.

(b) Laying of pipe

(i) Thick walled unplasticised PVC pressure pipe, complying with AS 1477, and having a nominal diameter of 58mm, and a minimum pipe wall thickness of 6.5mm, shall be used with crushed rock subbases having not more than 10 per cent of material passing the 9.5mm AS sieve and having layer thicknesses neither less than 150mm nor more than 200mm or open graded asphalt subbases having layer thicknesses neither less than 80mm nor greater than 100mm.

(ii) Where crushed rock subbases require pavement drains and have a depth exceeding 200mm, the type of pavement drain will need to be certified to have adequate crushing strength and a written approval from the Superintendent to the proposed pavement drain type will be required. Similar proposals shall require Superintendent and council approval for pavement drain in asphalt subbases greater than 100mm in depth.

(iii) All pipe shall be slotted except where otherwise shown on the drawings. Details of slot sizes and spacings shall be in accordance with SC6.4.6.21 Attachment A for thick walled unplasticised PVC pressure pipe.

(iv) Thick walled unplasticised PVC pressure pipe shall have square ends and shall be butt jointed.

(v) Where spigot and socket type pipes are used, the pipes shall be joined with the socket ends facing upstream.

(vi) The pipe shall be laid to the specified line and level. The pipe shall not deviate from the specified line by more than 100mm at any point.

(vii) The inlet ends of all pipes shall be fitted with caps.

(viii) All pipes shall be securely held to the layer under the free-draining subbase to prevent movement of the pipes during placement and compaction of the free draining subbase. At least 7 days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes to the layer under the free-draining subbase for the approval of the Superintendent.

(ix) Notwithstanding the Superintendent's approval to the use of a method of securing the pipes to the layer under the free draining subbase, if such securing method allows movement of the pipes, the method shall be discontinued and the Contractor shall propose an alternative securing method for approval by the Superintendent.

(x) Any additional costs resulting from the use of the alternative method of securing the pipes shall be borne by the Contractor.

(xi) The outlet length of pipe from the outside edge of the free-draining subbase to an outlet structure in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with suitable couplings or mastic.

(c) Backfilling

(i) Subbase material shall be spread, compacted and trimmed, where appropriate, as follows:

(A) for crushed rock subbase, in accordance with sub-section SC6.4.6.12 Flexible pavements; and

(B) for open graded asphalt subbase, in accordance with sub-section SC6.4.6.13 Asphaltic concrete.

(ii) Tipping, spreading and compaction of the subbase shall be undertaken in such a manner as not to damage the intra-pavement drain pipes. If any pipes are damaged as a result of the tipping, spreading and compaction of the subbase, the Contractor shall remove and replace the damaged pipes.

(iii) The cost of the removal and replacement of such damaged pipes shall be borne by the Contractor.

(iv) The thickness of the layer of subbase material enclosing the pipe shall be within the limits specified in clause SC6.4.6.20.2(b) Laying of pipe for the type of pipe used in the intra-pavement drain.

(d) Outlets

(i) Outlets are to be provided as shown on the drawings or at maximum intervals of 150m. Where possible intra-pavement drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, each pipe shall be extended using a 60 degree bend and unslotted pipe to discharge through the fill batter and an outlet structure constructed on the discharge end in accordance with the drawings.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(iv) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a PVC cap.

(3) Edge drains

(a) Excavation

(i) The verge material shall be trimmed to subgrade level and to the minimum width shown on the drawings. The bottom of the trench is to be constructed at the same grade as the roadway and in such a manner that localised ponding of water does not occur.

(ii) Where the grade of the roadway is less than 0.25 per cent the trench shall be excavated to provide a minimum grade of 0.25 per cent.

(iii) When the pipe is to discharge through the fill batter a suitable trench shall be excavated to provide the required grade.

(b) Laying of pipe

(i) Generally, 65mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric, complying with SC6.4.6.21 Subsurface drainage, shall be used for edge drains.

(ii) Where any part of a shoulder consists of material other than concrete, slotted thick walled unplasticised PVC pressure pipe, complying with AS 1477, shall be used. Spigot and socket type pipes shall be joined with the socket ends facing upstream and the ends of each pipe shall be securely held against the vertical face of the rigid pavement. At least seven days before commencement of pipe laying, the Contractor shall submit details of the proposed method of securing the pipes against the rigid pavement for the approval of the council.

(iii) The pipe shall be laid on a prepared bed to the specified line and level. The pipe shall not deviate from the specified line by more than 100mm at any point.

(iv) Joints in the pipe shall be kept to a minimum number and shall be made using an external joint coupling approved by the Superintendent.

(v) The inlet end of the pipe shall be fitted with a cap.

(vi) The outlet section of a pipe from the vertical face of the rigid pavement to an outlet in the embankment batter shall be unslotted and the pipe joints in this length of pipe shall be sealed with mastic.

(c) Backfilling

(i) The pipe shall be covered with Type B filter material to the dimensions shown on the drawings.

(ii) Mechanical compaction of this filter material is not required, however after placement of the filter material it shall be soaked with water. Where necessary additional filter material shall be added and soaked to provide the final dimensions shown on the drawings.

(iii) Backfilling over the edge drain shall be done in such a manner as to avoid damage or disturbance of the pipe. Backfill material shall be selected material as required for verges and in accordance with the requirements of sub-section SC6.4.6.10 Earthworks (construction). Backfilling shall be compacted to a relative compaction of not less than 100 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iv) Upon completion of backfilling, pump clean water into the cleanout at the commencement of each

run until only clean water discharges at the outlet. The minimum rate of flow of flushing water at the inlet must be 100L/min.

(d) Cleanouts

(i) Cleanouts are to be provided at the commencement of each run of edge drain line and at intervals of approximately 60m or as shown on the drawings.

(ii) Details of the required cleanout construction are shown on the drawings. The standard CI caps as shown on the drawings shall be supplied by the Contractor.

(e) Outlets

(i) Unless otherwise shown on the drawings outlets are to be provided at maximum intervals of 150 m. Where possible edge drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the drawings shall be constructed at the discharge end.

(ii) The outlet shall be made rodent proof in accordance with the requirements of SC6.4.6.21 Subsurface drainage.

(iii) The outlet shall be located so that erosion of the adjacent area does not occur, or shall be protected by the placement of selected stone in the splash zone of the outlet.

(4) Foundation drains

(a) Excavation

Excavation shall be undertaken in accordance with the requirements of SC6.4.6.21 Subsurface drainage and clause SC6.4.6.20.2(1) Subsoil and sub-pavement drains of this sub-section.

(b) Laying of pipe

(i) The 100mm diameter corrugated slotted plastic piping, complying with SC6.4.6.21 Subsurface drainage, shall be laid on a bed of filter material 50mm in thickness and shall be laid to the required line and grade.

(ii) The type of filter material shall be shown on the drawings as per the requirements of sub-section SC6.4.6.21 Subsurface drainage or as directed by the Superintendent.

(iii) Joints in the pipeline shall be kept to the minimum number and, where required, shall be made using a suitable external joint coupling. The inlet end of the pipe shall be fitted with a PVC cap.

(c) Backfilling

(i) The trench shall be backfilled with filter material in accordance with the provisions of clause SC6.4.6.20.2(3)(c) Backfilling.

(ii) The upper section of the trench, above the level specified for filter material backfill, shall be backfilled with suitable earth backfill material, compacted for its full depth to a relative compaction of not less than 97 per cent (standard compaction) as determined by AS 1289.5.4.1.

(iii) Where shown on the drawings or as directed by the Superintendent, a geotextile, conforming with the requirements of SC6.4.6.21 Subsurface drainage, shall be provided at the interface between the filter material and adjoining materials. Laps of 500mm shall be provided at joints in the fabric.

(d) Outlets

An outlet structure in accordance with the detail shown on the drawings and SC6.4.6.21 Subsurface drainage shall be constructed at the discharge end.

The outlet shall be located so that erosion of the adjacent area does not occur or shall be protected by the placement of selected stone in the splash zone of the outlet.

SC6.4.6.20.3 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.20.1 Summary of limits and tolerances below.

Table SC6.4.6.20.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation**		SC6.4.6.20.2(3)(a)
	Trench Grade	0.25%	
2.	**Laying of Pipe**		
	• Alignment	Deviation <100mm from specified line at any point	SC6.4.6.20.2(3)(b)
3.	**Subsoil and Sub-Pavement Drain Backfill**		
	(a) Layer thickness	300mm max	SC6.4.6.20.2(3)(c)
	(b) Compaction (Relative)	70% Density Index	SC6.4.6.20.2(3)(c)
	Filter material	97% (Standard)	
	Backfill material		
4.	**Outlet Spacing**	150m max	SC6.4.6.20.2(3)(d)
5.	**Cleanout Spacing**	60m approx	SC6.4.6.20.2(3)(d)
6.	**Intra-Pavement Drain**		
7.	(a) Alignment	Deviation <100mm from specified line at any point.	SC6.4.6.20.3(b)
	Edge Drains		
	(a) Alignment	Deviation <100mm from specified line at any point	SC6.4.6.20.3(b)
	(b) Compaction (Relative) Backfill material	97% Standard	SC6.4.6.20.3(c)

SC6.4.6.21 Sub-surface drainage

SC6.4.6.21.1 Introduction

(1) Introduction

This is the general specification common and applicable to all types of subsurface drainage and must be read in conjunction with subsurface drainage sub-sections:

(a) SC6.4.6.20 Subsoil, foundations and pavement drains; and

(b) SC6.4.6.8 Drainage mats.

(2) Scope

(a) The work to be executed under this sub-section consists of:

(i) preparation for subsurface drainage construction;

(ii) siting of subsurface drainage facilities;

(iii) the supply of all materials associated with the provision of the subsurface drainage system;

(iv) all activities and quality requirements associated with the supply, placement and compaction of filter material;

(v) the provision of a detailed record of all subsurface drain installations; and

(vi) the marking on the ground of the location of all subsurface drains.

(b) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Supervision and construction guidelines.

(3) Extent of work

Details of the work are to be shown on the approved drawings.

(4) Temporary drainage during construction

(a) All drainage works carried out by the Contractor must provide measures of erosion and sedimentation in accordance with the requirements of the accepted project erosion and sediment control plan and/or *Best Practice Erosion and Sediment Control* and make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.

(b) The Contractor must make adequate provision for runoff flows at subsurface drainage works under construction, to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures as a result of the Contractor's activities.

(c) The Contractor's material and equipment must be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows.

(5) Siting of work

(a) Before commencing construction of any subsurface drainage activity, the Contractor must set out on site the position of the work to the location and levels shown on the drawings, and must present this set-out for inspection by the Superintendent.

(b) The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions. Should the Superintendent require a change to the conditions of installation an appropriate variation must be ordered.

(c) Should the Contractor propose changes to the location, length, designed levels, conditions of installation or cover to suit the Contractor’s construction procedures, the Contractor must present the proposed set-out in addition to the designed set-out for consideration by the Superintendent. No changes shall be made unless the prior written approval of the Superintendent is obtained.

(6) Excavation

(a) In undertaking trench excavation the Contractor must provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

(b) Where public utilities exist in the vicinity of drainage works the Contractor must obtain the approval of the relevant authority/corporation to the method of excavation before commencing excavation.

(c) Excavation by blasting, if permitted, must be carried out to ensure that the peak particle velocity measured on the ground adjacent to any previously installed structure does not exceed 25 millimetres per second. The Contractor must comply with other requirements concerning blasting operations in SC6.4.6.10 Earthworks (construction).

(d) Trenches must be excavated to the line, grade, width and depth shown on the drawings or as directed by the Superintendent. The bottom of the trench must be constructed so that no localised ponding can occur. All loose material must be removed by the Contractor.

(e) Any material at the bottom of the trench or at foundation level which the Superintendent deems to be unsuitable must be removed and disposed in accordance with SC6.4.6.10 Earthworks (construction) by the Contractor and replaced with backfill material in accordance with the requirements of this sub-section. The bottom of the excavated trench or foundation, after any unsuitable material has been removed and replaced, must be parallel with the specified level or grade of the pipe.

(f) The excavated material shall be used in the construction of embankments backfilling or spoiled in accordance with SC6.4.6.10 Earthworks (construction).

(7) Backfilling

Backfilling must be carried out in accordance with the requirements of the relevant subsurface drainage structures sub-sections.

(8) Outlet structures for subsurface drainage

(a) Subsurface drainage pipes must be connected to discharge into gully pits or to outlet structures as shown on the drawings or as directed by the Superintendent.

(b) Outlets must be spaced at a maximum interval of 150m.

(c) Outlets, including those discharging into gully pits, must be made rodent proof using galvanised wire netting unless otherwise indicated on the approved drawings.

(d) The outlet must be located so that erosion of the adjacent areas does not occur or must be protected by the placement of selected stone or similar treatment together with a marker post to indicate location and assist maintenance.

(e) Outlet pipes from curtain drains must be unslotted. At no point shall an outlet pipe be higher than the pipe at the end of the curtain drain.

(f) All concrete used in the construction of outlet structures must conform to the requirements of sub-section SC6.4.6.28 Minor concrete works.

(9) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:
SC6.4.6.10 – Earthworks (construction)
SC6.4.6.28 - Minor concrete works

(b) Australian Standards:

AS 1141.11.1	*Particle size distribution - Sieving method*
AS 1141.22	*Wet/dry strength variation*
AS 1289.5.5.1	*Determination of the minimum and maximum dry density of a cohesionless material – Standard method*
AS 1477	*PVC pipes and fittings for pressure applications*
AS 2439.1	*Perforated drainage pipe and associated fittings*
AS 2758.1	*Aggregates and rock for engineering purposes – Part 1: Concrete aggregates*
AS 3705	*Geotextiles - Identification, marking and general data*

AS 3706	*Geotextiles - Methods of test*
AS 3706.9	*Determination of permittivity, permeability and flow rate*
AS 3706.11	*Determination of durability - Resistance to degradation by light, heat and moisture*

(c) Other:

Austroads, *Guide to Pavement Technology - Part 4G Geotextiles.*

ASTM International, ASTM-D2434-68 – *Standard test method for permeability of granular soils (Constant Head)*

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

SC6.4.6.21.2 Materials

(1) Corrugated plastic pipe

(a) Corrugated plastic pipe must be Class 1000 complying with AS2439.1 of 65mm or 100mm diameter as indicated on the drawings. All pipe must be slotted except where shown on the approved drawings.

(b) Joints, couplings, elbows, tees and caps must also comply with AS2439.1 and only the manufacturer's recommended fittings shall be used.

(c) The Contractor must obtain from the Manufacturer Test Certificate demonstrating compliance with AS2439.1.

(2) Other types of subsurface drainage

Where a Contractor wishes to use a subsurface drainage pipe other than corrugated plastic pipe, the Contractor must submit full details of the type of pipe, certification from the manufacturer of its suitability and quality and written acceptance by the council for its use in each particular application. Certification of the suitability of any pipe must address the crushing strength, flexural strength, jointing system and slotting details.

(3) Filter material

(a) General

The types of filter material covered by this sub-section shall include:

(i) Type A filter material for use in trench drains and Type B drainage mats;

(ii) Type B filter material for use in trench drains and Type B drainage mats;

(iii) Type C filter material comprising crushed rock for use in Type A drainage mats; and

(iv) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

All filter material must consist of clean, hard, tough, durable particles. A sample of the proposed filter material must be submitted to the Superintendent for approval.

(b) Type A filter material

Type A filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.1.

Table SC6.4.6.21.1 Type A filter material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	6.7mm	100
	4.75mm	85 to 100
	2.36mm	0 to 40
	1.18mm	0 to 5
	425µm	0 to 2

(c) Type B Filter Material

Type B filter material must be granular material complying with the following grading requirements in Table SC6.4.6.21.2.

Table SC6.4.6.21.2 Type B filter material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	4.75mm	100
	2.36mm	95 to 100
	425µm	20 to 80
	300µm	0 to 30
	150µm	0 to 2
	75µm	0 to 0.1

In addition to the above grading requirements, Type B filter material must have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS1289.5.5.1 and then tested in accordance with Test Method ASTM D2434 68, of at least 8m per day after 3 hours of flow.

Type B filter material must not vary from its original grading as a result of compaction processes by more than the following amounts listed in Table SC6.4.6.21.3.

Table SC6.4.6.21.3 Type B filter material variation

AS Sieve	Variation From Grading Before Treatment (per cent of mass)
2.36mm	± 3
1.18mm	± 1
425µm	± 1
300µm	± 1
150µm	± 0.5
75µm	± 0.1

(d) Type C Filter Material

Type C filter material must be crushed rock complying with the following requirements in Table SC6.4.6.21.4.

Table SC6.4.6.21.4 Type C Filter Material

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	37.5mm
	Maximum passing the 9.5mm AS Sieve	5% by mass
	Maximum (D90:D10)*	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

Note—the D90 value must be determined by sieving the material using 75mm, 53mm, 37.5mm, 26.5mm, 19mm, 13.2mm and 9.5mm AS sieves, as appropriate, and then plotting the results on a graph of AS sieve size v percentage passing. The plotted points must be joined by straight lines and the D90 must shall be determined as the theoretical sieve size corresponding to 90 per cent passing.

D10 denotes the theoretical size of a sieve through which 10 per cent of the material would pass and must be determined from the same graph used to determine the D90 value.

(e) Type D Filter Material

Type D filter material must be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS2758.1 and the following requirements in Table SC6.4.6.21.5.

Table SC6.4.6.21.5 Type D Filter Material

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	75mm
	Maximum passing the 9.5mm AS sieve	5% by mass
	Maximum (D90 : D10)	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

(4) Geotextile

Prior to placing geotextiles, documentary evidence that the geotextile and installation process conform to the requirements of this sub-section must be produced and submitted to the Superintendent.

(a) General

The geotextile, other than seamless tubular filter fabric, must consist of either a woven or a non-woven type which must be manufactured from synthetic materials other than polyamide. Rolls of geotextile shall be marked with product identification and supplied with data sheets and information in accordance with the requirements of AS 3705.

The geotextile must be bio stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents when tested in accordance with the appropriate parts of AS3706.

The geotextile must be resistant to ultra violet light. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of 21 days. If exposure in excess of 21 days does occur, the geotextile must be tested in accordance with AS 3706.11 and if its characteristics have deteriorated to or below 90 per cent of the characteristics claimed by the manufacturer or the characteristics determined on unexposed geotextile, whichever is the better, it must be removed and replaced with a geotextile complying with this specification.

The geotextile material type, strength rating “G”, and minimum mass requirements must be as shown on the drawings.

The type, properties, functions, design and construction requirements for a particular application of geotextile installation must be compatible with recommendations provided by the Guide to Pavement Technology – Part 4G, as well as requirements indicated on the drawings.

In addition to the above mentioned requirements, geotextiles for curtain drains must consist of either polyester, polypropylene or polyethylene. The required rates of water flow are shown on Table 4.1 of Guide to Pavement Technology – Part 4G, under 100mm constant head determined using the perpendicular flow test to conform with AS3706.9.

(b) Seamless tubular filter fabric

Seamless knitted tubular filter fabric must be used to enclose all slotted pipes and must be manufactured from either polypropylene or polyester. The fabric must be free of imperfections in weave or yarn and have abrasion resistant and weave stability qualities such that it shall not form holes, ladder, deweave, tear or unravel more than 5mm from a cut end.

Fitting of the seamless tubular filter fabric must be in accordance with the requirements of SC6.4.6.21 Attachment A. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying will be removed and replaced so as to eliminate any damaged lengths.

SC6.4.6.21.3 Recording of subsurface drainage information

(1) The Contractor must keep a detailed record of all subsurface drainage pipes and the completed subsurface drainage systems must be shown on the work as executed plans to be returned to the Superintendent upon completion of work.

In addition, the Contractor must prepare a subsurface drainage information sheet or sheets; at the completion of construction of each drain or drainage system and must submit the subsurface drainage sheet or sheets to the Superintendent within 5 working days of the completion of the drain or drainage system.

SC6.4.6.21.4 Limits and tolerances

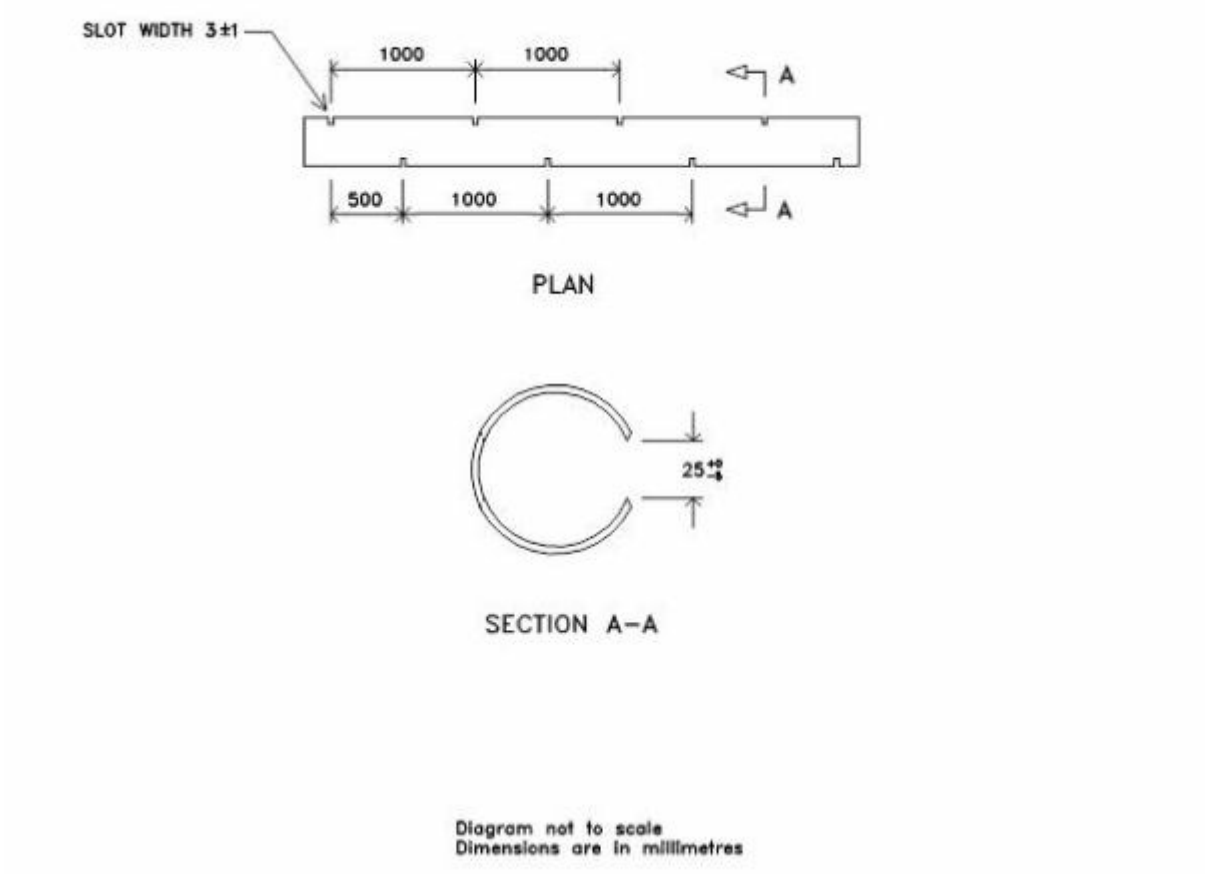
The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.21.6 Summary of limits and tolerances below.

Table SC6.4.6.4.21.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Excavation by Blasting** Peak particle velocity	25mm/s	SC6.4.6.21.1(6)
2.	**Outlets** Spacing	Max 150m	SC6.4.6.21.1(8)
3.	**Filter Material**		
	(a) Type A	Table SC6.4.6.21.1	SC6.4.6.21.2(3)
	(b) Type B	Tables SC6.4.6.21.2 and SC6.4.6.21.3	SC6.4.6.21.2(3)
	(c) Type C	Table SC6.4.6.21.4	SC6.4.6.21.2(3)
	(d) Type D	Table SC6.4.6.21.5	SC6.4.6.21.2(3)
4.	**Geotextile**		
	(a) Exposure to sunlight	<21 days If >21 days deterioration not to exceed 10% of claimed characteristics	SC6.4.6.21.2(4)

Attachment A

Figure SC6.4.6.21.1 Slotting details for thick walled PVC plastic pipe



1. Slotted pipes fitted with seamless tubular filter fabric

(a) Procedure for fitting seamless tubular filter fabric to slotted pipe

(i) Seamless tubular filter fabric must be fitted to slotted pipe immediately before the slotted pipe is to be laid in its final position in the work.

(ii) The filter fabric must be initially pulled over and onto a short length of smooth pipe of internal diameter between 20mm and 30mm greater than the external diameter of the slotted pipe to be enclosed by filter fabric. The short, larger diameter pipe must be referred to as the "mandrel".

(iii) The pipe to be enclosed by the filter fabric must be passed through the mandrel. The filter fabric must be slipped on to the pipe as the pipe emerges from the mandrel leaving enough overhang of the filter fabric to make a suitable joint with the filter fabric on the adjacent pipe. The filter fabric must be firmly held to the forward end of the pipe so that it cannot slip back along the pipe.

(iv) The pipe must be pulled right through the mandrel allowing the filter fabric to progressively slip over the pipe. The filter fabric shall be restrained from easily slipping off the mandrel thus ensuring the filter fabric is stretch fitted onto the pipe.

(v) When the end of the pipe emerges from the mandrel, the filter fabric must be clamped to that end of the pipe so that the filter fabric cannot slip down the pipe. The filter fabric must remain clamped to each end of the pipe to ensure the filter fabric remains stretch fitted onto the pipe when the pipe is placed in its final position in the drain. The filter fabric must be cut cleanly leaving enough overhang off the end of the pipe to make a fully covered join with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

(b) Precautions to be taken when using slotted pipe fitted with seamless tubular filter fabric

(i) Slotted pipe fitted with seamless tubular filter fabric must not be dragged over the ground. If carried, the pipe must be lifted clear of the ground and the filter fabric must be protected from damage at all times.

(ii) Seamless tubular filter fabric which has been so damaged as to affect its filtering properties must be removed from the pipe and replaced with undamaged filter fabric.

(iii) If at any time during the installation of a slotted pipe it is found that the enclosed filter fabric has become loose on the pipe it must be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric must be removed from the pipe and replaced with undamaged filter fabric.

SC6.4.6.22 Pavement markings

SC6.4.6.22.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for the removal, setting out, supply and application of pavement marking paint, thermoplastic pavement marking material, pavement marking tape and raised pavement markers. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS1580.205.4	*- Paints and related materials – Methods of test – Application properties – Airless spraying*
AS1906.3	*- Raised pavement markers (retroreflective and non-retroreflective)*
AS2009	*- Glass beads for pavement-marking materials*
AS2700	*- Colour Standards for general purposes*
AS4049.1	*- Solvent-borne paint - For use with surface applied glass beads*
AS4049.2	*- Thermoplastic pavement marking materials - For use with surface applied glass beads*
AS4049.3	*- Waterborne paint - For use with surface applied glass beads*

(c) Queensland Department of Transport and Main Roads Publications:

Manual of Uniform Traffic Control Devices (MUTCD)

Guide to pavement markings (GTPM)

Q513 *Wet Film Thickness of Paint (Wheel Gauge), Materials Testing Manual*

MRS45 *Road Surface Delineation*

Traffic and Road Use Management Manual (TRUM):

- TRUM 1.34 - Coloured surface treatments for bicycle lanes, Volume 1: Signing and pavement marking
- TRUM 3.23 - School zones, Volume 3: Road Safety

(d) Other:

Australian Paint Approval Scheme – Specification 0041/4 - Roadmarking paint, thermoplastic

Australian Paint Approval Scheme – Specification 0041/5 - Roadmarking paint, water borne

(3) Type of markings

Details of the various types of pavement markings and devices are in accordance with the requirements of the MUTCD, TRUM and GTPM.

Colours

White paint must have a colour equivalent to or whiter than Off White, Colour Y35 in AS2700.

Where yellow is used, the colour shall be equivalent to Y12, Wattle or Y14, Golden Yellow as detailed in AS2700 or any other colour deemed to lie between these two colours.

Where Green is used as a coloured surfacing on bicycle lanes, guidance on the application of green coloured surface treatments is contained within TRUM 1.34. The colour must be equivalent to Emerald, Colour G13; Traffic Green, Colour G16 or Shamrock, Colour G23 in AS2700. Where only one shade of each colour is specified, Traffic Green, Colour G16 is used.

(4) Types of materials to be applied
The materials shall be applied as follows:

(a) Pavement marking paint
Permanent markings on all wearing surfaces. Temporary markings, other than on the final wearing surfaces. Traffic islands and kerbs where specified;

(b) Thermoplastic pavement marking material
Permanent markings where explicitly indicated on the drawings;

(c) Pavement marking tape
Temporary markings on final wearing surfaces;
Temporary raised pavement markers (TRPMs);
Temporary markers fixed on any surface as a temporary marking.

(d) Reflective glass beads
To be applied to all painted and thermoplastic markings; and

(e) Raised pavement markers
Studs which may be retroreflective (RRPM) or non-retroreflective (NRPM) set into the roadway or attached to the road surface with adhesives, lane dividers, or pavement bars are installed as permanent as shown on the drawings.

(5) Material quality
The Contractor shall submit to the Superintendent NATA Registered Laboratory Test Reports, at least 7 days before work is scheduled to commence, on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use.
Only materials conforming to the requirements of the referenced Specifications/Standards shall be used.

(6) Setting out
The Contractor shall set out the work "spotting" to ensure that all markings are placed in accordance with the drawings.
The locations of pavement markings shall not vary by more than 20mm from the locations shown on the drawings. Spotting for longitudinal lines is generally at 10m intervals with 3m intervals on curves of less than 50m radius.
The contractor must obtain approval from the administrator of the spotting prior to any application of pavement marking.

(7) Surface preparation
Surfaces which are to receive pavement markings shall be cleaned of all dirt, loose material and other contaminants. Pavement surfaces shall be thoroughly dry immediately prior to the application of pavement markings. Pavement marking shall not be carried out during wet weather or, if rain is likely to fall during the process.
In all cases, the reinstatement of longitudinal markings, particularly barrier lines and dividing lines, should occur as soon as possible after the new seal has been laid.
Where raised pavement markers are specified for pavements having a concrete wearing surface, the full area under each raised pavement marker shall be lightly scabbled to remove fine mortar material (laitance).
All painted markings whether installed by machine or hand are retroreflectorised by the application of drop-on glass beads (ballotini).

(8) Provision for traffic and protection of work
In accordance with MUTCD, Part 3 Works on Roads, and SC6.4.6.30 Control of traffic while undertaking the work and shall protect the pavement markings until the material has hardened sufficiently (no pick-up) so that traffic will not cause damage.

(9) Maintenance of pavement markings
The Contractor shall be responsible for the maintenance, and replacement if necessary, of raised pavement markers and all pavement marking during the contract period and the contract defects liability period.
Council requires all linemarking to be refreshed prior to to the end of the Defects Liability Period.

SC6.4.6.22.2 Pavement marking paint

(1) Materials

Paint shall comply with the requirements of AS4049.1 or AS4049.3. In this sub-section, the term “paint” shall mean “pavement marking paint”.

Glass beads shall comply with the requirements of AS2009 for drop-on beads.

(2) Mixing of paint

All paint shall be thoroughly mixed in its original container before use in accordance with the manufacturer’s recommendations to produce a smooth uniform product consistent with the freshly manufactured product.

(3) Application of paint and beads

All longitudinal lines shall be sprayed by an approved self-propelled machine. Line must have uniform thickness and intensity. Two coats of paint and glass beads shall be applied on longitudinal lines to new surfaces. The first coat shall be cured to “no pick up time” prior to the application of the second coat. The two sets of lines forming a one way or two way barrier line pattern shall be sprayed concurrently.

Hand spraying with the use of templates to control the pattern and shape shall be permitted for transverse lines, symbols, legends, arrows and chevrons.

The paint shall be applied uniformly and the wet film thickness shall be neither less than 0.35mm nor more than 0.4mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 1.3kg/sqm immediately after application of the paint. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

Glass beads shall be similarly applied to all other paint markings at a net application rate of 0.3kg/sqm immediately after application of the paint by an applied method.

Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the surface of the pavement.

The lengths and widths of longitudinal lines and transverse lines must be within the tolerance specified in MUTCD/GTPM and MRST45.

The dimensions of arrows, chevrons and speed markings must be within the tolerances specified in MUTCD/GTPM as appropriate.

Arrows and speed markings shall be placed square with the centreline of the traffic lane.

Glass beads shall be uniformly incorporated in all coats of paint concurrently with the application of the paint.

Longitudinal line marking, when applied, must have a minimum retroreflectivity of 350mcd/lux/m2 measured between 10 and 20 days of wear.

(4) Field testing

The thickness of the wet film applied to the road pavement shall be checked by the method described in AS1580, comb gauge or test Q513 – (07/10).

The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

(5) Application rates

The minimum application rates for the paint and glass beads shall be as specified in Table SC6.4.22.1.

Table SC6.4.6.22.1 Application rates for paint and glass beads

Work type	Coverage (minimum per coat)	Wet application rate
Longitudinal lines – first coat Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Longitudinal lines – second coat Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Longitudinal lines – repaint Type B (drop-on beads)	> 200g/m^2	0.300L/m^2 ± 0.20
Longitudinal lines – second coat or repaint applying Type D beads	> 400g/m^2	0.500L/m^2 ± 0.25
Transverse lines – Type B (drop-on beads)	> 300g/m^2	0.375L/m^2 ± 0.25
Transverse lines – Type D beads	> 400g/m^2	0.500L/m^2 ± 0.25

Source: MRTS 45

The combination application rates for anti skid and glass beads shall not exceed the values specified above and in SC6.4.6.22.2(6) unless specified by the manufacturer.

Table SC6.4.6.22.2 Volume of glass beads (ml) required in 10 seconds of operation

Road Speed km/h	Line Widths			
	75mm	**100mm**	**125mm**	**150mm**
8	371	495	619	742
13	603	804	1006	1207
16	742	990	1238	1484

Note—

1. Tolerance of +10% shall be permissible when measuring the above volume.
2. When two or more glass bead dispensers are to be used, each dispenser shall be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53g/ml.

(6) Anti skid

Transverse markings shall incorporate an anti skid treatment with a skid resistance greater than 45 BPN. The application of anti-skid shall comply with the manufacturer's requirements.

SC6.4.6.22.3 Thermoplastic pavement marking material

(1) Primer

A primer, of the type recommended by the manufacturer of the thermoplastic material, shall be applied to the surface immediately in advance of, but concurrent with, the application of thermoplastic material.

The primer shall be applied at the application rate recommended by the manufacturer and shall not be thinned.

(2) Application of thermoplastic material

Thermoplastic material may be applied by screeding, extrusion or profiling or as preformed material.

Thermoplastic material shall be applied to the pavement at a temperature between 180ºC and 200ºC unless a different temperature is recommended by the manufacturer.

The pavement surface to which thermoplastic material is applied shall be completely coated by the material and any voids in the pavement surface shall be filled.

(3) Application rate

Thermoplastic material shall be applied at the minimum thickness specified in Table SC6.4.6.22.3.

Location	Minimum application thickness (mm)
Longitudinal lines	2
Transverse markings	2

Editor's note - the term “thermoplastic material” shall mean “thermoplastic pavement marking material”.

Where specified, glass beads shall be applied immediately to the surface of the molten thermoplastic material at a rate of not less than 0.12kg/m2.

(4) Materials

Thermoplastic pavement marking material shall comply with the requirements of AS4049.2.

Glass beads shall be incorporated in thermoplastic material, in the proportion of 10% of the total mass, as part of the aggregate constituent and shall comply with the requirements of AS2009, Intermix type.

Glass beads for surface application shall comply with the requirements of AS2009, Drop-on beads.

Tack coat material shall be to the manufacturer's specification.

(5) Preparation of thermoplastic material on site

Immediately before application, the thermoplastic material shall be uniformly heated in a suitable oil bath kettle to the temperature recommended by the manufacturer. The thermoplastic material shall not be heated above the temperature recommended by the manufacturer. The thermoplastic material shall not remain molten for more than 6 hours for hydrocarbon resins and 4 hours for wood and gum resins. Should over-heating occur and/or the time expires for molten materials, then the thermoplastic material shall be discarded.

(6) Application of thermoplastic material and beads

Where the wearing surface of the pavement is smooth or polished, a tack coat of material may be required by the Superintendent and shall be applied in accordance with the recommendations of the thermoplastic manufacturer. The tack coat shall be applied immediately before the application of the thermoplastic material in accordance with the directions of the manufacturer of the thermoplastic material and the manufacturer of the tack coat material.

All longitudinal lines shall be sprayed by a self-propelled machine. The two sets of lines forming a one way or two way barrier line shall be sprayed concurrently. The thermoplastic material shall be applied uniformly and the cold film thickness shall be 2mm with a tolerance of plus or minus 0.5mm.

Glass beads shall be applied by air propulsion to the surface of all longitudinal lines at a net application rate of 0.3kg/sqm immediately after application of the thermoplastic material. The actual application rate shall be set to overcome any loss of beads between the bead dispenser and the sprayed line.

All transverse lines, symbols, legends and arrows shall be screeded. The screeded thermoplastic material shall be applied using a mobile applicator, and templates to control the pattern.

Preformed thermoplastic sheeting applied in accordance with manufacturer’s specifications is an approved process.

The thermoplastic material for transverse lines, symbols, legends and arrows shall be applied uniformly and the cold film thickness shall be 3.5mm with a tolerance of plus or minus 1.5mm. The surface finish shall be smooth.

Glass beads for other than longitudinal lines shall be uniformly applied to screeded markings at a net application rate of 0.3kg/sqm immediately after application of the thermoplastic material.

Pavement marking must be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a

neat and smooth marking on the wearing surface of the pavement.

The lengths of longitudinal lines shall not vary by more than 20mm from the lengths shown in MUTCD/GTPM. The widths of longitudinal lines shall not vary by more than 10mm from the widths shown in MUTCD/GTPM. The lengths and widths of transverse lines shall not vary by more than 10mm from the lengths and widths shown in MUTCD/GTPM.

The dimensions of arrows, chevrons and speed markings shall not vary by more than 50mm from the dimensions shown on the drawings or in MUTCD/ GTPM as appropriate. Arrows and speed markings shall be placed square with the centreline of the traffic lane.

(7) Field testing
The thickness of the cold film of thermoplastic material applied to the road pavement shall be checked by measurement, using a micrometer, of the thickness of thermoplastic material applied to a metal test plate. The application rate of glass beads applied to the surface of the markings shall be checked by the method described in SC6.4.6.22 Attachment A Procedure for measurement of rate of application of spherical glass beads.

SC6.4.6.22.4 Pavement marking tape

(1) Materials
Pavement marking tape shall be a strippable type of tape, such as “Staymark Detour Grade”, or equivalent tape approved by the Superintendent. Pavement marking tape must only be used on temporary works.

(2) Application of pavement marking tape
The method of application of pavement marking tape, including surface preparation, shall be in accordance with the manufacturer's recommendations.

(3) Removal of pavement marking tape
When directed by the Superintendent, the Contractor shall remove pavement marking tape in accordance with the manufacturer's recommendations.

(4) Temporary raised pavement markers (TRPMs)
Temporary raised pavement markers must comply with the requirements of AS1906.

Temporary raised pavement markers may be used to mark the temporary travelled path at short-term work sites, or to indicate the permanent travelled path on new work prior to the application of permanent pavement markings.

The use of temporary raised pavement markers may preclude the need for spotting where existing markings are to be reinstated after a reseal, and for respotting if proposed line markings were set out before the final seal on new works is applied. In these cases, the distance between TRPMs should be the same as would apply for spotting.

Temporary raised pavement markers should not take the place of spotting, as TRPMs may be broken off by traffic before final marking can be carried out. Once the longitudinal lines have been marked, the Temporary raised pavement marker flaps can be removed by cutting them off flush with the pavement surface.

SC6.4.6.22.5 Raised pavement markers

(1) Materials
Raised pavement markers, both reflective and non reflective, shall comply with AS1906.3 and shall have the dimensions shown on the drawings.
The adhesive used for attaching the raised pavement markers to the wearing surface of the pavement shall be a hot-melt bitumen adhesive or an equivalent product approved.

(2) Installation of raised pavement markers

The use of raised retroreflective pavement markers must be in accordance with the MUTCD, GTPM and TRUM 1.25 Fire Hydrant Indication System.

Raised pavement markers shall be fixed to the wearing surface of the pavement using a hot melt bitumen adhesive or an equivalent product. The adhesive shall be freshly heated to the manufacturer's instructions and thoroughly mixed.

The adhesive shall be spread uniformly over the underside of the raised pavement marker to a depth of approximately 10mm. The raised pavement marker shall be pressed down onto the pavement surface in its correct position and shall be rotated slightly until the adhesive is squeezed out around all edges of the marker. The raised pavement marker shall not be disturbed until the adhesive has set.

On rough surfaces, such as newly laid coarse sprayed bituminous seals, an initial pad of adhesive of diameter 20mm larger than the diameter of the base of the raised pavement marker, shall be provided. The adhesive shall be applied to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level. The adhesive pad shall be allowed to set. Additional adhesive shall be applied to the pavement, as described above, and then the raised pavement marker shall be pressed down onto the adhesive pad on the pavement surface to ensure good adhesion.

When installed, raised pavement markers shall conform to the tolerances specified in Table SC6.4.6.22.4.

Table SC6.4.6.22.4 Tolerances - raised pavement markers

	Tolerance (mm)	Distance
Lateral position –	+ 25, - 50	from edge of line
• barrier/edge line	± 10	from edge of line
• broken line	± 10	from centre of line
• flush medians		
Longitudinal position –	± 10	1m from start of line
• broken line	± 100	1m from start of line
• new construction	± 300	1m from start of line
• replacement		

(1) General

The Contractor shall remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

Where required, existing pavement markings must be removed by the appropriate method stated in Table SC6.4.6.22.5.

The method of removal shall be submitted to the Superintendent for approval before commencement of the work.

Table SC6.4.6.22.5 Method of removal of existing pavement marking

Method of removal	Duration of result
Black paint	< 1 week
Emulsion and sand	< 2 weeks
Black cold applied resin or plastic	< 6 months
Chip seal	Permanent
Line grinder (asphalt only)	Permanent
Profiler (asphalt only)	Permanent
Abrasive blasting	Permanent

SC6.4.6.22.7 Surface treatments for bicycle lanes and school zone threshold

(1) Coloured surface treatments for bicycle lanes

Refer to the Traffic and Road Use Management Manual - Coloured Surface Treatments For Bicycle Lanes.

(a) The preferred colour is G13 Emerald (AS2700 S 1996). To accommodate different materials and varying conditions, an approximate colour match to one of the following three AS2700 S greens is permitted - G13 Emerald, G16 Traffic green or G23 Shamrock. Approximate colour match is determined in accordance with AS/NZS1580.601.1.

(b) A consistent green colour should be provided along a route or within a given locality.

(c) Where green surface colouring is used, it should be continuous through the required area and be bounded by the bicycle lane lines. Pavement markings, such as bicycle symbols and any directional arrows, should be placed over the coloured surface.

(d) A coloured surface treatment needs to do more than just provide a colour contrast. It must be designed to function like any other road surfacing, providing a sound, durable surface layer, which maintains the required texture and skid resistance for its design life.

(e) The design and specification of a coloured surface treatment for bicycle lanes should:

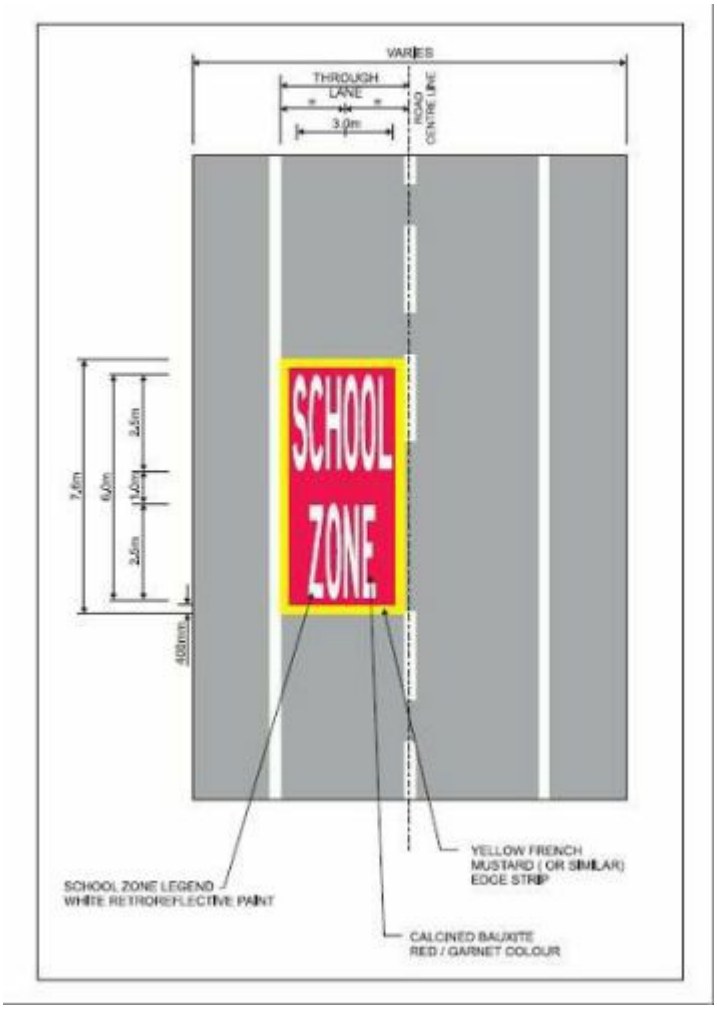
- ensure the suitability of the existing surface to support and bond with the colour treatment;
- provide a surface texture and skid resistance suitable for bicycle use, including in wet conditions; and
- limit differential skid resistance between the bicycle lane and adjacent traffic lanes.

(f) The Department of Transport and Main Roads is considering development of a formal specification for coloured surface treatments for Queensland. Until this is available it is recommended that advice on performance requirements, and the suitability of any product or service being considered for use, be sought from the Superintendent for approval before commencement of the work.

(2) Surface treatments for school zone thresholds

Refer to the Traffic and Road Use Management Manual - 3.23 Traffic and Road Use Management Manual - School Zones.

Threshold treatments may be provided at entrances to school zones to create a change in driver perception of the speed environment. A typical threshold treatment for a school zone is shown in Figure SC6.4.6.22.1.



Source:TRUM.

Figure SC6.4.6.22.1 Typical threshold treatment for a school zone

Advice on performance requirements, and the suitability of any product or service being considered for use, is to be sought from the Superintendent for approval before commencement of the work.

The pavement marking treatment (set out, type of material, preparation of surface, rate of application, method of application and maintenance) must be submitted to the Superintendent for approval before commencement of the work.

SC6.4.6.22.8 Limits and tolerances

The limits and tolerances applicable to the various clauses of this Specification are summarised in Table SC6.4.6.22.6 – Summary of limits and tolerances below:

Table SC6.4.6.22.6 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Location of Markings**	± 20mm from specified location	SC6.4.6.22.1(6)
2.	**Longitudinal Lines**		
	(a) Length	± 20mm from lengths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
	(b) Width	± 10mm from widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
3.	**Transverse Lines**		

	(a) Length	± 10mm from lengths and widths shown in MUTCD/MRDGPM	SC6.4.6.22.2(3)
	(b) Width		SC6.4.6.22.2(3)
4.	**Arrows, Chevrons, Speed Markings etc.**	± 50mm from the dimensions shown in MUTCD/MRDGPM	SC6.4.6.22.2(3) SC6.4.6.22.3(3)
5.	**Application of Paint**		
	(a) Film Thickness	>0.35mm <0.40mm	SC6.4.6.22.2(3)
6.	**Application of Thermoplastic**		
	(a) Longitudinal Lines Cold Film Thickness	2.0mm ± 0.5mm	SC6.4.6.22.3(3)
	(b) Transverse Lines, Symbols, Arrows etc. Cold Film Thickness	3.5mm ± 1.5mm	SC6.4.6.22.3(3)
7.	**Glass Beads**		
	(a) Volume used in operation	0.3kg/sqm + 10%	SC6.4.6.22.2(3) SC6.4.6.22.3(3)

Attachment A: Procedure for measurement of rate of application of spherical glass beads

(1) **Scope**

The following procedure shall be adopted for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

(2) **Spherical Glass Beads**

The glass beads shall comply with AS2009.

(3) **Measurement**

The method of field measurement shall be as follows:

(a) Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.

(b) Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level but do not compact the glass beads in the cylinder.

(c) Compare the volume of glass beads collected with the correct figure given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation. Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.3kg/sqm for different line widths and road speeds. The glass bead volume figures given in Table SC6.4.6.22.1 - Volume of Glass Beads (ml) required in 10 seconds of operation are calculated for an actual application rate of 0.34kg/sqm.

(d) These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line; and

(e) The volume is measured with beads not compacted.

SC6.4.6.23 Guide posts

SC6.4.6.23.1 Introduction

(1) Scope

This policy subsection provides, minimum requirements for the setting out, supply of all materials and erection of guide posts in areas where street lighting is not provided to maintain safety of movement network.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-section:
SC6.4.6.30 - Control of traffic

(b) Australian Standards:
AS 1906.2 - *Retroreflective devices (non-pavement application)*
AS1580 -*Paints and related material*

(c) Queensland Department of Transport and Main Roads specification:
MRST14 *Road Furniture*

SC6.4.6.23.2 Materials

(1) General

Guide posts must be a proprietary metallic or flexible (driveable or non-driveable) post.

The surface of all posts must have a gloss or semi-gloss white finish. The surface shall be smooth and easily cleaned.

Proprietary posts must be minimum 1500 mm in length and must have one face of a minimum 80 mm width.

(2) Proprietary posts

Where a proprietary metallic or flexible guide post is proposed, the Contractor must supply details of the proposed guide post including the manufacturer's recommended installation procedure, technical specifications and test certificates for approval by the Superintendent.

(3) Delineators

Corner-cubed delineators, conforming to AS 1906.2 must be attached to each post. The delineators must conform to MRST14 *Road Furniture*.

SC6.4.6.23.3 Construction

(1) General

The Contractor must at all times conform to the requirements of sub-section SC6.4.6.30 Control of traffic.

Where the shoulder is in embankment or at natural surface level, the guide posts must be placed near the outer edge of the shoulder and at a uniform distance, minimum 1m, from the pavement edge line. Where the shoulder is located in a cutting, the guide posts must be placed on the road pavement side of the table drain, and minimum 1m from the pavement edge line, in such a manner that it does not impede the flow of water in the drain.

Guide posts must be erected at the locations shown on the Drawings. Underground services laid in proximity to the guide posts must be located prior to erection of posts all care must be taken not to damage such services.

(2) Erection of guide posts

Guide posts must be set vertically in the ground to a depth of approximately 500mm. In order to offset shoulder irregularities this depth must be varied so as to give uniform display of guide posts to a height of approximately 1000mm above ground level, with the tops evenly graded. Each guide post must be erected with the widest face at right angles to the centre line of the road.

Allowance must be made in the height of guide posts above the ground for the effects of superelevation and other road geometry in order to keep the guide posts within the range of the beam of vehicle headlights.

Backfilling must be compacted in layers of depth not more than 150mm for the full depth of the guide posts up to ground level. The density of the compacted backfilling must not be less than that of the adjacent undisturbed ground. Guide posts must be firm in the ground to the satisfaction of the Superintendent.

Proprietary guide posts, when installed in the ground in accordance with the recommendations of the manufacturer, must resist overturning, twisting and displacement from wind and impact forces. The Contractor must provide the manufacturer's instructions for anchorage.

If the guide posts are proposed to be installed on concrete pavements, the Contractor must provide the Superintendent details of fixing the guide posts to the concrete prior installation.

All necessary steps must be taken to prevent people and stock from stepping into the post holes during the erection of the guide posts.

(3) Delineators

"Corner Cubed" delineators, complying with AS1906.2, must be attached to each guide post using one way, anti-theft screws or rivets etc. In the case of proprietary posts, the delineators must be glued or otherwise fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact. The delineators must be mounted so that the top of the reflector is 100mm below the top of the guide post. The delineators must be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side.

SC6.4.6.24 Signposting

SC6.4.6.24.1 Introduction

(1) Scope

This sub-section provides standards advice and guidelines for:

(a) the supply and erection of the regulatory, warning, guide, information and direction signs as described in Manual of Uniform Traffic Control Devices MUTCD.

(b) the supply and erection of sign support structures to support the signs, and

(c) the adjustment of existing signs and sign support structures.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:

SC6.4.6.28 - Minor concrete works

SC6.4.6.30 - Control of traffic

(b) Australian Standards:

AS 1163	*Cold-formed structural steel hollow sections*
AS 1214	*Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series)*
AS 1379	*Specification and supply of concrete*
AS/NZS 1554.1	*Welding of steel structures*
AS/NZS 1580.602.2	*Measurement of specular gloss of non-metallic paint films at 20 degrees, 60 degrees and 85 degrees*
AS 1580.108.2	*Dry film thickness - Paint inspection gauge*
AS/NZS 1734	*Aluminium and aluminium alloys - flat sheet, coiled sheet and plate*
AS/NZS 1866	*Aluminium and aluminium alloys - extruded rod, bar, solid and hollow shapes*
AS 2700	*Colour standards for general purposes*
AS/NZS 3678	*Structural steel - hot-rolled plates, floorplates and slabs*
AS/NZS 3679.1	*Structural steel - hot-rolled bars and sections*
AS 3990	*Mechanical equipment - Steelwork*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

(c) Queensland Department of Transport and Main Roads Publications:

Manual of Uniform Traffic Control Devices (MUTCD)

Traffic and Road Use Management Manual (TRUM)

(3) Provision for traffic

The Contractor shall provide all necessary traffic safety measures in accordance with the requirements of sub-section SC6.4.6.30 Control of traffic while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic.

Where a sign is erected before its intended use by traffic and is visible to traffic, the face of the sign shall be completely and securely wrapped in porous cloth sheeting or other opaque covering material approved by the Superintendent, until the Superintendent directs that the sign shall be uncovered.

SC6.4.6.24.2 Materials

(1) General

The Contractor shall advise the names of the proposed suppliers of signs and sign support structures for the Superintendent's concurrence. Only suppliers who have previously established or can now establish their competence to carry out the work in accordance with this sub-section shall be used.

The Contractor shall supply documentary evidence, satisfactory to the Superintendent that all materials and parts proposed for use comply with the requirements of the appropriate Australian Standard(s) as stated in this policy sub-section.

Details of the signs and sign support structures to be provided under the Contract shall be as shown on the drawings.

The dimensions, legend and background for each sign shall be in accordance with this sub section and the drawings.

(2) Sign blanks

Sign blanks shall be 1.6 mm thick aluminium sheet alloy. The aluminium alloy shall be Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS 1734.

Sign blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blank shall be within plus or minus 1.5 mm of the dimensions specified and the finished sign shall be flat within a maximum allowable bow of 0.5 per cent of the maximum dimension of the sign blank in any direction.

Sign blanks shall be one piece except where the sign is of such a size as to require more than one full sheet of aluminium in which case a multipiece sign shall be allowed.

A multipiece sign shall be made up of the minimum number of pieces practical and sheets of the multipiece sign shall be butted together with a maximum gap of 1 mm at any point along the joint.

All joints shall be covered by a backing strip. The backing strip shall be riveted to each sheet with rivets, coloured to match the background material on the face of the sign, at a spacing not exceeding 200 mm. Backing strips shall be of the same material and colour as used for the sign blank and shall have a minimum width of 50 mm over the full length of the joint.

The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.

The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. Where the sign blank is to receive a paint background, the face shall be spray painted with a compatible etch primer.

The back of each sign blank shall be uncoated and the surface finish shall be rendered dull and non reflective either by mechanical or chemical means and shall be free of scratches and blemishes.

Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the drawings.

(3) Aluminium extrusion backing

The signs shall include special aluminium extruded sections for mounting purposes. The aluminium shall be Type 6063 T5 in accordance with AS 1866.

The aluminium extrusion shall be fixed at the centre spacings as shown on the drawings and shall be riveted to the sign blank with correctly coloured rivets at a spacing not exceeding 200 mm.

(4) Retro-reflective material for background and legend

Retro reflective material shall conform in colour and class to the requirements of AS 1743 and Table 1 in Section 1.2 of DTMR’s Traffic and Road Use Management manual for Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the drawings, the material shall be Class 2.

(5) Non-reflective background material

(a) Background paint

Background paint shall be an approved long life industrial quality, two compound polyurethane paint. The paint shall exhibit high standards of adhesion, abrasion resistance, resistance to weathering and colour fastness under widely varying conditions of exposure. The paint shall be compatible with the etch primer used on the sign blank.

The paint shall be applied using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested in accordance with AS 1580.108.2.

Background paint shall be as specified from one of the following colours:

(i) White Gloss

(ii) “Dark” Green Matt Colour No G61 as specified in AS 2700.

(iii) “Tourist” Brown Matt Colour No X65, Dark Brown, as specified in AS 2700.

(iv) “Dark Grey” Matt Colour No N64, Dark Grey as specified in AS 2700.

(b) Background sheet material
Adhesive cast vinyl sheet material or other equivalent material approved by the Superintendent may be used in place of background paint.

(c) The material shall be of uniform density and compatible with the material used for the legend both in application and durability.

The colours and gloss levels shall be uniform and conform to the requirements of clause SC6.4.6.24.2(5)(a) Background paint.

(6) Non-reflective material for legend

(a) Legend screening ink
Screening ink shall be a high quality, full gloss, non fade, non bleed and scratch resistant type of ink compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which the screening ink is applied.

(b) Legend sheet material
Adhesive cast vinyl sheet material or other equivalent material approved by the Superintendent may be used in place of screening ink. The material shall be of uniform density and compatible with the material used for the background both in application and durability.

(c) Colours and finish
The requirements of clause SC6.4.6.24.2(5)(a) Background paint shall also apply to non reflective materials for legends but additional colours complying with AS 2700 may be specified.

(7) Rivets
Each rivet shall consist of a domed head and shank made of aluminium alloy and a steel mandrel which is discarded after securing the rivet.

A paint coating shall be applied to the domed head so that when the rivet is in position it will show the same colour as the material to which it is attached. Paint may cover the shank of the rivet, providing the coating thickness does not restrict the insertion of the shank into the standard drilled hole for that rivet.

The paint shall be an alkaloid enamel, which shall be applied after an appropriate treatment of the shank of the rivet to ensure long lasting adhesion.

(8) Reference markings
All signs shall be clearly and permanently stamped or engraved with an identification coding. The coding shall appear in ciphers of height neither less than 6 mm nor more than 10 mm on the rear of the sign and shall be carried out in such a manner that the front face of the sign is not damaged.

Manufacturers shall include coding information in the following format:

(a) sign reference number;

(b) manufacturer's name;

(c) month and year of manufacture; and

(d) manufacturer and class of retro reflective material.

(9) Sign support structures

(a) General
Sign support structures shall be fabricated from steel sections which shall comply with the requirements of AS 1163, AS 3678 and AS 3679.1.

Signs support structures shall be standard round galvanised posts of 50, 65 or 80 mm nominal bore or purpose designed steel structures as shown on the drawings and manufactured in accordance with the requirements of AS 1250.

Splices in members shall be restricted to a maximum of one splice per member. Splices shall be full penetration butt welds.

All welding shall be as shown on the drawings and in accordance with the requirements of AS 1554.1, Category GP.

(b) Protective treatment
Except for standard galvanised posts, all steel components including brackets shall be protected by hot dip galvanising after all fabrication processes are completed.

The steel components shall be finished by the hot dip galvanising process in accordance with AS/NZS 4680 to provide an average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains.

Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214.

Splices in standard galvanised posts shall be painted by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised by the Contractor.

(c) Attachment of signs
Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolt hole in the sign panel.

The Contractor shall submit details of the proposed attachment systems for the Superintendent's approval.

SC6.4.6.24.3 Erection of new signs

(1) Setting out
The location of signs shall be as shown on the drawings or as directed by the Superintendent. The Contractor shall set out the work to ensure that all signs and support structures are placed in accordance with the drawings or as directed by the Superintendent.

Signs shall be aligned approximately at right angles to the direction of the traffic they are intended to serve. On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located. Parking signs will generally be aligned at

45 degrees to the kerb line if not otherwise specified on drawings.

The Contractor shall submit details of and set out, for the Superintendent's inspection and approval, the proposed location and alignment of each sign support structure.

Work on the foundations of the sign support structure shall not commence until the Superintendent has approved the location and alignment of the sign support structure.

The Contractor is responsible in locating existing underground services in proximity of the signs prior to placement of footings and erection of signs to protect services from damage

(2) Clearing

The Contractor shall advise the superintendent of any trees and undergrowth within 3 m of the sign support structure and along a driver's line of sight to the front of the sign that are required to be cleared and removed. On receipt of this advice from the superintendent, council will inspect and advise what action is to be taken by the contractor.

(3) Sign structure footings

The footings for a simple pipe support or the footings for each post of a purpose-designed sign support structure shall be constructed in accordance with the drawings or as directed by the Superintendent.

The footings shall be neatly excavated to the depth and width shown on the drawings. The material from the excavation shall be disposed of in a responsible and legal manner.
When anchor bolt assemblies are specified they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure baseplates to allow adjustment of the structure after installation.

Steel reinforcement shall be placed as shown on the drawings.

Concrete in the footings of sign support structures shall comply with sub-section SC6.4.6.28 Minor concrete works and have a minimum compressive strength at 28 days of 20 MPa for pipe support footings and 32 MPa for purpose-designed support footings.

If ready mixed concrete is used, the concrete shall be mixed and delivered in accordance with AS 1379.

(4) Erection

All components shall be accurately positioned and supported during erection.

The top of each pipe support post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel.

For pipe support multi post installations, the tops of the posts shall be at the same level except where sign shape or the arrangement of sign panels dictates otherwise.

During erection, sign panels shall be suitably supported and braced and the sign face protected from damage. Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Contractor.

Galvanised coatings on purpose-designed support structures which are scratched or slightly damaged during erection shall be renovated by using an organic zinc rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680. This method of renovation shall be restricted to areas not exceeding 2500 square millimetres on any one structure. Any structure with totally damaged coating areas exceeding 2500 square millimetres shall be regalvanised.

SC6.4.6.24.4 Adjustment of existing signs and support structures

Where shown on the drawings and where directed by the Superintendent, the Contractor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including footings and re erection of signs including all fittings.

SC6.4.6.24.5 Special requirements

(1) Street name, service and tourist signs

All street name, service and tourist signs shall comply with council's adopted signage system and with the details as shown on the drawings.

Proprietary signs shall be manufactured and installed in accordance with the requirements of Parts 1 and 6 of MUTCD to the following details:

(Sample only - to be completed by compiler)

(a) Colour:

(i) Legend - Blue, Non-reflective

(ii) Background - Yellow, Class 1 Retroreflective

(b) Lettering and Numerals:

(i) Font Type - Series D

(ii) Height – 100 mm

Details of council's logo shall be supplied to the Contractor by the council.

Details of the signs and legends are to be shown on the drawings.

The Contractor shall submit details of Manufacturer, all sign materials and sign attachment system to the Superintendent for approval by the council prior to commencement of sign manufacture.

SC6.4.6.24.6 Limits and tolerances

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.24.1 Summary of limits and tolerances below:

Table SC6.4.6.24.1 Summary of limits and tolerances

Item	Activity	Limits/Tolerances	Clause
1.	**Sign Blanks**		
	(a) Dimensions	± 1.50mm	SC6.4.6.24.2(2)
	(b) Bow	< 0.5% of maximum dimension	SC6.4.6.24.2(2)
	(c) Butt gap in multipiece sign	< 1mm	SC6.4.6.24.2(2)
	(d) Rivet spacing in backing strip	< 200mm	SC6.4.6.24.2(2)
	(e) Backing strip width	> 50mm	SC6.4.6.24.2(2)
2.	**Extrusion Backing**		
	(a) Rivet Spacing	< 200mm	SC6.4.6.24.2(3)
3.	**Background Paint**		
	(a) For matt coatings, gloss level	> 12% and < 15%	SC6.4.6.24.2(5)
	(b) For gloss coatings, gloss level	> 85% and < 95%	SC6.4.6.24.2(5)

Item	Activity	Limits/Tolerances	Clause
4.	**Reference Marking**		
	(a) Height of Coding	> 6mm and < 10mm	SC6.4.6.24.2(8)
5.	**Sign Support Structures**		
	(a) Protective Treatment thickness	> 100 microns	SC6.4.6.24.2(9)(b)
	(b) Paint coating over Splices in standard galvanised posts	> 100 microns	SC6.4.6.24.2(9)(b)
	(c) Damaged Surface of galvanised surfaces		
	(i) Coating with zinc rich paint	Area < 2500 sq. mm	SC6.4.6.24.2(9)(b)
	(ii) Regalvanise	Area > 2500 sq. mm	SC6.4.6.24.2(9)(b)
6.	**Clearing**		
	(a) Trees and Undergrowth to be cleared	< 3 metres from sign support structure	SC6.4.6.24.3(2)
7.	**Concrete in Foundations of Sign Support Structures**		
	(a) Strength	> 25 MPa at 28 days	SC6.4.6.24.3(3)

SC6.4.6.25 Non-rigid road safety barrier system

SC6.4.6.25.1 Introduction

(1) Scope

The work to be executed under this sub-section consists of the setting out, supply of all materials and erection of road safety barriers and terminals, in accordance with the requirements for non-rigid road safety barrier systems in TMR Road Planning and Design Manual (Chapter 8), at the locations shown on the drawings or as directed by the Superintendent.

This sub-section details the requirements for public domain non-rigid road safety barrier systems. Where a patented non-rigid road safety barrier system is specified and shown on the drawings, all materials shall be in accordance with the manufacturer's specifications and, it shall be constructed strictly in accordance with the manufacturer's instructions.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied to this sub-section are as follows:
SC6.4.6.30 Control of traffic
SC6.4.6.28 Minor concrete works

(b) Department of Transport and Main Roads Standards:
Road Planning and Design Manual (RPDM) 1st edition – (Chapter 8), Safety Barriers and Road Side Furniture – as amended.

(c) Australian Standards:

AS/NZS 1906.2	*Retroreflective devices (non pavement application)*
AS/NZS 3845	*Road safety barrier systems*
AS/NZS 4680	*Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*

SC6.4.6.25.2 Materials

(1) Components

All steel components for public domain non-rigid road safety barrier systems, W beam and Thriebeam, shall be designed and constructed strictly in accordance with the RPDM (Chapter 8 – as amended) using crushable energy-absorbing materials and shall be of the type as shown on the drawings.

(2) Certification

Road safety barrier components shall not be erected until the Contractor has produced documentary evidence to the Superintendent that such safety barrier components conform to the requirements of this sub-section.

For galvanized steel components provide a manufacturers certificate of compliance certifying that the zinc coating mass conforms to AS/NZS 4680 or, for components of proprietary safety barrier systems or devices, to the manufacturer's recommendations.

SC6.4.6.25.3 Construction

(1) General

The Contractor shall at all times conform to the requirements of sub-section SC6.4.6.30 Control of traffic.

Construction of non-rigid road safety barrier shall comply with RPDM, except where explicit departures are approved on the drawings.

Road safety barriers shall be erected after the construction of the base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved by the Superintendent.

The Contractor shall set out the work to ensure that all road safety barriers and terminal sections are located,

in accordance with the drawings or as directed by the Superintendent.

Underground cables and ducts laid in the road safety barrier area shall be located prior to the erection of posts and all care must be taken not to damage such cables and ducts.

The posts should be set to the full depth as shown on the drawings. If this is not possible due to the presence of an underground obstruction, an alternative method of setting the posts, as approved by the Superintendent, shall be used.

Posts shall stand vertical and the spacing shall be such that when the safety barrier is erected no post movement is necessary in order to align holes or for any other reason.

(2) Erection of steel posts

The safety barrier posts are to be located as shown on the drawings. The top of the post shall be 750mm, 845mm or 905mm as appropriate for W beam, Thrie beam or modified blockout Thrie beam respectively, above the ground level, unless otherwise shown on the drawings. On terminal ends, the level of the posts shall be such as to conform to the extended crossfall of the main pavement unless otherwise shown on the drawings.

When erected in position the posts shall be on a smooth line both horizontally and vertically with the tops of posts within ±10 mm of the heights specified in paragraph 1 of this clause.

Steel posts shall be erected by driving, or by other means, as directed by the Superintendent, in accordance with the requirements for foundation posts in the TMR RPDM. The open section of the post shall point in the same direction as adjacent traffic. The posts are to be firm in the ground and any movement at ground level shall not exceed 3mm in any direction when force tested in accordance with TMR guidelines

The posts shall not have any obvious deformation as a result of driving. Any damage which does occur to the posts is to be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any post which has been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at their own expense.

(3) Erection of road safety barrier rails

Steel blockout pieces shall be erected with the open section pointing in the same direction as adjacent traffic.

All rail laps shall be in the same direction as adjacent traffic such that approach rail ends are not exposed to traffic.

Stiffening pieces, 300mm long, shall be used on intermediate posts.

Road safety barrier rails and blockout pieces shall be handled and erected in such a manner that no damage occurs to the galvanising. Any minor damage occasioned to the galvanising shall be repaired within 24 hours using an organic zinc-rich primer in accordance with the repair requirements of Appendix E in AS/NZS 4680.

Any road safety barrier rails or blockout pieces that have been excessively damaged will be rejected by the Superintendent and shall be replaced by the Contractor at their own expense.

Road safety barrier rail attachment bolts and splice bolts are to be tightened initially such that the barrier can be erected. Adjustments are then to be made to the rails using the slotted holes provided to produce a smooth regular line, free of any kinks or bumps. The overall line of the top of the safety barrier rails is to visually conform with the vertical alignment of the road pavement.

When the alignment both vertically and horizontally is obtained the splice bolts are to be fully tightened. The bolt head (not the shoulder) should be in full bearing with the rail.

(4) End treatment of road safety barriers

Both approach and departure ends of the road safety barrier shall be constructed with leading and trailing terminal sections at locations shown and as detailed on the drawings.

An appropriate terminal end treatment shall be constructed, as detailed on the drawings, at the approach and end locations of road safety barriers as shown on the drawings. Consideration of alternate terminal end treatments will include sufficient clearance behind the safety fence to accommodate pedestrians and cyclists, where applicable.

The approach and departure ends of double sided road safety barriers shall have terminal sections as detailed on the drawings.

Non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets shall be as detailed on the drawings.

(5) Delineators

Delineators complying with AS 1906.2 shall be fixed with brackets to the road safety barrier, to the details and at the locations shown on the drawings beginning at the first post and then in accordance with Table SC6.4.6.25.1 below.

Table SC6.4.6.25.1 Spacing of reflectors on barriers

Radius of Curve	Spacing of Reflectors on Barrier
m	every
30 - 90	3rd post
90 - 180	5th post
180 - 275	8th post
275 - 365	11th post
over 365 (including straight road)	16th post

The delineators shall be so arranged that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

(6) Connection to existing safety fencing

The Contractor is to inspect and document the condition of all existing barrier fencing and its suitability to meet current specifications and standards, prior to connection or incorporation into the subject works. All documentation of existing fencing is to made available to the Superintendent for future inspection, if requested.

If any existing safety fencing is deemed not to comply with current design and safety standards, it is to be replaced.

SC6.4.6.25.4 Limits and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.25.2 Summary of limits and tolerances below:

Table SC6.4.6.25.2 Summary of limits and tolerance

Item	Activity	Limits/Tolerances	Clause
	Vertical Alignment	± 10mm	SC6.4.6.25.3(2)
	(a) Tops of steel posts.		
	(i) Post Movement	£ 3mm	SC6.4.6.25.3(2)
	Concrete Footings	-0mm or +50mm	SC6.4.6.25.3(3)
	(a) Diameter		

SC6.4.6.26 Landscaping

SC6.4.6.26.1 Introduction

(1) Scope

This sub-section sets out the standards and provides advice and guidelines for the construction of landscape works that will become a council asset.

Landscape works includes but is not limited to, site co-ordination, turfing, gardens, grass seeding, tree plantings, pathways, paved areas, concrete works, stormwater drainage and infrastructure.
This sub-section consists of:

(a) the vegetation of cut and fill batters, median areas, pathway verges, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection works, hydroseeding, hydromulching and straw mulching; and

(b) the supply of plants, planting at locations fertilising, mulching, staking, watering and maintenance of plants.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents

All design and documentation, materials supplied and work carried out shall be in accordance with the following standards.

(a) Development manual planning scheme policy sub-sections to ne read and applied in conjunction with this policy sub-section are as follows:
SC6.4.6.10 - Earthworks (construction).

(b) Australian Standards:

AS 1160	*Bituminous emulsions for the construction and maintenance of pavements*
AS 1289	*Methods of testing soils for engineering purposes – General requirements and list of methods*
AS 1672.1	*Limes and limestones – Limes for building*
AS 2507	*The storage and handling of agricultural and veterinary chemicals*
AS 3000	*Electrical installations (known as the Australian/New Zealand Wiring Rules)*
AS 3700	*Masonry structures*
AS 3798	*Guidelines on earthworks for commercial and residential developments*
AS 3972	*General purpose and blended cements*
AS 4419	*Soils for landscaping and garden use*
AS 4454	*Composts, soil conditioners and mulches*
AS/NZS 4671	*Steel reinforcing materials*
AS 4843	*Synthetic weed blocking fabric*
AS 4970	*Protection of Trees on Development Sites*

(c) Other:

Electricity Act 1994
International Erosion Control Association (IECA), *Best Practice Erosion and Sediment Control*

(3) Terminology

For the purposes of this document the following definitions apply:

Defects liability period	refer to Section SC6.4.7 Acceptance of completed works.
Gardens, garden beds and garden areas	means a defined area of mulched “garden” containing various shrubs, trees, plants or hedges.

Litter	means bottles, paper, cigarette packets, cigarette butts, drink cans, ice cream sticks, plastic, rubber, glass, milk and fruit juice cartons, paper plates and the like. Litter also includes fallen branches, palm fronds, waste, household rubbish, condoms, sharps/syringes, leaves where leaves are unsightly or cause damage to lawn or garden areas, or other dumped material.
Maintenance period	equivalent to the defects liability period and includes the plant establishment period.
Plant establishment period	coincides with the defects liability period.
Planter box	means a transportable or in situ container designed specifically for containing a garden of trees and /or shrubs.
Sub grade	means the level at the underside of garden or turf top soil or the level at the underside of paving gravel base course.
Superintendent	means the nominated representative for council.

SC6.4.6.26.2 Works management

(1) Qualified personnel

Personnel shall be suitably qualified and competent in all aspects of landscape works and shall be familiar with all relevant Australian Standards. All maintenance work to new and existing trees shall be carried out under the supervision of an Arborist with formal qualifications (Level 5 Australian Qualification Framework) or at least 5 years recognised experience in Arboriculture.

(2) Design approval

The design of the landscape works will be prepared by a qualified Landscape Architect.

(3) Contractor inspections

Inspections must be certified and documented by a Registered landscape Architect (the supervising landscape architect). All approved works are required to be inspected by Townsville City Council.

(4) Council inspections

(a) Council may inspect the following:

(i) sub grade prior to placing fill;

(ii) sub grade prior to placing garden soil or turf soil;

(iii) sub grade prior to placing the gravel base course;

(iv) sub grade prior to placing paving or concrete works;

(v) installation of gypsum;

(vi) condition of plants after delivery to site and prior to planting, including planting holes prior to planting;

(vii) gardens prior to planting;

(viii) turf areas prior to laying turf;

(ix) areas to be hydro-mulched / seeded prior to treatment;

(x) concrete structures (formwork) prior to placing concrete;

(xi) block work and reinforcing prior to placing core fill concrete; and

(xii) other elements considered necessary by the Superintendent.

(b) Inspection of irrigation works shall be undertaken by the Superintendent and a council Irrigation Officer in association with the Landscape works and is detailed below:

(i) all mainline to be inspected prior to covering;

(ii) drip tube layout prior to covering;

(iii) 240v power conduit from Ergon POS to controller for correct depth prior to covering;

(iv) all envelopers (conduits) work under hard surfaces prior to covering;

(v) all envelopers (conduits) under hard surfaces must be continuous 100 mm PVC CL9, all conduit ends must be sealed with expanding foam prior to covering; and

(vi) water meter assembly installation prior to covering to ensure correct installation of thrust blocks and copper protection.

(5) Inspection results

(a) Work inspected that complies with the sub-section and/or the design plans will be accepted by council.

(b) Any work inspected that does not comply with the sub-section and/or the design plans, will not be accepted by council. Items not acceptable will be noted for rectification.

(c) The contractor is required to rectify these items prior to proceeding to the next construction phase and shall apply for a re-inspection by council on completion of the rectification work.

(6) A minimum of 24 hours notice by is required for notification of an Inspection. Failure by the Contractor to notify council of any inspections required, will result in the works being excavated at the Contractors cost to allow an inspection to be carried out.

(7) Inspection documentation.

Editor's note—this section relates to Inspection Test Plans and is currently under development.

SC6.4.6.26.3 Supply of materials

(1) Materials supply - general

(a) Substitutions

The Contractor shall notify the council immediately if an item is unavailable for inclusion in the works and shall provide alternative supply details if appropriate. Substitutions of any materials or products shall not be made unless approved by the Superintendent in writing.

(b) Material samples

In certain instances, council may request the Contractor to provide samples of materials to be installed or used for work under the development approval.

(c) Materials testing

In certain instances, council may request the Contractor to provide results of materials testing. Where applicable, testing requirements will be set out in the conditions of approval.

(d) Materials warranty

Where requested, the Contractor shall provide to council all relevant warranty details for the materials nominated in any conditions of approval.

(2) Supply of plants

(a) Plant specifications

(i) All plants supplied shall be in a healthy condition free from weeds, pests and diseases. Plants shall be well foliated, showing signs of active growth, true to type and of a form and shape considered typical for the species or variety.

(ii) Leaves shall be of normal size, shape, colour, and texture with no physical or insect damage or disease lesions.

(iii) The plant roots shall be fibrous, well developed and not root bound, with no kinking, knotting, girdling or spiralling and shall be free of any pests or diseases or any other root defects.

(iv) All plants supplied shall be hardened off and in a condition suitable for planting in the Townsville climate.

(v) Trees supplied (unless required to be multi-stemmed) shall have a single leading stem and shall

be self-supporting and unstaked.

(vi) Root bound plants, deformed plants and plants showing recent signs of root pruning will not be accepted.

(vii) At time of delivery to the site, each group of plant species shall be clearly and accurately labelled according to botanical nomenclature. Labels shall be water resistant and tied securely to one plant in every 20 for each species.

(viii) Plants which are above the minimum size requirements may be accepted for inclusion within the works.

(b) Container stock

Plants grown in containers shall have a root system firmly established with no large roots growing out of the container, shall be of such a size that the roots have penetrated to the bottom of the container and occupy 95-100% of the soil volume and/or have sufficient roots to hold the container soil together after removal of the plant from the container.

(c) Ex-ground stock plants

(i) Where plants are growing in ground prior to delivery to the site, the necessary root pruning and/or preparation procedures in accordance with accepted transplanting practice shall be commenced in sufficient time to ensure that, at the time of planting the plant is ready and will meet the specified requirements. Transplanting of ex-ground stock should be conducted under the supervision of a qualified (Level 3 Australian Qualification Framework) horticulturalist or arborist.

(ii) Refer to Table SC6.4.6.26.1 for minimum acceptable root ball sizes for ex-ground stock plants.

Table SC6.4.6.26.1 Acceptable root ball sizes

Small Trees		Large Trees	
Height of Tree (mm)	Root Ball Diameter (mm)	Approximate Tree Trunk Diameter (mm) (300 mm above ground)	Root Ball Diameter (mm)
600 - 900	300	40	500
900 - 1200	350	50	550
1200 - 1500	400	65	600
1500 - 1800	450	75	800
1800 - 2100	550	100	950
2400 - 2700	600	125	1200
2700 - 3000	650	150	1450
3000 - 3600	750	175	1600
3600 - 4200	800		
4200 - 5000	900		

(d) Substitutions

Substitutions of plants shall not be permitted unless approved in writing by council. In the event that a plant is unavailable the Contractor may request to provide a substitution. Substituted plants shall be of the same specified type, quality and size unless otherwise agreed to by council.

(3) Supply of imported soil mix

(a) Imported soil mix shall be organic soil, soil blend or top dressing in accordance with the Australian Standard AS 4419 Soils for landscaping and garden use.

(b) The Contractor shall note the requirements of AS 4419.

(4) Supply of turf

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf.

(b) The soil of the turf sod shall be an even thickness of 25 mm minimum.

(c) Turf shall be free from any matter toxic to plant growth and shall be free from roots, weed or weed

seeds.

(5) Supply of hydro seeding/mulching
The specific mix/blend of hydro seeding/mulching required shall be nominated on the drawings and supplied by specialist supplier of hydro seeding/mulch.

(6) Supply of mulch materials

(a) All mulch materials supplied shall be in accordance with the current relevant AS 4454 Composts, soil conditioners and mulches.

(b) Organic and inorganic mulch shall be of the type and quality as noted on the drawings.

(c) Organic mulch derived from vegetation cleared on site may only be used where it is free from deleterious materials such as rock, soil and weed material.

(7) Tree stakes and ties

(a) Unless otherwise noted on the drawings or approved by council, tree stakes shall be durable hardwood, straight, free from knots or twists and pointed at one end.

(b) Small plants may only require 1 stake where required.

(c) For trees up to 45 litre 2 stakes – 50 mm x 50 mm x 1800 mm long.

(d) For trees over 45 litre 3 stakes – 50 mm x 50 mm x 2400 mm long.

(e) Ties shall be 50 mm wide furniture grade hessian webbing or similar.

(f) Supply of proprietary items
Timber/concrete garden edging, soil conditioners, root barrier, furniture items, play equipment and other project specific items shall be supplied to the requirements and details noted on design and/or construction drawings.

(8) Supply of gypsum
Gypsum application rates shall be supply in accordance with AS 4454 and as required by soil types specific to the site.

(9) Supply of fertiliser
Fertilisers supplied shall be:

(a) delivered to the site in sealed bags clearly marked to show the manufacturer or vendor, weight, fertiliser type, N:P:K. ratio, recommended uses and application rates; and

(b) applied at the locations and frequencies in accordance with the manufacturer's recommendations.

SC6.4.6.26.4 Earthworks

(1) General
Earthworks relates to gardens, grass areas, pathways and paved areas and includes:

(a) site clearing;

(b) stripping of existing vegetation;

(c) stripping of existing top soil;

(d) excavation to sub grade level;

(e) filling to sub grade level; and

(f) cultivation of the sub grade surface.

(2) Quality management
All materials supplied and work carried out shall be in accordance with the current, relevant Australian Standards:

(a) AS 1289 - Methods of testing soils for engineering purposes; and

(b) AS 3798 - Guidelines on earthworks for commercial and residential developments.

(3) Existing services

Per sub-section SC6.4.6.11 Clearing and grubbing, the Contractor is required to locate all existing and newly installed services prior to commencement of any earthworks. Care shall be taken in areas to be excavated, filled or cultivated not to unearth or damage services. Any damage to services caused by the Contractor shall be reinstated by the Contractor at no cost to council.

(4) Site preparation

(a) Clearing/Demolition

(i) Clearing shall mean the removal of trees, shrubs, scrub and undergrowth and other vegetation above ground level and includes the removal of artificial obstructions such as fences, concrete slabs rubbish, timber, boulders, rubble and other man made products.

(ii) Clearing shall be carried out in accordance with sub-section SC6.4.6.11 Clearing and grubbing.

(b) Grubbing

Grubbing shall mean the removal from below ground level of trees, roots, stumps, rocks and artificial obstructions as defined and specified by sub-section SC6.4.6.11 Clearing and grubbing.

(c) Stripping of existing vegetation

Areas to be excavated or filled shall be stripped of all vegetation to a depth just sufficient to include the root zone (nominal 50 mm). All stripping of vegetation is to be in accordance with sub-section SC6.4.6.11 Clearing and grubbing and must not affect trees/vegetation to be retained, as per clauses SC6.4.5.2.1(18) and (19).

The striped material shall be removed from site or may be stockpiled on site for later reuse, if approved by council and in accordance with clause SC6.4.5.2.1(17) Stockpiling of materials.

(d) Existing topsoil

Existing topsoil excavated on site may be reused provided that the material conforms to the AS 4419 requirements and is approved for reuse by the Superintendent. The material may be stockpiled on site, in accordance with clauses SC6.4.5.2.1(16) and (17).

(5) Excavation (down to sub grade level)

(a) General

The existing surface of areas to be excavated shall be stripped of all vegetation prior to excavating. Care shall be taken not to unnecessarily expose subsoils through the area of construction by over excavation, to prevent any potential for the development of acid sulphate conditions.

(b) Excavation in gardens

(i) Garden beds shall be excavated down to subgrade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if present) and the topsoil shall be shaped to fall from the centre of the bed outwards in all directions.

(iii) Excavation in gardens shall be in accordance with council's approved standard drawings.

Editor's note— standard drawings for these works are under development.

(c) Excavation in grass areas

(i) Grass areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf.

(ii) The subgrade shall be shaped and graded evenly to fall towards subsoil drains (if any) and shall be graded evenly to follow the finished surface profile.

(iii) Excavation in grass areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(d) Excavation for pathways and paved areas (paving)

(i) Pathways and paved areas shall be excavated down to subgrade level as required to suit finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits or subsoil drains.

(ii) Excavation for pathways and paved areas shall be in accordance with council's approved standard drawings.

Editor's note—standard drawings for these works are under development.

(e) Excavation near existing trees
Excavation near existing trees shall be undertaken in accordance with clause SC6.4.5.2.1(19) Work adjacent to trees and protection of environmentally significant vegetation.

(f) Spoil

(i) Spoil material resulting from excavation shall be reused on site wherever practicable, provided that the material conforms to the specified requirements for its intended use (e.g. filling or top soil) as per AS 4419.

(ii) Spoil material to be reused may be stockpiled on site as per clause SC6.4.5.2.1(17) Stockpiling of materials.

(iii) After the excavation process has been completed, the sub grade surface shall be inspected for springs, soft soil areas and other structural weaknesses. Where such weaknesses are encountered the following remedial works may be required:

(A) excavation and replacement of unsuitable material;

(B) surface drainage blankets of sand; and

(C) subsoil drains.

(6) Filling (up to sub grade level)

(a) Existing surface treatment
The existing surface of areas to be filled shall be stripped of all vegetation prior to placing any fill. The existing surface shall then be scarified to a depth of 200 mm. If required, water shall be added to bring the existing surface up to optimum moisture content prior to placing any fill.

(b) Unsuitable existing surface
After the stripping process has been completed, the existing ground surface shall be inspected for springs, soft soil areas and other structural weaknesses in the naturally occurring soil. Where such weaknesses are encountered, the following remedial works may be required:

(i) excavation and replacement of unsuitable material;

(ii) surface drainage blankets of sand; and

(iii) subsoil drains.

(c) Acceptable types of fill material for gardens and grass areas
Fill material to garden and grass areas shall be either:

(i) "general purpose soil" to AS 4419 Clause 4.1; or

(ii) "natural soil" to AS 4419 Clause 4.3; or

(iii) spoil from on site excavations if approved by the Superintendent, with a maximum particle size 25 mm.

(d) Acceptable types of fill material for pathways and paved areas
Fill material to pathways and paved areas shall be:

(i) crusher dust, free from organic matter and lumps of clay; or

(ii) crushed rock gravel uniformly graded, nominal particle size 25 mm; or

(iii) other granular material approved by the Superintendent.

All material used shall have a linear shrinkage - 0 - 8%, Soaked California Bearing Ratio – 15 minimum.

(e) Fill in gardens
Gardens shall be filled up to sub grade level as required to suit the finished surface levels, the depth of garden mix soil and the depth of mulch. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any).

(f) Fill in grass areas
Grass areas shall be filled up to sub grade level as required to suit finished surface levels, the depth of turf top soil and the depth of turf. The sub grade shall be shaped and graded evenly to fall towards subsoil drains (if any) or gully pits and to mirror the finished surface profile.

(g) Fill to pathways and paved areas
Path ways and paved areas shall be filled up to subgrade level as required to suit the finished surface levels, the depth of the gravel base course, bedding sand, pavers or concrete. The subgrade shall be shaped and graded evenly to the falls shown on the drawings and/or to fall to stormwater pits.

(h) Fill around existing trees
For informatin regarding placement of fill and compaction issues refer to AS 4970 Protection of trees on development sites and Clause SC6.4.5.2.1(18) Work adjacent to trees and protection of environmentally significant vegetation.

(7) Placing and compacting fill

(a) Fill material shall be placed and compacted in successive horizontal layers to the dimensions, levels, grades, and cross sections as shown on the drawings and so that the surface is always self-draining. Refer to Table SC6.4.6.26.2 for compaction standards. Care shall be taken to ensure that fill to garden areas is not excessively compacted.

(b) Each fill layer shall be scarified, and/or harrowed and processed to a finely divided condition, uniformly watered or aerated as the case may be, to obtain moisture content within the range of 80% - 90% of the optimum moisture content. The loose depth of the material in each layer shall be not more than 150 mm.

(c) Fill shall be placed in layers simultaneously on both sides of structures, culverts and pipe work to avoid differential loading. Fill shall not be placed against concrete or masonry structures, walls and the like until the concrete or masonry work has been in place for a minimum of 14 days.

(d) Existing works and structures shall be protected from damage due to compaction operations. Compaction by mechanical means shall not be carried out within 300 mm of paths, kerbs or structures. Compaction in these locations shall be carried out by hand or the size of compaction equipment shall be limited to ensure no damage is caused. Commence compaction of each fill layer at the structure and proceed away from it.

Table SC6.4.6.26.2 Fill compaction standards

Location	Compaction standard
Gardens and Grassed Areas.	85% Relative Dry Density Standard Compaction.
Pathways, Paved Areas and Structures.	95% Relative Dry Density Standard Compaction.

(8) Grading

(a) Runoff from impervious surfaces such as roofs, driveways and car parks, and overland flows from turf and garden beds is to be captured and allowed to infiltrate into subsoils by reshaping existing landforms through the use of swales, contour banks, soaks, percolation pits and basins, rain gardens and bioretention filters.

(b) To reduce runoff and erosion and encourage rainwater infiltration into soil, a landscape embankment is not to exceed grades of 1 in 5.

(c) The regrading of land is not to occur within the tree protection zone of existing trees to be retained.

(9) Cultivation

(a) Applies to gardens and grass areas (if directed or if noted on the drawings).

(b) Where shown on the drawings, the sub grade of Gardens and Grass Areas shall be cultivated prior to placing garden mix soil or turf top soil.

(c) The sub grade shall be thoroughly cultivated by ripping parallel to the final contours to loosen the compacted ground and to the depths nominated in Table SC6.4.6.26.3.

Table SC6.4.6.26.3 Cultivation depths

Location	Cultivation depth
Garden Areas	200 mm
Grass Areas	100 mm

(d) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all gardens at a minimum rate of 2 kg per square metre and shall be thoroughly blended and incorporated into the subgrade during cultivation.

(e) In areas of heavy clay natural soil, granulated gypsum shall be spread over the entire area of all grass areas at a minimum rate of 2 kg per square metre and shall be:

(i) thoroughly blended and incorporated into the subgrade during cultivation if cultivation is to be carried out; or

(ii) spread prior to placing turf soil.

(f) Any soil additives and/or imported materials other than gypsum, that may be required to be applied to the natural soil shall be thoroughly blended with or spread over the subgrade.

(g) Cultivation shall not be carried out when the soil is wet or plastic.

(h) The Contractor shall ensure that no damage occurs to tree roots, underground services, kerbing and the like during the cultivation process. Cultivation by mechanical means shall not be carried out within the drip line of trees to be retained or within 300mm of pathways, paved areas and/or structures. Cultivation in these locations shall be carried out by hand. Refer to Clause SC6.4.5.2.1(19) Work adjacent to trees and protection of environmentally significant vegetation.

(i) After cultivation soil lumps shall have a maximum dimension of 50 mm. Stones exceeding 25 mm, clods of earth exceeding 50 mm, weeds, roots, sticks, rubbish and any other deleterious material brought to the surface during cultivation shall be removed. Any depressions caused by the removal of these materials shall be filled with top soil or on site spoil material approved by the Superintendent.

(j) After cultivation the surface shall be graded smoothly and evenly and trimmed to the required levels allowing for placing the specified depth of imported soil to achieve the finished surface levels as noted on the drawings. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(10) Backfilling trenches

(a) Backfill to trenches up to sub grade level under pathways and paved areas shall be clean sand or crusher dust compacted to 95% relative dry density standard compaction.

(b) Backfill to trenches up to sub grade level in gardens and grass areas shall be imported soil mix or material excavated from the trench or may be other on site material approved by the Superintendent.

(c) Trenches excavated in gardens within the imported garden mix soil shall be backfilled with imported garden mix soil mix as specified.

SC6.4.6.26.5 Vegetation of slopes and drains

(1) Execution and timing of work

(a) The work to be executed under this clause includes the vegetation of cut and fill batters, pathway verges, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the drawings.

(b) Exposed ground shall be vegetated before the area exceeds one hectare or lesser area in compliance

with council requirements.

(2) Materials

(a) Topsoil

The Contractor shall use topsoil stockpiled on site under the sub-section SC6.4.6.10 Earthworks (construction). Where imported topsoil is required it shall comply with AS 4419 and shall:

(i) be of a friable, porous nature;

(ii) be free of weeds and weed seeds, bulbs, corms and vegetable propagules;

(iii) contain no refuse or materials toxic to plant growth;

(iv) contain no stumps, roots, clay lumps or stones larger than 50 mm in size;

(v) have an organic content of at least 3 per cent by mass;

(vi) have a pH neither less than 5.5 nor more than 7.5; and

(vii) have a soluble salt content not exceeding 0.06 per cent by mass.

(b) Herbicide

Herbicide used shall be a glyphosate-based herbicide listed in SC6.4.6.26 Attachment A.

(c) Seed

(i) All seed used shall be of the species and varieties list in SC6.4.6.26 Attachment A and shall be sown at the application rates specified therein. The Contractor shall submit to the Superintendent the name/s of the proposed seed supplier/s within 2 weeks of the acceptance of the tender.

(ii) The Contractor's attention is drawn to the lead time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

(iii) All seed must be accompanied by a "Certificate of Authenticity" which shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

(iv) The Contractor shall not take possession of the seed more than 7 days before sowing is to occur. The seed shall be stored in clean, air tight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

(v) The Contractor shall replace at his own expense any exotic seed batch found not true to type.

(d) Turf

Turf shall consist of 25 mm depth of dense, well rooted, vigorous grass growth with 25 mm depth of topsoil. The type of grass turf to be used shall be selected from SC6.4.6.26 Attachment A and in accordance with the drawings. Unless specified, Kikuyu grass shall not be used. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300 mm, and shall be in sound unbroken condition.

(e) Fertiliser

Fertiliser shall be an organic type listed in SC6.4.6.26 Attachment A with Nitrogen: Phosphorus: Potassium (N:P:K) ratios of 8 : 3.6 : 2.

(f) Vegetable mulch

Vegetable mulch used in hydromulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm. Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50 per cent by mass of the total mulch.

(g) Water

Water used shall be potable.

(h) Binder

The binder used in hydromulching and strawmulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

(i) Wetting agent

The soil wetting agent added in hydromulching or hydroseeding shall be listed in SC6.4.6.26 Attachment A and applied at the application rate specified therein.

(j) Pesticide
Pesticide used shall be a liquid or powder listed in SC6.4.6.26 Attachment A. The storage and handling of pesticides shall be in accordance with AS 2507.

(3) Vegetation of slopes 3 to 1 or flatter

(a) Preparation of surface

(i) Slopes shall be sprayed with herbicide applied at the rate specified in SC6.4.6.26 Attachment A to kill weed infestation. Sprayed areas shall remain undisturbed for two weeks.

(ii) The surface shall then be tyned to a depth of 200 mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

(b) Topsoiling
Topsoil shall be uniformly applied to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location. The topsoiled area shall be cultivated to a depth of 50 mm to provide a roughened surface with soil lumps not exceeding 50 mm dimension.

(c) Mixing of seed
The Contractor shall give the Superintendent 2 days notice before each sowing operation. Seed shall be sown on the day of mixing with pesticide.

(d) Incorporation of pesticide
Immediately before sowing, all grass and native seed shall be treated with pesticide. The pesticide shall be thoroughly mixed as a dry powder with the seed at the rate specified in SC6.4.6.26 Attachment A to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with SC6.4.6.26 Attachment A.

(e) Sowing

(i) Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5 mm or shall be raked or harrowed to provide 5 mm cover.

(ii) Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in SC6.4.6.26 Attachment A. Fertiliser shall be applied concurrently with the seeding operation.

(f) Turfing

(i) Turf shall be placed on the prepared topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow. Turf seams shall then be topdressed with topsoil.

(ii) Four to six weeks after placement, the turf shall be lightly topdressed with topsoil to correct any undulations or unevenness in the established turf.

(g) Watering
The Contractor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of 15 days after sowing, or as otherwise directed by the Superintendent, to promote and maintain growth.

(4) Vegetation of slopes steeper than 3 to 1

(a) General
Where required or directed by the Superintendent, slopes shall be vegetated by one of the following methods:

(i) topsoiling and hydromulching;

(ii) topsoiling, hydroseeding and straw mulching; or

(iii) hydroseeding.

(b) Preparation of surface

(i) Weeds shall be killed by spraying with herbicides as specified in SC6.4.6.26 Attachment A.

(ii) No more than 7 days before seeding all loose material shall be removed from fill batters and cut

batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by the Superintendent.

(c) Topsoiling

Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(d) Hydromulching or hydroseeding

(i) The hydromulch or hydroseed shall comprise the materials shown in Table SC6.4.6.26.4. The materials shall be applied at the application rates shown in Table SC6.4.6.26.4.

(ii) Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

(iii) During preparation of the hydromulch or hydroseed slurry, liquid form pesticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of pesticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface in accordance with Table SC6.4.6.26.4.

(iv) Storage tanks, containers and equipment to be used in hydromulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.

(v) A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface.

(vi) Hydromulch or hydroseed shall not be applied under the following weather conditions at the site:

(A) when temperature is higher than 35 ºC;

(B) when winds exceed 15 km/hr;

(C) where, in the opinion of the Superintendent, the surface is too wet; or

(D) during rain periods or when rain appears imminent.

(vii) Application rates shall be in accordance with Table SC6.4.6.26.4.

Table SC6.4.6.26.4 Materials and application rates

Application Rate per Hectare		
Material	**Hydromulching**	**Hydroseeding**
i) Vegetable Mulch (kg)	2,500	Nil
ii) Water (L)	35,000	20,000
iii) Binder (L)	700	Nil
iv) Fertiliser	See SC6.4.6.26 Attachment A	
v) Seed	See SC6.4.6.26 Attachment A	
vi) Wetting Agent (L)	35	20
vii) Pesticide (L)	5	5

(e) Straw mulching

The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20 mm at any location.

(5) Vegetation of open drains

(a) Preparation of surface

The Contractor shall so execute the work that the excavation of open drains to the specified profiles is followed within 7 days by the vegetation of the surface as specified in this clause. Topsoil shall be spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

(b) Sowing
Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in SC6.4.6.26 Attachment A by one of the following procedures as directed by the Superintendent:

(i) mechanical sowing;

(ii) hydromulching or hydroseeding; and

(iii) by hand.

(c) Surface protection - general
Where shown on the drawings or directed by the Superintendent, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

(d) Surface protection - spraying with bitumen emulsion
An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of 1 litre of bitumen emulsion per square metre of surface.

(e) Surface protection - lining with organic fibre mat

(i) The channel surface shall be lined with an organic fibre mat listed in SC6.4.6.26 Attachment A. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched.

(ii) The upstream end of the matting shall be slotted into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. The trench shall be backfilled with soil and compacted by foot.

(iii) The pins shall be `U' shaped, 4 mm gauge wire, 50 mm wide and 150 mm long legs.

(iv) Adjacent runs of matting shall be overlapped 100 mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500 mm centres and along the middle of each run at 1 m centres. End overlaps shall be 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

(f) Turfing

(i) Turf shall be as specified under clause SC6.4.6.26.5(2)(d).

(ii) Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain, and pinned into position at 500 mm centres.

(iii) Seams of turf shall be topdressed with topsoil.

(g) Watering
The Contractor shall water treated areas in order to promote and maintain growth as specified under clause SC6.4.6.26.5(3)(g).

SC6.4.6.26.6 Garden construction

(1) Scope
The following work activities relate to the construction of garden beds, garden areas and mass planting areas:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing garden mix soil;

(d) supply and placing mulch;

(e) supply and planting of trees, shrubs, ground cover plants and the like including stakes and other plant supports;

(f) supply and application of fertiliser;

(g) supply and installation of garden edging; and

(h) supply and installation of subsoil drains.

All garden construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 - *Soils for landscaping and garden use*; and

- AS 4454 - *Composts, soil conditioners and mulches*.

(2) Co-ordination

The sequence for placing garden mix soil, installing irrigation, placing mulch and planting will vary according to the type of plants and irrigation system. The Contractor is required to liaise with other Contractors and the Superintendent to ensure the best possible method of construction is undertaken.

(3) Earthworks

Gardens may require Excavation or Filling to achieve the finished surface levels nominated on the drawings. After excavation or filling, all gardens may require cultivation.

(4) Garden bed dimensions

Planting bed dimensions are in accordance with the following:

(a) garden beds have an average minimum width of 1.2 m, provided that the bed is no less than 0.5 m wide; and

(b) root zone depths for plants are at least that of the root ball of the plant at planting.

(5) Soil condition

(a) Priority is to be given to using existing site soil as imported soil is a limited resource.

(b) Existing topsoil is conserved by either not disturbing the soil during construction or by stockpiling it prior to construction commencing, in accordance with SC6.4.5.2 Stockpiling of materials.

(c) Subsoil is to be cultivated to a minimum depth of 200 mm for garden beds and 100 mm for turfed areas unless this will adversely affect the roots of established trees.

(d) The minimum top soil depth is:

(i) 100 mm for non-irrigated turf areas;.

(ii) 200 mm for irrigated turf areas; and

(iii) 300 mm for garden beds.

(e) If additional soil is required to meet these minimum depths, soil is to meet AS4419 Soils for landscaping and garden use.

(f) The soil quality is sufficient to allow plants to grow effectively. Soil amelioration measures to improve the infiltration of existing soils, the soil's macropore and micropore balance and ensure a stable soil ecosystem, include the following:

(i) scarification of crusted topsoil layers;

(ii) aeration of topsoil layers;

(iii) deep ripping of subsoil layers;

(iv) using hand tools only within the tree protection zone of a tree identified for retention;

(v) the application of gypsum to sodic clay topsoils and subsoils;

(vi) installing a 50 mm layer of lucerne hay between the topsoil and mulch layer;

(vii) adding worms to the topsoil;

(viii) applying soil rhizobia in solution to the topsoil;

(ix) inoculating plants with Mycorrhizal fungi; and

(x) incorporating soil wetters, crystals and wettable foams.

(6) Soil improvement additives

Any soil additives to be applied shall be as required/recommended by soil test results.

(7) Placing imported soil in gardens

(a) Garden mix soil shall be an imported "Organic Soil".

(b) Garden mix soil shall be a minimum depth of 300 mm after consolidation.

(c) Garden mix soil shall be placed, spread and graded evenly in maximum 150 mm thick layers to finish at a level which allows the surface of the mulching material after consolidation to be flush with adjacent finished levels. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(d) Garden mix soil shall be graded evenly to form a gentle crowned appearance at the centre of the garden bed and/or shall conform to the finished levels detailed on the drawings.

(e) The surface of the garden mix soil shall be smooth and free from stones or lumps of soil prior to planting.

(8) Mulch material
Refer to clause SC6.4.6.26.3 Supply of materials.

(9) Placing mulch

(a) Mulch shall be placed as soon as practicable after planting and shall be placed progressively as planting proceeds along the length of the garden or planting area.

(b) Mulch shall be spread smoothly and evenly over the entire garden so that after initial consolidation the finished level of the mulch is flush with adjacent finished levels.

(c) Mulch shall be shaped around plants to slope into the plant and shall be kept a minimum of 50 mm clear of plant stems to avoid collar rot.

(d) Organic mulch
Organic mulch shall be placed to a depth not greater than 100 mm and as a minimum shall be maintained to a depth of 75 mm after consolidation.

(e) Inorganic mulch
Not less than 14 days prior to the placing of inorganic mulch, herbicide shall be applied to the entire area to be mulched and prior to placing the mulch.

(f) Inorganic mulch shall be placed to a minimum depth of 100 mm unless noted otherwise on the drawings for the type of mulch specified.

SC6.4.6.26.7 Planting

(1) General

(a) Planting shall be carried out in accordance with the best horticultural practices.

(b) Plants shall be installed at the spacings and locations detailed on the drawings to avoid existing services or to cover an area uniformly.

(c) In feature planting areas at least 25% of tree plantings are to be provided as larger advanced stock, with a minimum 25 litre pot size.

(d) The Contractor is required to locate all existing services prior to planting.

(e) Planting shall not be carried out if the soil is very wet or water logged or during periods of extreme weather conditions such as extreme heat, cold wind or rain.

(f) Plant supplies are to be healthy, attractive, and a general high standard of stock in order to ensure long-term viability of the specimen. The stock will be free from disease, pests and weeds and structural defects, as per clause SC6.4.6.26.3 Supply of materials.

(2) Planting procedure – container stock

(a) A planting hole with vertical sides shall be excavated to a width of twice the diameter of the root ball of the plant and to a minimum depth of 100 mm deeper than the height of the plant container.

(b) The depth of the planting hole shall allow for the clearance specified and shall be in relation to the finished surface level where applicable.

(c) The sub grade material at the bottom of the planting hole shall be loosened to a depth of at least 50% of the root ball depth and the compacted sides of the planting hole shall be loosened to prevent confinement of root growth to the hole. Additional excavation of the base of the planting hole may be

required to ensure that the plant has sufficient sub grade drainage.

(d) Plants shall be thoroughly watered in the pot prior to planting so that when removed from the pot the root ball is moist. Plants shall be removed from their pots without damage to the root system. Plants shall not be removed from pots until the planting hole is complete and ready for planting.

(e) The plant shall be placed in the centre of the hole with the stem vertical and shall be set at a height such that the top of the potting material is level with the surrounding soil. Plants placed on a slope shall be set in the centre of the hole with the top of the potting material level with the lowest side of the planting hole and the plant stem vertical.

(f) Fertiliser tablets or granules shall be placed in the planting hole at the time of planting in accordance with the manufacturers recommended rates of application. The fertiliser shall be placed around the plant at half the depth of the planting hole and shall be covered with backfill soil to ensure no direct contact with the plant roots.

(g) Plants other than container stock trees placed in gardens shall be backfilled with garden mix soil as specified for the entire planting hole. The garden mix soil shall be lightly tamped around the plant and thoroughly watered to eliminate air pockets.

(h) During planting care shall be taken to ensure that soil is not mixed with the mulch. Mulch that is contaminated with soil shall be replaced.

(i) Container stock trees shall be backfilled in 150 mm layers up to within 200 mm of the top of the planting hole. The backfill soil shall be tamped around the tree and thoroughly watered to eliminate air pockets. Backfill the top 200 mm with garden mix soil.

(j) In areas other than heavily planted borders, shrubs or tuft plants, each individual plant shall have a watering basin for the extent of the planting hole formed with garden mix soil around the base of the plant.

(k) Individual container stock trees located in irrigated grassed areas shall have a 150 mm high watering basin for the extent of the planting hole formed with garden mix soil around the base of the tree.

(l) Plants placed on a slope shall have a small horizontal terrace formed for the extent of the planting hole.

(m) Immediately after planting, the plants shall be watered to thoroughly water the root ball and the backfill. Watering shall be carried out progressively as planting proceeds to ensure that plants do not dry out and as a minimum, plants shall be watered within a maximum of 1 hour from planting.

(n) All identification labels, nursery ties and the like shall be removed from the plants immediately after planting

(3) Planting procedure - ex ground stock plants

Editor's note—content under development.

(4) Transplanting trees

(a) Trees to be transplanted will be noted on the construction drawings prior to the commencement of construction.

(b) Preparation of the tree prior to transplanting shall be carried out in accordance with accepted transplanting practice and any requirements provided by council to suit the particular species and project.

(c) Preparation of the tree for transplanting shall be commenced in sufficient time to ensure that at the time of planting the tree is adequately prepared and will meet the specified requirements.

(d) All transplanting work shall be carried out under the direction of a suitably qualified horticulturist or arborist.

(e) Planting of the transplanted tree shall be generally in accordance with the details shown on the drawings.

(f) The resulting excavation after the tree has been removed shall be backfilled with compacted fill material suitable for the location.

(5) Root barrier

(a) Locations and type of root barrier shall be noted on the drawings or shall be as directed by the Superintendent.

(b) Root barrier shall be installed as per the manufacturer's recommendations and with particular attention to the location of any underground services and service pits.

(c) Root barrier must be installed in all situations where it is likely that tree roots may interfere or adversely affect infrastructure - such as driveways, kerbs, pathways and other street furniture and buildings, e.g. where species such as Ficus are to be planted in reasonable proximity to pathways.

SC6.4.6.26.8 Staking, ties and guying

(1) Every container stock tree shall be staked and tied unless otherwise approved by the Superintendent. Tree stakes

(a) Stakes shall be:

(i) a minimum of 2 stakes per tree;

(ii) placed outside of the tree root ball;

(iii) driven into the ground a minimum one third of their length;

(iv) for smaller trees (trees up to 45 litre), at least 1.0 metre apart; and

(v) for columnar trees, spaced to avoid excessive root ball damage.

(b) Care shall be taken to avoid damage to the tree root system and any services when installing stakes.

(c) All stakes shall remain in place for the entire “maintenance period” unless otherwise instructed by the Superintendent.

(2) Ties

Ties shall be fixed securely with staples to the stakes in a figure eight pattern around the tree stem. As a minimum one tie at half the height of the main stem shall be provided with additional ties as necessary to stabilise the tree.

(3) Guying

(a) Trees requiring the installation of guying shall be noted on the construction drawings or shall be as directed by the Superintendent.

(b) Guying consists of a minimum of three heavy duty stakes of either steel or timber driven into solid ground, with heavy duty galvanised wire ties firmly fasten to the stakes and looped around the tree trunk with suitable wrapping to protect the trunk.

(c) Underground guying where required to be used, shall be positioned for stability purposes, placement of the guy wires shall away from the tree trunk to avoid girdling issues as the tree matures. Such tree guying practices shall be removed prior to Off Maintenance inspection and acceptance by council.

Editor’s note—underground guying is accepted where suitable for the tree in question.

SC6.4.6.26.9 Sub soil drains construction

(1) Sub soil drains in gardens may be required in areas of heavy clay soils and in roadway medians, roundabouts and the like. Sub soil drains shall be installed at the locations and to the details shown on the drawings.

(2) Pipes and fittings shall be perforated plastic Type 1 Class 200 to AS2439: Part 1. Sub soil drain filter fabrics shall be approved geo fabric material in accordance with the relevant Australian Standards.

(3) Pipe surround shall be a coarse washed river sand complying with the grading requirements given in Table SC6.4.6.26.5 and shall completely surround the perforated pipe.

(4) The subsoil drain pipe shall be laid to grade continuously to the outlets nominated on the drawings at a

minimum grade of 1:100.

(5) Sub soil drains may be inspected by the Superintendent prior to placing any garden mix soil or backfill.

Table SC6.4.6.26.5 Recommended grading for sub-soil drain sand

A.S. SIEVE	% PASSING
9.5 mm	100
4.75 mm	98-100
2.36 mm	70-100
1.18 mm	30-78
600 µm	2-15
300 µm	0-4
150 µm	0-1

SC6.4.6.26.10 Garden edging

(1) Supply and installation of timber, concrete or recycled plastic proprietary garden edging shall be in accordance with the details on the drawings and the manufacturer's recommendations where applicable. Timber or recycled plastic garden edging must have a minimum thickness of 30 mm.

(2) Supply and installation of concrete kerbing shall be as specified in clause SC6.4.6.26.15.

SC6.4.6.26.11 Planter boxes

(1) Planter boxes shall be constructed at the locations and to the details shown on the construction drawings.

(2) Planter box soil shall be an imported soil mix (Potting Mix). Refer to project specific specifications where applicable.

(3) Planter boxes must have appropriate drainage (see clause SC6.4.6.26.9 Sub soil drains construction) provided that it is connected to a lawful discharge point. The drainage discharge is not permitted to cause nuisance, such as staining or sediments, to adjacent areas.

SC6.4.6.26.12 Grass area construction

(1) General

The following work activities relate to grass areas construction:

(a) earthworks (excavation, filling and cultivation);

(b) supply and application of soil improvement additives;

(c) supply and placing turf soil;

(d) supply and lay grass turf;

(e) supply and lay grass seeding;

(f) supply and installation of hydro-seeding/mulching; and

(g) supply and application of fertiliser.

All grass area construction shall be in accordance with the current relevant Australian Standards:

- AS 4419 Soils for landscaping and garden use; and
- AS 4454 Composts, soil conditioners and mulches.

(2) Co-ordination

The sequence for placing turf soil, installing irrigation and placing turf will vary according to the type of plants and irrigation system.

(3) Earthworks

Grass areas may require excavation or filling to achieve the finished surface levels detailed on the construction drawings. Refer to clause SC6.4.6.26.4 Earthworks.

(4) Placing turf soil

(a) Turf soil shall be an imported soil mix Type 2 “Soil Blend”.

(b) Turf soil shall be a minimum depth of 100 mm after light compaction.

(c) Turf areas shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding. As a minimum turf areas shall be graded to fall at 1:100.

(d) Turf soil shall be spread evenly and shall be lightly compacted to finish at a level which allows for the finished turf surface to be flush with adjacent surfaces such as paved areas, pathways mowing strips and the like. Care shall be taken to prevent areas of excessive compaction being caused by construction equipment.

(e) The surface of the turf soil shall be smooth and free from stones or lumps of soil prior to laying the turf.

(5) Turf material

(a) Turf shall be the species nominated on the drawings and shall be supplied by a specialist grower of cultivated turf approved by the Superintendent.

(b) Where turf areas are provided within centre medians, round-abouts and other identified areas of road reserve where edging/mowing may require traffic control, all turf is to be Empire Zoysia or approved similar turf and of a minimum width of 1.6 m to allow for clear mowing access.

(6) Laying turf

(a) Prior to laying turf, fertiliser shall be thoroughly mixed into the turf soil. Refer to Table SC6.4.6.26.5 for application rates.

(b) Areas to be turfed shall be divided into sections that can be prepared and completed (including adequate watering) in the same day.

(c) Turf shall be laid in straight lines in a stretcher bond pattern across the fall of the slope or parallel with the long side of level areas. Cross joints shall be staggered with a maximum gap of 5 mm between adjacent sections of turf.

(d) Immediately after laying the turf shall be rolled with a roller weighing not more than 90 kg/m of width.

(e) As soon as practicable after rolling turf shall be watered thoroughly with a fine spray to a depth of 150 mm. Watering shall continue as necessary to maintain moisture to this depth and to maintain the turf in a healthy condition.

(f) Where levels have deviated from the design levels after placing and watering the turf shall be lifted and the section regraded with turf soil to achieve design levels prior to replacing the turf.

(g) Turf shall be protected from pedestrian traffic until established and shall be protected from vehicle traffic at all times.

SC6.4.6.26.13 Hyrdo seeding/mulching

(1) General

(a) Excavation, filling, cultivation and placing imported soil mix for hydro seeding/mulching areas shall be as specified for turf areas.

(b) Details for hydro seeding/mulching supply and sowing shall be as noted on the drawings and/or as specified under separate cover.

(c) Organic mulches are to be applied to landscaped garden beds and trees which:

(i) meet AS 4454 Composts, soil conditioners and mulches;

(ii) are applied to a depth of 75 – 100 mm;

(iii) are of a coarse texture to allow water penetration to prevent nitrogen drawdown of the soil;

(iv) are aged prior to application;

(v) do not use plastic sheeting, typically used for weed suppression as it prevents rainwater from infiltrating soils and inhibits gaseous exchange between the soil and air; and

(vi) use a biodegradable mulch mat on any waterway embankment.

(d) Inorganic mulches, such as recycled concrete or brick cobbles, are limited to feature or themed landscapes, or in windy areas where organic mulches may be blown away.

(2) Supply of mulch materials

(a) Mulch materials supplied shall be free of deleterious and extraneous matter such as soil, weeds, seeds, rubbish, vermin, insects, pests, fungus, sticks, disease, declared plants or noxious weeds and shall be free of any matter toxic to plant growth or germination.

(b) All mulch materials supplied shall be in accordance with AS 4454 Composts, soil conditioners and mulches.

(c) Organic mulch
Organic mulch may be either:

(i) tea tree mulch from an approved supplier; or

(ii) wood chip produced by the chipping of native and other approved vegetation removed during the clearing and grubbing process on site (max 50 mm size); or

(iii) wood chip obtained from a council stockpile as directed by the Superintendent or his delegated site supervisor; or

(iv) other material as noted on the drawings.

(d) Inorganic mulch
Inorganic mulch shall be of the type and quality and noted on the construction drawings.

(3) Surface preparation

(a) Level sites
Prior to hydro seeding/mulching the area to be treated shall be graded to fall evenly between the finished surface levels detailed on the drawings and/or shall be graded to drain freely to stormwater inlets without causing ponding.

(b) Embankments and slopes (1 on 5 maximum slope)
Prior to hydro seeding/mulching the area shall be lightly cultivated across the slope to minimise surface run-off and erosion. After cultivation, soil crumb size shall not exceed 20 mm.

(c) The surface of the area to be treated shall be free from weeds, stones, roots, sticks or other deleterious material and have a general moisture content of around 10% just prior to applying the hydroseed/mulch.

(4) Irrigation
An approved temporary above ground irrigation system shall be installed to ensure establishment of the hydro seeding/mulching is achieved within the timer frame specified. Refer to SC6.4.6.27 Irrigation.

SC6.4.6.26.14 Paving construction
Refer to sub-section SC6.4.6.18 Segmental paving.

All areas of road reserve fronting a subject site must be assessed against, and treated in accordance with SC6.4.3.3 Footpath treatment policy where specified.

SC6.4.6.26.15 Concrete kerbs
This section contains specific details for construction of concrete kerb in landscape and open space situations. Concrete kerb is most commonly used for garden edge or as a restraint for softfall areas in playgrounds.

All concrete garden edge kerb or similar structure shall have minimum rectangular profile dimensions of 150 mm wide x 200 mm deep with edges rounded to a radius of 20 mm (minimum) and constructed in accordance with clause

SC6.4.6.28.2(2) Kerb and channel. Where the concrete garden edge kerb abuts grass areas, the surface of the kerb must finish level with the surface level of the grass area.

SC6.4.6.26.16 Concrete works

For all concrete works associated with Landscaping activities refer to sub-section 6.4.6.28 Minor concrete works.

SC6.4.6.26.17 Masonry work

This section covers the supply of all materials, placing and finishing of all masonry blockwork including concrete core-filling and clay brickwork. Masonry Work includes walls, retaining walls, free standing piers, structures and the like. All masonry work shall conform to the requirements of AS 3700.

(1) Materials

(a) Blocks - Hollow load bearing masonry blocks shall conform to the requirements of AS 3700 - Section 2, and shall have a characteristic unconfined compressive strength of 15 MPa unless nominated otherwise agreed.

(b) Masonry blocks shall be sound, dry, clean and crack free and shall have been cured for not less than 14 days before delivery. The correct type of block shall be used to make provision for all lintels, pilasters, bond beams, openings, etc.

(c) Clean out blocks shall be used in the first course of all reinforced cores and/or where cores are to be concrete filled.

(d) Cement - for mortar shall be Portland Cement Type A and shall conform in all respects with the requirements of AS 3972.

(e) Sand - for mortar shall be clean, sharp and free from organic impurities and excess fines and efflorescing salts.

(f) Water - used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

(g) Hydrated lime shall conform to the requirements of AS 1672.1.

(h) Admixtures - no air-entraining additives or other admixtures shall be incorporated in the mortar unless specifically approved by the Superintendent.

(i) Reinforcement - shall comply with AS/NZS 4671 as applicable.

(j) Clay bricks - and brickwork shall conform to AS 3700. Clay brick shall have a characteristic unconfined compressive strength of 40 MPa unless otherwise agreed.

(2) Mortar for blockwork

(a) All mortar for blockwork shall consist of a homogeneous mixture of the ingredients and shall be classified as M4 in AS 3700. The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement 1: Lime 0 to 0.25: Sand 3.

(b) The mortar components shall be properly volume batched using calibrated volume boxes. Batching by shovel will not be permitted.

(c) Mortar shall be mixed in an approved mixing machine for not less than 3 minutes. Handmixing shall not be permitted unless specifically approved by the Superintendent. The dry ingredients shall be thoroughly mixed prior to the addition of water, which shall then be worked thoroughly through the mixture.

(d) Mortar shall be transported in a covered container such that excessive evaporation will be prevented. Retempering of mortar shall not be permitted.

(3) Core-fill concrete

(a) Core-fill concrete shall comply with the relevant requirements of AS 3600 Concrete Structures. Ready mixed concrete from an approved supplier shall be used. As a minimum and unless shown otherwise on the drawings, core-fill concrete supplied shall have the following properties in Table SC6.4.6.26.6.

Property	Design Value
Characteristic strenght F'c at 28 days	N 20
Norminal maximum size of aggregate	10 mm
Slump	230 mm +/-30 mm

(b) Testing of core-fill concrete supplied shall be carried out by the Concrete Supplier as part of the suppliers Quality Assurance System. The Contractor is required to provide the Superintendent with copies of the suppliers Test Certificates relating to the particular batch of core-fill concrete supplied.

Core-fill concrete supplied that does not meet the requirements of this specification shall be liable to rejection by the Superintendent. If directed by the Superintendent the Contractor will rectify any masonry wall which has been filled with rejected core-fill concrete.

(4) Laying blocks

(a) All work shall be carried out by experienced tradesmen to the general requirements of AS 3700 - Section 8. Blockwork shall be laid in lifts or not more than 2400 mm in height.

(b) All blocks shall be laid dry and wetting of the blocks shall not be permitted under any circumstances.

(c) Cutting of blocks shall be reduced to an absolute minimum by setting out to avoid irregular or broken bond.

(d) Blocks shall be stacked on planks or other supports free from contact with the ground and shall be covered at all times to ensure that the blocks remain dry.

(e) Blocks shall be laid in straight uniform courses of running bond unless noted otherwise on the drawings. Intersecting walls shall be bonded as shown on the drawings.

(f) The surface of the concrete footing, floor slab, beam, etc. on which the base course is to be laid shall be thoroughly cleaned prior to laying the base course to ensure all laitance is removed.

(g) The base course shall incorporate clean out blocks at every reinforced core, with the clean out opening on the inside face of the wall.

(h) Reinforcement starter bars shall be checked for alignment prior to laying the base course. Starter bars shall be vertical. Bending starter bars to allow the laying of the base course is not acceptable. Any starter bars out of position shall be rectified by the Contractor as directed by the Superintendent.

(i) For unreinforced and reinforced masonry walls, horizontal joints shall have full mortar coverage on the face shells and on the webs.

(j) For unreinforced masonry walls all vertical joints shall have full mortar coverage. For reinforced masonry walls all vertical joints shall be buttered only for the thickness of the face shells.

(k) All horizontal and vertical joints shall be 10 mm in width with a maximum mortar intrusion into the cores of 6 mm. Mortar droppings into cavities or cores shall be avoided.

(l) Tooling of the joints shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a V-shaped or round bar in a manner that will compact the mortar rather than drag it out. Raked joints shall not be permitted to encroach more than 5 mm in depth.

(m) If it is necessary to move a block after it has been set in place with mortar, then the block shall be removed from the wall, the mortar removed and the block shall be reset in fresh mortar.

(n) Capping blocks shall be fixed with a suitable flexible external grade adhesive as detailed on the drawings. Laying capping blocks in mortar only is not acceptable.

(o) Where new blockwork is to be laid on top of an existing masonry block wall, the existing core concrete shall be cleaned to expose all aggregate and treated using an adhesion enhancer such as bondcrete or approved equivalent before block laying is commenced.

(p) Extreme care shall be exercised to prevent mortar adhering to the face of blockwork. Acid shall not be used to clean down masonry walls.

(5) Reinforcement

(a) Steel reinforcement shall be supplied and bent in accordance with AS 3700. Rebending of reinforcement

with or without heating is not permitted unless approved by the Superintendent.

(b) Steel reinforcement shall be free from rust, oil, varnish, mud or any other coatings, cracks, scale blister and other defects and shall comply in all respects with AS/NZS 4671.

(c) All horizontal reinforcement shall be laid into the wall as the block laying progresses. Galvanised wire loops shall be cast into the horizontal joints prior to placing the reinforcement to ensure correct positioning of the reinforcement.

(d) Vertical reinforcement shall be placed after the wall has been laid and shall be placed in the core with the correct cover to the face of the blocks as detailed on the drawings. Unless noted otherwise on the drawings vertical reinforcement shall be placed in the centre of the core.

(e) Splice lengths for both horizontal and vertical reinforcement shall not be less than 45 bar diameters for plain round bars or 30 diameters for deformed bars or 450 mm, whichever is the greater.

(f) All reinforced block walls shall have vertical reinforcement in the core at the ends, corners, sides of openings, adjacent to control joints, at unbonded intersections and at the maximum centres between these points.

(6) Cast in elements

(a) The Contractor shall co-ordinate with all other trades as necessary to ensure that all conduits, fitments, penetrations and the like are incorporated in the masonry as detailed on the drawings and as specified.

(b) All bolts, anchors and other steel fittings shall be accurately set into the walls as the work progresses and positioned such that they shall be thoroughly embedded in mortar or core-filling concrete as required.

(c) Where items to be cast into the blockwork are found to be out of position and cannot be satisfactorily corrected, then the section of blockwork shall be completely demolished, and then reconstructed to allow correct positioning.

(7) Joints in blockwork

(a) Joints in blockwork shall be the type and at the locations detailed on the drawings. Joints with steel dowels shall have the dowels securely supported to ensure that the dowel remains in the correct position during the placing of core-fill concrete.

(b) Construction joints shall be located as detailed on the drawings or shall be located where agreed with the Superintendent to suit specific site requirements.

(c) Joint filling compounds shall be as detailed on the drawings and shall be installed in accordance with the manufacturers recommendations, with particular attention to the preparation of the blockwork surface to suit the application of the joint filling compound.

(8) Placing core-fill concrete

(a) Masonry walls shall cure for at least 3 days before core-fill concrete is placed.

(b) The cores to receive core-fill concrete shall be cleaned of all mortar protrusions by rodding from the top of the wall. All mortar droppings and foreign matter shall then be removed via the clean out openings at the base of the wall, the vertical reinforcement positioned and formwork fixed in place to seal the clean out block opening.

(c) Core filling shall not proceed until the reinforcement and cores have been inspected by the Superintendent. Clean out openings shall not be sealed until the inspection has been carried out.

(d) Core-fill concrete shall be thoroughly compacted into place as it is poured with the aid of small immersion vibrators or rodding. Block cores shall be topped up after settlement occurs.

(e) Core-fill concrete shall be placed for the full height of the blockwork in lifts of not more than 2400 mm in height. A minimum delay period of 1 hour and a maximum delay period of 3 hours shall be observed between lifts.

(f) Proprietary core plates shall be used to confine the core-fill concrete to the reinforced cores.

(g) Placing of core-fill concrete in bond beams shall be done in one continuous operation for the full length of the bond beam. Construction joints in bond beams other than control joints, are not acceptable.

(h) Extreme care shall be exercised to prevent slurry adhering to the face of blockwork. Acid shall not be used to clean down masonry walls.

(9) Mortar for clay bricks

(a) All mortar for clay bricks shall consist of a homogeneous mixture of the ingredients and shall be classified as M3. Refer to AS 3700.

(b) The following proportions by volume shall be used unless the minimum compressive strength of mortar at 28 days has been nominated on the drawings. Cement: 1, Lime: 1, Sand: 6.

(c) Mortar for clay bricks shall be generally in accordance with clause SC6.4.6.26.17(2) Mortar for block work.

(10) Laying clay bricks

(a) Clay bricks shall be fully bedded and fully faced. Bed joints shall be 10 mm nominal height.

(b) Clay brick masonry walls shall be laid with galvanised brick ties at 600 mm maximum centres each way and at 300 mm centres adjacent to openings in accordance with manufacturer's specifications.

(c) Laying of clay bricks shall be generally in accordance with clause SC6.4.6.26.17(4) Laying blocks.

(11) Protection of walls

(a) During construction and after the wall is laid and prior to placing core-fill concrete; under no circumstances shall masonry blocks be wetted or allowed to become wet.

(b) At the completion of a day's work and during wet weather the top and sides of all walls shall be covered to prevent rain penetrating the cores and wetting the blocks.

(c) During the construction of masonry walls and prior to the core-fill concrete having gained its full strength, the Contractor shall protect the wall by suitable means such as bracing to ensure that the wall is not damaged and to ensure the safety of workers on the site.

(12) Tolerances

(a) All masonry shall be built true and plumb such that the maximum "out-of-plumb" in a 3 m height does not exceed 10 mm.

(b) The bed joint at any level shall be within ± 3 mm.

(13) Surface finishes to masonry

(a) Surface finishes, such as painting, rendering or textured finishes shall be as detailed on the drawings or as nominated in the Finishes Schedule.

(b) Prior to applying any surface finish the substrate shall be free from dirt, dust, oil, grease, mould, fungi, efflorescence, release agents, bond breakers, scaling and laitance or any other contaminants or foreign material that may affect adhesion. Remove all traces of loosely adhering material by scraping, grinding, wire brushing or air blowing as necessary.

(c) Preparation of the surfaces to be treated, application of the surface finish and curing after application if required, shall be carried out in strict accordance with the manufacturer's recommendations. Particular attention shall be made to application during suitable weather conditions.

(d) Gap fill and/or sealant material used for joints or cracks in walls shall be checked for compatibility with the proposed surface finish.

(e) Anti-vandal coatings shall be used in circumstances where walls are exposed (i.e. not screened by soft landscaping) and prone to graffiti.

(f) Dissimilar materials adjacent to surfaces to be treated shall be masked to avoid contact, (e.g. capping and flashings).

(g) The Contractor shall provide the Superintendent with all warranty details of the surface finishes.

SC6.4.6.26.18 Stormwater drainage

All stormwater drainage shall be constructed in accordance with the relevant stormwater drainage guidelines contained in SC6.4.6.4 Stormwater drainage.

SC6.4.6.26.19 Infrastructure items

Supply and installation of infrastructure items such as timber decking, timber and steel fencing, seats, picnic sets, barbeques, play equipment and signage shall be as detailed on the drawings and constructed in strict accordance with the manufacturers' specifications. The Contractor shall provide the Superintendent with all warranty details. Concrete for footings, plinths and the like for infrastructure items shall be in accordance with clause SC6.4.6.26.16 Concrete works.

SC6.4.6.26.20 Electrical

The installation of electrical components shall comply with the requirements of AS 3000. Where required under the *Electricity Act 1994*, electrical installations shall be installed by a registered Electrical Contractor as defined by that Act. Refer to the electrical engineer's drawings and specifications for all requirements.

SC6.4.6.26.21 Summary of limited and tolerance

The limits and tolerances applicable to the various clauses in this sub-section are summarised in Table SC6.4.6.26.7 below.

Item	Activity	Limits/Tolerances	Clause
1.	**Topsoil**	>3% by mass	SC6.4.6.26.5(2)(a).
	a) Organic Content		
	b) pH	>5.5 <7.5	SC6.4.6.26.5(2)(a)
	c) Soluble Salt	<0.06% by mass	SC6.4.6.26.5(2)(a)
2.	**Turf**	Widths >300mm.	SC6.4.6.26.5(2)(d)
3.	**Vegetable mulch**	maximum size <10mm	SC6.4.6.26.5(2)(f)
	a) Material	<50% by mass of total mulch	SC6.4.6.26.5(2)(f)
	b) Paper Pulp		
4.	**Topsoiling**	Minimum compacted thickness	SC6.4.6.26.5(3)(b)
		at any location of 30mm	SC6.4.6.26.5(4)(c)
			SC6.4.6.26.5(5)(a)
5.	**Straw mulching**	Finished thickness >20mm.	SC6.4.6.26.5(4)(e)
	a) Straw Mat		
6.	**Mulch**	Shall not exceed 5% by volume.	SC6.4.6.26.3(6)
	a) Fines		
	b) Woodchip	Maximum size <50mm.	SC6.4.6.26.3(6)
7.	**Plant material**	Contain >20% <25% by volume	SC6.4.6.26.3(2)
	a) Container Soil Mix	of clay.	

Attachments

SC6.4.6.26 Attachment A: Landscaping materials

MATERIAL *(sample only - to be completed by compiler)*	**TYPE**	**MINIMUM APPLICATION RATE**
1. HERBICIDE *	"Roundup"	As per manufacturers recommendations
2. SEED		
a) Grass	Rye Corn (April-August) or	60 kg/ha
Japanese Millet (September-March		60 kg/ha
Hulled Couch		5 kg/ha
Red Clover (Inoculated)		5 kg/ha
White Clover (Inoculated)		5 kg/ha
"Elka" Perennial Rye		5 kg/ha
(b) Native	Acacia dealbata	4 kg/ha
Acacia buxifolia		1 kg/ha
Acacia decurrens		1 kg/ha
Acacia pravissima		1 kg/ha
Leptospermum lanigerum		1 kg/ha
Hardenbergia violacea		500 g/ha
Kennedia prostrata		500 g/ha
Acacia implexa		200 g/ha
Banksia marginata		200 g/ha
Bursaria spinosa		200 g/ha
Callistemon pallidus		200 g/ha
Dodonaea viscoca		200 g/ha
3. TURF GRASS (a) Medians (b) Verges/Footpaths (c) Other Areas	Couch Buffalo Couch	Refer to drawings " "
4. FERTILISER * (a) Vegetation of Slopes/Drains (b) Landscape Planting	Dynamic Lifter "Nitro" "Kokei" pellets	1000 kg/ha
5. WETTING AGENT *	"Aquasoil"	1 litre/1000 litres of mix water
6. PESTICIDE * (a) Liquid (b) Powder	"Lorsban 500 EC" "Lorsban 250 W"	5 litres 10 kg
7. ORGANIC FIBRE MAT *	"Sta-firma" (light grade)	-
8. MULCH	Composted/Pasteurized	100mm thick
* Material shall be as listed or equivalent as approved by council.		

SC6.4.6.27 Irrigation

SC6.4.6.27.1 Introduction

(1) Scope

(a) This sub-section sets out the standards for design, installation and construction of irrigation systems that will become a Townsville City Council asset.

(b) Irrigation systems that will be connected to an alternative water supply have additional requirements to this sub-section.

(2) Reference and source documents

All design and documentation, materials supplied and work carried out shall be in accordance with the following:-

(a) Australian Standards:

AS 1432	*Copper tubes for plumbing, gas fitting and drainage applications*
AS/NZS 1477	*PVC pipes and fittings for pressure applications*
AS 2032	*Installation of PVC pipe systems*
AS 2033	*Installation of polyethylene pipe systems*
AS 2053	*Conduits and fittings for electrical installations (all Parts)*
AS 2129	*Flanges for pipes and valves and fittings*
AS 2698.2	*Plastics pipes and fittings for irrigation and rural applications –Polyethylene rural pipe*
AS 2698.3	*Plastics pipes and fittings for irrigation and rural applications –Mechanical joint fittings for use with polyethylene micro-irrigation pipes*
AS 2845.1	*Water supply – Backflow prevention devices – Materials, design and performance requirements*
AS 2845.2	*Water supply – Backflow prevention devices – Registered air gaps and registered break tanks*
AS 2845.3	*Water supply – Backflow prevention devices - Field testing and maintenance of testable devices*
AS 3000	*Electrical installation (known as the Australian/New Zealand Wiring Rules)*
AS/NZS 3008.1.1	*Electrical Installations –Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions*
AS/NZS 3500	*Plumbing and Drainage*
AS/NZS 3500.0	*Plumbing and drainage Part 0: Glossary of terms*
AS/NZS 3500.1	*Plumbing and drainage – Water services*
AS 3500.1.1	*National plumbing and drainage - Water supply – Performance requirements*
AS 3500.2.1	*National Plumbing and Drainage Sanitary plumbing and drainage - Performance requirements*
AS 3500.2.2	*National Plumbing and Drainage Sanitary plumbing and drainage - Acceptable Solutions*
AS/NZS 3808	*Insulating and sheathing materials for electrical cables*
AS/NZ 3879	*Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ASA pipes and fittings*
AS/NZS 4129	*Fittings for polyethylene (PE) pipes for pressure applications*
AS/NZS 4130	*Polyethylene (PE) pipes for pressure applications*
AS/NZ 4158	*Thermal-bonded polymeric coatings on valves and fittings for water industry purposes*

(b) Legislation:

Water Act 2000

Electricity Safety Act 2002

Work Health and Safety Act 2011

(c) Other:

Department of Energy and Water Supply, *Queensland Water Recycling Guidelines*, December 2005

(d) Authorities

The rules and regulations of the relevant local electricity supply authority.

The rules and regulations of the relevant local water supply authority.
The requirements of any other Authority having jurisdiction over the installation.

SC6.4.6.27.2 Irrigation pipework

(1) Standards
All pipes shall be supplied, installed and joined in accordance with the manufacturer's recommendations and all relevant, current Australian Standards.

(2) Class of pipe

(a) Main line pipes (pressurised) of nominal 80mm diameter and larger shall be minimum Class 12 uPVC rubber ring jointed (RRJ) or PN12.5 (Poly pipe).

(b) Main line pipes (pressurised) of nominal diameter less than 80mm shall be minimum Class 12 uPVC solvent welded joint (SWJ) or PN12.5 (Poly pipe).

(c) All lateral line pipes (non pressurised) shall be minimum Class 6 (uPVC) or PN6.3 (Poly pipe), except for lateral line pipe work under road pavements which shall be Class 12 (uPVC) or PN12.5 (Poly pipe).

(d) Supply line to a drinking fountain or a water tap shall be a minimum of 32 mm Class 12 uPVC or PN12.5 (Poly Pipe). Copper pipe is not acceptable.

(e) Copper pipe to a Water meter, drinking fountain and water tap assemblies shall be minimum Type B.

(f) All irrigation pipe work under pavements (road or otherwise) shall be encased in a conduit.

(3) Conduit crossings

(a) All conduits used to encase irrigation line pipes shall be 100mm Class 9 PVC SWJ Pipe as standard unless otherwise approved by the Superintendent. Storm water or waste water pipe used as conduit is not acceptable.

(b) Conduit crossing ends shall be sealed with duct tape to stop the ingress of soil and material from entering the conduit.

(c) Conduit crossings within road reserves and medians are to have the outer 50mm of conduit sealed with expanded foam, to stop the transportation of water through the conduit.

(d) Where underground bores or conduits crossings have been installed, a stainless steel tag shall be used to mark the start and finish of the conduit. The tag shall be a minimum of 38mm diameter and 1.6mm thick. It is to be nailed, glued or set into the surface of the crossing. The marker shall be engraved with the words "Irrigation Water", given a unique number and recorded on the as constructed drawings.

(4) Pipe fittings

(a) All fittings for uPVC pipe shall be minimum Class 18 PVC SWJ.

(b) All fittings for poly pipe shall be metric compression fittings, Plasson or Philmac.

(c) All fittings for low density pipe shall be barbed type, with all joints fitted with stainless steel cobra clamps – or approved equivalent.

(d) All threaded fittings, except sprinklers, shall be sealed using PTFE thread tape and Liquid Teflon.

(5) Pipe installation generally

(a) Interior of pipes shall be kept free of dirt and debris at all times.

(b) Where pipe work is left unfinished during installation, the open ends of pipes shall be sealed off with plastic secured to the end of the pipe or have end caps fitted.

(c) Pipes laid in a common trench shall be separated by a minimum of 100mm.

(d) Refer to SC6.4.4.8 Standard drawings SD-13.1, Figures 1 to 6 for pipe alignments for all irrigation works in road reserves.

(6) UPVC rubber ring jointed pipe – installation (i.e. Main line pipes of nominal 80mm diameter and larger).

(a) All uPVC rubber ring jointed pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2032.

(b) All uPVC rubber ring jointed pipe work shall be laid in a minimum of 100mm sand bedding and surround.

(c) All connections and changes of direction horizontally and vertically in rubber ring joint (RRJ) pipe work shall be installed with concrete thrust blocks.

(d) Thrust block design and size shall follow pipe manufacturers recommendations ("Thrust Block Design – Pressure Pipeline Fittings" Iplex uPVC Design Manual). Thrust blocks shall be 15 MPA concrete in accordance with AS 2032. All thrust blocks are to be cast in situ against undisturbed ground and shall have neatly formed sides.

(e) The ends of pipes used for rubber ring joint (RRJ) connections shall have a smooth chamfer 15 degrees to the outer edge and shall be free of all burrs and rough edges. Rubber rings and lubricant used shall be in accordance with the pipe manufacturer's recommendations.

(f) Each pipe length shall be laid in the following direction; water flow runs from the socket end to the spigot end of the pipe, with the exception of ring mains.

(g) Trenches may be curved to avoid obstructions within the limits of the curvature of the pipe.

(7) UPVC Solvent welded joint pipe installation (i.e. main line pipes of nominal diameter less than 80mm or lateral line pipes).

(a) All uPVC Solvent welded joint pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2032.

(b) All uPVC solvent welded joints shall be primed and cemented.

(c) Primer and solvent cement shall conform to AS/NZ 3879.

(d) Primer is to be "Priming Fluid (red)".

(e) Solvent is to be "Christy's PVC Red Hot Blue Glue" or approved Type "p" solvent cement.

(f) All pipes shall be primed before cementing the joint.

(g) Pipe ends shall be free of all burs and rough edges.

(h) All uPVC solvent welded joints shall not be subjected to water pressure for at least 24 hours after cementing the joint.

(i) All mainline uPVC solvent welded joint pipes shall be laid in a minimum of 100mm sand bedding and surround.

(8) Polyethylene pipe installation

(a) All polyethylene pipe work shall be installed in accordance with the manufacturer's recommendations and AS 2033.

(b) Poly pipe shall be laid with sufficient allowance for contraction and expansion of the pipe.

(c) Pipe ends shall be free of all burs and rough edges and shall be chamfered with the appropriate tool before jointing.

(d) Polyethylene tapping saddles are only to be used to connect sprinklers and dripper tube to polyethylene pipe work.

(9) Trenching

(a) All pipe work shall be laid in trenches, with the exception of:

(i) pipes which are installed in underground conduits; or

(ii) pipes which are installed above ground due to obstacles i.e. bridges, walls, etc.

(b) Trenches shall:

(i) be sufficiently wide to allow adequate working clearance;

(ii) be excavated in straight lines between bends or pits;

(iii) have vertical sides and be a constant depth for the full length of the trench; and

(iv) be of adequate depth to allow for pipe bedding and adequate cover to the pipe as specified.

(c) Trenches for multiple pipes shall be sufficiently wide to allow adequate working clearance and a minimum of 100mm separation between pipes.

(d) Pipes shall be firmly and evenly supported with bedding material or approved backfill material in the centre of the trench.

(e) Minor adjustment to the irrigation systems design layout will be permitted to clear underground obstructions.

(f) Trenching machinery shall be avoided within 1m of existing services. Hand trench to expose existing services, prior to connection or use of trenching machinery.

(g) Cover to pipes

The minimum and maximum depth of cover to pipes shall be as noted in Table SC6.4.6.27.1.

Table SC6.4.6.27.1 Depth of cover to pipes

Pipe	Minimum	Maximum
Main lines in road reserves (UPVC and Polyethylene)	600mm	750mm
Main lines all other locations (UPVC and Polyethylene)	400mm	600mm
Lateral lines - all locations	300mm	500mm
Drinking fountain and water tap supply lines. (except in land fill sites)	300mm	400mm
Drinking fountain and water tap supply lines in land fill sites	450mm	600mm
Dripper tube (turf)	75mm	100mm
Dripper tube (garden)	Surface	Surface

Note—depth of cover is defined as the distance from the top of the pipe to the finished surface level or from the top of the pipe to the underside of paving, concrete or road pavement. Refer to SC6.4.4.8 Standard drawings SD-18.1 for Typical Pipe Trench details.

(10) Pipe bedding

(a) A minimum of 100mm sand bedding and surround is required for:

(i) all main lines;

(ii) all uPVC Rubber Ring Jointed pipes;

(iii) all pipes under road pavements;

(iv) all pipes laid on solid rock;

(v) all pipes where rubble, rocks and/or debris is encountered in the trench;

(vi) all potable water lines; and

(vii) all electrical conduits.

(b) Bedding sand shall be clean sand with rounded grains free of any rocks, debris and organic matter and graded such that 100 per cent passes a 4.75mm sieve size.

(c) Pipe work, other than those listed in clause SC6.4.6.27.2(10)(a) may be laid without sand bedding, provided the trench is free of rubble, rocks and /or debris.

(d) Pipe work, other than those listed in clause SC6.4.6.27.2(10)(a), in locations where the natural earth contains rocks, debris and any materials that may damage pipes over time or where excessive ground movement is likely to occur shall be laid in a minimum of 75mm sand bedding and surround.

(11) Approved backfill to trenches

(a) Excavated material may be used as backfill, provided that the material is free of rubble, rocks, debris, organic material and any sharp or solid objects and/or materials that may damage the pipe over time.

(b) Where material excavated from the trench is unsuitable for backfill, clean sand, garden loam shall be used as backfill.

(c) Backfill to trenches shall be compacted with a wheel roll or plate compactor. Completed backfill is to be mounded 50mm higher than the surrounding surface for the full length of the trench, to allow for further consolidation.

(d) Backfill to trenches under road pavements and pathways shall be crusher dust material placed in 150mm compacted layers.

(e) On completion of backfilling operations, all excess material is to be either reused on site where possible or shall be removed from the site.

(12) Exposed pipes

(a) Any exposed pipe shall be constructed of stainless steel or lagged copper and shall comply with AS/NZS 3500 standards for exposed pipe.

(b) All above ground works are to conform to AS/NZS 3500.1, Section 5.7 "Support and fixing above ground".

(c) Bracing around the pipes is to be lined with an appropriate material to prevent damage to the pipe.

(d) Pipes are to be labelled “potable” or "non potable" in accordance with Australian Standards.

(13) Proximity to other services

Table SC6.4.6.27.2 lists the separation required between water pipes and electricity and gas services. Separation for all other services shall be as outlined in AS/NZS 3500.1 Section 5.3 entitled “Proximity to other services”.

Service	Separation
Electrical Cables with Warning Tape or Mechanical Protection (Water Pipes DN65mm and below)	100mm
Electrical Cables with Warning Tape or Mechanical Protection (Water Pipes larger than DN65mm)	300mm
Electrical Cables with no Warning Tape or Mechanical Protection	600mm
Consumer Gas Pipe with Marker Tape 150mm above complying with AS2648.1 (Water Pipes DN65mm)	100mm
Consumer Gas Pipe with Marker Tape 150mm above complying with AS2648.1 (Water Pipes larger than DN65mm)	300mm
Consumer Gas with no Marker Tape or Mechanical Protection	600mm

SC6.4.6.27.3 Control system

(1) Scope

This section covers the furnishing of all labour, materials and services in connection with the fabrication, factory testing, delivery and site installation of the irrigation controller and associated cabinets.

(2) Network requirements

(a) Townsville City Council operates an irrigation control system that consists of a Motorola Irrinet Supervisory Control and Data Acquisition (SCADA) System. This system is commonly known as the Irrigation Central Control (ICC). The ICC System communicates to irrigation controllers throughout the Townsville region over UHF wireless telemetry communication networks.

(b) All irrigation controllers shall be operated via the ICC System unless an alternative controller system is approved by the Superintendent

(c) Contractors are required to provide an approved irrigation controller to adequately service the proposed irrigation system. The Controller shall provide for the number of stations including master valve and fertigation control valve required for:

(i) the current irrigation system to be installed; and

(ii) defined future requirements of the controller.

(d) Irrinet M Slave, Irrinet M and Irrinet ACE controllers by Motorola are the approved irrigation controllers.

(e) All irrigation controllers must be capable of communicating with the ICC System across the telemetry communication network. Each controller must be fitted with an approved radio transceiver and antenna.

The transceiver must have the correct frequency configuration to communicate on the network.

(f) Each irrigation controller shall be allocated a logical address by Maintenance Services – Irrigation Design Unit for communications to the ICC System.

(g) All irrigation controller system components shall operate within the ranges specified by the manufacturer.

(3) Irrigation controller selection

(a) Irrigation controllers are to be selected from Table SC6.4.6.27.3.

Table SC6.4.6.27.3 Controller selection list

Controller Name	Power Type / Source	Valve Capacity
AC Irrinet M Slave 12 - 24	AC / 240 V Mains	12 to 24
AC Irrinet M Slave 36 - 48	AC / 240 V Mains	36 to 48
AC Irrinet M 12 - 24	AC / 240 V Mains	12 to 24
AC Irrinet M 36 - 48	AC / 240 V Mains	36 to 48
AC Irrinet ACE 24 - 48	AC / 240 V Mains	24 to 48
XR 1 - 4	DC / 6 V Solar	1 to 4

(b) AC powered irrigation controllers are the preferred option of the Superintendent. DC powered irrigation controllers are not acceptable unless approved by the Superintendent.

(4) Operating environment
Ambient conditions

(a) All equipment mounted inside cabinets and cubicles shall be suitable for operation in temperatures up to 60 °C. Measures shall be taken to ensure that high ambient temperatures and full load operation do not cause temperatures to exceed maximum allowed operating temperatures.

(b) Since all cabinets are to be mounted outdoors, particular consideration shall be given to minimise heating by direct solar radiation.

(5) Irrigation controller specification (general)

(a) General requirements

(i) The irrigation controller cabinet and component parts shall conform in all respects to the highest standards of design and workmanship and appropriate requirements of the latest applicable state or local codes.

(ii) When mounting accessories to the back panel, use fine threaded tapped screws.

(iii) The irrigation controller cabinet shall be completely wired, and assembled, with all devices and controls installed as shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1 so that the entire assembly is an operating unit ready for installation and the wiring of field devices.

(iv) Wiring shall meet the latest requirements of the AS 3000 and applicable workplace safety codes.

(b) Wiring

(i) All wire shall be 0.5mm²/PVC 105/ stranded, insulated for 600 V.

(ii) A "bootlace ferrule" shall be used on wires connected to terminals which have only a screw for securing the wire. Ferrules shall be properly crimped using a professional crimping tool.

(iii) All manufacturer terminal block wiring shall be restricted to the panel side of the blocks. The manufacturer shall connect no more than two wires to any terminal point. The field side of the terminal blocks shall be left completely free of wires and jumpers. Wiring on terminal blocks shall be so arranged that not more than one wire to the field side of any terminal point will be connected with the exception of the earth.

(iv) All multiple common connections shall be wired via bridging links on the terminal blocks.

(v) Horizontal and vertical wiring between the terminal blocks and the devices shall be enclosed in ducts except wiring between the ducts and the devices may run exposed for distances not exceeding 100mm. Duct loading shall not exceed 75 per cent rated fill at any point.

(vi) All exposed wiring shall be formed neatly with square corners and where possible, grouped in packs. Each pack shall be bound with plastic ties and be substantially supported throughout its full length. Cabled wire is not acceptable.

(vii) Splicing of wires on electrical circuits is not acceptable.

(c) Terminal blocks

Terminal blocks shall be provided for all wiring which exits the panel. All terminal blocks shall be mounted and of the colour as shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-24.8.

(d) Consumer power

(i) The irrigation control cabinet shall be equipped with a (Clipsal 4CC6 or approved equivalent) enclosed consumer panel. Consumer power shall be wired direct into the consumer panel. The consumer panel shall enclose a neutral link and an earth bus with the panel structure connected to the bus so as to effectively earth the entire structure. A solder-less clamp type terminal lug shall be provided at the end of the earth bus for a 6mm² stranded earth cable to be attached from the external earth-stake.

(ii) Whenever the electrical diagrams indicate an earth for a circuit at the panel, a single wire for each circuit earthed shall be run independently to the earth bus and fastened thereto using a ring lug and a machine screw inserted in a tapped hole.

(iii) Earthing of the enclosure and back panel from the consumers panel shall be made using 4mm² stranded earth cable.

(iv) The consumer panel shall be wired with a main isolation switch an RCD/MCB and a suitably rated "Isatrol" mains filter unit, din-rail mounted within the consumer panel to provide power to the GPOs. One double GPO and one single GPO are to be mounted on the face cover of the consumer panel. Care shall be taken when positioning the GPOs not to cover the access screw holes to the consumer panel.

(v) Each device requiring 240 V AC power shall have an individual line plug and plug into an allocated GPO on the consumer panel.

(vi) Power will be supplied as a single phase voltage at 50 Hz and 240 V ± 10 per cent.

(vii) All 240 V connections are to be tool proof and either housed in the consumer panel or behind a protective cover.

(6) Irrigation controller specifications (specific)

(a) Irrinet M Slave, Irrinet M and Irrinet ACE.

(i) Each controller's maximum valve output is listed in Table SC6.4.6.27.3 including master and fertigation valves. The controller shall have as a minimum, two inputs from electronic pulse water meter and rain switch.

(ii) The general control voltage shall be 24 VAC for controller outputs used for water valve operation.

(iii) The 24 VAC power is via the PELV system with common tied to earth.

(iv) The irrigation controller cabinet layout, dimensions and wiring are shown in SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD 29.1.

(v) The irrigation controller cabinet shall be a B&R NI (NI06062/S) or (NI06063/S) with dual key lock (NI030) or approved equivalent as shown within SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1. The controller pole, mast and cross arms shall be coated with 2PAK Epoxy Paint in Heritage Green colour.

(vi) Control equipment shall be selected from the Preferred Equipment list - Controller and Telemetry Components within SC6.4.4.8 Standard drawings SD-5.1 through SD 5.10 and SD-20.1 through SD-29.1, unless otherwise specified by the Superintendent.

(vii) All firmware incorporated in CPUs and other intelligent modules shall be the latest released

version.

(viii) The radio telemetry equipment involves the installation of the following equipment:

(A) TX-3600 GME Transceiver with blind front panel, programmed with Parks Services frequencies;

(B) YB6-61 Yagi Antenna, UNV2 mounting bracket and RG58 coax cable terminated with a N88 N type male connector;

(C) PS123 GME Power Supply or DC1224X Aeon UPS (for Irrinet M controllers);

(D) IS50NX Surge Arrestor flange mounted with N type female connectors;

(E) RG58 Coax Fly Lead terminated with N88 N type and BNC113 male connectors; and

(F) Data cable connecting controller to transceiver.

(ix) The transceiver shall be mounted on the door such that the indicator lights are visible when the door to the panel is opened. The antenna cable and data cable are to be feed from the controller via the cabinet ducting towards the door hinge and onto the door bracket. The transceiver shall be mounted in such a way to allow for its easy removal. The mounting bracket is to be securely fastened to the back of the door. All cabling on the door shall be neat and fastened in place by cable ties, SC6.4.4.8 Standard drawings SD-26.2, SD-26.4 and SD-5.10 refers.

(x) A Surge Arrestor shall be mounted on the cabinet earth lug and suitably earthed refer SC6.4.4.8 Standard drawings SD-27.1 and SD-5.10. The coax fly lead shall be connected from the transceiver BNC connector to the “Equipment” side of the surge arrestor. The coax cable from the antenna will enter the panel and be terminated on the “Antenna” side of the surge arrestor.

(xi) Before the transceiver is powered up a qualified radio technician shall fit the antenna coax plug and carry out a SWR / radio check and set the modulation level.

(xii) The “data cable” shall connect the controller to the transceiver and shall be secured and neatly run through the ducting.

(xiii) PS123 GME Power Supply 240 VAC to 12 VDC is to be mounted on the door bracket to supply power to the Transceiver and Interposing Relays refer SC6.4.4.8 Standard drawings SD-5.5.

(xiv) DC1224X Aeon UPS (uninterrupted power supply) 240 VAC to 12 VDC is to be mounted on the door bracket to supply power to the Irrinet CPU memory and Transceiver, refer SC6.4.4.8 Standard drawings SD-20.1 through SD-29.1.

(xv) A separate 24 V AC power supply shall be provided as shown within SC6.4.4.8 Standard drawings SD-5.1 through SD-5.10 and SD-20.1 through SD-29.1:

(A) Irrinet M, Irrinet M Slave and Irrinet ACE controllers require 1 Powertech 240 V/24 V 150 VA Transformer part No. MP3045 to be direct mounted to supply power to the controller and field solenoids.

(xvi) The controller shall have two conduits connecting the cabinet to the ground. The following conduit types and sizes shall be used:

(A) M.D. 50 mm electrical conduit (24 V Control Cable); and

(B) H.D. 25 mm electrical conduit (240 V Power Supply).

(xvii) A Mini-Clik II Rain Switch or approved equivalent is to be installed on the controller pole. Construction details are given in SC6.4.4.8 Standard drawings SD-29.1. The device is to be set on a 13mm setting.

(b) Piccilo XR

(i) The output control voltage used is a DC Pulse through a 2 wire circuit suitable for activating DC latching coils used for water valve operation - Hunter ICV with DC Coil option or approved equivalent. With the Piccilo XR output voltage adjusted to 18 V (from the factory default of 12 V).

(ii) The controller assembly is powered by a 6 volt sealed lead acid battery which is charged via a solar panel and regulating semiconductors. SC6.4.4.8 Standard drawings SD-4.2.

(iii) The irrigation controller cabinet layout, dimensions and wiring are shown in SC6.4.4.8 Standard drawings SD-4.1 through SD-4.4.

(iv) The Irrigation controller cabinet shall be a B&R NI (NI03021/S) with single key lock (NI030) or

approved equivalent as shown within SC6.4.4.8 Standard drawings SD 4.1 through SD-4.4. The controller pole, mast and cross arms shall be coated with 2PAK Epoxy Paint in Heritage Green Colour.

(v) Control equipment shall be selected from the Preferred Equipment list - Controller and Telemetry Components within SC6.4.4.8 Standard drawings 4.5, unless otherwise specified by the Superintendent.

(vi) All firmware incorporated in CPUs and other intelligent modules shall be the latest released version.

(vii) The radio telemetry equipment involves the installation of the following equipment:

(A) Qty 1, CD51 Whip Antenna (cut to wave length) with .5M of RG58 coax cable terminated by a SMA type male connector;

(B) Qty 1, Antenna Mounting Bracket; and

(C) the radio telemetry component is integrated within the XR Controller unit. So no external transceiver is required.

(viii) The antenna coax SMA male plug shall be connected into the XR Controller SMA socket mounted on the top of the unit.

(ix) Before the XR Controller is powered up a qualified radio technician shall fit the antenna coax plug and carry out a SWR / radio check on site.

(x) A Kyocera Mini Module Solar Panel as detailed in SC6.4.4.8 Standard drawings SD 4.5 shall be fastened to the top of the enclosure refer SC6.4.4.8 Standard drawings SD-4.3. An external grade silicon base sealant shall be applied to the solar panel perimeter to maintain the enclosure IP rating.

(xi) The regulator components shall be installed as detailed in SC6.4.4.8 Standard drawings SD-4.2 and tested by an electronics technician prior to final connection of the battery and XR units.

(xii) A 6 V 12 AH SLA Battery is placed inside on the bottom of the enclosure and connected to the terminal blocks. Refer SC6.4.4.8 Standard drawings SD-4.1 and SD 4.2.

(xiii) The controller shall have one 25mm conduit connecting the cabinet to the first electrical pit.

(7) Controller location

The final location of the controller shall be determined by taking into consideration all of the following factors:

(a) radio path tests (to be carried out by a qualified radio technician) to ensure reliable communications from the controller to the ICC System Base Station;

(b) the location shall be clear of large trees or structures that may interfere with the performance of radio communications, or solar panel. In newly planted areas the location shall make allowance for future tree growth;

(c) safe 24 hour access for maintenance by maintenance services personnel and equipment;

(d) the location shall allow access by motor vehicle and elevated platform (antenna servicing); and

(e) the Controller shall not be installed less than 3 m from a roadway unless approved by the Superintendent.

(8) Cabinet installation

The pre-assembled Controllers shall be installed in the ground as follows:-

(a) The pre-assembled Controller cabinet support post shall be embedded in a 200mm diameter x 600mm deep hole with a 400mm deep concrete footing (N25 concrete minimum). The concrete shall be poured up to the underside of the conduits entering the support post. Covering the conduits in concrete is not acceptable. The Cabinet shall be installed at a height of 1200mm from the finished ground level to the underside of the cabinet (1090 mm for XR controllers Refer SC6.4.4.8 Standard drawings SD-4.4).

(b) XR Controller Cabinet is to be orientated with the door side facing north to maximise the absorption of solar radiation into the solar panel, unless approved by the Superintendent.

(9) Controller cabinet and controller wiring

(a) All conduits shall be terminated at the controller cabinet with a suitable conduit adaptor. All conduits shall be sealed with an external grade Butyl Mastic sealant, such as “Selleys Butyl Mastic” or similar approved to a depth of 25mm into the conduit to prevent vermin entering the controller cabinet.

(b) Earth stakes shall be located in the electrical pit adjacent the controller. The location of the earth stake is to be indicated on the as constructed drawing.

(c) Earth stake connections are to be sealed with cold gal paint.

(d) All field wired cables entering the controller cabinet shall be made secured – in this instance only by the application of sealant to the conduit end inside the enclosure (see clause (9)(a) above). From this point on, the double insulation shall be removed from the cable for ease of wiring to the terminal blocks.

(e) All single insulated cables inside control cabinets shall be loomed together and cable tied in a neat orderly manner to the panel so that the connections into the terminal strip are not stressed.

(f) All cables inside the controller cabinet shall be of sufficient length to ensure that all cores will reach their termination point without any stress or joining of cables.

(g) All field cables inside the controller cabinet shall be of sufficient length to ensure that all cores will reach the upper and lower most termination points without any stress or joining of cables.

(h) All cables to be connected within the controller cabinet shall be terminated with a bootlace ferrule, CABOC BLP 150 or similar approved. Pin lugs are not acceptable.

(10) Field electrical wiring

(a) Cable types

(i) All electrical cabling shall conform to current Australian Standards.

(ii) All cables shall be Tyflo multi-core irrigation cables or similar approved with a minimum core size of 1.5 mm. Table SC6.4.6.27.4 details cable specifications.

Table SC6.4.6.27.4 Multicore cable specifications

Nominal core dia.	Conductor no. and size	Amp rating	Resistance Ohms/Klm	Number of cores
1.5 mm	7/0.50	16	13.6	3,5,7,9,13
2.5 mm	7/0.67	23	7.4	2,7
4 mm	7/0.85	30	4.6	2

(iii) All cables shall have an outer sheath of flexible 75□C PVC to AS/NZS 3808, over an Inner core of a sheath of HDPE, over a multi-strand plain copper wire.

(iv) Inner cores are to be readily available in 13 colours namely- Black, Blue, Green, Dark Brown, Brown, Grey, Light Blue, Orange, Pink, Red, Violet, White and Yellow.

(b) Cable installation

(i) A 7 core cable shall be run continuously from the controller to the water meter assembly solely for the operation of Master Valve, Pulse Meter and Fertigation. The black core shall be common, red core shall be Master Valve control, brown core shall be Fertigation control and run to the Fertigation Venturi Point and the blue and white shall be Pulse Meter and Pulse Meter common respectively.

(ii) An additional 20% of the total number of cables or 2 extra cores (whichever is the greater) shall be provided as spares. Designated spares shall run from the controller to the furthest most point from the controller in the cable run. The spares are to be marked at the controller. At the furthest point all spares shall be connected together and sealed with heat shrink so that a continuity test can be performed at the controller to confirm the total number of spares.

(iii) All extra low voltage cables shall be installed inside a conduit. The conduit size used shall be a minimum size of 50mm or 2.5 times the combined size of all the cables being installed, whichever is the greater.

(iv) The single insulation on the cable core shall not be cut or damaged when the outer sheath (double

insulation) is removed. All cables shall have the insulation removed from the cores using appropriate cable strippers. Use of a knife or other sharp blade is not acceptable practice.

(v) Cables shall be continuous between electrical inspection pits. Cable joints located between electrical inspection pits are not acceptable. Cable joints shall be kept to a minimum and shall only occur at valve take off points.

(vi) Where required each individual cable shall be joined using the appropriately sized insulated crimp links, to maintain a double layer of insulation at the joint after the heat shrink is installed, and shall be installed with a professional ratchet type crimping tool.

(vii) Bare conductors shall not be exposed.

(viii) Each individual cable joint shall be waterproofed by using ES-2 resign filled heat shrink three times the length of the insulated crimp link.

(ix) Multiple cables shall not be joined or heat “shrinked” together.

(x) All cut unused cables (spares) shall be sealed using ES-2 resign filled heat shrink.

(xi) Cable markers shall be attached to each cable at every electrical inspection pit indicating the individual cable number as shown on the design plan; refer SC6.4.4.8 Standard drawings SD-7.2. Cable markers shall be round 38mm diameter aluminium identification tags commercially available. Numbering shall be clearly stamped onto one side of the tag using a punch set with 13mm high numerals. Tags shall be fastened to the appropriate cable using a quality grade plastic cable tie attached at the mid-point of the cable loop.

(xii) The Black cable shall be used as the designated common.

(xiii) All spare cable in electrical inspection pits shall be left full length, individually sealed with heat shrink and grouped together.

(xiv) All continuous cable that passes through an electrical inspection pit shall have a loop of at least 1.5m in length and be neatly coiled and tied.

(xv) A draw wire is to be left in the conduit from the controller cabinet to the first electrical inspection pit.

(xvi) All electrical cable locations shall be recorded on the as constructed drawings.

(c) Electrical inspection pits

(i) Electrical inspection pits shall be heavy duty rectangular with rounded ends and fitted with a precast concrete lid, type P1 or P2.

(ii) The first electrical inspection pit shall be located a maximum of 1m from the Controller cabinet support base. A draw wire together with the electrical cables is to be installed in the conduits from the controller to the first electrical pit to allow for future works.

(iii) Electrical inspection pits shall be located adjacent to valve boxes and offset from the main irrigation line a maximum of 200mm as shown in SC6.4.6.27 Attachment A 17.2 (Plan View).

(iv) Electrical inspection pits shall be located at changes in direction and no more than 50m spacing.

(v) Electrical inspection pits shall be installed so that the top of the pit is flush with the finished surface level and matches the slope of the finished surface level.

(vi) All electrical inspection pit locations shall be recorded on the as constructed drawings.

(vii) All conduits shall enter at the end of an electrical pit. Side entry of conduits into electrical pits in not permitted.

(viii) All conduits shall enter an electrical pit at no greater than 45 degrees of the horizontal centre.

(ix) Electrical pits shall not be installed in drainage swales or places where water is collected during rainfall and irrigation.

(x) Electrical pits shall not be installed less than 3m from the road kerb, unless approved by the Superintendent.

(d) Electrical conduits

(i) All electrical conduit shall conform to current Australian Standards.

(ii) All conduit (extra low voltage electrical) buried in ground shall be Grey M.D.

(iii) All electrical conduits that are exposed above ground shall have a protective outer sheath of polyethylene pipe rating PN12.5. The sheath is to encase the conduit for the entire length of conduit above ground and for a depth of 150mm minimum below ground.

(iv) All electrical conduits that are exposed above ground shall be fixed in place so that they are vertical and shall be secured firmly to the accessory.

(v) Electrical conduit above ground shall be adequately secured to avoid damage by grass cutting operations.

(vi) All electrical conduit ends shall be neatly cut and free of burrs or rough edges.

(vii) The final 500mm of conduit entering an electrical inspection pit shall be M.D. corrugated flexible conduit which is to be connected to the M.D. PVC Conduit by a Socket. SC6.4.4.8 Standard drawings SD-17.2 (Electrical Pit), gives a typical construction drawing of the assembly.

(e) Electrical conduit trenching

(i) All electrical conduits shall be laid in trenches and bedded in sand.

(ii) Low voltage conduits (240 V) shall be installed with continuous electrical warning tape laid over the conduit for the entire length of the trench.

(iii) Low voltage conduit (240 V) shall not be installed in the same trench as irrigation lines.

(iv) Extra low voltage conduits (24 V) installed in the same trench as irrigation lines shall be bedded in sand and separated from the irrigation lines by a minimum distance of 100mm.

(v) Depth of cover to electrical conduits from finished surface level or from the underside of finished pavement level (e.g. pavers or concrete) shall be:

(A) 300mm minimum - for extra low voltage cables (24 V); and

(B) 600mm minimum - for low voltage cables (240 V). Refer SC6.4.4.8 Standard drawings SD-18.1.

(vi) Electrical conduits under roadways shall be a minimum 50mm M.D. Electrical conduit encased in a 100mm Class 9 PVC Pipe.

SC6.4.6.27.4 Water meter assembly

(1) Design and installation

(a) Water meter assembly components vary, as follows:

(i) For drinking fountains and water taps (potable water) the water meter assembly includes:

(A) isolation valve; and

(B) mechanical water meter (supplied by Townsville Water, a business unit of Townsville City Council).

(ii) For irrigation the water meter assembly includes:

(A) isolation valve;

(B) mechanical water meter (supplied by Townsville Water);

(C) master valve and electronic flow meter unit;

(D) RPZ back flow prevention device with two isolation valves;

(E) screen filter;

(F) lockable cover;

(G) cable and conduit; and

(H) protective bollards (depending on location).

Table SC6.4.6.27.5 Allowable water meter assembly component size combinations

Water Service	Townsville Water Water Meter	Irrigation Water Meter	Backflow	Master Valve
25mm	25mm	32mm Arad Multijet (1 pulse/10L)	25mm	25mm Hunter ICV*
32mm	32mm	32mm Arad Multijet (1 pulse/10L)	32mm	25mm or 40mm Hunter ICV*
50mm	50mm	Include in Master Valve (1 pulse/10L)	50mm	50mm Arad Hydrometer
80mm	80mm	Include in Master Valve (1 pulse/10L)	80mm	80mm Arad Hydrometer
100mm	100mm	Include in Master Valve (1 pulse/100L)	100mm	100mm Arad Hydrometer

*external master valve

(iii) All water meter assemblies with a 25mm and 32mm Water Service are to have a master valve external to the main assembly. Refer to SC6.4.4.8 Standard drawings SD-10.3 and SD-10.4.

(iv) Water meter assemblies with a water service sized, 50mm, 80mm and 100mm are to have a master valve as part of the main assembly. Refer to SC6.4.4.8 Standard drawings SD-10.1 and SD-10.2.

(b) Water meters

(i) All water meters and pipe work from the town mains to the water meter shall be supplied and fitted by Townsville Water.

(ii) The water meter type is selected by the following criteria:

(A) for drinking fountains and water taps a standard mechanical water meters shall be used.

(B) for irrigation refer to Table SC6.4.6.27.5 for water meter selection relative to the water service size.

(c) Master valves

(i) All irrigation systems shall be fitted with a master valve.

(ii) The master valve is to be selected by the following criteria:

(A) all water service assemblies sized 25mm and 32mm shall have an external master valve installed in a valve box and shall be fitted to the copper tail pipe of the backflow device. Refer to SC6.4.4.8 Standard drawings SD-10.3 and SD-10.4 for installation details; and

(B) all water service assemblies sized, 50mm, 80mm and 100mm shall be fitted with an assembly mounted master valve. The master valve is to consist of a flange mounted Arad Hydrometer including water (flow) meter module as detailed in Table 5 and 24VAC Solenoid actuator; or approved equivalent. Refer to SC6.4.4.8 Standard drawings SD-10.1 and SD-10.2 for installation details.

(d) Backflow devices design and installation

(i) Backflow prevention is to conform to AS 2845.1, AS 2845.2 and AS 2845.3.

(ii) The Backflow device shall be selected on the required size:

(A) 25mm, 32mm, and 50mm - Tyco Backflow System RP03 or similar to the following specification. The assembly shall be connected with the “ring and tail” to allow easy removal or replacement of the device in accordance with AS/NZS 3500.1. Main valve and internals shall be of stainless steel construction and to have pressure rating of 1600 kPa and a temperature rating of 90ºC. All internal parts and elastomers are to be accessible through a top entry point of the main valve to allow inline maintenance. Valve shall also be fitted with test points with BSPT threads to allow testing to AS 2845.3; and

(B) 80mm and 100mm - Tyco Backflow System RP03 or similar to the following specification. The main valve shall be constructed from ductile iron and coated with Rilsan Nylon 11 to AS/NZ 4158. All internals shall be constructed from stainless steel and to have pressure

rating of 1600 kPa and a temperature rating of 60ºC. Main valve body shall not form part of the wetted check valve sealing area or mechanism. All internal parts and elastomers are to be accessible through a top entry point of the main valve to allow inline maintenance. Valve connection shall be flanged to AS/NZS 4087. Valve shall also be fitted with test points with BSPT threads to allow testing to AS2845.3.

(iii) The velocity through the backflow device shall not exceed 2.2 m/s.

(iv) All backflow devices shall be reduced pressure zone (RPZ) rating.

(v) All backflow devices sized 25mm, 32mm, and 50mm shall be fitted with a locking mechanism, which prevents the two isolation valves and the three test cocks from unauthorised opening. The backflow device is to be lockable at a single point. A council standard series A padlock is to be fitted to the locking mechanism.

(e) Isolation valves

(i) All isolation valves fitted to the water service assembly shall be tested and approved to Australian Standards.

(ii) All isolation valves fitted to the water service assembly shall be selected on the following criteria:

(A) all water meter assemblies sized 25mm, 32mm and 50mm shall be fitted with brass ball valves; and

(B) all water meter assemblies sized 80mm and 100mm shall be fitted with resilient seated gate valves.

(f) Strainer

All water meter assemblies shall be fitted with a brass strainer immediately downstream of the isolation valve and upstream of the back flow device. Refer SC6.4.4.8 Standard drawings SD-10.1 to SD-10.4 for details.

(g) Water meter assembly installation

(i) The water meter assembly shall be supported by the appropriate size Support Stands as detailed in SC6.4.4.8 Standard drawings 10.5 and set into a concrete footing as detailed SC6.4.4.8 Standard drawings SD-10.1 to SD-10.4. A minimum distance of 300 mm from the underside of the assembly to the finished ground level is required.

(ii) A lockable stainless steel sheet metal cover shall be fitted over the water meter and master valve to prevent vandalism and weather damage. Water meter assembly covers shall be built from 316 Stainless Steel as detailed in SC6.4.4.8 Standard drawings SD-31.1 and SD-31.2 and for water meter assemblies sized:

(A) 25mm, 32mm, the cover shall be held in place using U-bolts; and

(B) 50mm, 80mm and 100mm the cover shall be fastened between each set of tightened flanges, using flange bolts.

(iii) Each cover shall be locked using a 40mm KA1 series lock.

(iv) A minimum of two recycled plastic bollards shall be provided at each water meter assembly as directed by the Superintendent, to protect the assembly from vehicle damage, except in garden beds.

Bollards shall be nominal 100mm diameter blue recycled plastic, embedded 450mm minimum into a 350 mm diameter concrete footing. The top of the bollards shall be 900mm above finished ground level.

(v) All cables running from the water meter to the ground shall be encased in a protective outer sheath of polyethylene pipe rating PN12.5. The conduit shall be firmly installed vertical to the ground so as not to be easily damaged by grass cutting operations.

(vi) Copper pipes shall be Type B.

(vii) All fittings to the backflow device shall be either copper of brass. PVC or Poly fittings are not acceptable.

(2) Valve assembly

(a) Design and installation

(i) The valve assembly includes:

(A) solenoid valve;

(B) ball valve;

(C) brass barrel union; and

(D) valve box.

(ii) Refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4 for standard details. Valves shall be connected to the main line via a tee.

(b) Solenoid valves

(i) Refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4 for solenoid valve assembly details.

(ii) Solenoid valves used shall be sized in accordance with Table SC6.4.6.27.6.

Table SC6.4.6.27.6 Approved solenoid valves

Manufacturer	Model	Size	Maximum flow rate (litres per minute).
Hunter	ICV	25mm	100
Hunter	ICV	40mm	250
Hunter	ICV	50mm	360
Hunter	ICV	80mm	700

(iii) Electronic solenoids for AC systems shall be 24 volt coils.

(iv) Electronic solenoids for DC systems shall be 12 volt 2 wire latching coils.

(v) Solenoid valves shall be wired in the following order:

(A) the first controller output shall be assigned to the master valve control;

(B) stations are to be wired to the controller outputs from output 2 on. Station 1 (Controller output 2) is to be located on one side of the site. The last station is to be located on the opposite side of the site. The controller outputs are to follow a logical geographical pattern from one side to another; and

(C) the same wire colour shall be maintained along the entire length of the cable run between the controller and each individual solenoid valve.

(vi) Only one valve shall be allocated per controller output.

(vii) Doubling up of stations on the same output is not allowed.

(viii) Valve boxes shall not be installed within 3m of the road kerb unless approved by the Superintendent.

(ix) The distance from a valve to the first sprinkler or first drip emitter shall not exceed 50m.

(c) Gate and Ball valves

(i) A Ball valve shall be installed on the upstream side of the Solenoid valve. A brass barrel union shall separate the Ball valve from the Solenoid valve to allow for ease of maintenance. Refer to SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD 14.4.

(ii) Ball valves shall be tested and approved to AS 3500.1.

(d) Valve boxes

(i) The valve assembly is to be located in a heavy-duty lockable valve box fitted with a stainless steel lock-down bolt in the lid.

(ii) Valve boxes shall be Heavy Duty Carson or similar approved.

(iii) Valve boxes used are to be of adequate size to ensure that there is sufficient space around the valve assembly to allow for ease of maintenance.

(iv) Valve boxes shall not require removal to facilitate maintenance of the valve assembly.

(v) All valve boxes shall be:

(A) supported on bricks so that the box does not rest on any pipes;

(B) installed so that the top of the box is flush with the finished turf surface level for turf areas, or 50mm to 100mm above the finished mulch surface level for garden areas;

(C) installed so that the clearance from the underside of the valve box lid to the top of the stem of the valve is; 150mm maximum – 50mm minimum for non drip valves and 75mm maximum – 50mm minimum for drip valves, refer SC6.4.4.8 Standard drawings SD-10.6, SD-14.3 and SD-14.4;

(D) installed so that the clearance from the underside of the valve housed within the valve box to the bottom of the box is at least equal to or greater than 50mm;

(E) the pipe holes shall be sealed with Geofabric around the openings to prevent the ingress of foreign material in the valve box;

(F) cutting of valve boxes for entry/exit of pipe work shall be keep to a minimum, boxes cannot be cut higher than 1/3 its height. Over cut boxes are not acceptable; and

(G) installed in association with its housed components so as not to require excessive cutting of the valve box to the satisfaction of the Superintendent.

(vi) All valve box lids shall be clearly marked with the identification of the contents using the follow key:

(A) IV = Isolation Valve;

(B) MV = Master Valve;

(C) A1 = Controller A Station 1 (Refer SC6.4.4.8 Standard drawings SD-8.1) for valve key; or

(D) 3 digit DTMF number as supplied by the Superintendent, for example “045” identifying the Irrinet System number.

(vii) Valve box lids shall be engraved by using a 50mm to 75mm high Signet 14474 / 14494 zinc Stencil Set or approved equivalent as a template. The engraving finish shall be evenly 1.5mm deep at its deepest point and between 4mm to 8mm wide by using an engraving power tool fitted with a spherical engraving bit. The finished engraving shall then be painted with a Signet 12205 White Marker or approved equivalent. Note excessively deep engraving will weaken valve box lids and is not acceptable.

(viii) No valve boxes shall be installed in drainage swales or places where water is collected during rainfall.

(ix) Stainless steel re-enforcing plates may be fitted to valve box lids to repair damaged threads only.

(x) Conduit connecting valve boxes with electrical inspection pits and other Valve Boxes is to be M.D. corrugated flexible conduit of a minimum 500mm and maximum 1500mm in length. SC6.4.4.8 Standard drawings SD-17.2 gives a typical construction drawing of the assembly.

(e) Valve nest enclosures

(i) Refer to SC6.4.4.8 Standard drawings SD-33.1 through SD-33.4 for valve nest enclosure details.

(ii) Valve nest enclosures may be installed where groups of more than three valves can be located together.

(iii) Allowance must be made for larger lateral pipe sizes to offset increased friction losses where longer lateral pipe lengths are required.

(iv) Allowance must be made for increase lateral sizes and quantity leaving the one location.

(v) Where three or more laterals leaving a valve nest cover share a common trench, bedding sand must be used to back fill trenches.

(vi) Lateral pipes leaving a valve nest cover must be run parallel in trenches (not twisted).

(vii) Valves inside a valve nest cover must be clearly identifiable via round 38mm diameter aluminium identification tags commercially available. DTMF numbering shall be clearly stamped onto one side of the tag using a punch set with 13mm high numerals. Tags shall be fastened to the appropriate solenoid valve using a quality grade plastic cable tie.

(viii) Electrical cables shall be cable tied to each solenoid valve control valve.

(ix) Enclosures shall be fitted with a pad lock and keyed to fit council “F” series.

(x) Solenoid valves shall be connected to a common copper manifold via individual brass barrel union and ball valve.

(xi) Copper manifolds (from 40mm to 80mm) must be of sufficient size to allow multiple stations to run simultaneously in program where required.

(xii) Copper manifolds connecting to PVC mainline shall be done via Cop-A-Mate flange or approved similar, installed 25mm above ground level.

(xiii) Copper manifolds connecting to Poly mainline shall be done via metric female compression fitting installed 25mm above ground level.

(xiv) Install Valve Nest Cover using 10mm 316 S.S dyna bolts fastened to 200mm diameter by 300mm deep concrete footings poured on site.

(xv) Top of concrete footings shall be installed level and 25mm above finished ground level.

SC6.4.6.27.5 Sprinklers, turf valves and drip irrigation

(1) Sprinkler design

(a) Sprinklers used shall be in accordance with Table SC6.4.6.27.7.

Table SC6.4.6.27.7 Approved sprinklers

Manufacturer	Model	Type
Hunter	PGP	Gear
Hunter	MPR	Rotating Nozzle**
Toro	570	Static
Rainbird	3500	Gear
Rainbird	5000 Plus	Gear
Rainbird	5505	Gear
Rainbird	6504	Gear

** Use on Toro 570 Body.

(b) Sprinkler uniformity shall not exceed a scheduling coefficient of 1.3 (5 per cent Window) SC6.4.4.8 Standard drawings SD-19.1, provides a definition of the scheduling coefficient and the process for calculation.

(c) Where possible, individual sprinkler stations shall be fitted with either all full circle sprinkler arcs or all part circle sprinkler arcs.

(d) All sprinklers on the same valve shall provide “matched precipitation”. The ratio of water supplied shall be even across all arcs of coverage. Sprinklers of different pressure and / or precipitation rate on the same station are not acceptable.

(e) The variation in flow between any sprinklers on a single station is not to exceed 10 per cent.

(f) All sprinklers are to be run at the manufacturer’s recommended pressure.

(g) All sprinkler heads on each individual station shall be the same type.

(h) Locations which are susceptible to low head drainage shall be fitted with either internal check valves, or Hunter or similar approved external check valves.

(i) No water shall be applied by design to locations where over spray is undesirable, (i.e. adjacent non-irrigated areas, roads, footpaths, private property etc.). The manufacturer’s published throw distance shall govern for design purposes.

(j) On roadway corners no water shall be applied by design to the road pavement whilst no unirrigated areas shall exceed 1m from the road edge. The manufacturers published throw distance shall govern. Examples of acceptable sprinkler layouts are given in SC6.4.4.8 Standard drawings SD-16.1.

(k) All static sprinklers are to be fitted with “fixed pattern” nozzles.

(l) Sprinklers are to be designed and installed in such a way that no electrical boxes, control cabinets, transformers, meter assemblies and the like are hit by direct water streams.

(2) Sprinkler installation

(a) No sprinklers shall be fitted until all main lines, lateral lines and risers have been flushed clean.

(b) Sprinklers shall be placed 150mm clear from walls, garden edges, pathways and the back face of concrete kerbs or concrete garden edges.

(c) Sprinklers shall be installed as detailed in SC6.4.4.8 Standard drawings SD-12.1 Figure 2, slightly above the finished surface level.

(d) Sprinklers shall be installed plumb unless placed on a slope in which case they shall match the slope of the surface.

(e) Where directed by the Superintendent sprinklers in grassed areas shall be installed with a sod of turf (300mm square) placed around them at the finished surface level to help stabilise the sprinkler.

(f) Sprinklers shall be connected to pipes (lateral lines) via either a tapping saddle or a BSP/F Tee and a flexible swing hose riser. All swing hose risers shall face downstream of the solenoid valve. Refer to SC6.4.4.8 Standard drawings SD-12.1 Figure 1.

(g) In locations where soils may be of a corrosive nature, 316 stainless steel bolt and nuts shall be used on all tapping saddles.

(h) The flexible swing hose riser used shall be either:

(i) 25mm safety yellow industrial hose, with nylon type elbows secured with stainless steel hose clamps; or

(ii) HR Products E-Z riser tube and E-Z riser elbows. (for sprinklers with 15mm and 20mm inlets).

The length of the flexible swing hose riser shall be no less than 500mm and no greater than 750 mm.

(i) Nozzle diffuser screws shall not reduce the wetted throw of a sprinkler by more than 20 per cent of the undiffused radius of a sprinkler.

(3) Bollard sprinkler installation

(a) Bollard sprinklers shall be installed where approved by the Superintendent in locations where sprinklers may be obstructed by plants or plant growth.

(b) Bollard sprinklers shall be assembled and installed as detailed in SC6.4.4.8 Standard drawings SD-12.2.

(4) Turf valves

(a) All turf valves shall be plasson.

(b) Turf valves shall be installed with an articulated riser connected to the main line via a tee coupling. Connecting turf valves to main line with tapping saddles is not allowed.

(c) Turf valves that are to be used as a hose watering point for garden establishment shall be installed in a valve box.

(d) Turf Valves Systems where sprinklers are directly inserted into the turf valves may be installed without a valve box flush with the soil surface.

(e) Turf valves located under valve box lids shall have the lid of the valve box clearly marked with an engraving tool and paint with the letters “TV”.

(5) Drip irrigation design and installation

(a) All drip irrigation systems shall be installed with an RPZ backflow device.

(b) The length of the drip tube shall be determined, based on all drippers along the line having sufficient pressure to operate 100 Kpa above the pressure compensation point as nominated by the dripper manufacturer. The maximum allowable inlet pressure shall be 300 Kpa.

(c) All drip tube used shall be Netafim Uni Ram 16 - 0.4m spacing @1.6lph or approved equivalent.

(d) The maximum spacing for drip tube is as shown in Table SC6.4.6.27.8.

Table SC6.4.6.27.8 Dripper spacing

SOIL TYPE	LOCATION	
	Grassed areas	Gardens
Loam and Clay Soil	400mm maximum	500mm maximum
Sandy Soil	300mm maximum	400mm maximum

(e) Refer SC6.4.4.8 Standard drawings SD-14.1 and SD-14.2 for typical drip irrigation details.

(f) Pressure compensation shall be fitted to each individual drip irrigation station. The devices used shall be retro fitted to the solenoid valve. The following two options are acceptable:

(i) Hunter Accu-Set pressure regulator, refer SC6.4.4.8 Standard drawings SD-14.3; and

(ii) inline pressure regulation device as specified by the Superintendent, refer to SC6.4.4.8 Standard drawings SD-14.4.

(g) A 120 mesh Disc Filtration system shall be installed immediately up stream of the solenoid valve in accordance with the manufacturer's specifications to ensure that the correctly sized filtration system is used. The following two filtration systems are acceptable:

(i) Netafim Tech Filter, (rated at 120 mesh by Netafim); and

(ii) Arkal 120 mesh Disc Filter fitted into a Netafim Tech filter housing, may be used during construction and for a period no greater than 1 month after installation of the drip tube.

(h) The filter, pressure regulator valve and solenoid valve assembly shall be installed in a valve box. Barrel Union/s shall be fitted to allow for easily removal of the filter, refer SC6.4.4.8 Standard drawings SD-14.3 and SD-14.4. The order of component installation from upstream to downstream is to be: Barrel Union, Filter, Barrel Union, Solenoid valve and Pressure Regulator. The fitting of these devices and the size of the valve box shall allow for:

(i) the filter cartridge to be easily serviced and changed; and

(ii) the pressure regulator to be easily adjusted and serviced.

(i) Drip tube shall be installed:

(i) in turf with 75mm cover to the finished surface level.

(ii) drip Tube laid on the surface shall be fitted with holding pins placed every 1.5m along the tube. Holding pins are to be constructed from 2.3mm minimum diameter Stainless Steel wire of 304 grade. Refer to SC6.4.4.8 Standard drawings SD-15.1 for details.

(j) Drip tube shall not be installed:

(i) directly into heavy clay or rocky soils where conditions may cause damage to the drip tube. In these soil types the drip tube must be installed between a 50mm surround of imported loan soil; and

(ii) in areas subject to significant vehicle traffic, where these condition would cause damage to the drip tube.

(k) All dripper lines shall terminate to a flushing manifold on the downstream side of the line. The head loss in the manifold shall be sized to lose no more than 1m based on twice the flow rate of the flow during normal operation. Each flushing line shall be fitted with a ball valve and 1 m of industrial vacuum and delivery hose. The ball valve shall be installed to provide easy operation. The ball valve shall be positioned in the valve box to prevent the industrial vacuum and delivery hose from kinking. The hose is to be held in place with a stainless steel hose clip. See SC6.4.4.8 Standard drawings SD-14.1 and SD-14.2 for component layouts. The valve box shall be sized as follows:

(i) 25mm ball valve – Carson or equivalent round valve box; and

(ii) 40mm and 50mm ball valves – Carson or equivalent rectangular valve box.

(l) All high point(s) in the dripper layout shall be fitted with a Bermad vacuum relief valve (Model ARV). The vacuum valve is to be installed in a valve box. A section of drip tube shall cross connect all drip tubes to the vacuum relief valve. The vacuum relief valve shall not be fitted to the supply manifold. See SC6.4.4.8 Standard drawings SD-14.1 and SD 14.2 for a typical installation.

(m) Netafim HCNL drip tube and/or Hunter adjustable check valves (or approved equivalent) shall be fitted if

the fall in the drip irrigation system exceeds 3m. Each side of the check valve shall be fitted with independent Flushing Valves and Vacuum Relief Valves. The check valves shall be set to 3m. The two methods for installation of the check valves are:

(i) check valves fitted to each drip tube; and

(ii) check valves fitted to both the supply manifold and the flushing manifold.

(n) Each drip irrigation station shall be fitted with operation indicators. The operation indicators consist of a Toro 570 100mm pop-up sprinkler fitted with an SST nozzle set to zero flow, sealed with silicon and installed level with the ground. The operation indicators are to be installed in a garden bed or next to a tree (not be a tripping hazard) and be visible from the drip valve assembly. Additional operation indicators shall be installed at the ends of each station and connected using a HR Products E-Z riser tube and 15mm E-Z riser elbows.

(o) Prior to the installation of the drip irrigation system the area to be drip irrigated shall be soaked with water and allowed to dry. Any resulting subsidence or soil shrinkage shall be filled with soil up to the finished surface level. The process of soaking with water and filling to a finished surface shall be repeated until the required surface level is achieved. Drip tubes may then be laid with the correct cover.

(p) On slopes the drip irrigation tubes shall following the contour lines of the area.

(q) “Snaking” of dripper lines shall be avoided.

(r) The minimum size of the header manifold is to be 25mm low density poly pipe.

(s) Drip tube shall be laid in straight runs inside roundabouts.

(t) No drip tube shall be installed within 150mm from walls, garden edges, pathways and the back face of concrete kerbs or concrete garden edges.

(u) Drip tube shall only be connected to low density poly pipe 25mm and 32mm using FI Tees and Netafim elbow adapters (3/4 inch to 17mm) with all low density pipe fittings clamped using Cobra stainless steel clamps or similar approved type. The use of quick start connectors is not approved by the Superintendent.

(v) Drip tube shall only be connected to PN 6.3 Poly Pipe using poly tapping saddles and Netafim elbow adapters (3/4 inch to 17mm). The use of grommet connectors is not approved by the Superintendent.

(w) In locations where soils may be of a corrosive nature, 316 stainless steel bolt and nuts shall be used on all tapping saddles.

SC6.4.6.27.6 Drinking fountain and water tap

(1) Drinking fountain

(a) A drinking fountain assembly includes:

(i) bowl - cast alloy, powder coated white;

(ii) turret - Ex 219 OD stainless steel tube powder coated "Heritage Green";

(iii) tap - BUB228C cam action Enware;

(iv) bubbler - Enware Type 61 push button bubbler with 3/8th - 1/2"x 3" male BSP tail;

(v) copper tube connection – 13mm Annealed Copper;

(vi) isolation valve;

(vii) precast concrete plinth base;

(viii) precast concrete pipe and aggregate backfill;

(ix) potable water supply line and water meter; and

(x) SC6.4.4.8 Standard drawings SD-32.1 contains the construction drawings for the fountain assembly.

(b) All pipe work to a drinking fountain shall comply with AS 3500. All pipe work installation to a drinking fountain, shall be carried out by a licensed plumber.

(c) The supply line to a drinking fountain shall be a “standalone” potable water line with its own water meter. Pipe work shall be a minimum 32mm PN12.5 Poly Pipe (from meter to isolation valve) laid in a trench with sand bedding and surround to the pipe and with 300 mm minimum cover over the pipe. Drinking

fountains and water taps may be installed on the same potable water line.

(d) The drinking fountain turret shall be installed on a precast concrete plinth base set on top of a 600 dia x 1.2m long reinforced concrete pipe embedded into the ground and backfilled with 20mm aggregate for drainage. Details of the base are given in SC6.4.4.8 Standard drawings SD-32.2. Alternately, the drinking fountain may be connected into an existing sewer drainage line.

(e) The Drinking fountain shall be isolated by a 15mm Ball Valve. The isolation valve shall be located a nominal 600mm from the drinking fountain adjacent the concrete plinth base and shall be installed in a circular valve box.

(f) The drinking fountain tap and bubbler shall be connected to the isolation valve with a flexible stainless steel hose.

(g) All bolts, screws and masonry anchor bolts fitted to the drinking fountain assembly shall be stainless steel.

(h) On completion and at commissioning of the drinking fountain the pressure shall be adjusted so the stream of water exiting the bubbler does not spill over the bowl.

(2) Water tap

(a) A water tap assembly includes:

(i) tap with vacuum breaker;

(ii) stainless steel support post;

(iii) concrete splash pad; and

(iv) potable water supply line and water meter.

(b) All pipe work to a water tap shall comply with AS 3500. All pipe work installation to a water tap shall be carried out by a licensed plumber.

(c) The supply pipe line to a water tap shall be a “standalone” potable water line with its own water meter. Pipe work shall be a minimum 32mm PN12.5 Poly Pipe (from the meter to copper tail pipe) laid in a trench with sand bedding and surround to the pipe and with 300mm minimum cover over the pipe. Water taps and drinking fountains may be installed on the same potable water line.

(d) Tap shall be a 15mm brass hose cock or similar approved connected to a 20mm copper tail pipe installed inside the support post.

(e) Support posts shall be 40mm x 40mm x 1.6mm stainless steel SHS fitted with a plastic cap and cast 350mm minimum into a 350mm dia x 450mm deep concrete footing.

(f) Splash pads shall be either:

(i) 600mm square x 100mm thick N25 concrete cast insitu; or

(ii) 600mm square x 50mm thick precast concrete.

(3) Fertigation

A fertigation point consisting of 25mm tested ball valve connected to the irrigation main line close down stream from the back flow assembly must be installed unless advised by the Superintendent. The fertigation point is to be housed in a round enclosure with the lid marked “FRT” for identification.

SC6.4.6.27.7 Effluent reuse systems

(1) Design and installation

(a) All works must comply with the *Queensland Water Recycling Guidelines*, current health and safety, environmental and related acts.

(b) Effluent reuse irrigation systems shall have:

(i) sprinklers fitted with lilac ID caps;

(ii) lilac coloured drip tubing;

(iii) lilac coloured valve box lids;

(iv) mainline and lateral pipe material (plastic) shall be lilac in colour or contain a lilac strip;

(v) all above ground pipe work shall be lilac coloured and/or clearly labelled “Recycled Water”, “Non Potable Water”; and

(vi) minimum separation of Pipe work for Potable and Recycles water systems shall be maintained at 300mm for below ground pipe work and 100mm for above ground pipe work.

SC6.4.6.27.8 Installations located in landfill sites

(1) Trenching in landfill sites

(a) When excavating in landfill sites or areas containing rock the trench shall be excavated to a minimum depth of 600mm.

(b) All trenching material removed from the trench shall be removed to the local refuse dump.

(c) All trenching spoil shall be totally removed from the surrounding surfaces and site and inspected by the Superintendent.

(d) Bedding sand shall be used to backfill to 200mm below finished soil level. The final 200mm shall be filled with an approved loam.

SC6.4.6.28 Minor concrete works

SC6.4.6.28.1 Introduction

(1) Scope

(a) This sub-section provide details for the supply and placement of concrete, including sprayed concrete, and ancillary requirements including excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the drawings but not having individual policy sub-sections. These works include kerb and channel, New Jersey type barriers, drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

(b) The work also includes supply and placement of miscellaneous minor concrete work for water and sewerage construction such as valve chambers, thrust and anchor blocks, bulkheads, pumping stations, bedding, encasement and cast-in-situ access chambers.

(c) Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in SC6.4.5 Construction management.

(2) Reference and source documents
Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section are as follows:
SC6.4.6.6 - Pipe drainage
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.12 - Flexible pavements
SC6.4.5 Construction management.

(b) Australian Standards:

AS1012.1	*Sampling of fresh concrete*
AS1012.3.1	*Determination of properties related to the consistency of concrete - Slump test.*
AS1012.8.1	*Method of making and curing concrete - Compression and indirect tensile test specimens*
AS1012.8.2	*Method of making and curing concrete - Flexure test specimens*
AS1012.9	*Determination of the compressive strength of concrete specimens*
AS1012.14	*Method for securing and testing cores from hardened concrete for compressive strength*
AS1141.14	*Particle shape, by proportional caliper*
AS1141.21	*Aggregate crushing value*
AS1141.23	*Los Angeles value*
AS1141.24	*Aggregate soundness – Evaluation by exposure to sodium sulphate solution*
AS1289.3.3.1	*Calculation of the plasticity index of a soil*
AS1289.5.1.1	*Determination of the dry density/moisture content relation of a soil using standard compactive effort*
AS1289.5.4.1	*Compaction control test - Dry density ratio, moisture variation and moisture ratio*
AS1379	*Specification and supply of concrete*
AS1478.1	*Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete*
AS/NZS1554.3	*Welding of reinforcing steel*
AS/NZS1859	*Reconstituted wood-based panels*
AS2082	*Visually stress-graded hardwood for structural purposes*
AS/NZS2271	*Plywood and blockboard for exterior use*
AS2758.1	*Concrete aggregates*
AS3600	*Concrete structures*
AS3610	*Formwork for concrete*
AS3799	*Liquid membrane-forming curing compounds for concrete*
AS3972	*General Purpose and blended cements*
AS/NZS4671	*Steel reinforcing materials*
AS/NZS4680	*Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

(c) Other:
NSW RTA, *Shotcrete design guidelines*

SC6.4.6.28.2 Excavation and foundations

(1) General

The foundation where specified, shall be formed at the required depth below the finished surface levels shown on the drawings. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete. Compaction requirements must meet the appropriate compliance standards as specified in sub-section SC6.4.6.10 Earthworks (construction).

All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Superintendent, and the subgrade shall be compacted to provide a minimum relative compaction as specified in SC6.4.6.10 Earthworks (construction). If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

Preparation of the foundation is required in accordance with foundation type, as follows:

(a) concrete working base - remove projections above the plane surface, and loose material; and

(b) graded prepared subgrade - blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

Editor's note—Provision of a vapour barrier for external slabs on ground prevents water loss to the subgrade and has the potential to reduce slab curling at edges and corners.

AS2870 Section 5.5 provides additional requirements and detailing of damp proof membranes for concrete slabs and footings exposed to either saline or acid sulphate soils. AS2870 Section C5.5 and CCAA T56 provide information on concrete exposed to saline soils.

Polymeric Film Underlay must be installed over the prepared foundation. Lap joints at least 200mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces past the damp proof course where applicable, and tape fix at the top. Patch or seal punctures or tears before pouring concrete. Cut back as required after concrete has gained strength and forms have been removed.

The Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with statutory requirements. The excavation shall be kept free of water.

Prior to the construction of footings for cast-in-situ concrete walls on earth foundations, cover the latter with a mass concrete blinding slab. Unless otherwise specified, place precast concrete wall sections on a fresh mass concrete bedding layer while it is still in a plastic state. Ensure the following is adhered to:

(a) for earth foundation, place concrete not less than 50mm thick; and

(b) for rock foundation, place the concrete at least 50mm above the highest points of rock.

Place neither forms nor other materials on the bedding layer within 48 hours of the concrete being placed.

(2) Kerb and channel

Kerb and channel may be constructed in fixed forms, by extrusion or by slip forming, in accordance with AS2876.

The foundation, concrete quality, curing and testing details shall be in accordance with AS2876 except where placed on pavement courses, where the requirements of the respective pavement course must prevail. Kerb and channel will be constructed to the profile nominated on the drawings.

The top and face of the finished kerb and channel shall be true to line and the top surface shall be of uniform width, free from humps, sags or other irregularities. Kerb and channel shall have a steel float finish.

The level at any point on the surface of the kerb invert shall be within ±6mm of the design level. When a straight edge 3m long is laid on top of or along the face or invert of the kerb, the surface shall not vary more than 5mm from the edge of the straight edge, except at kerb laybacks, grade changes or curves or at gully pits requiring gutter depression. The drainage invert shall be free draining and shall not pond water.

Unless shown otherwise on the drawings, contraction joints, shall be formed every 5m of kerb invert length for a minimum of 50% of cross sectional area. The joint shall be tooled 20mm in depth to form a neat groove of 5mm minimum width.

Unless shown otherwise on the drawings, expansion joints, 15mm in width for the full depth of the kerb and channel, shall be constructed where the kerb invert abuts against kerb gully pits, both sides of kerb laybacks/ramps for vehicular or pedestrian access, retaining walls and overbridges. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

Where kerb and channel is cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and channel.

All house stormwater outlets shall be provided and/or extended, to match the existing type and size of pipe, through the kerb as shown on the drawings providing correctly graded drainage outlet into channel. Pipework shall be in accordance with the requirements for UPVC pipes in sub-section SC6.4.6.6 Pipe drainage, or as directed by the Superintendent for other types of pipe.

At all driveway crossings, where shown on the drawings or where directed by the Superintendent, barrier kerb shall be discontinued to provide for vehicular or pedestrian access. At such locations, kerb laybacks/ramps must be constructed in accordance with the drawings and Standards. Footpath crossovers shall be constructed to meet the laybacks as shown on the drawings, or reinstated to match existing materials where not otherwise shown.

After the new kerb and channel has been constructed and not earlier than 3 days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the drawings, or as instructed by the Superintendent.

Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50mm diameter, or material as approved by the Superintendent.

Backfill material behind the kerb shall be compacted in layers not greater than 150mm thick, to a relative compaction of 95% when tested in accordance with AS1289.5.4.1, for standard compactive effort. The whole of the work shall be finished in a neat and workmanlike manner, free draining and free from surface undulations and trip hazards.

Pavement material adjacent to new gutter shall be backfilled in accordance with the drawings or as directed by the Superintendent.

Where specified in drawings, kerb only work shall be pinned as detailed in Standard drawings.

(3) New jersey type barriers, driveways and footpaths

For New Jersey type barriers, driveways and footpaths a subbase of approved quality and of minimum 150mm compacted thickness, unless otherwise shown on the drawings, shall be placed over the subgrade. The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

The subbase material shall be compacted to provide a minimum relative compaction as determined by AS1289.5.4.1 of 100% for standard compactive effort as specified in SC6.4.6.10 Earthworks (construction).

The finished subbase shall not deviate more than 15mm under a straight edge 3m long, subject to any necessary allowance on vertical curves.

(4) Drainage pits and other supplementary structures
Where the excavation is in sound rock, and the Superintendent so directs, part of the concrete lining of gully pits and other structures may be omitted, provided that a neatly formed pit of the required dimensions is constructed, and provided that the wall of the pit adjacent to and parallel with the road is constructed of formed concrete in all cases.

(5) Retaining walls, headwalls and wingwalls
In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of 150mm. Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be reduced to 100mm.

Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete bedding layer at least 50mm thick and finished to a uniform surface. No forms or other materials shall be placed upon the bedding layer within a period of 48 hours after the concrete has been placed.

Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete bedding layer while it is still in plastic state. In the case of soil foundations, the concrete shall be not less than 50mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50mm above the highest points of rock.

SC6.4.6.28.3 Formwork

(1) General
Formwork shall be provided in accordance with AS3610 to produce hardened concrete to the lines, levels and shapes shown on the drawings or specified elsewhere. It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the insitu earth.

Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2m or to move concrete along the formwork after deposition.

Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the drawings. Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete. The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the drawings.

Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the drawings.

Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

(2) Approval of formwork design
For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall be submitted for the Superintendent's concurrence before manufacture of the formwork is commenced.

(3) Provision for drainage
Where shown on the drawings, or where directed by the Superintendent, weepholes of 50mm diameter shall be provided in retaining walls and wingwalls.

(4) Construction

The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.

Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales. The plywood used for forms shall comply with AS2271, the hardwood shall comply with AS2082 and the particle board with AS/NZS1859.

Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1m and uniform lengths of not less than 2m, except where the dimensions of the member formed are less than the specified panel dimensions. Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists. Where form panels are attached directly to the studding or joists the panel shall be not less than 15mm thick. Form panels less than 15mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20mm minimum thickness. All form panels shall be placed in a neat, symmetrical pattern.

Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board.

Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.

(5) Erection

(a) General

(i) Dimensions and position of forms shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete. Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work. For tolerances in plan position and levels, refer to clauses SC6.4.6.28.5(7) Finishing of unformed surfaces and SC6.4.6.28.5(10) Treatment of formed surfaces.

(ii) Joints as erected shall be mortar tight.

(iii) The interior surface of the forms shall be treated to ensure non-adhesion of the mortar. Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface. The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete. In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints.

(iv) Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.

(b) Approval by the Superintendent

(i) The formwork shall be inspected by the Superintendent, and the placing of reinforcement in the spaces formed, where specified, shall not commence until the formwork is approved by the Superintendent.

(ii) Placing of concrete shall not commence until the reinforcement, where specified, has been accepted by the Superintendent, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

(iii) When an inspection is requested by the Contractor, a notice of not less than 24 hours, excluding Saturdays, Sundays and public holidays, shall be given to the Superintendent.

SC6.4.6.28.4 Materials for concrete

(1) Cement

Cement shall be Type GP Portland Cement complying with AS3972.

When submitting details of the nominated mix in accordance with clause SC6.4.6.28.4(6) Testing of materials, the Contractor shall nominate the brand and source of the cement. On approval of the nominated mix by the Superintendent, the Contractor shall only use the nominated cement for the work.

Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, a re-test shall be required at the Contractor's expense before the cement is used.

All cement shall be transported in watertight containers, and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

(2) Water

Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty nor brackish.

Water which is not potable for human beings shall not be used in reinforced concrete.

(3) Fine aggregate

Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS2758.1 in respect of bulk density, water absorption (maximum 5%) material finer than 2 micrometres, impurities and reactive materials.

Fine aggregates shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.1 Fine aggregate grading, and shall not deviate from the proposed grading by more than the amounts in Table SC6.4.6.28.1.

Table SC6.4.6.28.1 Fine aggregate grading

Australian Standard Sieve	Proportion Passing (% of Mass)	Deviation from Proposed Grading (% of Mass of Sample)
9.50mm	100	
4.75mm	90 - 100	±5
1.18mm	40 - 85	±10
300µm	8 - 30	±10
150µm	2 - 10	±5
75µm	0 - 4	±3

(4) Coarse aggregate

Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag and shall conform to the requirements of AS2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5%), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness. In all other respects, the coarse aggregate shall comply with this sub-section. If required, coarse aggregate shall be washed to satisfy these requirements.

The percentage of wear shall be determined by AS1141.23, and the loss of weight shall not exceed 30%.

When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

(a) crushing value - AS1141.21
The aggregate crushing value shall not exceed 25%;

(b) soundness - AS1141.24
The loss of mass when tested with sodium sulphate shall not exceed 12%; and

(c) particle shape - AS1141.14
The proportion of misshapen particles (2:1 ratio) shall not exceed 35%.

Coarse aggregate shall be evenly graded within the absolute limits shown in Table SC6.4.6.28.2 Course aggregate grading and shall not deviate from the grading of the samples submitted under clause SC6.4.6.28.4(6) Testing of materials by more than shown.

Table SC6.4.6.28.2 Coarse aggregate grading

Australian Standard Sieve (mm)	Proportion Passing (% of Mass)			Deviation Proposed Grading (% of Mass of Sample)
	40mm Nominal	20mm Nominal	Extrusion Concrete	
	For Walls exceeding 150mm thickness	For all other structures		
53.0	100			±10
37.5	95 - 100			±10
26.5		100		±5
19.0	30 - 70	95 - 100		±5
13.2			100	
9.50	10 - 35	25 - 35		
4.75	0 - 10	0 - 10		
2.36	0 - 2	0 - 2		

(5) Admixtures
Chemical admixtures and their use shall comply with AS1478.1. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used.

During the warm season, (October to March inclusive), a set retarding admixture approved by the Superintendent shall be used to control slump within the limits stated in clause SC6.4.6.28.5(4) Consistency. The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations. A copy of the NATA endorsed Certificate of Compliance with AS1478.1 shall be submitted to the Superintendent, together with the proposed “dosage chart” in accordance with SC6.4.6.28.4(6) Testing of materials. If the Contractor proposes to vary the admixture between the warm and cool seasons such variation shall require approval by the Superintendent by providing the necessary certificate of compliance.

(6) Testing of materials
The Contractor shall submit to the Superintendent a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed to be used in the work.

The materials shall only be used after receipt of the Superintendent's notification of acceptance, and then only as long as the materials accord with the Specification.

SC6.4.6.28.5 Handling and treatment of concrete

(1) Measuring
All materials shall be measured by weight, except that:

(a) water may be measured by volume with an approved adjustable water-measuring and discharging device;

(b) cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement, and for this purpose one bag of

cement shall be assumed to weigh 40kg. Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper; and

(c) measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

(2) Measuring by weight, on-site mixing

Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table SC6.4.6.28.3 Materials in batch containing 1 bag (40kg) cement may be used as a guide to produce the classes of concrete specified. Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete. The use of proportions shown in Table SC6.4.6.28.3 shall not relieve the Contractor of his obligation to provide concrete of the specified compressive strength.

Table SC6.4.6.28.3 Materials in batch containing 1 bag (40kg) cement

MPa	Cement kg	Fine Aggregates kg	Coarse Aggregates kg	Total Aggregates kg
10	40	130	250	380
15	40	100	190	290
20	40	88	126	214

The proportions set out in Table SC6.4.6.28.3 make allowance for moisture contents of aggregates of 6% for fine aggregates and 1% for coarse aggregates. Where the moisture content of aggregates exceeds 8% or 3% respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

(3) Measuring by volume, on-site mixing

Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

The nominal proportions given in Table SC6.4.6.28.4 Volume batching may be used as a guide for volume batching.

Table SC6.4.6.28.4 Volume batching

MPa	Parts by Volume		
	Cement	Fine Aggregate	Coarse Aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins. The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level. Measurements by shovels or like methods will not be permitted. Batch proportions shall be so arranged that each batch contains 1 bag of cement. One 40kg bag of cement shall be assumed to have a volume of 27.5 litres.

(4) Consistency

A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface. If required by the Superintendent, the Contractor shall determine the consistence of the concrete in accordance with AS1012.3.1. Except for extruded concrete, the nominated slump shall not exceed 80mm, plus the field tolerance of ±15mm.

In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10mm to 15mm.

(5) Mixing and delivery

(a) General

(i) Concrete may be mixed either at the site or at a central mixing plant. All concrete shall be mixed

with mechanically operated mixers. In an emergency, hand mixing may be permitted. Submit proposal for concrete mixing other than pre mixed concrete for approval by superintendent.

(ii) Any concrete which exhibits signs of segregation shall not be used.

(b) Machine mixing at site

(i) The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.

(ii) The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer's rated capacity of the mixer.

(iii) The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.

(iv) The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

(c) Mixing in an emergency

(i) In the case of breakdown of the mechanical mixing equipment, hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint is permitted.

(ii) Hand mixing shall be done on a water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10% more than the amount specified for machine mixed concrete.

(iii) The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer. The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler. After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance. Hand-mixed batches shall not exceed 25m^3 each.

(d) Ready-mixed concrete

(i) The concrete shall be mixed and delivered in accordance with the requirements of AS1379 relating to:

(A) mixing and delivery; and

(B) use of non-agitating equipment,

(ii) The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

(6) Placing and compacting concrete

No concrete shall be mixed or placed, without the approval of the Superintendent, while the air temperature is, or is likely to be within 24 hours, below 5°C or while the shade temperature exceeds 38°C. All concrete shall be placed in the dry. Prior to placing concrete the area shall be clean and moist but free from any ponding of water.

The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible. Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2m, or be deposited in large quantities at any point and moved or worked along the forms. Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings. Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed. The concrete

shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face. The freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units. Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement.

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, comprised of two parts of plasterer's sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

(7) Finishing of unformed surfaces

(a) Surfaces other than wearing surfaces

Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface. Care shall be taken to drain or otherwise remove promptly any water which comes to the surface. A capping of mortar will not be permitted.

All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

(b) Wearing surfaces

Where a concrete wearing surface is shown on the drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than 2m. Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner. The departure from grade shall not exceed 5mm in any 3m length.

Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.

(c) Finished levels and location

The unformed surface of concrete structures not adjacent to road pavements shall not vary more than 25mm in plan position and not more than 25mm from the specified levels. In the case of barriers, drainage pits, culvert slabs and other structures adjacent to road pavements, the finished concrete shall not vary more than 10mm from the specified levels and alignment. Barriers, footpaths and similar shall not deviate from level or alignment by more than 5mm from a straight-edge 3m long, subject to any necessary allowances on vertical and horizontal curves.

(8) Curing and protection

All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds, in accordance with AS3799, for a minimum period of 3 days. During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete. All costs involved in making good or replacing any work that has been damaged due to the above mentioned factors shall be borne by the Contractor.

Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in AS3600.
If it is proposed to use a liquid membrane-forming curing compound submit the following information:

(a) certified test results for water retention to AS3799 Appendix B;

Editor's note—It is likely that polyvinyl alcohol (PVA-based) products will not comply with water retention requirements.

(b) evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.

For visually important surfaces, evidence that an acceptable final surface colour will be obtained.

(9) Removal of forms

All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10 °C during the periods specified.

Mass retaining walls, headwalls, wingwalls, gully pits, sumps, and similar drainage structures	48 hours
Footpaths, driveways and similar	17 hours
Sides of reinforced concrete walls when height of each day pour is:	
• under 0.6m	1 day
• 0.6m to 3m	2 days
• 3m to 6m	3 days
• 6m to 9m	5 days
Supporting forms under deck slabs of culverts	10 days

To permit the satisfactory finishing of barriers, forms shall be removed in not less than 12 hours nor more than 48 hours after placing concrete, depending upon weather conditions.

Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70% of the design strength.

Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

(10) Treatment of formed surfaces

All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result. Formed concrete surfaces shall be presented for inspection by the Superintendent within 1 day of stripping of formwork and finishes in accordance with the classes of surface finish in AS3610 as follows:

(a) Non-visible surfaces - Class 4.

(b) Visible surfaces - Class 2.

As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of

application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer.

The formed surfaces of concrete structures not adjacent to road pavements shall not vary more than 25mm in plan position and not more than 25mm from the specified levels. In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

(11) Joints

Submit proposed methods, timing and sequence of sawing joints for approval by superintendent a minimum of 7 days prior to works commencing.

Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Superintendent. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

Retaining walls shall be provided with vertical expansion joints as shown on the drawings. The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

Where barriers are extruded or cast in place, narrow transverse vertical grooves, 20mm deep, shall be formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints, shall be at intervals of 3m.

In barriers, unless shown otherwise on the drawings, expansion joints, 15mm in width for the full depth of the barrier, shall be constructed at intervals not exceeding 15 m and where the barrier abuts against gully pits. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

In footpaths, median toppings and driveways, unless otherwise shown on the drawings, expansion joints, 15mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15m and where the pavement abuts against gutters, pits and structures. Expansion joints shall consist of a preformed jointing material of bituminous fibreboard.

All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form “slabs” no bigger than $2m^2$. The ratio of the longest side to the shortest side shall not exceed 1.6.

(12) Strength of concrete

When tested in accordance with AS 1012.9, the concrete shall have a characteristic compressive strength not less than that shown on the drawings or if not shown shall have a compressive strength not less than that specified in Table SC6.4.6.28.5 Concrete strength requirements for the particular class of work. The cement content restrictions shown in Table SC6.4.6.28.5 refer to Portland cement. Where General Purpose Blended cements are utilised the acceptable minima are indicated in brackets.

The characteristic strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

In general, two pairs of test specimens shall be moulded for each $15m^3$ of concrete, or part thereof, one pair being intended for the 7 day test if required and the other pair for a 28 day test.

Table SC6.4.6.28.5 Concrete strength requirements

Use	Charac-teristic Strength MPa	Minimum Portland Cement per 3 metre (Minimum GB Blended Cement)	Coarse Aggregate Nominal Size	Characteristic Cylinder Strength Required	
				7 days	28 days
		kg	mm	MPa	MPa
Foundations, mass retaining walls	20	270 (330)	40	15	20
Mass concrete footings, pitching, linings etc.	20	270 (330)	20	15	20
Miscellaneous minor concrete work	20	270 (330)	20	15	20
Reinforced concrete culverts, drainage structures, driveways footpaths, headwalls, base slabs, sign structures. Large footings, retaining walls	32 50	320 (380) 350 (455)	20 20	24 36	32 50
Extruded concrete Safety Barriers	25 40	270 (330) 330 (380)	14 20	15 24	20 40

Note—the total cement and Portland cement quantities indicated as minima are aimed at providing suitably durable concrete for exterior public works under normal circumstances.

The strengths specified at 28 days shall be increased by multiplying by factors as shown in Table SC6.4.6.28.6 Concrete age conversion factors for tests at ages in excess of 28 days.

Table SC6.4.6.28.6 Concrete age conversion factors

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25
*For intermediate ages the factor shall be determined on a pro-rata basis	

If the test specimens fail to achieve the specified characteristic strength, the Contractor may, with the approval of the Superintendent, arrange for cores to be taken from the work. If the average strength of such cores complies with the specified requirements nominated in Table SC6.4.6.28.5 Concrete strength requirements, the concrete will be accepted.

If cores taken fail to satisfy the strength requirements, the concrete shall be removed.

(13) Sampling concrete

Equipment and facilities shall be provided by the Contractor for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work.

Concrete test specimens shall be cylinders 300mm long and 150mm diameter, moulded concurrently in the presence of the Superintendent or Superintendent's representative, in accordance with AS1012.8, from samples taken in accordance with AS1012.1.

SC6.4.6.28.6 Reinforcement for concrete

(1) Fibre reinforced concrete

Footpath/Bikeways/Driveways.
The concrete shall be reinforced with a mixed dose of High Performance Polymer and Discreet Graded Fibrillated filament fibres. These fibres shall be provided as a coarse filament in an engineered contoured sinusoidal profile of not less than 600 denier and discreet graded fibrillated filament fibres of not greater than 6 denier. These fibres are to be manufactured from virgin polypropylene and added to the concrete by the concrete company, at the rate of 4.6kg/m^3. The 4.6kg consists of 3.8kgs of HPP and 0.8kgs of discrete Graded Fibrillated filament fibres.

Two bags of "Novomesh" HPP as supplied by Tapex Concrete Fibres Qld or approved equivalent added per m^3, will be deemed suitable for council's use. Where footpaths/bikeways are not subject to wheel loads one bag of fibres per m^3 will suffice.
Any alternate product must have prior written approval obtained from council.

(2) Steel reinforcement

Steel reinforcement shall comply with AS/NZS4671 *Steel reinforcing materials*.
The type and size of bars shall be as shown on the drawings.

If changes are proposed to reinforcement shown on the drawings, submit details to superintendent for approval 2 days prior to commencing works.
Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Damaged galvanising must be repaired in accordance with AS/NZS4680 Section 8 and notification of repairs made to the superintendent for approval.

The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS4671. Test certificates shall show the results of mechanical tests and chemical analysis.

Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor. The samples shall be selected randomly and consist of three specimens each at least 1.2m in length. The cost of all samples and tests shall be borne by the Contractor.

Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200kg mass on the chair for one hour at 23 ± 5°C without malfunction. The Contractor shall demonstrate that the proposed chairs conform with these requirements.

(3) Bending

Reinforcement shall be formed to the dimensions and shapes shown on the drawings. It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the drawings will not be accepted. Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied. Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent. Heated bars shall not be cooled by quenching.

(4) Splicing

(a) General

All reinforcement shall be furnished in the lengths indicated on the drawings. If splicing is required, it shall be in accordance with the provisions of AS/NZS4671.

The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor.

(b) Lapped splices

Laps in reinforcing bars, wire or fabric shall be as shown on the drawings. Laps not shown on the drawings shall be as follows for unhooked bars:

(i) Plain bars, Grade 250 40 bar diameters.

(ii) Deformed bars, Grade 400 35 bar diameters.

(iii) Hard-drawn wire 50 bar diameters.

Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25mm.

(5) Marking

Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire. Each bundle shall have a stout metal label of not less than 40mm diameter attached to it. Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings. If called for on the drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately.

(6) Storage

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

(7) Delivery and receipt of reinforcement

Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until all tests and inspections have been satisfactorily completed and permission to deliver has been granted by the Superintendent.

The Contractor shall give 10 working days' notice to the Superintendent for carrying out inspection and testing. The Superintendent will carry out the inspection and testing with reasonable expediency, but the Contractor shall not be entitled to an extra as a result of any delays in this connection.

(8) Placing

Reinforcement shall be accurately placed as shown on the drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25mm. Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate. Reinforcement shall have the minimum cover shown on the drawings or otherwise approved by the Superintendent.

The Superintendent may approve the use of tack welding instead of wire ties on reinforcing wire. All welding of reinforcing steel shall be in accordance with AS1554.3. Tack welding of cold-worked and hard grade bars shall not be permitted.

The reinforcement in each section of the work shall be approved by the Superintendent before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours.

Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the drawings. Where not so indicated it shall be as stated below:

(a) concrete normally in contact only with air:

(i) slabs: 40mm;

(ii) other than slabs: 45mm; and

(b) concrete in contact with earth or fresh water:

(i) slabs of box culverts: 50mm; and

(ii) other than culverts: 50mm.

(9) Cores, fixings and embedded items general

Cores, fixings and embedded items identified on shop drawings showing the proposed locations, clearances and cover, and indicating proposed repositioning of reinforcement must be presented for inspection by the superintendent.

If cutting or coring of hardened concrete is proposed, provide details to the superintendent for approval.

For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. If required, provide for temporary support of adjoining elements during construction of the concrete.

If in external or exposed locations, galvanize anchor bolts and embedded fixings, or propose alternative materials such as stainless steel.

Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

SC6.4.6.28.7 Backfilling

(1) General

Backfilling at barriers, paving, etc., and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

No superimposed load on any part of what will become a load bearing structure within 21 days after placing concrete shall occur unless the structure is effectively and independently supported to the satisfaction of the Superintendent (approval must be sought at a minimum of 3 working days prior to loading upon evidence of early strength) or until the Contractor can demonstrate that 85% of the design strength of the concrete has been achieved.

Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS1289.3.3.1. The material must be placed in layers not exceeding 150 mm and must be compacted to provide a relative compaction as specified in sub-section SC6.4.6.10 - Earthworks (construction).

(2) Treatment at weepholes

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

(a) the maximum particle dimension shall not exceed 50mm; and

(b) no more than 5% by mass shall pass the 9.5mm A.S. sieve.

The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least

450mm vertically above the level of the weepholes.

Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal. It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.

SC6.4.6.28.8 Sprayed concrete

(1) References

NSW RTA – *Shotcrete Design Guidelines*.

(2) General

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

The minimum depth of sprayed concrete to be applied shall be 75mm.

Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour.

Sprayed concrete shall have a minimum cement content of 380kg/m3 as discharged from the nozzle and shall have a minimum compressive strength of 25MPa at 28 days when tested by means of 75mm diameter cores taken from in-place sprayed concrete.

Cores shall be secured, accepted, cured, capped and tested in accordance with AS1012.14. Equipment and facilities shall be provided by the Contractor for the taking of cores from the work. The Contractor shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores. Copies of test results shall be forwarded to the Superintendent.

The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.

At least 14 days prior to applying any sprayed concrete the Contractor shall submit to the Superintendent details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS3600.

(3) Test panels

Not less than 7 days before applying concrete, the Contractor shall prepare at least three test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent. The test panels shall be made by applying a 75mm thickness of sprayed concrete to a hardboard panel approximately 750mm square. The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works. The panels shall be submitted to the Superintendent for examination.

The Contractor shall cut four 75mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed. The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days.

Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Sprayed concrete shall not be applied to the Works until the Contractor produces test panels for the approval of the council.

(4) Surface preparation

Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.

Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete.

Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.

The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

(5) Application of sprayed concrete

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

Spraying shall be discontinued if wind causes separation of the nozzle stream.

Concrete shall not be sprayed in air temperatures less than 5 °C.

Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

(6) Curing

Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS3799 and applied in accordance with manufacturer’s specifications.

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least 7 days.

SC6.4.6.28.9 Summary of limits and tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table SC6.4.6.28.7 – Summary of limits and tolerances below:

Item	Activity	Limits/Tolerances	Clause
1.	**Foundation**		
	(a) Relative Compaction	³95% RDD(standard compactive effort) within 0.3m below subgrade	SC.6.4.6.28.2(1)
2.	**Barriers, Footpaths etc.**		
	(a) Finished Subbase	To be trimmed and compacted so that the levels do not vary more than 15mm under a straight-edge 3m long.	SC6.4.6.28.2(2)

Item	Activity	Limits/Tolerances	Clause
	(b) Relative Compaction of Subbase	³100% (standard compactive effort)	SC6.4.6.28.2(2)
3.	**Formwork**		
	(a) Position of Forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	SC6.4.6.28.3(5)
4.	**Fine Aggregate**		
	(a) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.1.	SC6.4.6.28.4(3)
5.	**Coarse Aggregate**		
	(a) Percentage of wear	Loss of weight shall not exceed 30%	SC6.4.6.28.4(4)
	(b) Crushing Value	Crushing value shall not exceed 25%	SC6.4.6.28.4(4)
	(c) Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	SC6.4.6.28.4(4)
	(d) Particle Shape	The proportion of misshapen particles (2:1 ratio) shall not exceed 35%	SC6.4.6.28.4(4)
	(e) Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table SC6.4.6.28.2.	SC6.4.6.28.4(4)
6.	**Aggregate Moisture Content**	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	SC6.4.6.28.5(2)
7.	**Consistency**	In accordance with AS1012.3, Method 1 the slump shall not exceed the nominated slump ±15 mm.	SC6.4.6.28.5(4)
		In the case of concrete placed by extrusion machine, the slump will be between 10mm and 15mm.	SC6.4.6.28.5(4)
8.	**Ready-Mixed Concrete**		
	(a) Mixing & Delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours. Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	SC6.4.6.28.5(5)
9.	**Placing & Compacting of Concrete**	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	SC6.4.6.28.5(6)
10.	**Finishing of Unformed/Formed Concrete Surfaces**		
	(a) Wearing Surface	to be finished true and uniform so that departure from designed grade shall not exceed 5mm in any 3m length.	SC6.4.6.28.5(7)(b)
	(b) Finished Surfaces		

Item	Activity	Limits/Tolerances	Clause
	(i) Not Adjacent to Roads	≤25mm Plan position	SC6.4.6.28.5(7)(c)
		≤25mm Level	SC6.4.6.28.5(10
	(ii) Adjacent to Roads	≤10mm Alignment	SC6.4.6.28.5(7)(c)
		≤10mm Level	SC6.4.6.28.5(10)
	(iii) Culvert Inverts	≤25mm Alignment	SC6.4.6.28.5(7)(c)
		≤10mm Level	SC6.4.6.28.5(10)

SC6.4.6.29 Boundary fencing

SC6.4.6.29.1 Introduction

(1) Scope

The work to be executed under this sub-section includes setting out, clearing of fence line, supply of material and erection of fencing and gates, in accordance with the drawings or as directed by the Superintendent.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections:

SC6.4.6.11 - Clearing and grubbing

SC6.4.6.28 - Minor concrete works

(b) Australian Standards:

AS 1289.5.4.1 - *Compaction control test - Dry density ratio, moisture variation and moisture ratio.*

AS 1725.1 – *Chain link fabric fencing - Security fences and gates.*

AS 2423 - *Coated steel wire fencing products for terrestrial, aquatic and general use.*

(c) Queensland Department of Transport and Main Roads publication:

Manual of Uniform Traffic Control Devices (Queensland) (MUTCD)

SC6.4.6.29.2 Materials

(1) General

All materials shall be supplied by the Contractor and shall be of dimensions, manufacture and quality in accordance with the requirements of this policy and all galvanised wire fencing products shall conform to AS 2423.

For each type of material to be supplied, the Contractor shall submit to the Superintendent for approval the source, manufacturer, and also the type if applicable.No materials shall be used until approved by the Superintendent.

(2) Galvanised posts, braces and rails

All posts, bracing and rails shall be galvanised iron pipe in accordance with AS 1725.1. The pipes shall be to the dimensions shown on the drawings.

All pipe joints shall be welded. All welds shall be satisfactorily cleaned and painted with a cold galvanising compound to the satisfaction of the Superintendent.

(3) Chain wire

Galvanised chain wire mesh, 1200 mm high, 1450 mm high or 1830 mm high for Manproof Fencing shall be of 3.15 mm diameter wire woven to a 50 x 50 mm square mesh. Chain wire shall be supplied in lengths of not less than 30 m. The zinc coating shall be uniform, continuous, free from imperfections and thoroughly adherent. The coating shall be applied to the wire before the mesh is woven. The weight of the zinc coating shall not be less than 290 g/sq m of wire surface.

Where specified, the chain wire shall be coated in black PVC after galvanising.

(4) Wire netting

Wire netting shall be standard quality galvanised 1.40mm diameter wire, 40mm mesh, 1.05m wide for normal use and 1.60mm diameter wire, 50mm mesh, 0.90m wide where used in creek crossings.

(5) Gates

Gates shall be of galvanised tubular steel construction, 3.6m in width by 1.5m or 1.2m (as specified) in height,

and shall be fitted with substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the drawings or directed by the Superintendent.

Where required, gates shall have stout and well supported rabbit-proof mesh to a height of at least 900mm above ground level.

(6) Reinforced concrete posts

(a) Strainer posts
Concrete strainer posts shall be approximately 150 x 150 square in section and lengths as shown on the drawings. Each post shall be provided with 12mm dia holes to suit the spacing of the wires shown on the drawings for the particular type(s) of fencing to be erected.

The posts shall be reinforced longitudinally with not less than four reinforcing bars each 12mm diameter. All posts shall have suitable stirrup reinforcement to control diagonal cracking. Longitudinal reinforcement shall have 25mm minimum cover. End cover on reinforcement shall be 25mm.

(b) Intermediate posts
Intermediate Posts shall generally conform to the requirements for Strainer Posts, except that the longitudinal reinforcing bars may be 9mm dia.

(7) Prestressed concrete posts

(a) Strainer posts
At least four longitudinal high carbon deformed high tensile strands (or equivalent) of 5mm diameter, shall be provided. The strands shall be tensioned to a stress of 800 MPa minimum prior to placing concrete. Cross sectional dimensions of the posts shall be as shown on the drawings.

Concrete shall have a minimum compressive strength of 32 MPa at 24 hours. In lieu of holes for wires, grooves may be provided to suit the spacing of the wires shown on the appropriate drawings for the particular types of fencing to be erected. The grooves shall be at least 5mm deep and 5mm wide at the surface of the post.

(b) Intermediate posts
Intermediate posts and strainer stays shall generally conform to the requirements for Strainer Posts except that two only high tensile, high carbon deformed strands shall be required.

Cross sectional dimensions shall be as shown on the drawings.

(8) Steel posts (rural fencing)
Steel posts shall be "STAR" pattern. Posts shall be drilled to suit the spacing of the wires shown on the Drawing(s), and shall be black varnished or galvanised. The total weight of 300 posts each 1.65m long shall be at least 1 tonne.

(9) Galvanised pipe posts (rural fencing)
Galvanised pipe posts shall be used where shown on the drawings. The pipes shall be of the dimensions shown on the drawings and shall be of first grade quality in accordance with AS 1725.

(10) Wires

(a) Plain wire
Plain wire shall be standard galvanised drawn annealed steel wire of diameters shown on the drawings.

(b) High tensile plain wire
High tensile wire shall be galvanised and of diameters shown on the drawings.

(c) Barbed wire
Barbed wire including barbs shall be 2.5mm diameter galvanised drawn annealed steel wire, with clusters of four barbs spaced at 90mm maximum. Alternatively barbed wire may be of 1.6mm diameter high tensile steel wire, with clusters of barbs spaced at 90mm maximum.

(d) Cable wire
Cable wire shall consist of three pairs of 2 x 3.15mm galvanised iron wire tightly twisted around posts and located as shown in the drawings.

(e) Tie wire
The wire shall be 2mm diameter galvanised wire.

(11) Concrete backfilling
All concrete backfilling of post holes specified on the drawings shall be of minimum 20 MPa 28 day compressive strength and shall conform to the requirements of sub-section SC6.4.6.28 Minor concrete works.

SC6.4.6.29.3 Construction

(1) General
Fencing shall be erected prior to the commencement of other work on a particular section of the work, unless directed otherwise by the Superintendent.

All fencing shall be erected in a workmanlike manner, and when completed shall be sound, strong and of neat appearance.

For a clear width of one metre on either side of the fence line, and for the full length of the line, all logs, boulders, stumps, roots, undergrowth and rubbish shall be removed and disposed of by the contractor in accordance with SC6.4.6.11 Clearing and grubbing. Trees within this area shall be removed only as directed by the Superintendent and approved by council's authorised officer.

If trees on or adjacent to the fence line are to be retained the arrangement of the fencing at the trees shall be as directed by the Superintendent.

Wire shall not be strained around or against any trees to be left in the fence line, and strainer posts are to be provided on both sides of each tree.

Where minor irregularities occur in the ground the vertical alignment of the fence shall not follow these irregularities, but shall be aligned to a uniform grade between definite changes in the natural slope of the ground.

All boundary fencing is to be erected on the common boundary line (where practicable) which has been surveyed and marked with pegs by a registered cadastral surveyor. The placement of the proposed fence (including footings), relative to the marked boundary line, is to be such that no (or minimal) loss of accessible land results for either property owner once the fence is erected. Any deviation of the proposed fence line away from the marked property boundary is to be mutually agreed to by all parties prior to erection of the fence.

The Contractor shall maintain the fencing at all times in a condition secure against the ingress or egress of stock, and shall take such precautions as are necessary to prevent people or stock from stepping into holes excavated for the construction of fencing.

Where old fencing is to be replaced by new fencing, all holes left after removal of the old fencing shall be backfilled and rammed firmly in layers of maximum depth 150mm.

The Contractor shall be held responsible for any loss, damage, or injury to buildings, goods, crops, livestock, property of any kind or persons due to negligence on the Contractor's part.

(2) Chain link fencing

(a) Erection of posts
All posts shall be erected vertically and set in concrete blocks approximately 250mm diameter and 600mm deep except for end, corner, strainer and gate posts which shall be set in concrete blocks approximately 250mm diameter and 900mm deep unless otherwise shown on the drawings. Concrete shall have a minimum compressive strength of 20 MPa at 28 days and shall conform to the requirements

of sub-section SC6.4.6.28 Minor concrete works.

Galvanised weather caps shall be fitted to all galvanised posts.

Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. Distances between strainer posts shall not exceed 120m.

(b) Erection of wire

All wire shall be spaced as shown in the drawings. Wire shall be securely fastened and strained to an even tension between strainer posts.

Where specified, or shown on the drawings, chain wire mesh shall be erected on the outside of the posts and fastened with two turns of tie wire to each cable wire on both sides of each post and at intervals of not more than 900mm between posts and to each post midway between cable wires.

(3) Stock-proof fencing

(a) Erection of posts

All posts shall be erected vertically. Reinforced concrete posts shall be erected in neatly cut holes sunk in earth, or in rock where this is encountered. Steel posts, except where placed in rock, shall be driven with suitable driving equipment, care being taken not to damage the tops of the posts during driving.

Where prestressed posts are proposed to be used, they shall be either erected as for reinforced concrete posts or shall be driven. Where driven, the Contractor shall use a suitable post driver which shall be equipped with two sets of guiding rollers, to hold the post vertical and in position during driving.

A steel cap with a plywood cushion shall be used to protect the top of the post during driving.

If the post cannot be driven for the full depth specified, or if it becomes significantly damaged, or cannot be driven vertically, it shall be removed. The same post if undamaged, or a new post, shall be erected as described for reinforced concrete posts.

Posts shall be sunk to the depths shown in Table SC6.4.6.28.1 Post depth in ground.

Table SC6.4.6.29.1 Post depth in ground

Type of Post	Depth	
	Earth	Rock
Concrete Corner Posts and Strain Posts	900	*600
Concrete Intermediate Posts	600	*450
Steel Posts	450	450

Note —*permitted only in cases where posts of the correct length are provided (see below), otherwise the depth of sinking shall be the same as for earth.

Cutting of concrete posts will not be permitted, and in order to take advantage of the lesser depth of sinking permitted in rock, it will be necessary to use posts manufactured in lengths to suit the depth of sinking. Where rock is encountered, steel posts shall be sunk in drill holes of sufficient diameter to permit them to be refilled with cement mortar consisting of one part of cement to two parts of clean sand.

Earth shall be backfilled around intermediate posts in layers of maximum depth 150mm for the full depth of the hole and up to ground level. The relative compaction of the rammed material shall be not less than that of the original undisturbed ground.

Where concrete posts are placed in rock, the space around the posts shall be tightly filled with cement mortar consisting of one part of cement to two parts of sand, or concrete where this is available.

Strainer posts shall be used at ends of fencing, angles, intersections with other fencing, gates and at intermediate points. These posts shall be backfilled with approved concrete to their full depth.

Distances between strainer posts shall not exceed 120m in the case of fencing using steel intermediate posts, and 90m in the case of fencing for the retention of cattle (for which only concrete posts are permitted). Junctions with existing fencing shall be made in an approved manner.

(b) Erection of wires

All wire shall be placed as shown on the drawings. Wires shall be securely fastened and strained to an even tension between strainer posts with an approved wire strainer. Where barbed wire is to be used, it shall be tied in position at the top of intermediate posts, and where additional barbed wires are called for they shall be secured to the sides of the posts as shown on the drawings.

Where concrete posts are used and the barbed wires are secured either to the tops or sides of the posts by tie wire, the tie wire shall be stretched tight and shall fit snugly against the sides of the posts to prevent movement of the barbed wire.

Where prestressed posts are used, wires shall be securely tied so that they seat firmly in the grooves.

All joints in wires shall be as shown on the drawings.

(4) Crossing of watercourses and depressions

The crossing of all watercourses and depressions, shall be made secure by longer posts, suitably strutted as directed by the Superintendent. Additional cable wire and chain wire/wire netting shall be provided as necessary to make the fence stock proof.

The fence shall allow the passage of floodwater without the accumulation of debris. If directed by the Superintendent, flood gates shall be provided in accordance with clause SC6.4.6.29.3(6) Flood gates.

(5) Connections to existing fences

Existing cross fences shall be connected to the new fence using a strainer post with braces in each direction of strain (including cross fence) and the wires in both fences properly fastened to the post.

(6) Flood gates

(a) General

Suitable provision for the passage of flood waters past the fence shall be made at all watercourses. In all cases flood gates shall be of the type indicated on the drawings, or as directed by the Superintendent, and shall be erected so as to prevent the accumulation of flood debris, while remaining stock-proof or rabbit-proof.

(b) Small watercourses

Flood gates, in accordance with the drawings, shall be provided in small gullies at the locations indicated on the drawings or as directed by the Superintendent. The opening of each flood gate shall provide a waterway area at least twice that of the culvert opposite to which it is placed, or as otherwise directed by the Superintendent.

(c) Large gullies and creeks

Flood gates, in accordance with the drawings, shall be provided in gullies and creeks at the locations indicated on the drawings, or as directed by the Superintendent.

A 9mm galvanised wire rope shall be carried over the gully in one span, threaded through a strainer post and tied back to an anchor at an adjacent concrete intermediate post. Turnbuckles are to be provided at each end to tension the wire rope. Netting shall be suspended from the wire rope and shall be overlapped and securely tied. The netting shall be of sufficient length to lie on the ground for a distance of not less than 1.0m on the downstream side.

Ballast, of sound timber securely tied to the netting, shall be provided at the downstream end of the netting.

The sides of the gully shall be trimmed, as necessary, to ensure that the flood gate shall be stock-proof

or rabbit-proof. The flood gate shall have sufficient movement of the suspended portion under the flow of flood waters to prevent damage to the fence and the accumulation of debris against it. Each strainer post shall be stayed in three directions, as shown on the drawings.

(7) Erection of gates

Where gates are specified or shown on the drawings, they shall be erected so that they swing away from the road. Double gates shall be supplied if directed by the Superintendent, otherwise a single gate only shall be supplied.

At the location of gates the surface shall be levelled and shall be nearly horizontal. The area where the gates swing shall be similarly levelled.

The gates shall be hung as indicated in the drawings.

(8) Where required, existing fencing is to be removed as shown on the drawings.

No fencing is to be removed if there is a risk of egress or ingress of stock. If the existing fence is a rabbit-proof fence, then the contractor shall ensure that at night and weekends and other such times when work is not in hand that the whole of the fence is maintained in a rabbit-proof condition, even if temporary fencing is required.

All material removed in demolishing existing fencing shall be disposed by the Contractor as provided by clause SC6.4.6.29.3(9) Removal and disposal of surplus material and rubbish.

(9) Removal and disposal of surplus material and rubbish

All surplus material, offcuts, timber, roots and other debris resulting from the fencing contract shall be removed or otherwise disposed of to the satisfaction of the Superintendent.

The contractor shall not burn any timber, vegetation or refuse on site unless specifically approved by council's authorised officer.

(10) Cattle grids

Cattle grids shall be erected in accordance with the drawings.

The cattle grid shall be evenly bedded on a continuous layer of compacted sand or other granular material approved by the Superintendent. The bedding material shall be compacted so that the relative compaction as determined by AS 1289.5.4.1 is not less than 95 per cent.

Cattle grids shall be installed on raised abutments with approach ramps where possible. Alternatively, a cattle grid may be placed over an excavated pit, in which case adequate drainage shall be provided.

Crossfall for single lane cattle grids shall be level and for two lane cattle grids each section shall have a crossfall conforming to the crossfall of the approach road.

The cattle grid construction shall include all activities associated with the cattle grid including any adjustments to the fencing as shown on the drawings.

Advance signposting, in accordance with MUTCD, shall be provided on each approach to the cattle grid in accordance with sub-section SC6.4.6.24 Signposting.

SC6.4.6.30 Control of traffic

SC6.4.6.30.1 Introduction

(1) Scope

This sub-section provides standards, advice and guidelines for work necessary to provide for the safe movement of traffic and the protection of persons and property through and/or around the work site.

The extent of work includes the design, construction, maintenance and removal of temporary roadways and detours, the provision of traffic controllers, signposting, roadmarkings, raised pavement markers, lights, barriers and any other items required. All temporary traffic arrangements required by works are included under this sub-section except where specified otherwise.

Control of traffic shall be in accordance with Manual of Uniform Traffic Control Devices (MUTCD), this sub-section, and the drawings.

(2) Reference and source documents

Documents referenced in this sub-section are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

(a) Development manual planning scheme policy sub-sections to be read and applied in conjunction with this sub-section one as follows:

SC6.4.6.4 - Stormwater drainage
SC6.4.6.5 - Drainage structures
SC6.4.6.6 - Pipe drainage
SC6.4.6.9 - Open drains
SC6.4.6.10 - Earthworks (construction)
SC6.4.6.11 Clearing and grubbing
SC6.4.6.12 - Flexible Pavements
SC6.4.6.13 - Asphaltic concrete
SC6.4.6.16 - Sprayed bitumen surfacing

(b) Australian Standards:

AS 1742 – *Manual of uniform traffic control devices*
AS 1742.3 - *Manual of uniform traffic control devices – Traffic control for works on roads*
AS 1743 - *Road Signs - Specifications*
AS 1744 - *Standard alphabets for road signs*
AS/NZS 1906 - *Retroreflective materials and devices for road traffic control purposes*
AS/NZS 4602 - *High visibility safety garments*

(c) Austroads publications:

Guide to Road Design - Part 3 Geometric Design
Guide to Traffic Management – Part 6 Intersections, Interchanges and Crossings
Guide to Road Safety – Part 9 Roadside Hazard Management

(d) Queensland Department of Transport and Main Roads publication:

Manual of Uniform Traffic Control Devices (Queensland) (MUTCD).

(e) Other:

International Erosion Control Association (IECA), *Best Practice Erosion and Sediment control council*

(3) Traffic guidance scheme

The Contractor shall construct the work with the least possible obstruction to traffic.

Two weeks before undertaking work which would involve any obstruction whatsoever to traffic the Contractor shall submit, for the Superintendent's approval, a Traffic guidance scheme in accordance with Part 3 of the MUTCD.

The Traffic guidance scheme shall include:

(a) design drawings for any temporary roadways and detours in accordance with clause SC6.4.6.30.2(3) Design drawings, showing pavement, wearing surface and drainage details;

(b) details of arrangements for construction under traffic in accordance with Part 3 of MUTCD;

(c) a signpost layout plan showing:

  (i) location, size and legend of all temporary signs;

  (ii) temporary regulatory signs and temporary speed zones, and

  (iii) all traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guard fence and barrier boards; and

(d) working times when traffic control measures are in place to minimise disruption to traffic during periods of peak flows.

The Contractor shall obtain all necessary approvals for temporary traffic arrangements except where specified otherwise.

Where the Traffic guidance scheme involves Regulatory traffic control signs or devices and/or where a disruption to traffic (including pedestrian) to the existing road is likely to be significant, the contractor must undertake consultation with all stakeholders and where identified, must include changes to bus routes and the establishment of temporary bus stops, relocation of any taxi ranks and parking bays for people with disabilities, establishment of any work zones on the roadway amd arrangements for the safe movement of pedestrians past the work site as part of the application to council for approval.

In the case of an intersection with a State controlled road approval from the Department of Transport and Main Roads (DTMR) must also be obtained.

The Traffic guidance scheme shall be in accordance with the requirements of this sub-section and the drawings.

Special consideration to the safety of pedestrians and workers shall be given in the preparation of the Traffic guidance scheme. Particular care shall be taken when requiring reversal of traffic flows or the separation of unidirectional flow by medians or other physical separation.

An approved copy of the Traffic guidance scheme must be kept on site at all times. This must be used to check the arrangement and maintenance of traffic control devices.

For staged works and complex traffic guidance schemes, the Contractor shall conduct a regular safety audit during the construction phase including risk assessments for the workers safety as recommended in *Guide to Road Safety – Part 9 Roadside Hazard Management.*

For non-complex traffic guidance schemes such as short term and mobile works not involving full or part road closure or works involving relatively simple part-roadway closures, the Contractor is required to carry out risk assessments considering factors such as traffic volume and speed, road geometry and width and general behaviours of road users. A fully protected work site will be required if identified risks cannot be tolerated.

(4) Side roads and property accesses

The Contractor shall provide safe and convenient passage for vehicles, pedestrians and stock to and from side roads and property accesses connecting to the roadway. Work that affects the use of side roads and existing accesses shall not be undertaken without providing adequate alternative provisions to the prior satisfaction of the Superintendent.

Where interuptions to access is required, they are to be kept to a minimum and the contractor must advise the property owners of any interruption to access by way of a letter drop at least 24 hours before the intended interruption. The contractor shall repeat this advice verbally to the property owner where possible before proceeding with the access closure. All interuptions to access must have the the approval of the superintendent.

(5) Traffic controllers

The Contractor shall advise the Superintendent of the names of proposed traffic controllers with a signed declaration that they are appropriately trained in the duties of traffic controllers in accordance with the MUTCD.

In situation where restricted sight distance is identified by the Superintendent, an additional traffic controller shall be placed at the tail end of the queue.

(6) Approved clothing for work personnel

All personnel shall wear high visibility clothing to the requirements of the MUTCD.

(7) Temporary speed zoning

Where a temporary speed limit has been approved by the council, or in the case of a gazetted or State controlled road the District Manager of DTMR, the Contractor shall arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection. Where and when directed by the Superintendent, the Contractor shall erect these signs, cover the signs when the speed zone is not in use and remove the signs when the speed zone is no longer required as part of the provision for traffic. A diary recording operation times of the speed zone shall be kept by the Contractor.

(8) Plant and equipment

During the day plant and equipment working in a position adjacent to traffic and having a projection beyond the normal width of the item, for example, a grader blade, shall have a fluorescent red flag attached to the outer end of the projection. During poor light conditions or at night, an additional traffic controller with an illuminated red wand shall direct traffic around such plant and equipment.

At night, where traffic is permitted to use the whole or portion of the existing road, all plant items and similar obstructions shall be removed from the normal path of vehicles to provide a lateral clearance of at least 6 m where practicable, with a minimum clearance of 1.2 m.

Plant and equipment, within 6 m of the normal path of vehicles, shall be lit by not less than two yellow steady lamps suspended vertically from the point of the obstruction nearest to a traffic lane and one yellow steady lamp at each end of the obstruction on the side furthest away from the traffic lane.

SC6.4.6.30.2 Temporary roadways and detours

(1) Approval

The design of all proposed temporary roadways and detours; to be undertaken in accordance with this policy sub-section

(2) Design standards

The standard of alignment and grading adopted shall be in accordance with specific provisions of this policy and shall otherwise be in accordance with the *Guide to Road Design – Part 3 Geometric Design*

Intersections shall be designed in accordance with the Guide to Traffic Management – Part 6 Intersections, Interchanges and Crossings.

Design drawings, geometric standards, design speed, wearing surface type and pavement design of the proposed temporary roadways and detours shall be submitted by the Contractor with the Traffic Guidance Scheme.

(3) Design drawings

Design drawings submitted for approval should show:

(a) alignment and grading at a horizontal scale of 1:2000 for rural roads and 1:500 for urban roads. Where the temporary road rejoins the existing road, levels showing the full cross section shall be extended along the existing road for a minimum length of 200 m;

(b) a sight distance diagram if opposing traffic is to use a single carriageway;

(c) intersections, and any other locations where traffic may be required to make turning, merging or diverging movements, at a scale of 1:500;

(d) pavement marking details;

(e) sufficient cross sections to indicate the feasibility of making connections between various parts of the work;

(f) sufficient dimensions, especially lane widths, to make clear the geometry and clearances of the proposed works;

(g) a north point or some other location method to orientate the plan;

(h) roadside furniture;

(i) drainage structures (existing/temporary and proposed); and

(j) pavement and surfacing type.

(4) Drainage

Drainage structures and drains shall be constructed in accordance with the following sub-sections:

(a) SC6.4.6.4 - Stormwater drainage;

(b) SC6.4.6.6 - Pipe drainage;

(c) SC6.4.6.5 - Drainage structures; and

(d) SC6.4.6.9 - Open drains.

Drainage proposed in accordance with clause SC6.4.6.30.1(2) Traffic guidance scheme shall be able to cope with upstream rainfall run off resulting from all rainfall intensities up to that expected for a once in five year frequency, without overflow over the road.

Pavements shall be designed and constructed to not pond water on the wearing surface or shoulders. Temporary formations to be constructed shall not dam water.

(5) Construction of earthworks and pavement

Temporary roadways shall be constructed in accordance with the following specifications:

(a) *Best Practice Erosion and Sediment Control*;

(b) SC6.4.6.11 Clearing and grubbing;

(c) SC6.4.6.10 Earthworks (construction); and

(d) SC6.4.6.12 Flexible Pavements.

(6) Surfacing

The wearing surface width shall extend across the full width of the traffic lanes plus the width for each shoulder, or as otherwise demonstarted.

The wearing surface shall be carried onto any existing connecting roadway so as to finish square to the existing roadway centreline.
Surfacing shall be constructed in accordance with:
SC6.4.6.16 - Sprayed bitumen surfacing; and
SC6.4.6.13 - Asphaltic concrete

(7) Road safety barrier

Corrugated steel road safety barrier shall be erected on all temporary embankments where the vertical height between the edge of the shoulder and the intersection of the embankment slope and natural surface exceeds 2m.

Road safety barrier shall be erected in accordance with:
SC6.4.6.25 - Non-Rigid Road Safety Barrier Systems.

(8) Opening to traffic

Temporary roadways and detours (including portable or temporary traffic signals sites) shall not be open to traffic until they have been inspected, approved and authorised in writing.

All signposting, pavement marking, guardfence and portable or temporary traffic signals shall be completed before the opening of temporary roadways to traffic.

The opening of temporary roadways shall be arranged so that sections of existing roadway being replaced are not disturbed for a minimum of 48 hours in the event of temporary roadway failure and there is a warrant to redirect traffic back onto the existing roadway. The determination to redirect traffic shall be by the Superintendent.

The redirection of traffic back onto the existing roadway shall be the responsibility of the Contractor.

Unless otherwise approved by the Superintendent, traffic shall be switched to a temporary roadway or detour only where the Contractor's usual workforce will be on site for a minimum of 2 days thereafter.

(9) Maintenance

The Contractor shall be responsible for the maintenance of temporary roadways and detours and shall ensure the road surface is kept safe for traffic. Any potholes or other failures shall be repaired without delay.

(10) Removal

Upon completion of the work the temporary roadways and/or detour arrangements shall be removed and the area restored to a condition equivalent to that which existed prior to the commencement of the work.

SC6.4.6.30.3 Arrangements for traffic

(1) Construction under traffic

Where a temporary roadway or a detour is not provided or available then, subject to the approval of the Superintendent, construction under traffic may be permitted provided a minimum of 3.5 m lane width is available for through traffic on a two lane roadway and where 3.5 m lanes are available in both directions for through traffic when working on multilane roads.

The carriageway/s shall be restored to a safe and trafficable state for through traffic prior to cessation of work each day in accordance with the approved Traffic guidance scheme.

Full details of temporary signposting, traffic control devices and traffic control methods, in accordance with the appropriate arrangement diagrams in MUTCD, are to be submitted for the Superintendent's approval at least 5 working days before undertaking any work which would involve construction under traffic.

(2) Opening completed work

The Contractor shall give the Superintendent at least 5 working days written notice confirming the date of opening completed work to traffic. The procedure for opening shall be determined through consultation between the Superintendent, the Contractor and the council.

The Contractor shall be responsible for the removal of all temporary traffic control devices no longer required for the safety of traffic, when the works or part thereof are opened to traffic.

SC6.4.6.30.4 Traffic control devices

(1) Arrangement of traffic control devices

The arrangement and placement of traffic control devices shall be carried out in accordance with the approved Traffic guidance scheme, and MUTCD. The arrangement diagrams illustrate the more common examples of the arrangement of traffic control devices and set out the minimum requirements.

All temporary traffic control devices, when no longer required, shall be covered and/or removed without delay in order to maintain unambiguous safe guidance to traffic.

(2) Maintenance of traffic control devices

All traffic control devices shall be maintained in accordance with MUTCD so that they are in good order and in the correct positions day and night. They shall be neat and clean, and signs shall be clear and legible at all times.

To ensure the preceding clause is complied with, the Contractor shall inspect the site at least once every 24 hours for the maintenance of all traffic control devices.

The Contractor may need to be contacted outside normal working hours to arrange for adjustments or maintenance of traffic control devices. The Contractor shall notify the Superintendent and the council in writing, the names, addresses, and means of communicating with personnel nominated for this purpose.

(3) Adequate traffic control devices

Where the Contractor fails to provide and maintain adequate traffic control devices specified in this sub-section, the Superintendent shall arrange to have such items provided and maintained.

(4) Regulatory traffic control signs and devices

A regulatory traffic control sign or device shall be in accordance with the MUTCD, and shall require approval by the council, or in the case of a gazetted or State controlled road, the District Manager of DTMR, before its erection. This approval should be obtained through the Superintendent, refer to clause SC6.4.6.30.1(6) Temporary speed zoning.

(5) Signs

Signs shall be designed and manufactured in accordance with AS 1743. Details of each letter shall be as shown in AS 1744.

The reflective material used on signs shall be Class 2 material complying with AS 1906.1 except where otherwise specified.

(6) Supplementary signs

Signs supplementary to the MUTCD are shown in SC6.4.6.30 Attachment A Supplementary temporary warning signs to MUTCD. Approval must be obtained from DTMR prior to their use.

(a) Heavy Machinery Crossing
This temporary sign, shown as Sign SW5-22, if approved, may be used in lieu of W5-22, trucks entering.

(b) Cycle Hazard Grooved Road
This temporary sign, shown as Sign ST1-10, if approved, may be used in addition to T1-10 of AS 1742.3 where the road is grooved and is a hazard to cyclists.

(c) Tar Spraying Possible Short Delay
This temporary sign, shown as Sign ST3-1, if approved, may be used in addition to T3-1 for bituminous surfacing works.

(7) Flashing arrow signs

Flashing arrow signs shall comply with MUTCD.

(8) Barrier boards

Barrier boards shall comply with MUTCD.

Trestles supporting the barrier boards may be manufactured of timber, metal or other suitable material and shall be yellow. The trestles shall provide firm supports for the barrier board and be kept in place by sandbags suitable devices. The bases of the trestles shall not protrude beyond the ends of the boards.

(9) High visibility mesh fencing

High visibility mesh fencing shall be constructed where shown on the drawings, Traffic Guidance Scheme or as directed by the Superintendent.

High visibility mesh fencing shall be constructed in accordance with MUTCD, containment fences.

The mesh fencing shall be approximately 1 m in height and of a red-orange colured flexible material as approved by the Superindendent.

(10) Temporary post-mounted delineators
In addition to the requirements of MUTCD, temporary post mounted delineators shall be provided in conjunction with high visibility mesh fencing which is erected parallel to and in close proximity to traffic.

(11) Cones and bollards
Traffic cones and bollards shall comply with MUTCD and be placed in accordance with the arrangement diagrams in MUTCD.

Unless cones are firmly fixed in position they shall be used only while work is in progress, or in locations where there is an employee in attendance who shall reinstate any of the cones which have been dislodged by traffic. Otherwise they shall be removed and bollards or barriers substituted.

Cones and bollards used under night conditions shall be reflectorised in accordance with MUTCD.

(12) Traffic warning lamps
Traffic warning lamps shall comply with MUTCD and shall be installed in accordance with MUTCD. The Contractor shall ensure that warning lamps are in good working order, correctly aligned and positioned with respect to the direction of traffic flow each night, before the site is left unattended.

(13) Temporary pavement markings
All pavement markings shall be reflectorised and consist of painted lines, roadmarking tape and/or raised pavement markers in accordance with the relevant Australian Standards or as otherwise approved by the Superintendent and shall be provided in accordance with MUTCD.

Where the adjoining roadway is edgelined, temporary roadways shall be similarly edgelined.

(14) Temporary linemarking
Where temporary linemarking is required on the final wearing surface, only pavement marking tape shall be used.

Where the pavement linemarking has become ineffective in the opinion of the Superintendent, remarking shall be undertaken within 48 hours of direction by the Superintendent.

Where a single carriageway is opened adjacent to or used in lieu of an existing dual carriageway length, pavement arrows indicating the direction of flow of traffic shall be placed at not more than 500 m or at a spacing nominated by the Superintendent. The arrows shall be removed if the section is then reincorporated as dual carriageway.

Immediately before or after placement of new markings all superseded pavement markings shall be obliterated or removed to the satisfaction of the Superintendent.

On a final surface, obliteration by painting shall not be permitted.

(15) Raised pavement markers
Where raised pavement markers have become ineffective in the opinion of the Superintendent, they shall be replaced within 24 hours of direction by the Superintendent.

All superseded raised pavement markers shall be immediately removed from the pavement by the Contractor.

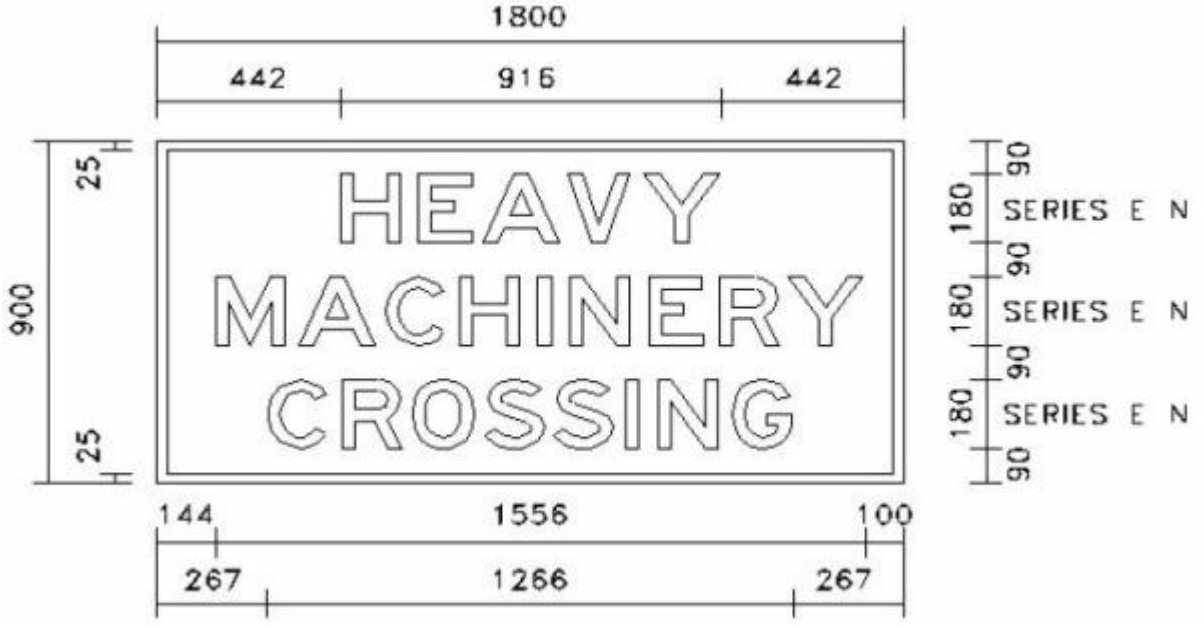
Attachment

SC6.4.6.30 Attachment A Supplementary temporary warning signs to MUTCD

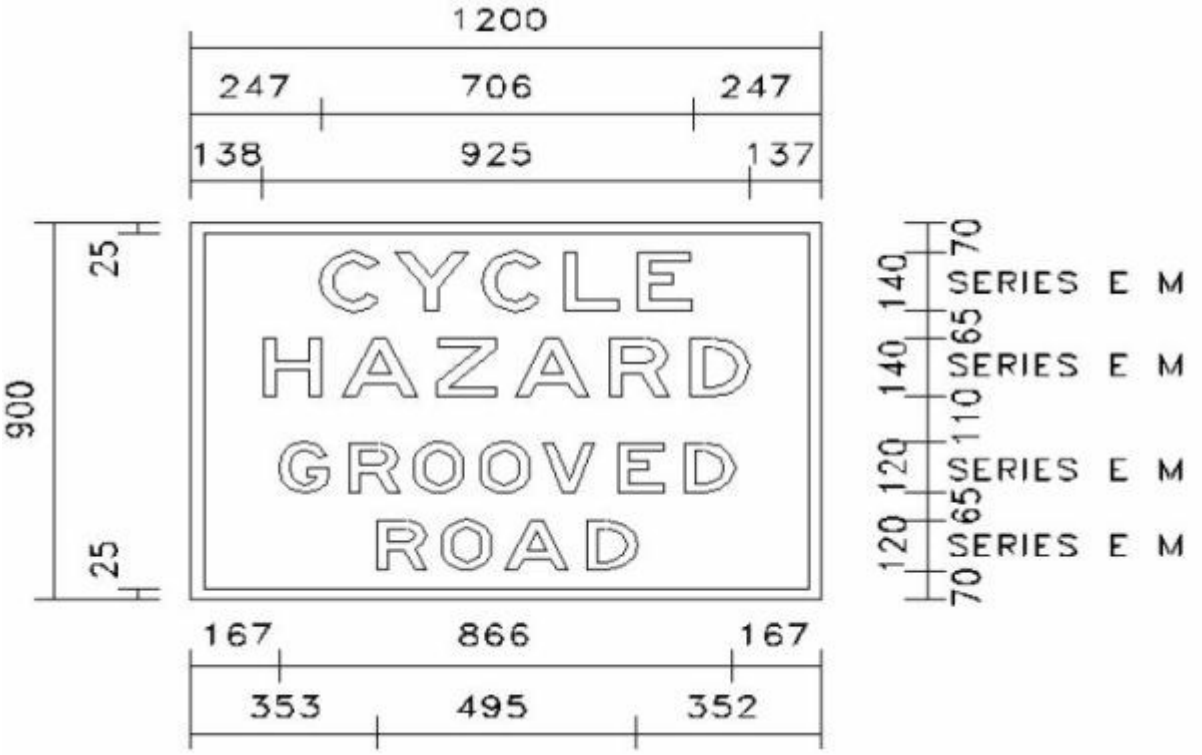
(1) Black letters and border on yellow reflectorised ground.

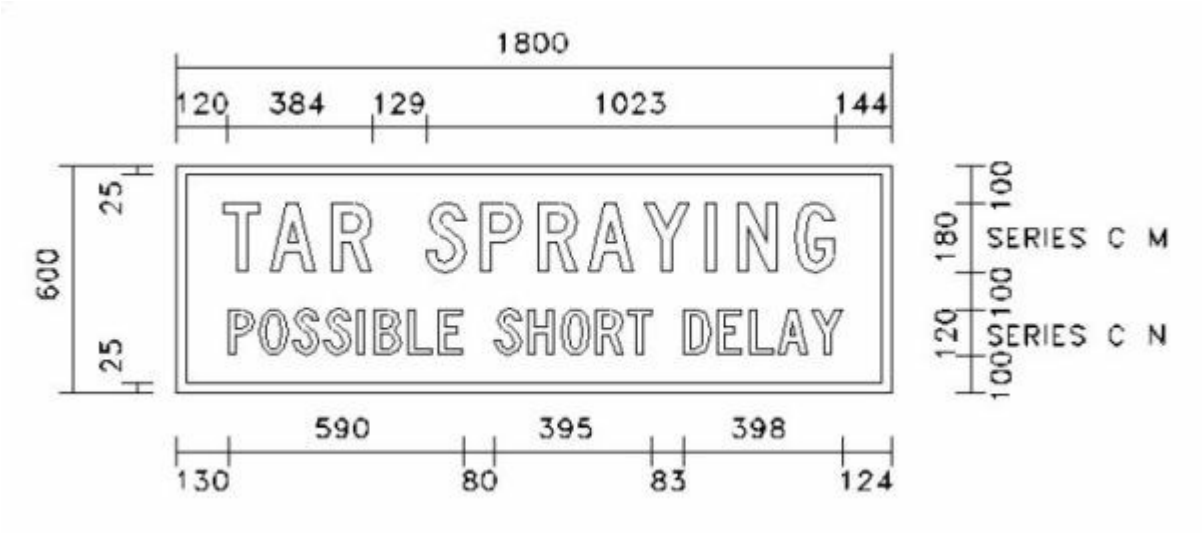
(2) Dimensions are in mm.

SW5-22



ST1-10




1800
120
384
129
1023
144
600
25
25
TAR SPRAYING
POSSIBLE SHORT DELAY
180
100
SERIES C M
120
100
SERIES C N
100
590
395
398
130
80
83
124

ST3-1

SC6.4.7 Acceptance of completed works

SC6.4.7.1 Release of the plan of survey

SC6.4.7.1.1 Introduction

The Release of the plan of survey sub-section details the requirements that must be met prior to the release of the Plan of Survey.

(1) Principles

Prior to the release of the Plan of Survey the developer must:

(a) comply with all conditions of the development permit; and

(b) ensure that all required fees, bonds, contributions, infrastructure charges and outstanding rates are paid.

Works will not be accepted on maintenance until the formal Plan of Survey has been released.
Where exceptional circumstances exist and an early release of the Plan of Survey is agreed to by the Director Planning and Development, the developer is required to bond any outstanding work.

(2) Terminology

Terms in this policy have the same definition as in the *Planning Act 2017*, unless otherwise defined.

DEHP	*Department of Environmental and Heritage Protection*
Plan of Survey	Includes all surveys undertaken by a cadastral surveyor as defined by the *Surveyors Act* 2003 and for the purpose of: • subdividing one or more lots; or • dedicating land to public use; or • redefining a lot by resurvey; or • amalgamating two or more lots to create a smaller number of lots; or • defining an area for an easement, lease, profit a prendre or covenant; or • any other purpose that the Registrar may require the registered proprietor to undertake.
On maintenance date	The date the works have been inspected and are complete, relevant conditions of the Development Permit have been satisfied, council has accepted maintenance responsibility for agreed public infrastructure and the developer commences the defects liability period.
Off maintenance date	The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes.
Maintenance period	The period of time between when council accepts the works on-maintenance until council accepts the works off-maintenance. This includes any establishment periods and the defect liability period, the period of time during which the developer is required to repair defects that occur. A defect is an imperfection, fault of deficiency in the works and does not include general wear and tear of items or damage due to misuse.

SC6.4.7.1.2 Release of plan of survey requirements

The following must be received or completed prior to the release of the Plan of Survey.

(1) Certification

(a) The developer must submit one print of each drawing, excluding council Standard Drawings:

(i) as originally approved by council;

(ii) including amendments incorporated in the construction of the development; and

(iii) overprinted with a certificate from a Licensed Surveyor or Registered Professional Engineer of

Queensland (RPEQ) as detailed below.

(b) An RPEQ and/or a Registered Landscape Architect must certify that the completed works comply with the development approval, the specific outcomes of the applicable regulations and good engineering practice.

The RPEQ and/or Registered Landscape Architect must also certify the 'as constructed drawings by including the following statement on each drawing:

"I/We (Name) of (Firm) hereby certify that the works as shown on the 'as constructed' drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated)".

(c) A Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each as constructed drawing:

"I/We (Name) of (Firm) herby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated)".

(2) As constructed drawings

One signed hard copy and digital copies of the as constructed drawings (AutoCAD DWG and a copy converted to PDF A1 format correctly scaled to A3 size) must be submitted and approved by council. As constructed information must be provided for all completed works, and must include the following information.

(a) Lot

(i) The lot layout as approved and as shown on the Plan of Survey.

(ii) Approved street names.

(b) Earthworks

(i) As constructed contours or where allotments are under 2000m^2 spot levels will be adequate to verify a minimum as constructed surface gradient of 1 in 250.

(ii) Denote location, extent and depth of fill.

(iii) The maximum depth of fill on each lot must be indicated.

(iv) Flood lines as adopted by council.

(v) Street names as approved by council and noted on the Plan of Survey.

(c) Infrastructure

(i) Pavement and kerb and channel information (e.g. edge of pavement and kerb and channel alignment and depths of pavement, kerb type, road surface type and depth, road pavement details, type and depth, road cross sections).

(ii) Stormwater drainage information, including:

(A) pipe alignments denoting sizes and invert levels at each end;

(B) manhole location; and

(C) inlet pit types to be denoted.

(iii) Major overflow paths and trunk drainage channels located and clearly shown.

(iv) Invert levels and offsets of the junction points and manhole connections where roof water drainage systems have been used.

(v) Sewerage 'as constructed plans', including all required details, lodged and approved.

(A) Location of maintenance structure (MH, MC, JU and end of PCS or house drain connection point); and

(B) Material type and sizes.

(vi) Details of all water mains, fittings of consequence and markers, including relevant dimensions,

included on as constructed plans, which are to be lodged and approved.

(vii) Location and dimensioning of subsoil cleanout points.

(viii) BOS data to detail location of house drain connection point - building envelop upgraded.

Editor's note: -

a) The accuracy of as constructed plans locating house connections is essential.

b) Council's Inspector, while on site, may take measurements that will permit some cross checking of as constructed plans. Should these checks indicate discrepancies, then reopening of the work will be required for checking measurement of the work.

(3) Ongoing operational requirements

Where requested, applicants are required to identify the ongoing operational requirements in a relevant Maintenance Plan, as detailed in Section SC6.4.2 Development application guidelines.

(4) The on maintenance inspection

The on maintenance inspection must be satisfactorily completed prior to the release of the Plan of Survey. The Consulting Engineer must undertake and report on the following prior to requesting the on maintenance inspection.

(a) Lodgement

(i) Demonstrated full compliance with all conditions of relevant Development Approvals.

(ii) Building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA).

(iii) Plan of Survey submitted in accordance with approved proposal plan and any approved amendments, or where the Plans of Survey differ from the approved proposal plan, details of any changes must be provided with the application.

(iv) A Supervision Certificate from the Consulting Engineer and request to have the works accepted on maintenance.

(v) Infrastructure Agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure.

(vi) Approval by other authorities, e.g. evidence of NBN Agreement, Certificate of Acceptance or Letter of Supply from Ergon.

(b) Sewer

Sewerage works

(i) Pressure test all sewers and manholes to ensure the requirements of the specification are met.

(ii) Check by internal examination (closed circuit television) that all sewers are straight, clean and to grade.

(iii) Check that all manholes are sound, smooth and clean and benched as per the required standard.

(iv) Check that house connection jump up construction complies with council's standards.

(v) Performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station.

(vi) Obtain licences for overflows to the sewerage system from DEHP.

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers must have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.3 Sewer pump-out agreements.

(c) Water

(i) Water reticulation

(A) Pressure test and supervise the swabbing (if necessary) and sterilisation of the water mains.

(B) Check location of hydrants and valves to ensure they are in their correct location.

(C) Check that all valves and hydrants are working satisfactorily (include lid arrangement as per SD-350).

(D) When water mains have been constructed, mains must be commissioned in accordance with council requirements.

(ii) All works associated with water supply on site must be 100 per cent complete, and all water mains must be tested and live. Reservoirs and associated pump stations must be commissioned prior to the lodgement of survey plans unless otherwise approved by council.

(d) Earthworks

(i) All allotment preparation work and earthworks on allotments must be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthwork construction, with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(ii) Where specific revegetation works have been bonded for future completion, the earthworks and top soiling must be complete prior to the release of the Plan of Survey.

(iii) All survey pegs placed.

(e) Roads

(i) Roads must be completed and fully sealed.

(ii) Pavement line markings completed at major intersections.

(iii) All traffic control devices, including traffic islands to be completed.

(iv) All traffic signage to be in place and completed compliant with Manual of Uniform traffic control devices (MUTCD) requirements.

(v) Traffic signals, if present, to be installed, completed and fully functional, compliant with the relevant requirements and legislation.

(vi) Retaining walls within road reserve to be completed and maintenance requirements documented.

(vii) Fences and noise abatement/screening walls to be completed and maintenance requirements documented.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(iii) Performance testing of pumping equipment must be passed satisfactorily. This testing will require the connection of the electricity supply and water to the pump station.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and NBN Co infrastructure, reticulation of electricity and the provision of street lighting, and gas service providers for provision of gas (if gas is provided).

(h) Payments and Bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be a minimum 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding rates paid.

(iii) All infrastructure charges required by the conditions of the development permit must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

SC6.4.7.1.3 Bonds

To enable early release of the Plan of Survey it will be necessary to bond all outstanding works and requirements. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(1) Standard bond conditions

(a) Estimates

(i) To verify the maintenance bond estimates, council must be supplied with a schedule of the works together with the appropriate estimated rates and amounts for all the items.

(ii) To verify the incomplete works bond estimates, council must be supplied with a schedule of the incomplete works together with the appropriate estimated rates and amounts for the incomplete works.

(iii) Such estimated prices must be fair and reasonable.

(b) Conditions

(i) The amount of the security for incomplete works must be for an amount of not less than one hundred and fifty per cent (150 per cent) of the certified cost of the works remaining to be completed as at the date of the release of the subject Plan of Survey.

(ii) Incomplete works must be itemised, valued and certified by an RPEQ.

(iii) All bonds submitted must be clearly identified as to the particulars of the site and the purpose of the bond.

(iv) Insurance and indemnity certificates must be current and valid to cover the period outstanding works are being completed.

(c) Acceptable security

(i) Cash bonds.

(ii) Unconditional bank guarantees.

(A) A bank guarantee must include:

- a binding contractual relationship between council and the guaranteeing bank;
- specific requirements for renunciation of the guarantee; and
- a requirement of adequate notice of renunciation.

(B) Bank guarantees must not have expiration dates.

(2) Incomplete works bond

(a) Incomplete works condition

In addition to the standard bond conditions:

(i) Where council consents to the early release of a Plan of Survey in line with the minimum requirements listed in Section 3, the developer will be required to lodge a security (bond) and an undertaking to complete the works within an agreed timeframe. These works must be completed to the satisfaction of council and the security submitted in a format as detailed in this sub-section. Security bonds for incomplete works will be subject to a minimum value of $15,000.

(ii) Outstanding works must be itemised, valued and certified by an RPEQ.

(iii) Potential purchasers of lots must be advised of the arrangements.

(b) Required information

The RPEQ must provide the following information:

(i) certification of the value of incomplete works;

(ii) detailed schedule of the scope and cost of the incomplete works for auditing purposes;

(iii) certification that all external and internal works can be completed and accepted on maintenance within the timeframes detailed elsewhere in this Policy sub-section;

(iv) certification that the contract has been let for the construction of the remaining internal and external works and the name of the Contractor;

(v) proposed finish dates for remaining internal and external works; and

(vi) security lodgement form completed clearly indicating that the purpose of the bond is for incomplete works.

(3) Revegetation bonds

Revegetation bonds may be required where conditioned by a development permit. At the time of on maintenance council may accept the drains and earth batters within a subdivision whereby the vegetation is not in accord with the objectives of this and other SC6.4 Development manual planning scheme policy sub-sections, subject to the following requirements.

(a) Revegetation performance bond

(i) A bond for the incomplete revegetation must be included as a performance bond for incomplete works along with all other bonds for incomplete works upon that subdivision.

(ii) The bond for the revegetation works must be 150 per cent of the approved estimated cost of the revegetation works to allow for the typical seasonal weather encountered in the region, due to the risk of erosion and scouring in areas of exposed earth.

(iii) The revegetation performance bond will be considered for acceptance on and off maintenance separate to the general subdivision works.

(b) Revegetation maintenance bond

(i) The revegetation performance bond will be reduced to a revegetation maintenance bond upon achievement of a minimum scour protection, which is deemed as 40 per cent vegetal coverage, which includes 15 per cent of the total area having the specified species. The revegetation maintenance bond must be equal to the approved estimate of the value of the works required to achieve the specified grass coverage by the off maintenance date.

(ii) The acceptance of revegetation on maintenance will correspond with the reduction of the performance bond for revegetation works. The acceptance of the revegetation works off maintenance and release of the revegetation maintenance bond will require the specified grass coverage to be completed but will not occur prior to the remainder of the development being accepted off maintenance.

(4) Sewer pump station bonds

(a) Where a sewage pump station is a pump station identified by council in the Priority Infrastructure Plan (PIP) and that sewage pump station is identified as minor trunk infrastructure, then consideration will be given to the release of the Plan of Survey prior to the completion of the works associated with that pump station.

(b) The pump station must be located upon land that is or will be under the control of the council upon the registration of the subject Plan of Survey.

(c) The working drawings and specifications must have been completed and approved by council for construction.

(d) The Consultant Engineer acknowledges that with respect to the nominated works that they are working for council and not the developer, and that the specifications nominate council as the Principal of the Contract.

(e) The tenderers must have been reported to council and council must have approved the successful tenderer.

(f) The Contract must have been let, and a submitted works program must indicate that the trunk

infrastructure is programmed to be completed prior to when the commencement of dwelling construction is envisaged, including provision for a normal wet season.

(g) The developer must enter into a Deed of Agreement with council, as detailed in SC6.4.7.3 Sewer pump-out agreements that includes provision for a pump-out service and a security for this pump-out. The template in Attachment A of SC6.4.7.3 Sewer pump out agreements may be used for the Agreement.

SC6.4.7.1.4 Early release of the plan of survey

(1) Justification for early release

Council may elect to release plans of survey prior to satisfaction of the development permit on the basis that critical works are provided and security is afforded for the outstanding works. This process requires the developer to request the early signing in writing at the time of lodging a survey plan and payment of a fee, demonstrating how conditions of the development approval are satisfied or secured.

Early approval and dating of the Plan of Survey does not discharge the developer from obligations to satisfy the conditions of development approval, and the development may be subject to enforcement action for non-compliance with the development permit(s) and/or the undertaking given to complete the outstanding works.

The aim of this clause is to enable the developer to have the Plan of Survey released from the council as early as possible while at the same time ensuring that the allotments being constructed will be fully serviced at the time that the Plan of Survey is registered and subsequent sales of the allotment takes place.

(2) Early release of survey fees

A fee for the early release of the Plan of Survey in accordance with council's schedule of fee's and charges at the time of payment will also be required as payment separate to the incomplete works bond.

(3) Minimum requirements

Council will not sign any Plans of Survey where the relevant works or matters are incomplete, unless the following are completed:

(a) Early Plan of survey on maintenance inspection

An on maintenance inspection must be satisfactorily completed in accordance with SC6.4.7.1.2(4) and as detailed below, however some minor defects may be outstanding, with minor defects defined as those not impacting on public safety and/or the ability of council to operate and maintain the infrastructure.

(b) Earthworks

All allotment preparation work and earthworks on allotments to be 100 per cent complete in accordance with the requirements of SC6.4.6.10 Earthworks (construction), with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotments submitted and approved by council. All works within allotments must be fully completed and no further disturbance required on the allotments. Appropriate erosion and sediment control measures must also be in place for all disturbed areas.

(c) Sewerage

All sewerage works including pump stations, rising mains, trunk mains and the proposed sewers have been inspected and certified by the supervising engineer as being 100 per cent complete and in full working order. Sewer systems must be installed, tested and operational. (Bonding of pump stations may be accepted; refer to SC6.4.7.1.3(4)). Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment.

(d) Water

All works associated with water supply on site are 100 per cent complete, and all reticulation has been pressure tested, sterilised, completed and connected to an existing supply. All water pumping stations must be certified by an RPEQ as being 100 per cent complete and in full working order.

(e) Roads

Roads must be completed to the point where the pre-seal inspection has been carried out by council's inspectors and the pavements are approved for application of bitumen or asphalt.

(f) Stormwater

(i) Stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage, other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided.

(ii) This excludes large WSUD measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines.

(g) Services

Evidence must be provided of street lighting, telecommunications and electrical supply works commitments. Satisfactory evidence must be provided to council of a negotiated agreement with service providers for telecommunications and broadband infrastructure, reticulation of electricity (e.g. Letter of Supply) and the provision of street lighting and gas service providers for provision of gas (if gas is provided).

(h) Payments and bonds

(i) The full payment of fees and bonds, including the maintenance bond and any bonds for incomplete works. The maintenance bond will be 5 per cent of the value of the works as certified by the RPEQ and accepted by council, and must be lodged with council until the development is accepted as off maintenance.

(ii) All outstanding levied rates are paid.

(iii) All infrastructure charges required by the conditions of approval must be paid.

(iv) Accompanied by the prescribed form and fee of an amount in accordance with council's fees and charges current at the time of payment.

(i) Land

The developer must covenant that all transfers of land and interests in land to council are free of encumbrances and registered in the Title's Office at the same time as the Plan of Survey is registered at no cost to council.

(j) As constructed plans

As constructed plans must be submitted in accordance with SC6.4.7.1.2(2) showing all works completed to date, including as a minimum, the requirements above in parts (a) – (i). All works not shown on the as constructed drawings at the time of submission for early release of Plan of Survey, will be required to be bonded in accordance with the requirements of this section.

(4) Timing

All incomplete works must be completed and ready for council inspection within 1 month of council releasing the Plan of Survey. Should the developer not be able to meet this requirement they must submit justification to council detailing exceptional circumstances. The RPEQ must submit for the approval of council, a program of works to certify that the incomplete works can be completed within 1 month (or longer as agreed by council).

(5) Sewer pump stations

Early release of the Plan of Survey may be considered if council developed sewer pump stations are almost complete. See SC6.4.7.1.3(4) for more information.

SC6.4.7.2 On maintenance/final completion/off maintenance requirements

SC6.4.7.2.1 Introduction

This sub-section provides guidance and advice for the requirement for on maintenance/final completion/off maintenance to facilitate the release of the plan of survey (see SC6.4.7.1 Release of the plan of survey).

SC6.4.7.2.2 Lodgement

(1) Requirements for on maintenance:

(a) building approval for all buildings/structures, where required by the *Building Code of Australia* (BCA);

(b) a supervision certificate from the Consulting Engineer and request to have the works accepted on maintenance;

(c) a workmanship guarantee from the Contractor;

(d) submission to and acceptance by council of as constructed information. The RPEQ must certify the "as constructed" drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the as constructed drawings reflect any changes that were made during the course of construction (signed with RPEQ No and dated);

(e) a Registered Surveyor must certify that the locations, surface and invert levels of all works and infrastructure presented on the as constructed drawings and digital submissions have been surveyed and are true and accurate representations of the works by including the following statement on each relevant as constructed drawing:

I/We (Name) of (Firm) hereby certify that this drawing accurately describes and records the nature and the location of the works depicted hereon as they have been constructed for the purposes of the development (signed and dated);

(f) infrastructure agreements, if required, must be in place for the provision of and/or connection to trunk infrastructure;

(g) approval by other authorities, e.g. evidence of NBN Agreement, or Certificate of Acceptance from Ergon;

(h) the works must remain on maintenance for a minimum period of 12 months;

(i) the works subject of other approvals for which the works of this approval are dependent must also have been accepted on maintenance; and

(j) where on maintenance can be achieved within 1 month of the release of the plan of survey then the date for the on maintenance will be backdated to the date of the release of the plan of survey. Otherwise, on maintenance will be from the date that all requirements have been satisfied.

SC6.4.7.2.3 Sewer

(1) Requirements for on maintenance:

(a) pressure test all sewers and manholes in accordance with WSA to ensure the requirements of the specification are met;

(b) check by internal examination (closed circuit television) that all sewers are straight, clean and to grade. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment;

(c) check that all manholes are sound, smooth and clean and benched as per the required standard;

(d) check that house connection "jump up" construction complies with council's standards;

(e) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(f) certified results of pressure tests on all mains;

(g) certified results of field tests on pumping equipment;

(h) operations manual, performance specifications and maintenance requirements for all pump stations; and

(i) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

SC6.4.7.2.4 Water

(1) Requirements for on maintenance:

(a) pressure test and supervise the swabbing and sterilisation of the water mains (if necessary);

(b) check location of hydrants and valves to ensure they are in their correct location;

(c) check that all valves and hydrants are working satisfactorily(include lid arrangement as per SD-350;

(d) when water mains have been constructed, mains must be commissioned in accordance with council requirements;

(e) certified results of pressure tests on all mains;

(f) certified results of field tests on pumping equipment;

(g) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications; and

(h) no concrete footpaths installed over water main where property connections are yet to be constructed.

SC6.4.7.2.5 Earthworks

(1) Requirements for on maintenance:

(a) all survey pegs placed; and

(b) compaction results of each layer of earthworks on roads and on each allotment where depth of fill exceeds 0.5 m. The maximum depth of fill on each lot must be indicated on the as constructed drawings. Allotment fill must be in layers no greater than 200 mm and compacted a minimum standard of 95% standard compaction for residential subdivision and 98% standard compaction for commercial subdivision. The fill material must be free of vegetation and organic material.

SC6.4.7.2.6 Roads

(1) Requirements for on maintenance:

(a) roads must be completed and fully sealed;

(b) all tests and hold point documentation completed and finalised;

(c) pavement line markings completed, including passing and turning lanes at major intersections;

(d) where a double coat bitumen seal has been used, copies of bitumen spray sheets and calculated average spray rate and aggregate spread rate are required;

(e) where asphaltic concrete surfacing has been used, test results on samples of the material supplied to the site must be taken at the Asphalt Plant together with field tests to confirm asphalt depth and percentage of voids filled;

(f) all traffic control devices, including traffic islands, to be completed;

(g) all traffic signage to be in place and completed in accordance with *Manual of uniform traffic control devices'* requirements;

(h) traffic signals, if present, to be installed, completed and fully functional in accordance with the relevant requirements and legislation;

(i) retaining walls within road reserve to be completed and maintenance requirements documented;

(j) fences and noise abatement or screening walls to be completed and maintenance requirements documented;

(k) compaction results of subgrade and each course of pavement; and

(l) grading, Atterberg limits and a California Bearing Ratio (CBR) test of each course of pavement material in accordance with SC6.4.5.3 Quality management system.

SC6.4.7.2.7 Stormwater

(1) Requirements for on maintenance:

(a) stormwater drainage works must be installed with all erosion controls in place and able to function without detriment to the system. Allotments must be provided with the nominated flood immunity. All

stormwater systems must be constructed, including kerb and channel. Downstream drainage easements must have been executed in favour of council, necessary drainage and other easement documentation must have been submitted, and required reserves for drainage, parkland, etc. must have been provided;

(b) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications. Conduit inspection must be undertaken in accordance with SC6.4.2.2.6 Conduit assessment;

(c) performance testing of pumping equipment. This testing will require the connection of the electricity supply and water to the pump station;

(d) certified results of field tests on pumping equipment;

(e) operations manual, performance specifications and maintenance requirements for all pump stations; and

(f) certification from the Consultant that the pipes and fittings used are as per the drawings and specifications.

This excludes large water sensitive urban design (WSUD) measures such as bio-retention basins and wetlands, where the acceptance of the asset and ongoing maintenance requirements is to be in accordance with SC6.4.3.9 Water sensitive urban design guidelines and SC6.4.6.1 Water sensitive urban design construction and establishment guidelines.

SC6.4.7.2.8 Landscaping and irrigation

(1) Introduction

This clause outlines the conditions and timeframes associated with acceptance by council of landscape and irrigation works (Works) constructed as part of a Development Permit.

(2) Principles

(a) the establishment period will be included within the maintenance period;

(b) council will accept works on maintenance that have reached practical completion and have met the relevant conditions of the Development Permit, but may still require time to establish;

(c) the establishment date will be used to determine satisfactory establishment;

(d) council will accept responsibility for maintenance of hard landscape assets from the on maintenance date;

(e) the Developer will remain responsible for maintenance of soft landscape assets during the maintenance period;

(f) the Developer is responsible for all defects in the works until the off maintenance date; and

(g) council will accept responsibility for maintenance of soft landscape assets from the off maintenance date.

(3) Terminology

In addition to the terms previously defined in SC6.4.7.1.1(2) the following terms and definitions apply to this clause, specific to landscape and irrigation works:

Contractor	A person or company who has entered into a contract with the developer to supply and install infrastructure, landscaping and/or an irrigation system.

Establishment period	The period of time between when council accepts the works on-maintenance until when council accepts the works as established (the established date). Works are deemed established when: (i) all the defects identified at the on-maintenance and practical completion; (ii) defects identified at inspection have been rectified unless agreed otherwise; (iii) all turfed areas have "taken root" and there are no obvious gaps between strips of turf; (iv) all turfed areas have been rolled and/or topdressed to fill any depressions; (v) all plants are showing signs of healthy, new growth, and that the planting design intent is starting to take shape; (vi) generally, the landscape works indicate that they are being maintained in accordance with the Development Permit; and (vii) revegetation areas have achieved specified cover.
Hard landscaping	Structures, paths and facilities such as playground equipment constructed from building materials (but excluding irrigation systems).
Maintenance period	The period of time between when council accepts the works on-maintenance until council accepts the works off maintenance. This includes any establishment periods and the defect liability period. This is to be: (i) a minimum of 12 calendar months; and (ii) include the establishment period and the defect liability period.
Off maintenance date	The date the works are fully accepted by council following an inspection by council, which considers that all works are satisfactory, and the defects liability period concludes. This date must be: (i) after the established date; (ii) after all defects have been remedied; (iii) at least 12 months after the on maintenance date; (iv) after an inspection by council which considers that all works are satisfactory.
Soft landscaping	Trees, plants, grass and vegetation generally and any irrigation system associated with such vegetation.

(4) Ownership and responsibilities

The ownership of the works transfers to council on the earlier of:

(a) the date when the land on which the works are constructed is transferred to council; or

(b) the on maintenance date.

(5) Typical timelines

(a) Construction

(i) achieve practical completion;

(ii) conduct inspections to determine the on maintenance date; and

(iii) release Plan of Survey if applicable.

(b) 0 weeks

(i) on maintenance date.

(c) 12 weeks

(i) normal established date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory, establishment date will be deferred.

(d) 52 weeks

(i) normal off maintenance date;

(ii) landscape inspection to be carried out; and

(iii) if works are unsatisfactory the off maintenance date will be deferred.

(6) Landscape works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) maintenance inspection;

(ii) the Registered Landscape Architect must certify as constructed drawings by including the following statement on each drawing:

I/We (Name) of (Firm) hereby certify that the works as shown on the "as constructed" drawings reflect any changes that were made during the course of construction;

(iii) all asset transfer documentation is submitted and approved by council including the following:

(A) Open Space Asset Data Collection Form – This form contains the asset information relating to the construction of new assets; or

(B) Asset Change Form – This form contains information about minor changes to existing assets; and

(C) warranty details for all items with a value greater than $500.00. This information is required by council to assist in future warranty claims;

(iv) plantings, gardens and turfed areas must be exhibiting a "strike", but compliance with full establishment requirements is not essential at on maintenance;

(v) the defects liability period for soft landscape works shall be concurrent with the defects liability period for any associated irrigation system; and

(vi) the defects liability period for landscape works shall not commence until:

(A) the associated irrigation system has been commissioned; and

(B) all requirements of the Special Conditions of Approval have been met.

(7) Landscape works defects liability period

(a) Establishment

(i) All soft landscaping will be subject to a 12 week landscape establishment period. The landscape establishment period is included in the 12 month maintenance period. The Developer is responsible for establishing the works during the establishment period until the established date as advised by council.

(ii) The developer may be required to undertake additional works during the establishment period such as additional watering, formative pruning, topdressing, turfing, replenishment of mulch and replacement of plants.

(iii) At the conclusion of the landscape establishment period a landscape establishment inspection may be conducted, and if the landscaping establishment is not satisfactory additional works may be requested and/or the maintenance period may be extended.

(b) Landscape maintenance period requirements and responsibilities

(i) Council is responsible for maintenance of hard landscaping during the maintenance period.

(ii) The developer is responsible for maintenance of soft landscaping during the maintenance period until the off maintenance date.

(iii) Water costs

(A) The developer is responsible for the cost of water during the maintenance period.

(B) Council is responsible for cost of water from the off maintenance date.

(iv) Vandalism, theft and damage caused by unexpected events or third parties

(A) For soft landscaping, the developer is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(B) For hard landscaping, the council is responsible for rectification works to remedy vandalism, theft and damage caused by unexpected events during the maintenance period.

(v) Extended maintenance periods

(A) In addition to provisions detailed, where negotiated as conditions of the development approval, extended maintenance period beyond the 12 month period may apply.

(B) Where the landscape maintenance period is extended as a condition of development approval or due to provisions within this policy, this extension may concurrently apply to any irrigation system associated with the landscape works.

(vi) General maintenance activity requirements

(A) All maintenance activities must be undertaken in accordance with council's public open space maintenance specifications. Any maintenance activities that deliver a level of service above and beyond council's specification is at the discretion and cost of the developer.

Editors Note - council's Public open space maintenance frameworks are currently under development.

(B) Maintenance activities include, but are not limited to mowing, top dressing, litter collection, watering, pruning, fertilising, weeding, mulching, pest and disease control.

(C) All maintenance work to new and existing landscaping shall be carried out in accordance with the best horticultural practices.

(vii) Watering requirements

(A) All soft landscaping shall be watered regularly (either by hand watering or by irrigation) to ensure the continuing healthy establishment and growth of all plants taking into account soil type, plant type and size, prevailing weather conditions and seasonal variations.

(B) Watering methods are to be suitable for watering the root ball of newly planted plants during the critical first several weeks of establishment.

(C) Watering shall not cause displacement of mulch or erosion of garden mix soil.

(viii) Weeding, pest and disease control

(A) Gardens and turf shall be regularly weeded. Six weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for weed growth and treated with an appropriate selective herbicide. All chemicals shall be used in accordance with the manufacturer's recommendations.

(B) Plants shall be regularly inspected for pest and diseases throughput the defects liability period. Any pest or disease detected shall be reported to the Superintendent. Acceptable horticultural techniques shall be employed by the Contractor to manage any infestations as directed by the Superintendent. 12 weeks prior to the end of the defects liability period ("off maintenance"), the area shall be inspected for pests and disease and treated with an appropriate pest and disease control.

(ix) Planting and tree maintenance

(A) All maintenance work to new and existing trees shall be carried out by an arborist with formal qualifications or at least 5 years recognised experience in Arboriculture. The works shall be carried out in accordance with the AS 4373 *Pruning of Amenity Trees* and shall not proceed without the written approval of the Superintendent.

(B) Stakes and ties and guying shall be checked for firmness and support and shall be adjusted as necessary to prevent any damage to the bark or roots of the tree. Stakes and ties or guying shall be removed when the tree is self-supporting and/or as directed by the Superintendent.

(x) Planting, trees, turf and hydroseed failure and replacement

(A) Plants and trees lost through vandalism, theft or that have died shall be replaced by the Contractor on a monthly basis.

(B) Plants, trees, and turf supplied by the Contractor that have failed to become established during the defects liability period or are diseased and/or dying shall be removed and replaced by the Contractor twelve weeks prior to the end of the defects liability period ("off maintenance") and at no cost to council. If the loss is significant, it will be at the discretion of the Superintendent if an extension on the defects liability period for the failed landscaping is warranted.

(C) Areas of hydro seeding/mulching that have failed to become established or have died during the defects liability period shall be removed and retreated by the Contractor at no cost to council. If the area is of significant size it will be at the discretion of the Superintendent if an extension to the defects liability period for the failed area is warranted.

(8) Landscaping inspections during the defects liability period

In addition to the requirements outlined in SC6.4.7.2.8(2) Principles, the following requirements apply to landscaping works:

(a) any work inspected that does not comply with the specification and/or the design plans or has not been adequately maintained in accordance with SC6.4.7.2.8(2) will not be accepted by council and will be noted for rectification. The contractor is required to rectify these items as soon as is practical and as a minimum before the next scheduled inspection; and

(b) failure by the Contractor to rectify unacceptable items prior to the next inspection may result in the defects liability period for those items being extended by the number of weeks that have lapsed prior to the rectification work being completed.

(9) Landscaping off maintenance/final completion

(a) Final inspection and completion

(i) Soft landscaping shall be inspected by the Superintendent for acceptance ("off maintenance") at the end of the defects liability period, subject to any special conditions of approval.

(ii) In addition to the requirements outlined in SC6.4.7.2.8(2), the final inspection and completion requirements apply as detailed below.

(b) Final acceptance criteria (Gardens)

The acceptance criteria for gardens shall be:

(i) gardens shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(ii) gardens shall be free of disease and pests;

(iii) mulch shall be to the minimum thickness specified;

(iv) plants shall be as specified; and

(v) plants shall be placed at the spacings nominated and in the quantities nominated as detailed on the drawings or as specified.

(c) Final acceptance criteria (plantings)

The acceptance criteria for plants shall be:

(i) plants shall exhibit signs of healthy active growth;

(ii) plants shall show no signs of yellowing or wilting;

(iii) plants shall be well formed;

(iv) plants shall be free of disease and pests;

(v) plants shall have healthy root systems and shall not be root bound; and

(vi) plants are true to cultivar, type or form as specified.

(d) Final acceptance criteria (turf)

The acceptance criteria for turf areas shall be:

(i) the achievement of an even green colour with a dense sward over the entire area with no open joints;

(ii) turf shall exhibit signs of healthy active growth;

(iii) turf shall be free from weeds, stones, roots, sticks, rubbish and other deleterious material; and

(iv) turf shall be free of disease and pests.

(e) Final acceptance criteria (hydro seeding/mulch)

The acceptance criteria for hydro seeding/mulch areas shall be:

(i) the achievement of an even green colour over the entire area and exhibiting healthy active growth with acceptable vegetative cover. Of this cover 95% shall be the nominated dominate grass species with the remaining 5% made up of annual and perennial grasses;

(ii) free from weeds, stones, roots, sticks, rubbish and other deleterious material;

(iii) free of disease and pests; and

(iv) the area shall not be mowed for at least 5 days prior to the inspection.

(f) Final inspection documentation

(i) Following the final inspection (off maintenance) council will issue a site inspection report (defects list). Any items not acceptable to council will be noted for rectification.

(ii) The Contractor is required to rectify these items and apply for a re-inspection when all rectification items have been completed.

(iii) A certificate off final completion will be issued by council following the rectification of all defects noted at the off maintenance inspection.

(10) Irrigation works on maintenance/practical completion

(a) Requirements for on maintenance:

(i) all as constructed drawings and documentation nominated in SC6.4.7.2.8(2) is submitted and approved by council;

(ii) all asset transfer documentation including the following:

(A) Irrigation Asset Data Collection Form – This form contains the asset information for the construction; or

(B) Irrigation Asset Change Form – This form contains information about minor changes to existing assets;

(C) Irrigation Network Controller Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will configure the telemetry network. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system;

(D) Irrigation Program Setup Request Form – This form is used to provide information to the infrastructure Services Irrigation Technician who will setup the irrigation controller program. The form shall be submitted to council a minimum of 4 working days prior to commissioning of the system. After the program has been set up, the Infrastructure Services Irrigation Technician will issue a copy of the program to the Contractor;

(E) Warranty details for all irrigation components with a value greater than $500.00 excluding GST. This information is required by council to assist in future warranty claims; and

(F) Plumbing and Drainage Application Forms 1, 2 and 7 are to be completed by a licensed plumber and submitted to the Hydraulic and Building Services Unit of the Townsville City Council. The Backflow Test Certificate must be lodged with Hydraulic and Building Services Unit of the Townsville City Council. A copy of the Backflow Test Certificate must also be supplied to Infrastructure Services; and

(iii) commissioning of the irrigation system shall not proceed until all of the above documentation is submitted and approved by the council.

(11) Irrigation defects liability period

(a) A defects liability period applies to all irrigation systems installed by contractors. The defects liability

period shall be undertaken in accordance with this policy and any special conditions of approval.

(b) If applicable the defects liability period for the irrigation system shall be concurrent with the Defects Liability Period for any associated landscaping works.

(c) The defects liability period for an irrigation system shall not commence until:

(i) all of the documentation nominated in SC6.4.7.2.8(10)(a) above is submitted and approved by council;

(ii) all requirements of the special conditions of approval have been met;

(iii) if applicable the associated landscaping works are accepted “on maintenance”;

(iv) the irrigation system has been commissioned; and

(v) the site has been jointly inspected by the council and contractor and the irrigation system is free of defects at the time of inspection.

(12) Irrigation inspections during the defects liability period

During the defects liability period, council may require access to the site to undertake the following tests:

(a) main lines pressure test – the main line is pressurised to test for leaks. All valves are shut and the pressure is taken over a determined length of time;

(b) sprinkler pressure test – the sprinkler pressure is taken at the nozzle using a pitot pressure gauge and is then compared to manufacturer recommendations;

(c) dripper pressure test – measurement at flushing valves are taken and the pressure gauged to make sure it conforms to the manufacturer recommendations. The inlet pressure is then tested under the same conditions to check it does not exceed 300Kpa; and

(d) lateral pressure loss test – the first and last sprinklers of the lateral line are pressure tested. The variation in flow is then calculated and compared with the limits nominated in the specification.

(13) Irrigation off maintenance/final completion

(a) Final inspection and completion
Final completion shall be managed in accordance with this policy and any special conditions of approval.

(i) Following the final inspection, council will issue an irrigation inspection defects list detailing items that do not comply with the specification and/or design plan.

(ii) The contractor is required to rectify these items and apply for a reinspection when all rectification work has been completed.

(iii) After reinspection of the rectification work, and if the work is satisfactory to council an Irrigation Inspection Report (Defects List) will be issued with the status noted as “Ready to proceed to off maintenance”.

(iv) A Certificate of final completion will be issued by the Superintendent when the Contractor has met all obligations under the Contract.

SC6.4.7.2.9 Quality assurance documentation

(1) Requirements for on maintenance

(a) Copies of the Test Certificates from a National Association of Testing Authorities (NATA) registered laboratory; and

(b) A single quality control document must be submitted, including but not be limited to:

(i) pavement levels;

(ii) compaction tests;

(iii) pavement materials tests;

(iv) concrete tests;

(v) asphalt tests;

(vi) sewer pressure tests;

(vii) water pressure tests;

(viii) water bacteriological tests;

(ix) landscaping soil tests;

(x) playground and fitness equipment certification;

(xi) softfall under surfacing certification;

(xii) structural certification (forms 15, 16 and 21);

(xiii) electrical safety, testing compliance certification; and

(xiv) backflow certificate.

SC6.4.7.2.10 Defects liability period

The defects liability period for all works is a minimum of 12 months from the date of the release of the formal plan of survey or from the date of acceptance on maintenance, whichever is later, at which time the bond will be refunded subject to the off maintenance requirements being completed to the satisfaction of council. If for any reason during the maintenance period, a defect of substantial proportions is discovered then council reserves the right to extend the defects liability period for a further 12 months from the date of correction of the defects, or as negotiated e.g. infrastructure is required to be reconstructed after a significant failure due to deficiency in design/construction.

SC6.4.7.2.11 Bonds and fees advice

(1) Requirements for on maintenance

(a) A works inspection fee (at the rate applicable at the time of payment) must be paid prior to the works being accepted.

(b) A reinspection fee (at the rate applicable at the time of payment) will be applicable where an additional inspection is required due to works being incomplete or unsatisfactory at the initial inspection. The reinspection fee must be paid prior to the additional inspection being conducted.

(c) A maintenance bond (5% of the value of the works as determined and certified by a Registered Professional Engineer of Queensland (RPEQ) or Registered Landscape Architect) and supporting Schedule of Works with costs certified by the RPEQ or Registered Landscape Architect must be lodged with council. The bond must be in favour of council and in the form of cash or an unconditional bank guarantee (non-expiring). If the security is in the form of a bank guarantee, the guarantor must be a bank or financial institution acceptable to council.

(d) In the event of a default by the developer relating to defects, council may undertake whatever action required to secure compliance with the conditions of approval and may apply the security for that purpose. The security (or balance) will be returned to the developer upon satisfaction of the conditions of approval relating to maintenance responsibility.

SC6.4.7.2.12 On maintenance inspection and final inspection and compliance check

(1) Requirements for on maintenance:

(a) The developer must provide council at least 5 business days' notice, requesting the works be checked for compliance with the approvals and be accepted on maintenance.

(b) A report must be submitted, showing the scope of works, date and outcome of works inspected by the supervising Registered Professional Engineer of Queensland or supervising Registered Landscape Architect.

(c) Council must be satisfied with the results of an on maintenance inspection and compliance checks against the development approvals. Council will issue an On Maintenance Certificate, identifying the relevant works and any defects applicable.

(d) Prior to requesting an on maintenance inspection, the developer must correct any defects arising from faulty workmanship, materials or design identified in the On Maintenance Certificate or during the maintenance period (or extended period following rectification of such defects).

(e) The on maintenance date may be backdated to the date of the initial on maintenance inspection date or the release of the plan of survey (whichever is the latter), if all outstanding requirements were met within 4 weeks of identification.

SC6.4.7.2.13 Off Maintenance

(1) The works will become off maintenance subject to:

(a) rectification of all defects identified at on maintenance or during the maintenance period;

(b) council being satisfied with the results of an off maintenance inspection and compliance check against development approvals conducted by council officers following the end of the maintenance period;

(c) the development will only be accepted off maintenance in its entirety and all works must be performing satisfactorily at this stage;

(d) the developer, or their representative, must arrange with council an inspection of all defects 1 month prior to the work being due off maintenance;

(e) the whole of the works must be inspected at the off maintenance inspection. The consulting engineer is responsible for thoroughly inspecting the development and any necessary remedial work prior to the off maintenance inspection; and

(f) acceptance of the works off maintenance does not discharge the developer from their obligation to provide a development free of defects. Any defect that is discovered after the acceptance off maintenance, which attributed to the failure to deliver a development in accordance with the conditions of the development permit, must be repaired at the developer's expense.

SC6.4.7.3 Sewer pump-out agreements

SC6.4.7.3.1 Introduction

(1) Purpose

In accordance with SC6.4.7.1 Release of the plan of survey, council may consider early sealing of the survey plan for a development if:

(a) incomplete or non-commissioned trunk infrastructure is preventing the developer providing infrastructure from being fully commissioned; and

(b) the non-delivery of this trunk infrastructure is impacting on council's process for signing of the survey plan.

(2) Scope

This sub-section sets out the circumstances in which a sewage pump out agreement may be entered into, and the mandatory requirements that will be included in such an agreement under the *Sustainable Planning Act 2009.*

(3) Reference and source documents

This section shall be read in conjunction with the following standards and legislation:
Environmental Protection Act 1994
Local Government Act 2009
Plumbing and Drainage Act 2002
Sustainable Planning Act 2009
Water Supply (Safety and Reliability) Act 2008
WSA 02-2002 2.3 *Sewerage Code of Australia*
WSA 04-2005 2.1 *Sewerage Pumping Code of Australia*

SC6.4.7.3.2 Sewage pump-out deed of agreement requirements

(1) A Deed of Agreement relating to the incomplete or non-commissioned trunk infrastructure must be entered into. The agreement must ensure that all risks associated with the temporary pumping out and disposal of sewage are adequately addressed by the developer. The following sections must be addressed within the Deed of Agreement at a minimum:

(a) Timing

The trunk infrastructure must be programmed to be commissioned prior to when the completion of dwelling construction is envisaged.

(b) Supply of electricity

(i) Sewer pump stations must be provided with a continuous and reliable electrical supply. Details of the provision of power supply must be provided with the sewage pump station design.

(ii) Alternatively, if temporary power supply is proposed to be supplied by a generator, details of this arrangement must be included as part of the agreement.

(c) Lawful effluent disposal and access arrangements

Access arrangements for pump stations and/or other wastewater maintenance holes required for the pump-out service must be specified, and the wastewater maintenance hole or licensed septic disposal facility designated. The disposal of all sewage must be as directed by Townsville Water from time to time by a registered operator following agreed transport routes, for the duration of the agreement, and under the supervision of a suitably qualified engineering consultant.

(d) Developer's provision of pump-out service
A minimum standard for the developer's provision of a pump-out service must be specified.

(e) Management of odour complaints, fish kills and wastewater spills
Details of management of overflow/spills or environmental harm must be included in the Deed of Agreement and actions undertaken in accordance with the *Environmental Protection Act 1994.*

Click here to obtain a copy of the following form.

SC6.4.7.3.3 Template agreement

Council's Template Agreement for Sewage Pump-Out may be used to assist in the preparation of the Deed of Agreement (see SC6.4.7.3 Attachment A).

SC6.5 Economic impact assessment planning scheme policy

SC6.5.1 Introduction

Short Title - The planning scheme policy (PSP) may be cited as the Economic impact assessment PSP.

SC6.5.1.1 Purpose

(1) The purpose of this planning scheme policy is to provide applicants with direction on how to undertake an economic impact assessment which council request to inform the proper assessment of a development application. Particularly, the policy provides direction on the standard information requirements expected to be incorporated within an economic impact assessment report.

An economic impact assessment report may be required to demonstrate compliance with the Townsville City Plan particularly for significant in-centre or out-of-centre development of a commercial nature. It is likely to be required where there is potential conflict with the Townsville City Plan, or for impact assessable development of a commercial nature in any zone.

SC6.5.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.5.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan.

SC6.5.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1 terminology.

SC6.5.2 Planning scheme policy details

SC6.5.2.1 Terms of Reference for an economic impact assessment report

(1) Council intends to protect the economic viability and the intended role and successful functioning of centres. An economic impact assessment report will need to demonstrate that the proposed development will meet the relevant performance outcomes in the planning scheme codes and the intentions expressed in the strategic framework. Where the development is inconsistent with the planning scheme the assessment may form part of the basis for determining whether sufficient grounds exist to approve such a development.

(2) The standard requirements for the preparation of an economic impact assessment report should typically provide the following information:

(a) an outline of the purpose of the study;

(b) a description of the methodology used;

(c) a description of the proposed size, function and tenancy mix of the proposed development, together with details of any pre-commitment;

(d) the identification of the proposed development's trade area, supported by the reasoning and methodology behind the identification of the area;

Note—Refer to section SC6.5.2.2 Trade Area of this policy for guidance on identification of trade areas.

(e) an examination of the population growth prospects and socio-economic characteristics of the trade area, including socio-economic factors such as expenditure potential;

(f) the identification of any approved or proposed development that may affect the proposed development or be affected by the proposed development;

(g) the identification of the location, size, nature, function and tenancy mix of competitive business, commercial or centre uses likely to be affected by the proposed development;

(h) evidence that any feasible alternative, appropriately zoned location/s have been investigated and discussed so that reasoning behind the selection of the preferred site is clear;

(i) an estimation of the demand, or likely future demand, for business, commercial or centre floor space in

the trade area;

(j) an estimation of the market share of the proposed development;

(k) where an out-of-centre development is proposed, demonstration as to why the proposed development is required, including why the development cannot be accommodated within the existing centres;

(l) commentary on changes to the supply/demand balance upon approval of the proposed development, including whether the proposal represents an excess of supply for the community;

(m) a calculation of the quantitative economic impact upon competitive centres likely to be affected by the proposed development including a description of the consequent effects on the competitive centres;

(n) the identification of the impacts the proposed development would have on the successful trading of other centres (including the period of time) and the identification of the impacts on the Townsville hierarchy and functionality of activity centres;

(o) the changes, if any, to the range of services that existing centres will continue to provide; and

(p) a summary of the overall need for the proposed development including a description of the community benefits.

(3) The economic impact assessment report referred to in (1) above must be prepared by a suitably competent person.

Note — For the purpose of this section of the planning scheme policy, a competent person is an appropriately qualified and experienced economist or economic analyst with appropriate and proven technical experience in providing advice about the economic impacts of development.

SC6.5.2.2 Trade Area

For developments that are trade area based, the definition of the trade area should have due consideration to the following:

(1) the existing centres hierarchy and other relevant competition;

(2) the nature, scale and functionality of the proposed development;

(3) the nature of the potential users of the development (e.g. residents, workers, students, other businesses);

(4) typical travel routes of potential users of the development; and

(5) the attracting capacity of any neighbouring uses.

A map(s) of the trade area should be included in the economic impact assessment report, which clearly defines the trade area boundary, identifies relevant existing centres, identifies the site of the proposed development and includes key transport corridors. The economic impact assessment report should include a justification of the proposed trade area boundary.

SC6.6 Emerging community planning scheme policy

SC6.6.1 Introduction

Short Title - The planning scheme policy (PSP) may be cited as the Emerging community PSP.

SC6.6.1.1 Purpose

The purpose of this planning scheme policy is to provide applicants with direction on how to undertake structure planning for a greenfield development area contained within an emerging community zone. Such a structure plan is likely to be required to demonstrate compliance with the zone code and reconfiguration of a lot code.

The provision of this planning scheme policy may also be relevant to other large scale development within the city.

SC6.6.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.6.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in Parts 6 and 9. The Emerging community planning scheme policy specifically relates to the assessment of any development application for a material change of use or reconfiguring a lot within the Emerging community zone.

SC6.6.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1.

SC6.6.2 Planning scheme policy details

SC6.6.2.1 Structure planning framework

A structure plan prepared under this planning scheme policy will address the following aspects at a minimum:

(1) type of development and land uses proposed;

(2) scale, density and height of development;

(3) servicing of the development by transport and other infrastructure;

(4) how the proposal addresses the relevant planning scheme overlays; and

(5) integration of the development with the local context.

SC6.6.2.2 Structure plan contents

A structure plan should identify the major elements of the locality surrounding a development that can impact on the planning and design of the site. It does not constitute an approval for land outside the development site but ensures the continuation of corridors, networks and linkages.

The major components of the development are to be designed with consideration of this broader context. It must be clear how the proposed development will integrate with the surrounding community and with the existing parks, centres, service and infrastructure networks and the movement system (road network, public transport facilities and pedestrian and cyclist paths) in the area. Where necessary, the structure plan will identify upgrades to infrastructure which are required to achieve the development outcomes proposed in the structure plan.

(1) Preparing a structure plan:

The steps that should be followed and information provided when preparing a structure plan are outlined below. Separate maps and reports may be provided for each step.

(a) Step 1—Site context:

Prior to preparing the structure plan an assessment of the site and its context must be undertaken and a site description of the land prepared, supported by a map containing the following features as a minimum:

(i) topography—contours and levels;

(ii) the street network, intersections and treatments, and public transport routes and stops;

(iii) existing and approved land uses on surrounding sites (including subdivision layouts) and including the location of nearby schools, activity centres, employment generators and other community facilities; and

(iv) the existing and proposed park network and pedestrian and cyclist paths.

(b) Step 2—Constraints mapping (identification):

Land may possess attributes or be subject to constraints which affect the development on the site. State planning regulatory provisions and overlays must be considered as part of the constraints mapping process.

(c) Step 3—Constraints analysis, land use allocation and infrastructure provision:

The site context mapping (step 1) and identification of constraints (step 2) will inform a further detailed analysis of the conditions on the site. This process will seek to 'ground truth' the sites constraints. It will involve technical investigation to identify specific constraints and their implications on future development of the land. The outcomes of the constraints analysis will determine which land is able to be developed for urban purposes and will also provide guidance to suitable uses of the land.

The design response should consider:

(i) the proposed layout and land use mix are integrated appropriately with surrounding land;

(ii) constraints are reflected on the structure plan and are in accordance with their relevant values;

(iii) an appropriate and well-designed proposed transport network;

(iv) the development incorporates appropriate provision for infrastructure (water, sewer, stormwater, parks and community services) for the land and demonstrates how the infrastructure is able to be coordinated with adjoining development where applicable; and

(v) where needed, land uses buffers to other uses or values.

(d) Step 4—Documenting the structure plan:

The structure plan for the land may include the following, as relevant to the land:

(i) the vision and principles for the structure plan area;

(ii) appropriate controls for land use and density, connectivity, open space and public realm and built form and design;

(iii) identification of specific precincts with individual characteristics and development outcomes, as relevant to the land and the site constraints;

(iv) levels of assessment where this is proposed to be altered through a preliminary approval; and

(v) any alternative code provisions where these are proposed to be altered through a preliminary approval. Any proposed code is to be constructed to be consistent with the format of codes within the Townsville City Plan.

SC6.7 Flood hazard planning scheme policy

SC6.7.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Flood hazard PSP.

SC6.7.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) provide background information on the derivation of the Flood hazard overlay identified as overlay maps OM-06.1 and OM-06.2; and

(2) provide applicants with additional information and guidance in meeting the requirements of the Flood hazard overlay code.

SC6.7.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016.*

SC6.7.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan and applies to the whole of the local government planning scheme area. Flood hazard PSP specifically relates to the assessment of Flood hazard overlay code.

SC6.7.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 – Definitions, is to be interpreted in accordance with Part 1.3.1 Definitions.

SC6.7.2 Background information

SC6.7.2.1 Flood mapping

The flood hazard overlay maps show flood hazard derived from numerous sources and include:

(1) Detailed flood modelling studies identified in SC6.7.2.1.1 of this planning scheme policy; and

(2) Interim flood assessment overlay mapping completed by the Queensland Reconstruction Authority and amended for local constraints by Townsville City Council.

SC6.7.2.1.1 Flood modelling studies

Flood modelling studies are complex technical investigations requiring a detailed understanding of catchment hydrological processes and floodplain hydraulic controls. Computer simulations are used to quantify runoff from rainfall and evaluate flow patterns and flooding extents around floodplains. There are numerous flood modelling studies which have been completed for the Townsville local government area. Results from these flood modelling studies have been combined to provide the Flood overlay maps.

At the commencement date of the planning scheme, the flood modelling studies that have contributed to the Flood overlay maps are:

(1) Alligator and Whites Creek Flood Study (Alligatorcreek);

(2) Althaus Creek Flood Study - Baseline Flooding Assessment (AlthausCk);

(3) Townsville Flood Hazard Assessment Study (Arcadia, NellyBay and PicnicBay);

(4) Balgal Beach Infrastructure Master Planning Report (BalgalBeach);

(5) Black River Flood Study - Baseline Flooding Assessment (BlackRiver);

(6) Bluewater Creek Flood Study (Bluewater);

(7) Captains Creek Flood Study - Baseline Flooding Assessment (CaptainsCreek);

(8) Deeragun Flood Study - Baseline Flooding Assessment (Deeragun);

(9) Douglas/Annandale Flood Study - Baseline Flooding Assessment (DougAnnan);

(10) Gordon Creek Flood Study - Baseline Flooding Assessment (GordonCreek);

(11) Horseshoe Bay Flood Study - Baseline Flooding Assessment (HorseshoeBay);

(12) Little Bohle River Flood Study - Baseline Flooding Assessment (LittleBohle);

(13) Lousia Creek Flood Study - Baseline Flooding Assessment (LousiaCreek);

(14) Lower Bohle Flood Study - Baseline Flooding Assessment (LowerBohle);

(15) Townsville State Development Area - Flood Modelling (LowerStuart);

(16) Middle and Upper Bohle Flood Study - Baseline Flooding Assessment (MiddleBohle and Upper Bohle);

(17) North Ward Flood Study - Baseline Flooding Assessment (NorthWard);

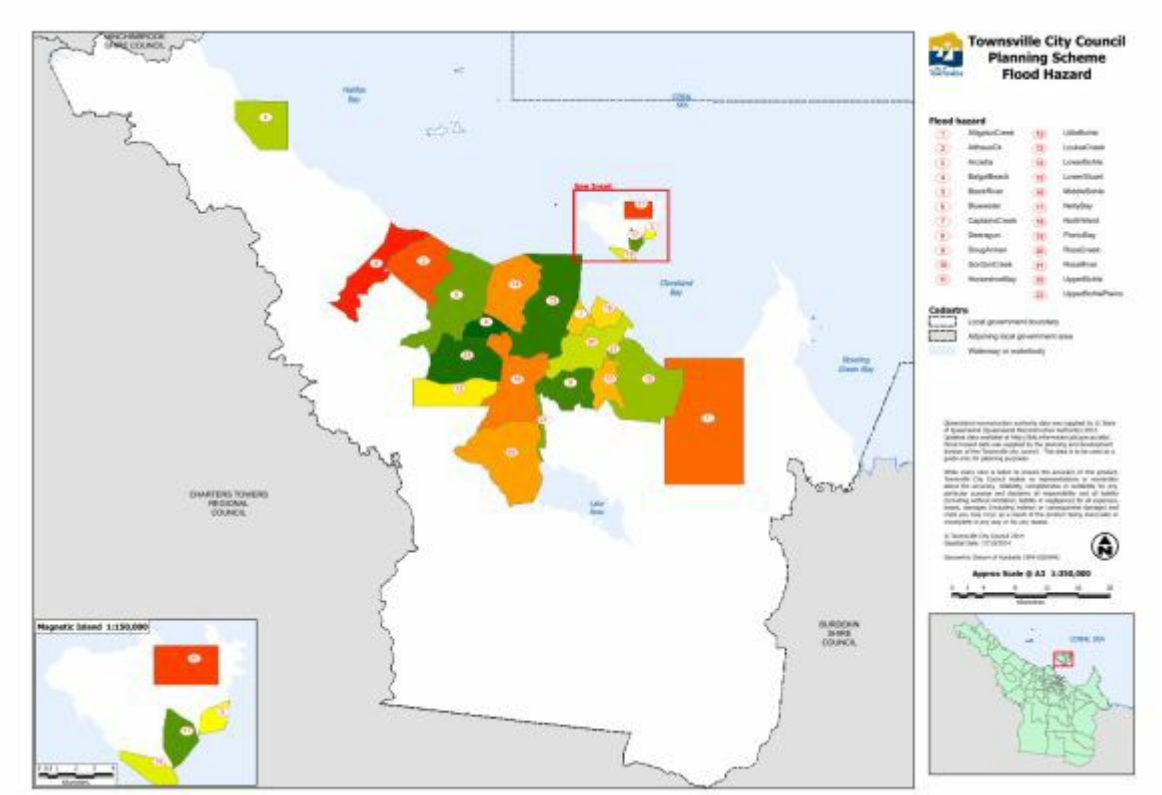
(18) Ross Creek Flood Study - Baseline Flooding Assessment (RossCreek);

(19) Ross River Flood Study - Baseline Flooding Assessment (RossRiver); and

(20) Upper Bohle Plains Flood Study - Baseline Flooding Assessment (UpperBohlePlains).

The area of applicability for each of the flood modelling studies identified in the aforementioned have been graphically presented on Figure SC6.7.1– Flood modelling study areas.

Flood modelling studies are under constant development due to the construction of infrastructure and the acquisition of new data. This information is available on Townsville City Council's website and contains digital copies of the latest and current flood modelling studies.



Click here to view PDF high resolution map.

Figure SC6.7.1 - Flood modelling study areas

SC6.7.2.2 Flood hazards

The Flood hazard overlay maps OM-06.1 and OM-06.2 have the following flood hazard ratings identified:

(1) high flood hazard;

(2) medium flood hazard;

(3) low flood hazard; and

(4) medium flood hazard – further investigation.

SC6.7.2.2.1 High and medium flood hazard

Both the high flood hazard and the medium flood hazard areas mapped on the Flood hazard overlay maps OM-06.1 and OM-06.2 are based on the 1% AEP flood. A velocity-depth criterion is used to distinguish between high flood hazard and medium flood hazard areas. High flood hazard areas are characterised by faster flowing and/or deeper floodwaters.

Figure SC6.7.2 – Flood hazard categorisation on 1% AEP flood (below) - shows the velocity depth criteria for designating the high flood hazard and the medium flood hazard areas from the 1% AEP flood. Velocity and depth information for the 1% AEP flood has been determined from flood modelling studies (refer SC6.7.2.1.1).

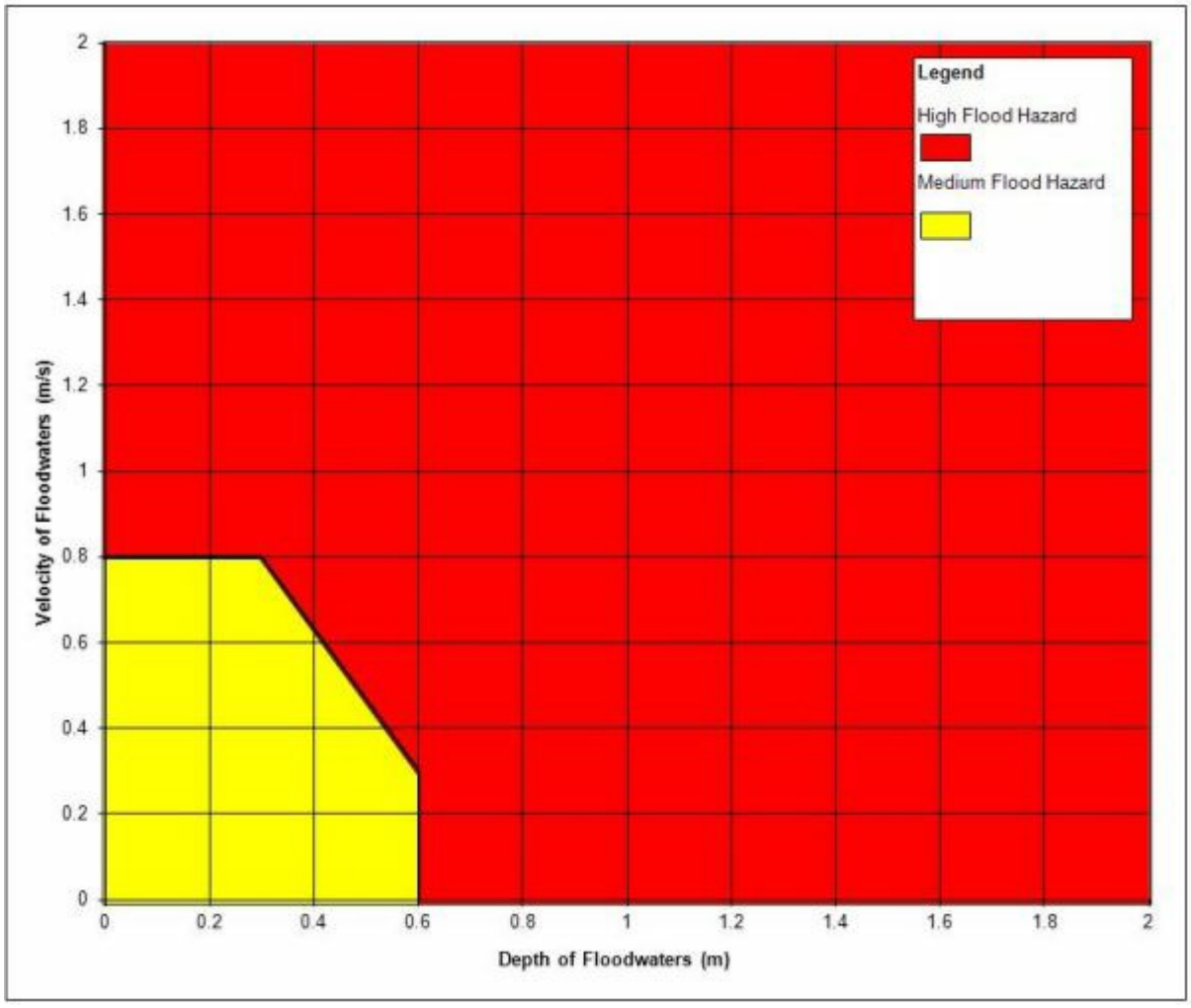


Figure SC6.7.2 - Flood hazard categorisation on 1% AEP flood

SC6.7.2.2.2 Low flood hazard

Areas of the floodplain outside the 1% AEP flood extent are still susceptible to flooding in rarer, more extreme flood events. Within the Flood hazard overlay maps OM-06.1 and OM-06.2, the low flood hazard area is identified as areas inundated by the probable maximum flood outside the combined extent of the high and medium flood hazard areas. The extent of the probable maximum flood has been determined from flood modelling studies (refer SC6.7.2.1.1).

SC6.7.2.2.3 Medium flood hazard - further investigation

Areas identified as medium flood hazard – further investigation on the Flood hazard overlay maps OM-06.1 and OM-06.2 are areas outside the extent of flood modelling studies and have been mapped by the Queensland

Reconstruction Authority. The Interim flood assessment overlay mapping produced by the Queensland Reconstruction Authority has been reviewed and amended by Townsville City Council to reflect local conditions. This information is less reliable than the other areas mapped on the flood hazard overlay maps OM-06.1and OM-06.2. Limited information is available on the flood characteristics in these areas as there is no information about flood depths, levels or velocities.

Within areas identified as medium flood hazard – further investigation, assessable development is likely to require further detailed flooding investigation, involving:

(1) development of a base-line flood study in accordance with Attachment 1 - Guidelines for preparation of flood studies and reports at a scale suitable to represent relevant floodplain process and site specific features;

(2) assessment of the potential impacts on flooding of the proposed development;

(3) identification of suitable measures to mitigate any adverse impacts on flooding; and

(4) demonstration of how the proposed development layout reduces the risk of flooding.

SC6.7.2.3 Defined flood level

Most development applications for which the Flood hazard overlay code is triggered will require details of the defined flood event (DFE). The DFE is the 1% AEP flood, which is spatially represented by the combined extent of the high flood hazard and the medium flood hazard areas mapped on the Flood hazard overlay maps OM-06.1 and OM-06.2.

For development which is accepted subject to requirements, it is most likely that existing information from flood modelling studies for the DFE will be adequate to address the acceptable outcomes of the Flood hazard overlay code. Information on the DFE derived from the flood modelling studies can be obtained from council's website.

SC6.7.3 Application requirements

This section provides information for a development application, guidance and advice for addressing assessment benchmarks.

SC6.7.3.1 Addressing assessment benchmarks

SC6.7.3.1.1

Development that is accepted subject to requirements and triggers the Flood hazard code only has to address the acceptable outcomes for performance outcomes 1 and 2 of the code.

Performance outcome 1
Development in medium and high hazard areas is designed and located to minimise susceptibility to and potential impacts of flooding.

Other than in the medium hazard - further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer SC6.7.2.1.1).

In some areas, storm tide hazard areas will also co-exist with flood hazard areas. In these instances, the floor levels and other design responses will need to be sufficient to comply with both the Coastal environment overlay code, the Flood hazard overlay code and the *Building Regulation 2006*. Typically, floor levels will need to be based on the highest of either the defined flood level or the defined storm-tide level as depicted in Figure SC6.7.3.1.1.1-Floor control levels for both flooding and storm tide (below).

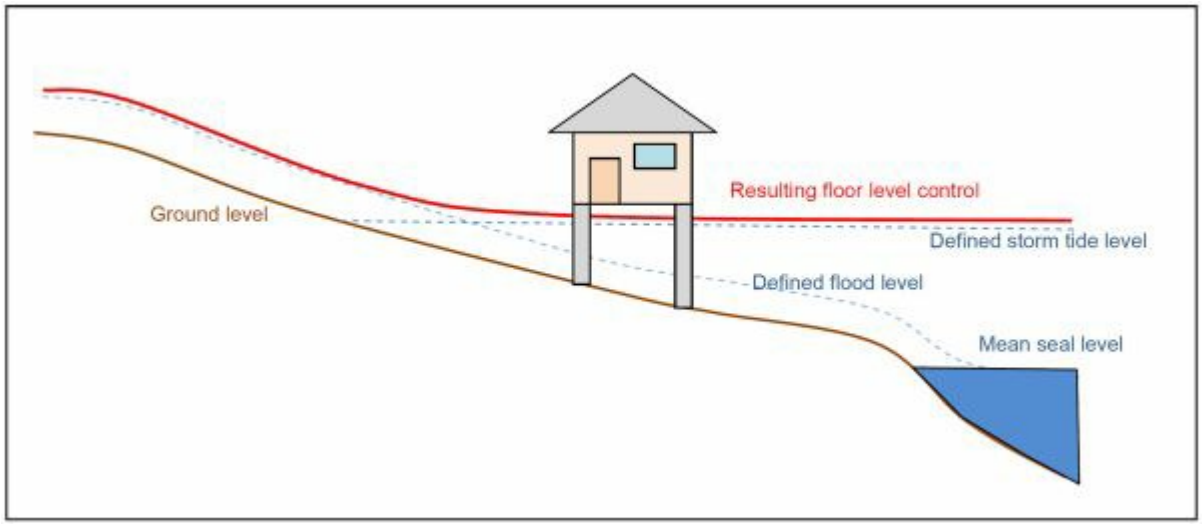


Figure SC6.7.3.1.1.1 - Floor control levels for both flooding and storm tide

Performance outcome 2

Development in high hazard areas does not significantly impede the flow of flood waters through the site or worsen flood flows external to the site.

The delineation of the high flood hazard areas on Flood hazard overlay maps OM-06.1 and OM-06.2 allows for clear identification of areas where performance outcomes 2 is applied.

Performance outcome 3

Development does not intensify use in high hazard areas, in order to avoid risks to people and property.

The delineation of the high flood hazard areas within Flood hazard overlay maps OM-06.1 and OM-06.2 allows for identification of areas where performance outcome 3 applies. Where flood flows are potentially altered by the development, a flood study will likely be required and the revised extent of the high flood hazard area will need to be mapped.

Performance outcome 4

Siting and layout of development maintains the safety of people and property in medium hazard areas.

Other than in the medium hazard – further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer to SC6.7.2.1.1).

Alternatively, council's online flood mapping service can be used to obtain the height of flood levels for any particular locations.

Where flood flows are potentially altered by the development, a flood study will likely be required and the revised extent of the medium flood hazard area will need to be mapped.

Performance outcome 5

Signage is provided within high and medium flood hazard areas to alert residents and visitors to the flood hazard.

Signage will need to clearly state the nature of the flood hazard, with regards to inundation depths and flow velocities. Signage should also be able to function during a flood event and be practically visible.

Performance outcome 6

Development within high and medium flood hazard areas ensures any changes to the depth, duration, velocity of flood waters are contained within the site.

A flood modelling study, completed by a suitably qualified and experienced Registered Professional Engineer of Queensland (RPEQ), in accordance with Attachment 1 - *Guidelines for Preparation of Flood Studies and Reports*, will likely be required.

As a minimum, evaluating the impacts on floods up to the defined flood event will require a flood modelling study to evaluate the minor drainage system capacity event and the defined flood event for the catchment-wide critical duration and the site-specific critical duration. In addition, certain areas of the Townsville Local Government area will require evaluation of other frequency floods to assess adverse impacts on flooding. Attachment 2 – *Adverse Flooding Impacts Assessment – Additional Design Floods for Assessment* outlines areas where impact assessment and flood mitigation works will need to consider additional design floods to the minimum requirements.

To confirm adverse impacts on flood levels/depths, flow velocities and time of inundation are contained to the site; a pre- and post-development scenario will need to be assessed. Where possible, council requires the base-line flood modelling study that was used for deriving the flood hazard overlay to be used for evaluating development impacts. The RPEQ undertaking the impact study will need to determine if there is a need to update the base-line flood modelling with site specific survey/detail to adequately describe the hydrologic or hydraulic controls.

Performance outcome 7

Development within high and medium flood hazard does not directly, indirectly or cumulatively worsen flood characteristics outside the development site, having regard to:

(a) increased scour and erosion; or

(b) loss of flood storage; or

(c) loss of or changes to flow paths; or

(d) flow acceleration or retardation; or

(e) reduction in flood warning times.

To adequately assess the impacts of development on flooding regimes may require a hydrological and hydraulic assessment to be carried out by a suitably qualified and experienced hydrologist or engineer in accordance with Attachment 1 - *Guidelines for Preparation of Flood Studies and Reports.*

As a minimum, evaluating the impacts on floods up to the defined flood event will require a flood modelling study to evaluate the minor drainage system capacity event and the defined flood event for the catchment-wide critical duration and the site-specific critical duration. In addition, certain areas of the Townsville Local Government area will require evaluation of other frequency floods to assess adverse impacts on flooding. Attachment 2 – *Adverse Flooding Impacts Assessment – Additional Design Floods for Assessment* outlines areas where impact assessment and flood mitigation works will need to consider additional design floods to the minimum requirements.

To evaluate the potential for worsening flooding outside the development site; a pre- and postdevelopment scenario will need to be assessed. Where possible, council requires the baseline flood modelling study that was used for deriving the flood hazard overlay to be used for evaluating development impacts. The RPEQ undertaking the impact study will need to:

(a) determine if there is a need to update the base-line flood modelling with site specific survey/detail to adequately describe the hydrologic or hydraulic controls; and

(b) undertake analysis to adequately assess the potential for directly, indirectly or cumulatively impacting on flooding.

Figure SC6.7.1 – Flood modelling study areas of this PSP identifies which flood study has derived the flood hazard overlay in given areas.

Performance outcome 8

Facilities with a role in emergency management and vulnerable community services are able to function effectively during and immediately after flood events.

It is appropriate to have a higher level of flood immunity for critical community infrastructure. Table 8.2.6.3(b) within the Flood hazard overlay code outlines the required immunity for critical community infrastructure with a role in emergency management. The identified flood immunities within Table 8.2.6.3(b) should be used for setting flood levels as well as designing building services associated with the facility.

Performance outcome 9

Public safety and the environment are not adversely affected by the detrimental impacts of flooding on hazardous materials manufactured or stored in bulk.

The delineation of the low, medium and high flood hazard areas are shown the Flood hazard overlay maps OM-06.1 and OM-06.2 and allows for clear identification of areas where performance outcome 9 is applied.

Other than in the medium hazard – further investigation, council will be able to make available the height of the flood level for any particular location, upon request, where flood modelling studies have been undertaken (refer to SC6.7.2.1.1).

Alternatively, council's online flood mapping service can be used to obtain the height of flood levels for any particular locations.

SC6.7.4 Attachment 1 - Guidelines for preparation of flood studies and reports

Abbreviations

AEP	Annual exceedance probability
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff (1998)
DEM	Digital elevation model
DFE	Defined flood event
DRAINS	Urban hydrology and hydraulics software
HAT	Highest Astronomical Tide
HEC-RAS	Steady State One Dimensional Hydraulic Model
ISIS	Fully Dynamic One Dimensional Hydraulic Model
LiDAR	Light Detection and Ranging (Aerial Laser Survey)
MHWS	Mean High Water Springs
MIKE11	Fully Dynamic One Dimensional Hydraulic Model
MIKE21	Fully Dynamic Two Dimensional Hydraulic Model
MIKE FLOOD	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
MLWS	Mean Low Water Springs
QUDM	Queensland Urban Drainage Manual
RAFTS	Runoff Routing Software
RORB	Runoff Routing Software
SWMM	Fully Dynamic One Dimensional Hydraulic Model
TUFLOW	Fully Dynamic Coupled One & Two Dimensional Hydraulic Model
URBS	Runoff Routing Software
WBNM	Runoff Routing Software

SC6.7.4.1 Introduction

A flood study consists of the following parts:

(1) the hydrological determination to calculate the likely volume of water that results from the storm under consideration;

(2) the hydraulic determination to calculate the inundation levels and flow velocities that will most likely occur from the flow of water determined in the hydrological determination; and

(3) subsequent modelling to determine development impacts for the proposed development along with evaluation of works to mitigate the impacts of development.

Flood studies will be accepted based on approved inundation estimation calculation procedures and on observed historical records that can be quantified and related to an Average Recurrence Interval (ARI) by the use of the appropriate statistical flood frequency analysis procedure. It should be noted, use of historical records may allow for determination of inundation levels, however, will not be able to quantify the impacts on flooding of a development.

For analysis purposes a specific storm event is nominated as the benchmark event or standard to which council requires immunity against inundation for a development. That event is called the Defined Flood Event (DFE).

This guideline provides guidance on the appropriate use of given methods as well as some guidance on parameter values within the Townsville Local Government Area. There are numerous industry technical documents that detail the methods that should be consulted when completing flood studies including:

(1) Australian Rainfall and Runoff (AR&R); and

(2) Queensland Urban Drainage Manual (QUDM).

SC6.7.4.2 Catchment land use

Catchment land use is an important consideration for flood studies. The level of urbanisation within a catchment influences the volume of runoff and magnitude of peak discharges by:

(1) increasing the impervious fraction of the catchment which reduces the volume of infiltration and increases the total volume of runoff; and

(2) decreasing the time to peak discharge due to construction of open drains and stormwater networks which

concentrates flows and may increase the magnitude of peak discharges.

Strategies to avoid and increase in flooding as a result of any works may include:

(1) mitigation of flows at the individual development;

(2) catchment wide approach to mitigation of flows; or

(3) allowance for additional flow capacity within flow paths.

The strategy for accommodating flows will depend on existing land uses within the catchment and the environmental value of the watercourse. In preparing a flood study, **council must be consulted to identify the proposed approach to flood mitigation within the catchment.** The flood study may require assessment beyond the planning horizon in the current planning scheme, and make a determination of potential ultimate possible development or at least into the future for a period of 50 years, and even possibly 100 years.

As a general principle, drains are an opportunity to have several functions including providing flood mitigation for an area, however for the rest of the time they can be quite an effective open space for the community.

SC6.7.4.3 Hydrological determination

SC6.7.4.3.1 General

The hydrological process that is to be used for determining the design flows for the hydraulic modelling is to be cognisant of the proposed land uses. When calibration is being undertaken based on historical events, then the model being calibrated is to be based on the land use at the time of the storm event under calibration.

The choice of hydrologic method must be appropriate to the type of catchment and the required degree of accuracy. Simplified hydrologic methods such as the Rational Method should not be used whenever a full design hydrograph is required for flood mapping or to assess flood storage issues. Instead the more reliable runoff-routing techniques presented in publications such as Australian Rainfall & Runoff (ARR) should be adopted. Chapter 4 of the Queensland Urban Drainage Manual (QUDM) provides detailed guidance on the selection of an appropriate hydrologic method.

SC6.7.4.3.2 Hydrologic method

The hydrologic method adopted for the required analysis should be appropriate to the type of catchment and the design problem being assessed. Designers should be aware of the limitations, for each of the methods.

Approach	Applicability	Notes
Rational method	• Regular shaped catchment; • Homogenous catchments (generally uniform land use within the catchment); • Storage or timing issues are not relevant; • Rural catchments smaller than 25km^2; • Urban catchments smaller than 5km^2; • Time of concentration is likely to be less than 30 minutes; • **Rational method should only be used for drainage design as it is not appropriate for impact assessment at master planning stage.**	An appropriate method for calculating the time of concentration is essential to applying the rational method.
Synthetic unit hydrograph procedure	• Rural catchments; • Larger flood events where overbank flows are developed; • Rainfall can be assumed to be uniform across the catchment; • **Synthetic Unit Hydrograph Procedure has limited practical application in development assessment.**	Use of synthetic unit hydrograph procedures is not preferred and should preferably be undertaken by an experienced hydrologist with an extensive knowledge of the catchment.

Non-linear runoff-routing models (RORB, RAFTS, WBNM, URBS)	• Rural and Urban catchments (Rural only for RORB and all others should be used with caution in urban areas); • Storage or timing issues are relevant. • **Non-linear Runoff Routing Models are appropriate for drainage design or impact assessment at master planning stage, particularly for areas comprising both rural and urban land uses.**	Council uses RAFTS and requires any flood studies completed within the Townsville LGA to be completed using RAFTS. Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.
Time area runoff-routing models (DRAINS, ILSAX)	• Urban catchments with significant underground pipe network; • Storage or timing issues are relevant. • **Time Area Runoff Routing Models are appropriate for drainage design or impact assessment at master planning stage, particularly for areas only urban land uses.**	Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.
Direct rain on grid application in hydraulic model (MIKE FLOOD, TUFLOW)	• Flatter areas to prevent instabilities forming from flows down steep surfaces; • Study area needs to be small enough so that the model grid cell is not too large. • Storage or timing issues are relevant. • **Rain on Grid approach is appropriate for drainage design or impact assessment at master planning stage, and can represent areas comprising both rural and urban land uses.**	Although these methods are a component of hydraulic determination, they supplement the need for hydrologic determination and are gaining wider acceptance within the industry. Models should be generally developed by suitably experienced practitioners, with appropriate verification / calibration of the models.

Any hydrologic method using emerging technologies needs to clearly demonstrate:

(1) The approach and the principles it employs;

(2) Assumptions and limitations; and

(3) Appropriate calibration or verification.

SC6.7.4.3.3 Catchment parameters

Discussion on catchment parameters is required in particular:

(1) Overall catchment area and sub-catchment areas;

(2) (Sub-) catchment roughness and how the roughness or retardance was developed (may include a photographic record);

(3) Fraction impervious and how values have been derived including reference to what date values represent;

(4) Rainfall losses; and

(5) (Sub-) catchment slopes and how these have been derived.

All information used to define catchment parameters should be clearly referenced. A site assessment in the selection of some parameters is essential.

Catchment roughness

Catchment roughness or surface retardance accounts for the influence of vegetation and surface roughness on the generation of flows from sub-catchments. Ideally, values should be determined from calibration of the hydrological model to stream gauging. Values should be in the ranges presented below:

Catchment land use	Roughness coefficient (n*)
Urban impervious areas	0.010-0.030
Bare soil	0.010-0.050
Sparse vegetation	0.050-0.130
Heavily vegetated areas	0.080-0.200

Note that a sub-catchment may consist of numerous surface types that need to be accounted for in the specification of the catchment roughness.

Rainfall Losses
Rainfall losses account for rainfall which does not contribute to stormwater runoff because of infiltration and storage in surface depressions. Rainfall losses can vary from event to event and depend on antecedent rainfall conditions. Loss values for historical floods should be determined from calibration with loss values within the range of values as follows:

Surface type	Loss values
Pervious	Median initial loss 15 – 35 mm Median continuing loss – 2.5 mm/h Initial loss 0 – 140 mm Continuing loss 0.1 to 8 mm/h
Impervious	Initial loss 1mm Continuing Loss 0 mm/h

It should also be noted that loss values can vary between design storms of different frequencies. Guidance on appropriate loss values for different ARI storms can be obtained by matching peak discharges with peak flows determined from flood frequency assessment.

Sub-catchment slope
Sub-catchment slope can be derived from topographic maps or survey. Slopes applied should be representative of the sub-catchment and the modeller should ensure:

(1) The appropriate slope schematisation is applied when assigning values (equal area slope, vectored slope,); and

(2) Limitations of slope within the hydrological calculation method (i.e. Laurensen's method – minimum slope 0.3-0.5%, maximum slope 15%).

SC6.7.4.3.4 Rainfall intensities
Design Intensity-Frequency-Duration (IFD) Rainfall - IFD relationships shall be derived in accordance with the methodologies outlined in Australian Rainfall & Runoff, for the particular catchment under consideration. Input parameters shall be shown in the calculations submitted to council.

SC6.7.4.3.5 Partial area effects
If the Rational Method is being used, then there should always be checks to ensure that flows of greater magnitude are not apparent for partial catchment areas with faster runoff characteristics. These partial areas should be checked with the higher intensities relating to the shorter times of concentration.

Likewise, when using hydrograph techniques (such as runoff routing or Rain on Grid procedures), a range of storms of different duration for the same ARI should be checked to ensure that the worst event for the ARI is calculated and adopted. It should be noted that a range of storm durations may be required to evaluate sites that cover longer reaches of watercourses or numerous watercourses.

SC6.7.4.3.6 Calibration and verification of hydrological models
Calibration of results based on observed inundation events is desired. There are many pluviograph stations located within and adjacent to the City. Information from these is generally available from the Bureau of Meteorology or relevant Queensland Government department(s). Records from stream gauging stations will be required to match to hydrologic calculations and are generally available from the relevant Queensland Government department(s).

If observed data is not available to assist in the study, then it is suggested that the estimation of discharge flows from several methods will be considered with greater confidence in the result than the estimation of flows from one method alone.

SC6.7.4.3.7 Assessment of development impacts

When undertaking an assessment of the potential for development impacts on flooding, the development must be appropriately accounted for in the hydrological assessment including:

(1) Changes to imperviousness and expected rainfall losses;

(2) Changes to catchment layouts or extents;

(3) Changes to catchment roughness;

(4) Changes to slopes; and

(5) A re-evaluation for the potential for partial-area effects.

SC6.7.4.3.8 Preparation of reports

Reporting requirements

The method chosen should be adequately referenced and values derived should be substantiated by defining procedures used in their derivation. Where parameters are chosen or assumed, references and reasons should be supplied. The preferred method of setting out the hydrology is to describe in the text of the report the method to be used, and then to set the calculations out in a clear and concise table with sufficient data to enable quick verification of the results. The time of concentration or critical duration storm from the hydrological assessment should be clearly identified for areas relevant to the site.

Where computer methods for calculation of flows are used, the text of the report should describe the method that is utilised by the computer programme. Parameters that have been chosen should be referenced with reasons stated for any assumptions. A figure should be used to clearly demonstrate the layout of the model. Output from software should be tailored to produce concise tabular results to enable quick verification of the results. Where recognised computer programmes are utilised, council may require the electronic data files to be provided in acceptable format.

Where insufficient data is supplied then delays will occur while studies are returned to enable the additional data to be provided.

Catchment maps

Most hydrological techniques will require a catchment analysis and stream slope analysis. The catchment analysis should be presented on as large a scale map (smallest reduction ratio) as possible. The following scales for catchment sizes are recommended for use:

Scale	Catchment area
1:1000	up to 0.5 sq. kms (50 ha)
1:2000	up to 1.0 sq. kms (100ha)
1:5000	up to 1.5 sq. kms (150ha)
1:10000	up to 50 sq. kms (5000ha)
1:25000	limited to 300 sq. kms per sheet

Maps should be well presented with catchments contained upon one sheet where possible. Standard sized sheets should be used. Sub-catchments should be boldly defined and the contours should be clearly defined to enable easy verification of the catchments in relation to the contours. Where sub-catchments are not consistent with the contour information then reasons should be stated in the text and clearly labelled on the map. Good drafting standards should be maintained in the presentation of these maps.

SC6.7.4.4 Hydraulic determination

SC6.7.4.4.1 General

The hydraulic determination involves the calculation of flood levels and velocities for the flood flows from the hydrological determination. Australian Rainfall and Runoff and the Queensland Urban Drainage Manual set out

aspects of hydraulic calculations that can be utilised to determine the water levels for design discharges.

Unless the channel consists of long lengths of uniform section and uniform flow, the Mannings equation cannot be used in its simple form. This equation describes flow in a uniform channel at non-varying steady state flow conditions.

Australian Rainfall and Runoff describes methods for flood level determination in gradually varied flow conditions. The method for hydraulic determination will be dependent on the hydraulic controls of the study area. In general, it is appreciated that these methods will use computer applications.

SC6.7.4.4.2 Hydraulic method

The hydraulic method adopted for the required analysis should be appropriate to the hydraulic controls of the study area and the design problem being assessed. Designers should be aware of the limitations, for each of the methods.

Approach	Applicability	Notes
Steady state – one dimensional (HEC-RAS)	• Storage or timing issues are not relevant; and • Flows are one-dimensional, largely within a watercourse and the immediate overbank area.	Generally only suitable for small site scale hydraulic determination.
Fully dynamic – one-dimensional (MIKE11, ISIS, SWMM)	• Storage or timing issues are relevant; • Flows are one-dimensional, largely within a watercourse and the immediate overbank area.	Suitable for smaller onedimensional watercourses. Provides stability advantages over 2D models for steeper areas. Council uses MIKE11 and requires any flood studies completed within Townsville using a fully dynamic – onedimensional model, to use MIKE11.
Fully dynamic – two dimensional (MIKE21, TUFLOW)	• Storage or timing issues are relevant; • Flows are two-dimensional,	Flood maps are generally direct output from models. Council uses MIKE21 and requires any flood studies completed within Townsville using a fully dynamic – two-dimensional model, to use MIKE21.
Fully dynamic–coupled one & two dimensional (MIKE FLOOD, TUFLOW)	• Storage or timing issues are relevant; • Flows are combination of one and two- dimensional; • Large areas need to be represented in combination with fine detail	Council uses MIKE FLOOD and requires any flood studies completed within Townsville using a fully dynamic – one & two-dimensional model, to use MIKE FLOOD.

SC6.7.4.4.3 Topographic data

Topographic data used for the hydraulic determination will be dependent on hydraulic method:

(1) One-dimensional models employ cross-sections along branches to represent the study area topography; and

(2) Two-dimensional models employ digital elevation models to represent the study area topography.

The accuracy of the topographic data governs the accuracy of the hydraulic determination.
The accuracy of the topographic data should be clearly stated.

Cross-sections

Cross-sections are required at representative locations along a stream reach and at locations where changes occur in discharge, slope, shape, or roughness, and at bridges, culverts or control structures such as weirs. Where abrupt changes occur, several cross sections should be used to describe the change in shape regardless of the distance between sections. Cross-section spacing is also a function of stream size, slope and uniformity of cross section

shape. For one-dimensional models, the cross-sections should be wide enough so that the water surface is contained within the extent of the cross-sections. The accuracy of the hydraulic modelling will be dependent upon the spacing of cross-sections and the accuracy of the cross-section survey.

Digital elevation models

Digital elevation models used for two-dimensional models should use a grid spacing fine enough to resolve watercourses within the study area. As a general rule, a watercourse should be represented by a minimum of 5 grid-cells across the width of the watercourse. Coupled models can be used as an alternative to maintain the resolution within the watercourse.

The digital elevation model should be orientated to minimise disturbance of flows by the grid cell orientation. Aligning grid cells with streets (often part of the major drainage system) helps to achieve an appropriate orientation.

Digital elevation models are often captured from aerial surveying methods such as LiDAR or Photogrammetry. These methods can lose accuracy in areas of dense vegetation. It should be clearly demonstrated what steps (including ground survey) have been taken to improve the accuracy in areas potentially obscured by vegetation.

SC6.7.4.4.4 Roughness values

Based on the procedure developed by Cowan (1956), stream roughness values are a combination of influences from:

(1) Bed material;

(2) Surface irregularities;

(3) Variations in channel cross-section;

(4) Obstructions;

(5) Vegetation and flow conditions; and

(6) Meandering.

Different methods for hydraulic determination such as fully dynamic and fully dynamic twodimensional modelling will account for some of these influences within the underlying digital elevation model or solution scheme of the model.

Suggested ranges for roughness values based on the hydraulic method are provided below:

Land use	Roughness values (Manning's n)		
	1D Steady state	1D fully dynamic	2D fully dynamic
Natural watercourse	0.03-0.08	0.025-0.06	0.02-0.05
Riparian corridor	0.15-0.2	0.08-0.16	0.06-0.12
Open grassland	0.04-0.08	0.035-0.06	0.03-0.05
Low density vegetation	0.06-0.12	0.045-0.08	0.04-0.06
Medium density vegetation	0.08-0.18	0.06-0.1	0.05-0.08
High density vegetation	0.1-0.25	0.08-0.15	0.06-0.12
Roads	0.03-0.06	0.025-0.05	0.02-0.04
Open channels	0.03-0.05	0.025-0.05	0.02-0.04
Rural residential	0.06-0.1	0.05-0.08	0.04-0.07
Urban residential	0.06-0.15	0.05-0.12	0.04-0.1
Parks	0.04-0.18	0.035-0.1	0.03-0.08

Where possible, roughness values should be determined from calibration. Often, calibration will not be possible and sensitivity analysis to variations in roughness should be undertaken.

In the case of a one-dimensional model, roughness should be appropriately defined across the cross-sections based on the land use. In the case of a two-dimensional model, roughness should be appropriately defined using a grid to

represent the study area based on the land use.

SC6.7.4.4.5 Bridges and culverts
Australian Rainfall and Runoff and Queensland Urban Drainage Manual provide useful information and references for the determination of afflux levels and water profiles at bridges and other structures.

Head-losses across major drainage structures assessed within fully dynamic models should be verified by hand-calculations or assessment with a steady state model.

SC6.7.4.4.6 Tailwater conditions
Tailwater conditions for hydraulic models will be dependent on the location of the downstream extent of the model. Tailwater conditions may be one of the following:

(1) Sea levels for a coastal boundary;

(2) A gauged rating curve;

(3) Flood levels from the same ARI flood based on a previously accepted flood study; or

(4) Flood levels calculated from simplified means in the absence of other information (e.g. normal depth or critical depth).

In using flood levels calculated from simplified means, the method of calculation should be justified and sensitivity to input parameters should be evaluated. The downstream boundary should be located so that the boundary conditions do not influence results at the study site. Ensuring the boundary is sufficiently far enough downstream from the study site will reduce the impact on results at the site.

Requirements for some specific boundary conditions are discussed below.

Coastal boundaries
When calibrating hydraulic models, tailwater conditions should be based on observed sea levels for the event. Sea-levels are monitored at the Townsville port, with the information available through the Bureau of Meteorology.

To maintain the probability of the assessed flood event for design purposes, the tailwater condition adopted should not have a frequency of occurring any less than once a year. A fixed tailwater condition equal to the height of the Mean High Water Springs (MHWS) tide should be adopted. For storm events greater than 24 hours, a representative tidally varying water surface level between MHWS and Mean Low Water Springs (MLWS) can be adopted.

Backwater effects in tributaries from larger streams
Where a smaller stream discharges into a larger stream, it will be most probable that the larger stream will experience more severe flooding for storms of longer duration and hence lesser intensity for the same average recurrence interval. The tributary is to be checked for a storm of the same duration and intensity as that causing the peak flow in the larger stream.

The hydraulic assessment should assess the flooding for both the storm duration critical for the larger stream and the local tributary. Flood levels in the area will be based on the highest flood level determined from both storm durations. Peak velocities in the area will be based on the fastest velocity determined from both storm durations regardless of whether the storm duration that generates the fastest velocities produced the highest flood levels.

It is acknowledged that runoff routing models combined with fully dynamic hydraulic models will adequately account for these processes.

Estuary boundaries
Sometimes downstream boundary conditions for hydraulic models will be required in reaches of watercourses that are influenced by tides, but are not located at the coastline. In this instance, it is inappropriate to use neither a tidal water level boundary condition nor a rating curve boundary condition alone. The downstream boundary condition must account for both the tidal conditions and the ability for water levels to be elevated due to flood flows. Typically, this would involve the development of a rating curve with flows below MHWS set to zero and flows above MHWS to be calculated based on an appropriate water surface slope.

SC6.7.4.4.7 Impact of climate change

The impacts of climate change on flooding are likely to manifest from increased sea levels and changes in extreme event rainfall intensities. As part of understanding the risk associated with climate change, a sensitivity assessment should be undertaken as part of a flood study. The sensitivity should account for the latest projections in sea-level rise and increased rainfall intensities, specific to the area from leading authorities including relevant Queensland Government department(s), Australian Rainfall and Runoff, Commonwealth Scientific and Industrial Research Organisation, Bureau of Meteorology or Intergovernmental Panel on Climate Change. At the time of preparing this PSP appropriate values were:

Parameter	Value
Sea level rise to 2100	0.88m
Extreme rainfall Intensities to 2100	+15%

The DFE should be assessed in combination with the maximum sea-level rise applied to the MHWS level and the increase in rainfall intensities to evaluate the additional risk associated with climate change. The results from the climate change sensitivity should be assessed with commentary provided about:

(1) Areas where the floor level freeboard above the DFE would be exceeded;

(2) Any new flow paths that are formed; and

(3) What is the AEP of the climate change DFE relative to existing conditions.

SC6.7.4.4.8 Determination of impacts of development

Developments have potential to cause significant adverse impacts on flooding due to:

(1) Increasing the impervious fraction, reducing amount of infiltration and generating a larger volume of runoff;

(2) Providing more efficient conveyance of flows through the site so that flows are concentrated faster at the downstream end of the site producing larger peak flows; and

(3) Removing floodplain storage due to filling which reduces the natural flow attenuation of the floodplain and increases flood levels.

It will be necessary to carry out studies of the catchment in the pre-developed state (base case) and the developed state to determine increased amounts of flow and flood levels. The pre-developed state should represent the state of development within the catchment and floodplain immediately prior to time of construction of the proposed works.

Adverse impacts on flooding may preclude development unless appropriate flood mitigation measures are proposed as part of the development. As a result of developments:

(1) Flood levels should not increase beyond the accuracy of the method of hydraulic determination (generally 0.01 m) either upstream, downstream or adjacent to the site;

(2) There should be no significant change in flow patterns so that new flow paths on adjacent land are formed; and

(3) Any changes in flow velocities should be shown to have minimal impact on erosion potential.

Mitigation works such as levees or detention basins, involving embankments, need to be shown to have a safe overtopping failure. Such works should be modelled for the Probable Maximum Flood (PMF) to demonstrate safe passage of these flows without catastrophic failure of embankments.

Any mitigation measures recommended beyond the subject site will need to undergo the development assessment process including:

(1) Clear identification of the land parcels impacted;

(2) Development applications (material change of use, reconfiguration of a lot or operational works) - as required; and

(3) Identification of maintenance measures including responsibilities and funding sources.

Mitigation measures should generally be on the subject site unless prior discussions have been entered into with council and the landholder and there is an agreement for works outside of the subject site.

Hydraulic modelling of development

When representing development typically the hydraulic model is updated by:

(1) Changing the topography (cross-sections/DEM) to represent the development;

(2) Updating inflows to represent changes in hydrological response; and

(3) Updating roughness to represent the development.

Roughness values should only be changed to reflect the change in land use resulting from the development. These changes need to be clearly identified and justified. In assigning roughness values within new drainage channels or areas impacted by flooding, there should be consideration given to the way regrowth can occur within these areas. Areas below Highest Astronomical Tide (HAT) are likely to have mangrove regrowth occur. In areas further upstream, regrowth by tea-tree is likely to occur and can create a significant impediment to flows. Also, most flood events within Townsville occur towards the end of the wet season (January to March), when earlier rain has enabled grass in drains to grow with minimal ability to mow. Roughness values within drainage corridors for development assessment should be adopted towards the higher end of the range of values to account for regrowth, which may have minimal maintenance.

Freeboard for existing areas

Within some existing urban areas, design criteria have changed over time and have resulted in freeboard to existing buildings being less than is required in new development. To ensure the freeboard for existing areas is maintained, there should be no adverse impacts on flooding for all events floods up to the DFE. As a minimum, the assessment should demonstrate that there are no adverse impacts on flooding for the minor system drainage capacity AEP and the DFE.

SC6.7.4.5 General matters

SC6.7.4.5.1 Presentation of reports

As stated in the previous sections all reports and tabulations are to be printed on A4-sized sheets, and drawings presented on standard size sheets prepared using good drafting standards. The expected content of the reports is as discussed in SC6.7.4.2, SC6.7.4.3 and SC6.7.4.4 above. In summary the contents of a study report must include:

Hydrology section

(1) catchment Map - large as possible;

(2) report on procedure (brief), including hydrologic method, catchment characteristics, assumptions and discussions on results including critical duration /time of concentration as detailed in SC6.7.4.3 above; and

(3) calculations and model results - tabulated where possible and attached in appendix if significant in volume.

Hydraulics section

(1) report on procedure including hydraulic method, stream/floodplain characteristics and assumptions as detailed in SC6.7.4.4 above;

(2) model Results – Clearly presented as maps and tabulated values;

(3) stream Flood profile and bed profile of the study area;

(4) drawings/figures of topographic data used for the model (Digital Elevation Model map or plan of cross-section locations and cross- sections with X and Z coordinates included);

(5) a plan containing the proposed works showing any filling and excavation associated with development; and

(6) model results updated on the basis of including the development with the revised flood extents and impacts on flooding.

General

(1) discussion on sensitivity analysis for critical parameters (e.g. roughness, infiltration etc.);

(2) discussion on accuracy of inundation mapping and the resulting required flood line;

(3) recommendations as to methods of flood mitigation within the site;

(4) recommendations as to method of flood mitigation beyond the site together with development approvals,

construction proposal and funding proposals; and

(5) electronic data for both the hydrology and hydraulics in an agreed format (modelling platforms and GIS).

Drawings should be bound into the report where sizes are A3 or A4. Larger drawings are to be appropriately folded and inserted in a pocket in the back cover.

Recognition by the consultant, that the assignment of data to council, and use of the studies by council for its sole use, is a mandatory requirement before a study is commissioned and/or the results of any study will be accepted by council.

All studies, reports and submissions forwarded to council shall be prepared by, or at least certified by, a Registered Professional Engineer Queensland (RPEQ) who is registered in the specific area of engineering in which the study or report has been prepared e.g. an RPEQ (Structural) shall not certify a stormwater report.

SC6.7.4.5.2 Preference of computer models

It is acknowledged that where no modelling has been undertaken, then any modelling will provide a more accurate estimation of inundation levels than collated levels from observed inundation events.

Modelling studies where the results have been calibrated using observed levels and measured rainfalls will be recognised as providing a more representative result for the study area.

The hydrologic and hydraulic methods adopted should be suitable for purpose as indicated in SC6.7.4.3.2 and SC6.7.4.4.2. Townsville City Council requires that any flood studies completed within the Townsville Local Government Area uses software that is run internally which includes:

(1) Non-linear Routing – XP-RAFTS;

(2) 1D Steady State – HEC-RAS;

(3) 1D Fully Dynamic – MIKE11;

(4) 2D Fully Dynamic – MIKE21; and

(5) Coupled 1D/2D Fully Dynamic – MIKE FLOOD.

SC6.7.4.5.3 Copyright of reports, studies and drawings

Prepared directly for council

It is acknowledged that intellectual capacity has been demonstrated in the preparation of the report. However, the report is prepared and based on accepted engineering fundamentals and principles. In addition, the practices adopted are those developed by the engineering profession through initiative and ingenuity and ratified through the professions recognised body “The Institution of Engineers, Australia” currently trading as “Engineers Australia”.

All reports and studies (including drawings, tables, model files etc.) prepared for council under direct commission will become the sole copyright of council, and those reports will be used by council in a manner that will provide the optimum benefit to the community. All reports adopted by council will also be available for public and professional perusal on council’s website.

In any reference to the report, the author of the report will be acknowledged by council and should be acknowledged by any authorised third party user.

Submitted as part of a development application

Submitted as part of a Development Application and adopted as supporting the application only

When a technical report or study is submitted to council as part of a development application, this report/study, along with all components of the submission, can be made available to the public as part of the notification stage. The report can be provided to anyone seeking the report during this stage and following the approval. Use of the report for any third-party use will be at the complete risk of the third party. It should be noted that it will be only the approved report including any council requested amendments, which should be referred to in future.

Submitted as part of a Development Application and adopted by council as a benchmark report for future development or other purposes

From time to time, reports etc. submitted as part of a development application, or supporting an application, could provide a wider ‘regional’ significance and importance than just the development site for which they were prepared. Council may choose to open discussions with the developer to determine if obtaining all supporting digital and electronic data along with software input/output files would allow the option of adopting the report as a ‘base-line’ report for council. The decision as to whether a report has wider regional significance will be council’s alone.

Once these reports have been adopted by council as a ‘base-line’ report, the report assumes the status as if the report was prepared by or for council, and the copyright previously assigned by the author is released and the copyright provided to council. Council can use the report to achieve optimal outcomes for the wider community.

SC6.7.4 Attachment 2 - Adverse Flooding Impacts Assessment - Additional Design Floods for Asessment

Location	Design flood event
Ross River - Downstream *Within the immediate area around Ross River downstream of Ross River Dam and the lower Ross River Floodplain.*	0.2 % AEP
Ross River Upstream *Upstream of Ross River Dam*	0.5 % AEP

SC6.8 Mitigating bushfire hazard planning scheme policy

SC6.8.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Bushfire PSP.

SC6.8.1.1 Purpose

(1) The purpose of the planning scheme policy is to:

(a) support the outcomes presented in the Bushfire hazard overlay code; and

(b) provide guidance and information relating to the preparation of a Bushfire hazard assessment, and where necessary a Bushfire management plan.

SC6.8.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.8.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, in particular, the Bushfire hazard overlay code.

SC6.8.1.4 Terminology

Terms used in this planning scheme policy are as defined in Schedule 1 – Definitions. A term used in the planning scheme policy which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 Definitions.

SC6.8.2 Planning scheme policy details

SC6.8.2.1 Bushfire hazard assessment

A Bushfire hazard assessment (and where necessary a Bushfire management plan) may be required as part of an assessable Reconfiguring a Lot or Material Change of Use development application as determined by assessment under the Bushfire hazard overlay code.

Where a Bushfire hazard assessment is required or is submitted, assessments are to be prepared and undertaken by a suitably qualified and experienced professional.

As a guide, the features sought by council to achieve a comprehensive Bushfire hazard assessment are addressed below.

The Bushfire hazard assessment should have regard to the following –

(1) Australian Standard AS3959 - 2009: Construction of buildings in bushfire prone areas.

(2) State Planning Policy and supporting guidelines.

Editor's note—A detailed guide on how to undertake this type of risk assessment is provided in QRA (2012) publication. Although this focuses on flooding the evaluation process can be applied for any natural hazard.

(1) A bushfire hazard assessment should provide:

(a) the name and qualifications or experience of the person(s) preparing the assessment;

(b) the use description;

(c) location of the extent and level of bushfire hazard in relation to the spatial extent of existing and forecasted land uses;

(d) details of the storage of any dangerous or hazardous goods to be kept on the site;

(e) details of existing vegetation, including slope and aspect characteristics of the site;

(f) details of weather conditions that influence bushfire intensity; and

(g) details of existing bushfire records and local knowledge.

(2) Risk appropriate development;

(a) mapping details of the proposed development through GIS overlays or comparison of hard copy mapping;

(b) a determination of the consequence of a bushfire hazard for each lot within the study area, and a qualitive assessment of

  (i) vulnerability;

  (ii) tolerability;

  (iii) a bushfire risk assessment to identify how development mitigation measures will work in conjunction with other risk management measures including building controls, mitigation infrastructure, early warning systems, community awareness and emergency managements to address the risk of bushfire, should it not be classed as a low hazard on the subject site; and

  (iv) recommendations.

SC6.8.2.2 Bushfire management plans

Where a bushfire management plan is required to respond to the risk, these are to be prepared and undertaken by a suitably qualified and experienced professional.

Where required, a Bushfire management plan is to include with the following:

(1) a discussion of proposed mitigation measures, the reduction of the hazard risk and the feasibility and reasonableness of these measures;

(2) identification of the key factors such as vegetation type, slope and aspect and include matters such as: likely direction of bushfire attack, environmental values that may limit mitigation options, location of evacuation routes and/or safety zones;

(3) an assessment of the specific risk factors associated with the development proposal, including matters such as the nature of activities and materials to be conducted or stored on the site, numbers and types of persons likely to be present, particular warning and/or evacuation requirements; and

(4) a plan for mitigating the bushfire risk. The plan should address all of the matters raised and recommend specific mitigation actions for the proposed development including:

  (a) road and lot layout and land use allocations;

  (b) firebreaks and buffers;

  (c) building locations or building envelopes;

  (d) landscaping treatments;

  (e) warning and evacuation procedures and routes;

  (f) firefighting requirements including infrastructure;

  (g) any other specific measures such as external sprinkler systems and alarms;

  (h) purchaser/resident education and awareness programs;

  (i) ongoing maintenance and response awareness programs; and

  (j) a description of the control measures that will be use to ensure compliance.

The level of detail required will vary with the nature of the development proposal and site, and with the type of development application.

The level of detail required to accompany a particular application should be determined in consultation with the assessment manager.

SC6.9 Natural assets planning scheme policy

SC6.9.1 Introduction

Short Title -The planning scheme policy (PSP) may be cited as the Natural assets PSP.

SC6.9.1.1 Purpose

(1) The purpose of the planning scheme policy is to:

- (a) support the use of the Natural assets overlay code;
- (b) provide background information on the derivation of the natural assets overlay maps;
- (c) outline information the council may request for a development application; and
- (d) provide guidance or advice about satisfying assessment benchmarks.

SC6.9.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.9.1.3 Relationship to Townsville City Plan

This planning scheme policy supports the assessment provisions specified in Townsville City Plan. Natural assets PSP specifically relates to the assessment of the Natural assets overlay code.

SC6.9.2 Natural assets

SC6.9.2.1 General guidance - environment protection

A healthy natural environment underpins the social and economic fabric of a sustainable city. Human modification of the natural environment interferes with physical and biological processes, natural cycles and energy flows. Natural systems can tolerate some amount of human modification however when the resilience level is exceeded, natural system break down and life support functions are diminished or damaged. In extreme cases damage may be irreparable as with endemic habitat loss, species extinction and desertification. Protecting the environment from human activities is a prerequisite for achieving ecological sustainability.

SC6.9.2.2 Land use and environment protection

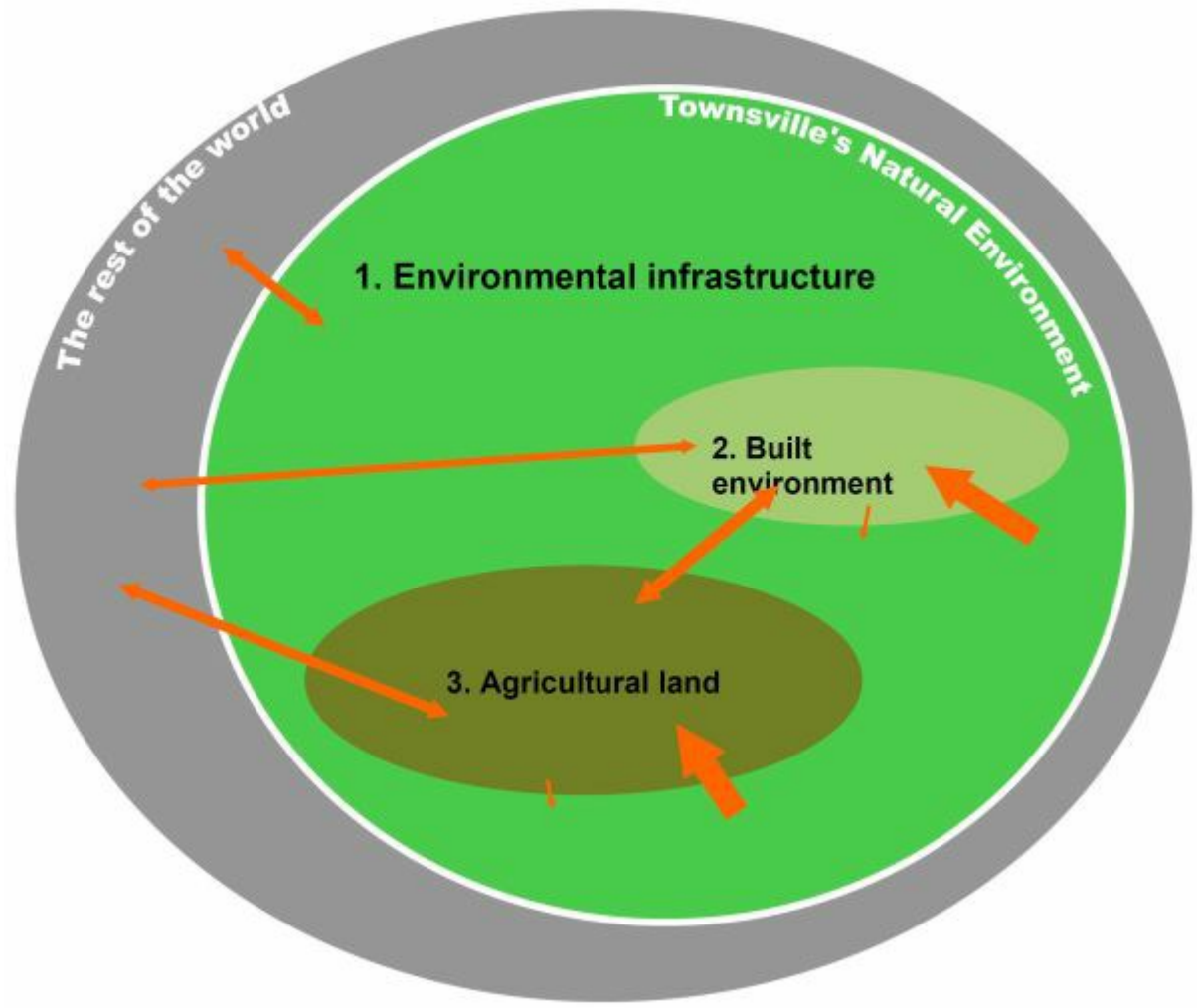
In broad terms, the three main functional land use units are:

(1) Environmental infrastructure;

(2) Built environment; and

(3) Agriculture land.

The three units are overlain on the single pillar of our existence - the natural environment, as illustrated conceptually in the diagram below.



SC6.9.2.3 Ecological planning

To seek to achieve ecological sustainability requires ecologically-based planning solutions. The underlying principle of ecological planning is the maintenance of our quality of life through the protection of our life support systems. This can best be done in a planning context through the recognition and protection of significant environmental areas.

Ecological planning takes an 'organic' approach to planning where the placement of built structures is dictated by environmental features and the need to protect and maintain natural assets and significant environmental infrastructure.

SC6.9.2.4 Environmental infrastructure

Environmental infrastructure is the basic framework or underlying foundation of the natural environment that contains the myriad of life support systems for all forms of life. Environmental infrastructure and function include:

(1) waterways/drainage systems (water drainage, water storage, seed transport, nutrient relocation, soil formation, sediment redistribution, habitat, connectivity, aquifer recharge, recreation, base flow, food source, biodiversity);

(2) wetlands (water filtering, water storage and aquifer recharge, habitat, seasonally high productivity, food source, biodiversity);

(3) riparian vegetation (shading, nutrients, ground cover; bank stabilisation, erosion prevention, water filtering, shelter/refuge, habitat, connectivity, recreation, food source, buffering, biodiversity);

(4) coastal dune systems (first line storm protection, buffering, water filtering, recreation, habitat, biodiversity);

(5) extensive forest in mid and upper catchments slopes >15% (erosion prevention, soil and slope stabilisation, soil formation, habitat, recreation, food source, aquifer recharge/intake, biodiversity, climate stabilisation);

(6) corridors and connections (wildlife movement, seed and vegetation dispersal, habitat, shade, shelter/refuge, food source, buffering, recreation, biodiversity);

(7) habitat/sustainable living space (biodiversity, connectivity, buffering, food source, recreation);

(8) native vegetation (biodiversity, habitat, wildlife movement, buffering, seed and vegetation dispersal, food source, recreation, soil health, shade, shelter/refuge, fuel, timber, erosion prevention;

(9) floodplains (habitat, biodiversity, nutrient and sediment dispersal, food source);

(10) aquifers (water storage, sub surface connectivity, hydraulic pressure); and

(11) protected areas (National Parks, Conservation Parks, Forest Reserves, Fish Habitat Areas and other socially delineated conservation areas).

Environmental infrastructure is unlikely to follow the same lines as appear on cadastral maps.

SC6.9.2.5 Ecosystem services

When planning and designing the built form we need to be aware of the intrinsic value of the surrounding environment and the ecosystem services operating in the background.

These services are provided without the need for any extra mechanical or chemical intervention and operate continually at variable rates determined by environmental conditions and climate. When we 'adjust' the environmental conditions we change the balance of ecological functions and ecosystem services at times beyond the resilience of the system to bounce back. If the change in environmental conditions is exacerbated by climate variability then a system may collapse due to the cumulative combination of natural and human impacts.

A risk management approach is adopted in ecological planning due to the uncertainties about how much of our natural assets (land, vegetation, water, soil, wildlife, soil microbes) is required to sustain an increasing human population and still maintain ecological processes at functional levels.

Determining or estimating the extent and influence of the ecological processes and ecosystem services is necessary in a planning context so that planning policies and intent can be applied to small areas (e.g. a house lot) as well as across broader landscape units such as regional ecosystems and land units.

SC6.9.2.6 Categories and components

The environmental importance ratings depicted on the Natural assets overlay map identify the likely significance of the natural environment and the likely extent of environment protection required to maintain habitat, species, vegetation communities, strategic habitat units, ecological processes, ecosystem services and hydrological function. Each of the three categories (medium, high and very high) are based on a variety of environmental and ecological components. The components associated with each category are listed in Table SC6.9.1—Environmental importance categories and components.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description
Very High	• Endangered ecological communities − semi evergreen vine thicket* − littoral rainforest and coastal vine thicket − broad leaf tea tree* • Endangered remnant vegetation (VMA vegetation management status) − Brigalow belt north bioregion − sub-regional (<10% left OR <300ha of pre-clearing extent remains) − local government area (<10% left OR <300ha of pre-clearing extent remains) • Remnant vegetation (VMA biodiversity status - endangered (dominant)) • Endangered high value regrowth (VMA) • Non bioregional ecosystems* • GBR wetland protection areas • Main connecting corridors • Mahogany glider habitat • Southern Cassowary habitat • Land units of limited extent* − Alligator Creek delta − *Eucalyptus acmenoides* lowlands − *Eucalyptus brownii* woodlands major occurrence − *Corymbia clarksoniana* alluvial fans − *Eucalyptus platyphylla — Melaleuca viridiflora* alluvial fan complex − *Eucalyptus tereticornis* on holocene deposits − *Grevillea striata* dominant − Land zone 4 grasslands − Pleistocene dunes − Terminal wetlands − *E. platyphylla — C. clarksoniana* woodlands on old levees and prior streams	This category includes endangered species habitat and vegetation communities along with the main connecting corridors (riparian, coastal and biogeographic units), land units of limited extent and Great Barrier Reef (GBR) wetland protection areas. These areas have been allocated as very high priority as they are the last examples of this type of vegetation community and/or habitat (generally less than 10% remains) and are the most vulnerable to loss and/or extinction in the short to medium term. Any further loss of these endangered elements could result in their loss from the landscape with little chance that they will recover or could result in their loss from the landscape with little chance that they will recover or could be restored.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description
High	• Of concern remnant vegetation (VMA vegetation management status) − Brigalow belt north bioregion − sub-regional (<10% left OR <300ha of pre-clearing extent remains) − local (30-50% of the pre-clearing extent remains) • Remnant vegetation (VMA biodiversity status - Endangered (sub dominant)) • High value regrowth − endangered (sub dominant) − of concern (dominant) • Wetland regional ecosystems (Estuarine, Palustrine, Lacustrine and Riverine) • Black-throated Finch habitat* • Essential habitat (regional ecosystems) • Very high ecosystem diversity (SDI >75% of the maximum value for the Bioregion) • A significant habitat for 'at risk' species • Waterways (buffered as per VMA bioregion codes) • Essential regrowth habitat (VMA)* • Wet tropics corridors* • Statewide corridors (remnant)* • Magnetic Island corridors (remnant)* • Magnetic Island lowland values(remnant)* • Land units of limited extent* − Castle Hill − (Sandy Creek and Double Barrel Creek) floodplain complex − watercourses (and associated areas subject to flooding)	This category includes the next most threatened suite of habitat, species and regional ecosystems (generally less than 30% of these components remaining in the landscape) along with strategically important connecting corridors, essential regrowth habitat, wetland regional ecosystems and endemically important landscape elements. It also includes a significant portion of the network of waterways and buffers (not included in the very high category) that are critical to the maintenance of ecological functions and ecosystem services. This category includes environmental elements close to the probable 'survival edge' as 30% is considered to be at the lower limit of ecological viability and function for habitat and vegetation communities. Any further reduction of extent is likely to result in a downward spiral that could ultimately lead to species endangerment and/or the endemic loss or degradation of vegetation communities and ecological processes. To take into account the relative importance of this category, if there are two or more environmental parameters with a high rating in a given polygon then the polygon was elevated to the very high category.

Table SC6.9.1 — Environmental importance categories and components

Category	Environmental importance components	General description

Medium	• Least concern remnant vegetation (VMA vegetation management status)
	  − Brigalow belt north bioregion
	• Remnant vegetation (VMA biodiversity status — Of Concern)
	• High value regrowth
	  − of concern (sub dominant)
	  − least concern
	• GBR wetland protection trigger areas (buffers)
	• Statewide corridors (nonremnant)*
	• Magnetic Island corridors (nonremnant)*
	• Magnetic Island lowland values (regrowth)*
		This category includes the widest range of environmental values from near threatened (30% remnant vegetation remaining) to relatively stable (100% remnant vegetation remaining). This category also includes some of the less tangible environmental and ecological functions, such as catchment protection, buffers, landscape connectivity and viable- sized habitat and ecosystems.
		
		This is the category that is likely to require the highest level of investigation prior to any development, as it is the least 'certain' in terms of priority for environmental protection. It is likely to have very high and high environmental value features, which have not been identified at the mapping resolution used for the categorisation. It may also include some low value features.
		
		If there are three or more environmental parameters with a medium rating in a given polygon then the polygon has generally been elevated to the high category.

Footnote—SDI is Simpson's Diversity Index

Footnote—*Denotes amendments/additions using DEHP mapping

It should not be assumed that any area has no environmental values. Areas not included in the overlay map (depicted without an infrastructure rating) generally consist of areas that have significantly less environmental value due to the level of disturbance resulting from anthropogenic activities, including clearing of native vegetation and the construction built form. The environmental values of some of these areas could be reinstated.

Applicants and landowners should be aware that other land not included in the overlay map may contain other remnant and non-remnant vegetation or other environmental value that is subject to the requirements of other state and/or federal legislative requirement.

In addition, there are provisions in some zone codes that require applicants to respond appropriately to any localised values that may exist outside the overlay area.

SC6.9.2.7 Mapping limitations

The general mapping resolution used for the environmental importance ratings map (Overlay Map OM-08) is 1:100,000. The Queensland Government's Regional Ecosystem mapping has been used as the base map for the environmental importance rating map and, while being the best available data source for this type of environmental categorisation, it is recognised that there are inaccuracies in the base map and therefore there will be inaccuracies in the resulting product - i.e. environmental importance ratings.

To overcome some of the inaccuracies, a review of the environmental importance ratings has been undertaken for the urban, rural and rural residential areas using 2011 aerial photography (the most recent available at the time of review). Further refinement of the mapping is required, for example, to accurately locate waterways, wetlands, riparian zones and buffers as the current Queensland Government mapping is not accurate at the local/urban scale and especially for order 1 and order 2 streams.

In light of these mapping limitations, it is imperative that an environmental assessment is undertaken for areas mapped with medium, high and very high environmental importance to ensure that development applications are assessed with the benefit of the best available information.

Council will continue to improve its environmental mapping, over time, to more accurately reflect environmental importance across the entire Townsville landscape, to reduce the incidence of unsustainable land use and development, and thereby contribute to the achievement of ecological sustainability and a sustainable Townsville.

SC6.9.2.8 Supporting maps

Supporting maps have been produced to assist applicants in using the Natural assets overlay code. The data presented on each of the supporting maps has been extracted from data contained on map OM-08 and are provided to assist applicants identify environmental and ecological features within the Townsville landscape.

Supporting maps may be used to assist applicants address relevant assessment benchmarks of the natural assets code.

Maps supporting the natural assets overlay code are:

(1) Figure SC6.9.1 – Natural assets – waterways represent the Queensland Government 1:100,000 waterways mapping. Waterways have been mapped to enable identification of stream orders specifically and are designed to allow applicants to identify the relevant stream order that affects a given location.

(2) Figure SC6.9.2 – Natural assets – wetlands include Great Barrier Reef wetlands of high ecological significance (wetland protection areas), riverine wetland regional ecosystems and other wetland regional ecosystems. Ramsar wetlands and wader roosts have also been shown to identify the presence of these areas at their given location.

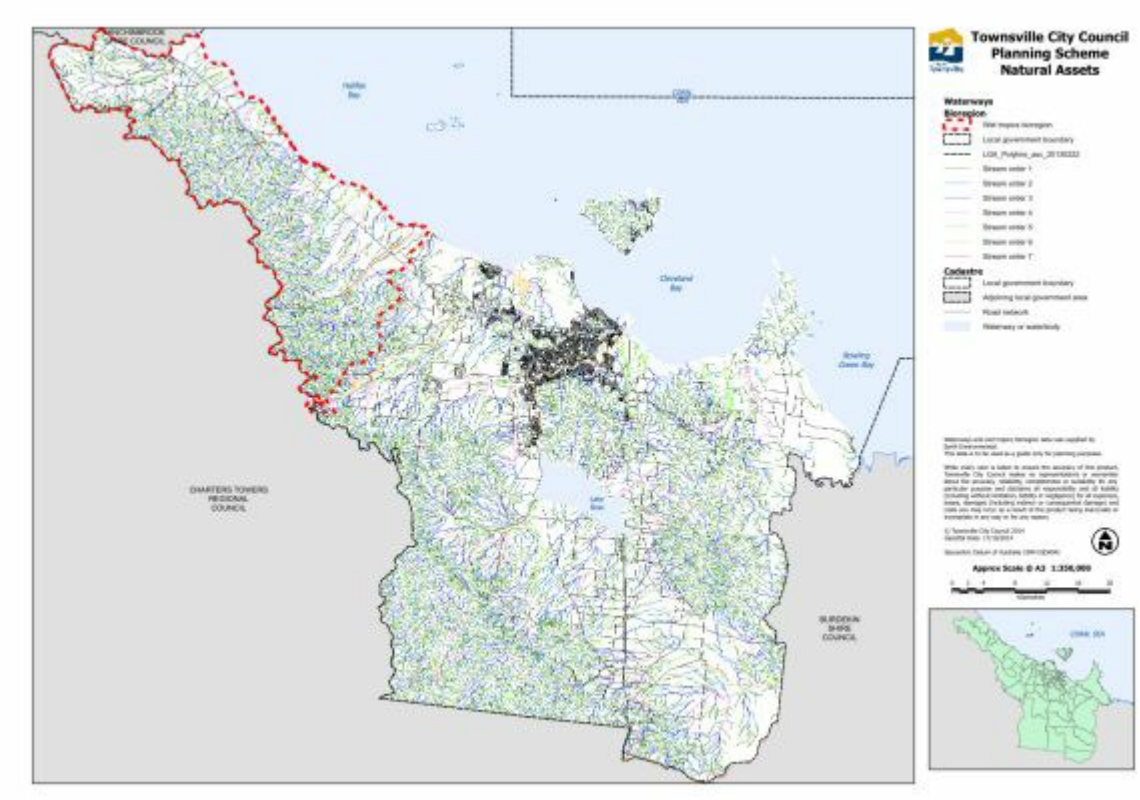
(3) Figure SC6.9.3 – Natural assets – ecological corridors include:

  (a) priority corridors from the Environment and Biodiversity Study: Final Report (Chenoweth April 2011);

  (b) state corridors from data provided by the Department of Environment and Heritage Protection (DEHP); and

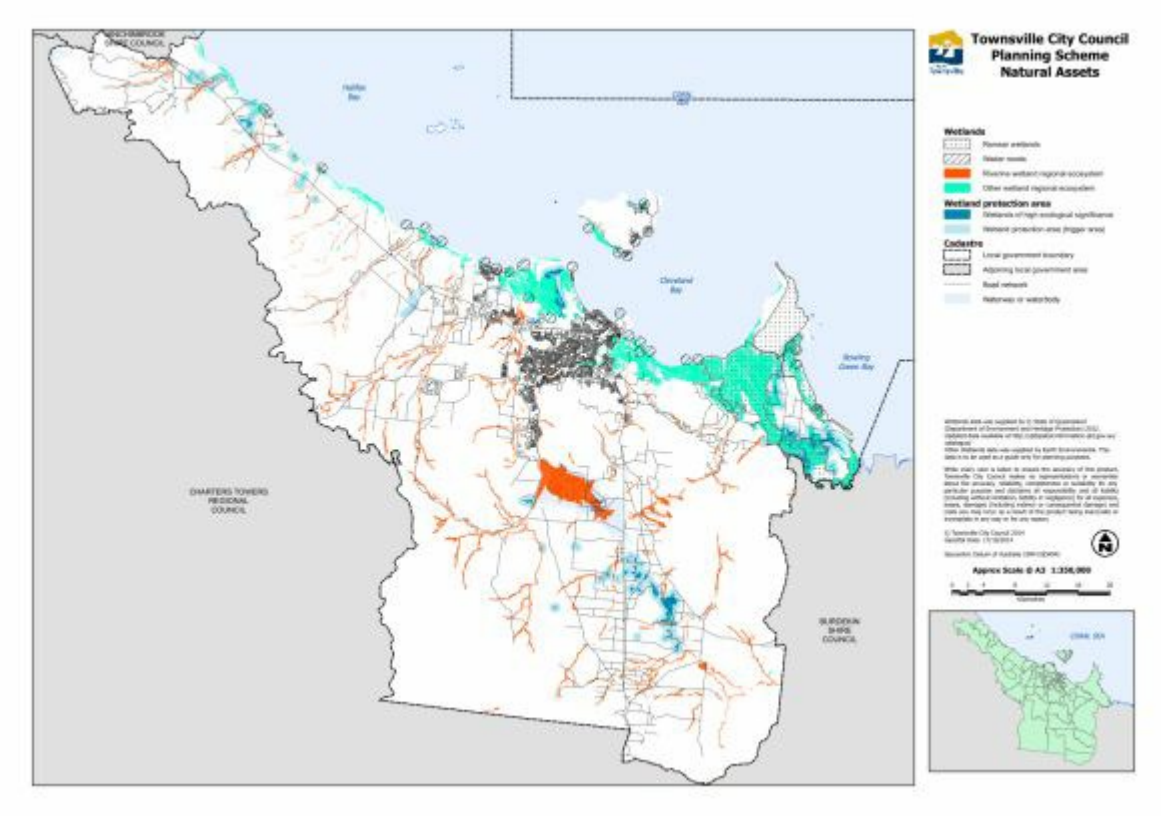
  (c) the state and priority corridors as major ecological corridors and the great eastern ranges conservation corridor. Major ecological corridors shown on the map consist of a 250m core corridor and a 50m buffer either side of the core corridor.

(4) Figure SC6.9.4 – Natural assets – core habitat includes Cassowary, Mahogany Glider and draft Black-throated Finch habitats in addition to essential habitat for other threatened species as mapped by DEHP including declared fish habitat areas.



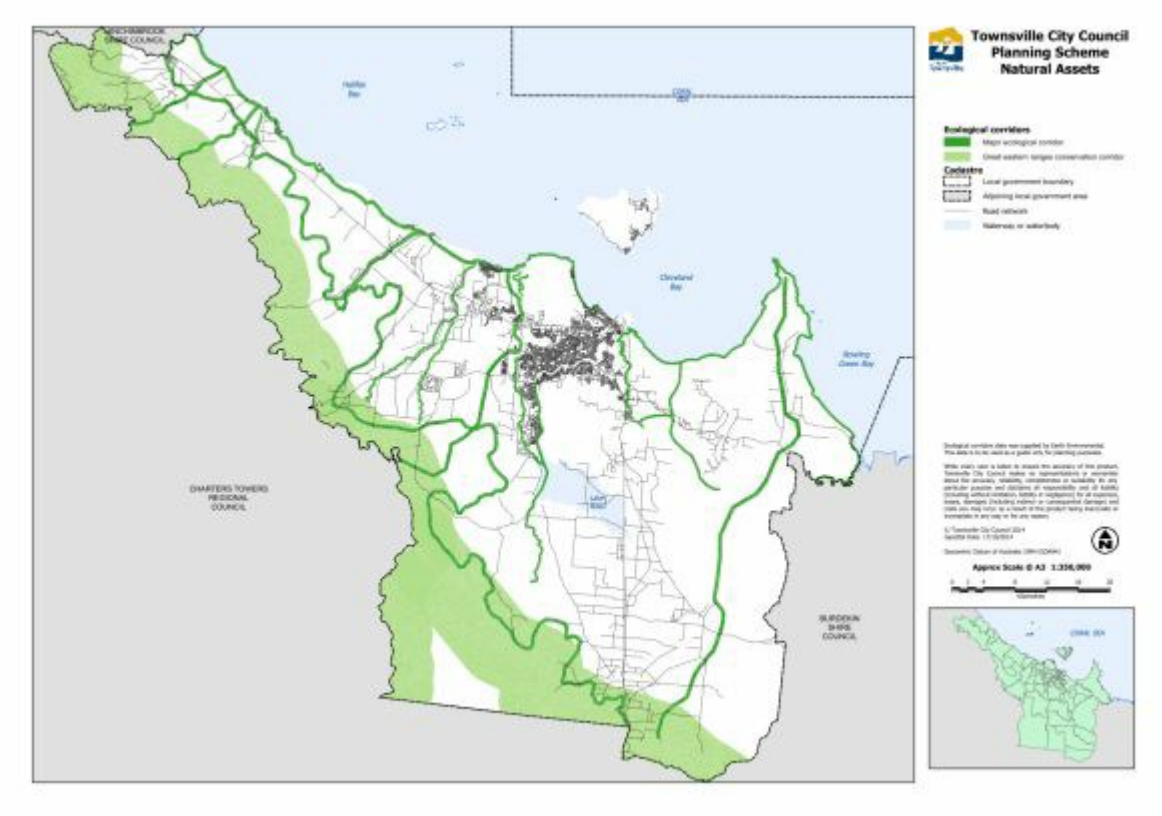
Click here to view PDF high resolution map.

Figure SC6.9.1 - Natural assets - waterways



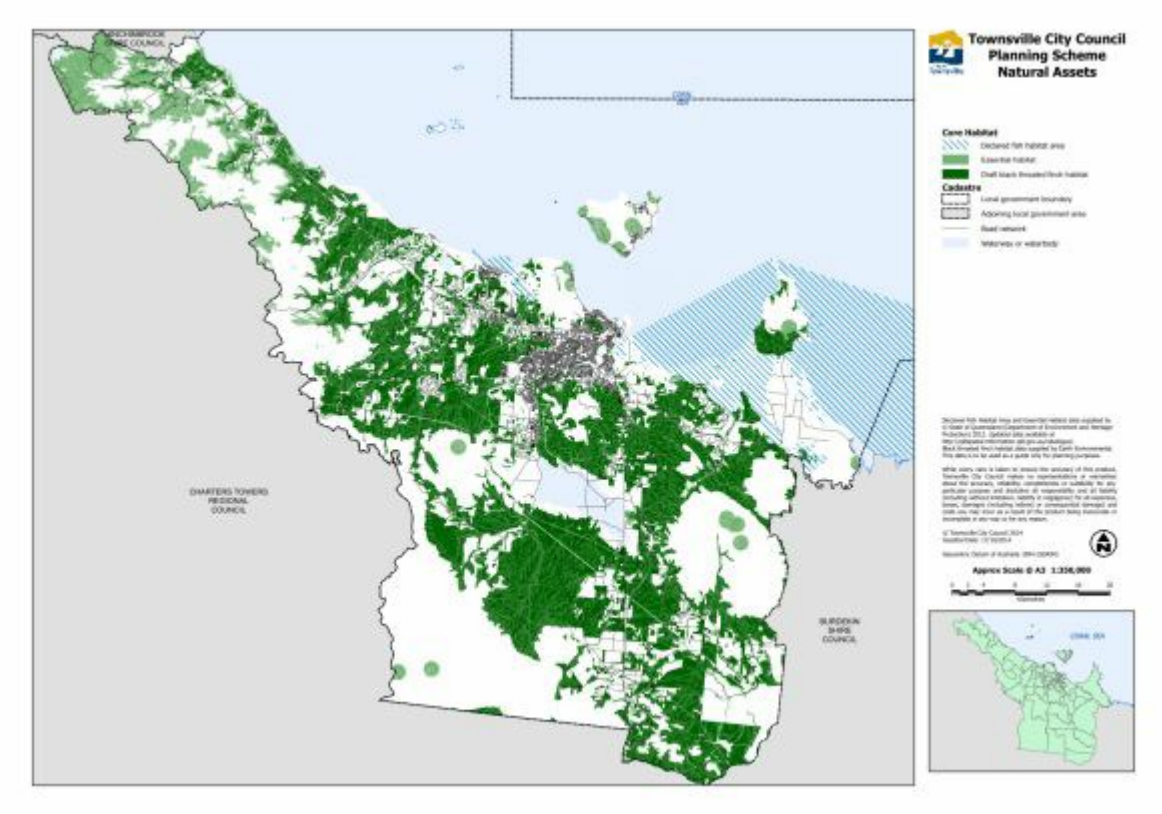
Click here to view PDF high resolution map.

Figure SC6.9.2 - Natural assets - wetlands



Click here to view PDF high resolution map.

Figure SC6.9.3 - Natural assets - ecological corridors



Click here to view PDF high resolution map.

Figure SC6.9.4 - Natural assets - core habitat

SC6.9.2.9 Environmental assessments

An environmental assessment may be required to show what impacts the development activity may have on the environment and how potential adverse impacts on the environment can be mitigated. To demonstrate compliance with the Natural assets overlay code, such an assessment may need to include a detailed ecological assessment.

The required assessments should be undertaken by a suitably qualified and experienced professional and provide a site specific investigation of the values present and their significance to ground truth the data reflected on the overlay mapping. The level of investigation required and techniques utilised should be commensurate with the scale and nature of the proposed development and the type of values present on the site. The environmental assessment should provide the appropriate level of information to assess the potential impact of a proposed development on the environment including:

(1) identification of the physical and ecological features of the site;

(2) identification of the ecological processes and ecosystem services associated with the site;

(3) identification of the physical and ecological connections between the site and the surrounding environment, including ecological processes and ecosystem services; and

(4) comparison of the environmental importance components and features identified on OM-08 to on ground findings.

The environmental assessment and reporting process also provides the development proponent with the opportunity to propose potential solutions that prevent or minimise potential environmental harm to natural assets and ecological processes associated with the proposed development. Potential solutions may include:

(1) environmental offsets;

(2) operational environmental management plans;

(3) succession plans and criteria for handover of natural assets to council;

(4) establishment of Nature Refuge areas;

(5) stormwater management plans incorporating water sensitive urban design (WSUD);

(6) resourced rehabilitation plans (in addition to or instead of environmental offsets); and

(7) innovative ideas for the progression of the development and protection of environmental values.

SC6.9.2.10 Environmental assessment report

The environmental assessment report should be set out in accordance with the framework provided below.

Physical and ecological features of the site including:

(1) Introduction providing information about:
   (a) the applicant;
   (b) tenure;
   (c) location; and
   (d) current land use and proposed land use.

(2) Site description including:
   (a) surrounding land use;
   (b) location in the water catchment;
   (c) proximity to HEV waters;
   (d) proximity to World Heritage Areas and other protected areas;
   (e) geology and soils; and
   (f) Regional ecosystems.

(3) Environmental importance components and features identified on OM-08 (Natural assets overlay).

(4) Likely ecological processes and ecosystem services associated with the site and adjoining areas.

(5) Social, physical and environmental constraints identified in other overlays including flooding, fire hazard, slope and visual amenity.

Physical and ecological features of the site (on ground site assessment results):

(6) The physical and ecological features of the site, based on on-ground assessment including:
   (a) soils and their geological derivation;
   (b) drainage and wetland features;
   (c) Other native vegetation and regrowth;
   (d) Regional Ecosystem type and extent;
   (e) habitat type and extent;
   (f) exotic species presence (terrestrial and aquatic – plant and animal); and
   (g) fauna sightings and signs (additional targeted survey work may be required where threatened species and ecological communities are likely to be present).

(7) Ecological processes and ecosystem services associated with the site.

(8) The physical and ecological connections between the site and the surrounding environment including ecological processes and ecosystem services.

Comparison of desktop review features with site assessment features:

(9) Comparison of the environmental importance components and features identified on OM-08 council's Natural assets overlay to on ground findings.

Suggestions for development impact avoidance or mitigation, including, but not limited to the following considerations:

(10) stormwater management including erosion prevention and sediment movement control;

(11) habitat management including weed control;

(12) maintenance of ecological processes; and

(13) maintenance or improvement of connectivity.

Environmental assessments and the preparation of management and rehabilitation plans are to be undertaken by a

person/people/organisation with the appropriate skills and experience. Where a person with less than four years' experience in field work is involved in the assessment, they should be supervised by an experienced environmental practitioner. Regardless of experience and qualifications, all work should be thoroughly reviewed as part of a quality assurance process prior to submission of studies, reports and plans to council.

SC6.9.2.11 Site-based management and rehabilitation plan

Where there is a requirement in the Natural assets overlay code, a site based management plan and/or a rehabilitation plan should be prepared to address the site specific situation. Generally, content should be in a format that identifies:

(1) the physical and biological condition of the site (from the Environmental assessment report);

(2) the issue/s being addressed and their location (from the Environmental assessment report);

(3) how and over what time scale the issue will be addressed (with input from Part 4 of the Environmental assessment report); and

(4) the commitment of resources allocated to implement the plan.

Plans need to provide enough information to show that the performance outcomes in the Natural assets overlay code will be met by the implementation of the plan. The use of maps and accompanying tables with management actions are encouraged to simplify the plan and reduce the size of documents.

SC6.9.2.12 Additional information

Additional material may be required as part of the environmental assessment depending on the environmental importance components and features identified in the Natural assets overlay. This involves proximity to areas of significant ecological or environmental value and requirements for vegetated buffers as well as the proximity to wader roosts. Additional information will be required if the proposed development is within:

(1) 200 metres of a wader roost area as indicated on Figure SC6.9.2 – Natural assets – wetlands;

(2) 200 metres of core habitat and endangered ecological communities;

(3) 200 metres of HEV waters;

(4) 200 metres of a wetland area;

(5) 100 metres of an ecological corridor;

(6) 100 metres of a declared fish habitat area; and

(7) 100 metres of a waterway.

Information derived from on ground investigations will be required to show:

(1) the actual distance from the environmental feature to the edge of the development and a comparison to the Natural assets overlay.

(2) the physical condition of the area between the environmental feature and the development including:

  (a) soils;

  (b) drainage patterns;

  (c) habitat type/s;

  (d) vegetation type and condition;

  (e) presence of exotic species;

  (f) observed fauna and signs of fauna; and

  (g) built infrastructure e.g. fences, drains and roads; and

(3) how buffer areas will maintain natural assets and ecological processes if a proposed buffer area/width is less than that specified in the Natural assets overlay code.

It is the responsibility of the development proponent to provide council with alternative solutions, when digressing from council's acceptable solutions, to ensure natural assets and ecological processes are not degraded as a consequence of the proposed development. Council may adopt the proponent's suggestions as conditions of development approvals.

SC6.9.2.13 Background information to assist environmental assessments

Council has compiled a range of environmental information to assist development proponents with the preparation of their environmental assessments. A list of the information is provided below with associated references:

(1) schedule of locally significant fauna, flora and vegetation/ecological communities along with those scheduled under legislation;

(2) landscaping guidelines expounding the use of local native species and excluding environmental weed species;

(3) local and regional movement requirements of wildlife (refine connectivity corridors based on species habitat location and known ecology);

(4) fauna survey techniques (e.g. types of trapping, call play back etc.) including the most appropriate targeted survey techniques and when these may be required for particular species;

(5) pest species (flora and fauna) specific to Townsville and appropriate management techniques; and

(6) Black Ross (Townsville) Water Quality Improvement Plan

SC6.9.2.14 Terminology

The following table provides a useful compendium of environmental terms, including terms used in this policy.

Word / Term	**Explanation**
Aquatic	Of the water, or living or growing in water.
Arboreal	Tree dwelling. Adapted to living in or among trees. Spending a significant part of the life cycle in trees or relying on arboreal habitats for shelter and/or food.
Avian	Birds. Of or pertaining to birds.
Biodiversity	The variety of all life forms: (1) *genetic diversity*—the variety of genetic information contained in individual plants, animals and other organisms. (2) *species diversity*—the variety of species. (3) *ecosystem diversity*—the variety of habitats, ecological communities and ecological processes. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Biodiversity values	As biodiversity is the variety of all forms of life biodiversity values are difficult to quantify. Biodiversity values are often based on a combination of biological and biophysical parameters including; habitat species richness and endemic anomalies. Some of these parameters have been included in the environmental importance rating map prepared for the Natural Assets Overlay.
Biophysical processes	Processes involving interaction between the biological (organic) world and the physical (inorganic) world e.g. soil formation and nutrient recycling.
Bioregion	As described in the *Vegetation Management Act 1999* (VMA).
BTF is Black-throated Finch	The Black-throated Finch BTF is an Endangered species under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 2000* (EPBC Act) and Queensland's *Nature Conservation Act 1992*. BTF habitat mapping is draft and will require further investigation to determine actual core habitat. A greater level of assessment will be required for development applications in BTF habitat areas.
Buffer	The threat management space between a natural or environmental asset and the threat. Buffers can also act as ecological corridors and provide habitat for wildlife. [anything serving to neutralise the shock of opposing forces (The Macquarie Dictionary (2nd Edition) 1991, p.234)]

Buffering	The practice of providing a managed ecotone between the area of environmental significance and the threatening process/es.
Connectivity	The physical linkages serving to connect dissimilar or separated patches of habitat. The name given to the concept of landscape elements being connected. The capacity of landscapes or aquatic environments to allow ecological movement and function. The broad concept can be considered to have several main elements:*landscape connectivity*—the physical connection between areas with vegetation cover across a landscape. (1) *habitat connectivity*—the connection between patches of habitat suitable to a particular species. (2) *ecological connectivity*—the ecological processes that underpin the function of landscapes; for example, the transfer of pollen or seeds and the sequestration of soil carbon. (3) *evolutionary connectivity*—populations of species are able to interact naturally, sharing genes and adapting to changing environmental conditions. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Core area, core habitat area	An area of habitat that is of a suitable size, shape and condition for an assemblage of species or a single organism. Core habitat provides nutrients and water resources, and supports successful reproduction. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45- 49).
Corridors	Corridors are passageways that facilitate the movement of organisms and serve as habitat. Corridors exist at a range of scales depending on the organism and their ecological requirements. Corridors are not confined to linear strips of vegetation or riparian zones but rather include an interconnected network of native vegetation and habitat across the landscape. Waterways and wetlands provide ecological corridors for aquatic organisms.
Degraded	In a lessor state as a result of human interaction and natural causes e.g. storms.
Ecological communities	Assemblages of species (plants, animals, bacteria and fungi) that interact with each other in a common environment and often as part of a food chain or trophic web.
Ecological functions	Functions and processes involving the interaction of organisms with each other and their environments including , nutrient cycling, pollination, animal and plant breeding.
Ecological significance	The term used to describe areas that are important for maintaining biodiversity and ecological processes.
Ecotone	The gradation or transition zone between different habitats or vegetation communities.
Ecosystem	Ecosystem is “1. a community of organisms interacting with one another and with the environment in which they live.” (The Macquarie Dictionary (2nd Edition) 1991, p.555). A complex network or interconnected system or a biological community of interacting organisms and their physical environment; for example, combinations of plant, animal and other organisms in communities and their non-living environment (soil, water, climate, and so on) interacting as a functional unit, such as forest, wetland or grassland. (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Ecosystem health	A measure of the condition of ecosystems from sustainable to threatened.

Ecosystem processes	Those life processes and interactions between organisms and the environment that (generally) contribute to the overall health of the ecosystem.
Ecosystem services	The multitude of resources and processes that are supplied by natural ecosystems. Collectively, these benefits are known as ecosystem services and include products like clean drinking water and processes such as the decomposition of wastes. The term is generally applied to benefits to human beings as with the Millennium Ecosystem Assessment 2005 definition “the benefits people obtain from ecosystems”. This is a narrow, anthropogenic definition that could restrict the protection of important ecosystem services if they are not seen as beneficial to humans. The definition has been broadened in the National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012 to read; “the processes or materials provided by ecosystems. Ecosystem services benefit biodiversity, humans and society through the provision of essential goods and services such as clean air, water, food, shelter, energy, nutrients, amenity values and cultural resources”. (pp.45-49)
Endemic	Refers to organisms that are native to a particular area or region. Having a limited distribution or habitat extent or confined to a specific area.
Environmental infrastructure	Environmental infrastructure is the basic framework or underlying foundation of the natural environment that contains the myriad of life support systems for all forms of life.
Hydrological function	The function of water moving through the landscape as part of a natural drainage process. Hydrological function is shaped by geological features and influences those features over time e.g. erosion. Hydrological function can be impeded by: (1) the placement of obstacles in waterways, (2) obstructing overland flow e.g. raised roads and rail lines, (3) reduced aquifer recharge.
Migratory species	Animals, especially birds and marine species, that travel significant distances (compared to remaining in a home range) to: (1) avoid climatic extremes and resource (food) depletion, (2) find sufficient resources to maintain physical health, (3) breed in more favourable conditions.
Native habitat	Habitat that is in a relatively natural state with minimal disturbance from human activities with a low incidence of exotic plant species.
Native species	Species (plant or animal) that would normally be found in the (Townsville) natural environment.
Natural areas	Those parts of the environment that have not been significantly altered from their natural state and that retain their ecological processes, biophysical functions and suite of native species.
Naturalised	Non-native species introduced to Australia that flourish and become part of the landscape.
Non-native	Not having evolved in Australia. Introduced into Australia from another country within the last 300 years.
Pest fauna and flora	Introduced species that threaten the viability and/or productivity of native ecosystems.

Refuge/refugia	An area that provides shelter, food or water for organisms when other parts of the landscape are inhospitable. For example, rocky areas can provide shelter during bushfires, while riparian areas might provide food and water during times of drought (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012, pp.45-49).
Resilience	The ability to recover after being impacted by threatening processes.
Riparian areas	Areas of vegetation alongside watercourses, lakes and wetlands. They often contain vegetation that differs from that in the surrounding landscape, providing important habitat and ecological resources (from National Wildlife Corridors Plan: A framework for landscape-scale conservation 2012 pp.45-49).
Significant ecological communities	Those ecological communities that are limited in extent (endemic) or population, confined to specific habitats or have characteristics that result in a vulnerability to environment changes and threatening process.
Threatened species	Threatened wildlife means native wildlife that is prescribed under the *Nature Conservation Act 1992* as— (a) extinct in the wild wildlife; or (b) endangered wildlife; or (c) vulnerable wildlife.
Threatening processes	Human activities that adversely impact the environment, natural values and ecological processes and result in adverse impacts including habitat loss, native vegetation destruction and reduced populations of native and migratory species.
Wader roosts	As defined in the Environment and Biodiversity Study: Final Report (Chenoweth 2011) and represented as a 700 metre buffer trigger area around wader roosts.
Wetland mapping and classification methodology	The "A Method to Provide Baseline Mapping and Classification for Wetlands in Queensland (VERSION 1.2) published by the Environmental Protection Agency, Queensland Government and produced in conjunction with the Australian Government (Department of the Environment and Heritage) in 2005.

SC6.10 Parking rates planning scheme policy

SC6.10.1 Introduction

Short Title – The planning scheme policy (PSP) may be cited as the Parking rates PSP.

SC6.10.1.1 Purpose

The purpose of the planning scheme policy is to:

(1) define the particular rates of parking that provide the relevant acceptable outcome under the Transport impact, access and parking code in the Townsville City Plan.

SC6.10.1.2 Legislative authority

This planning scheme policy is made under Chapter 2, Part 3 of the *Planning Act 2016*.

SC6.10.1.3 Relationship to the Townsville City Plan

This planning scheme policy is to be read in conjunction with the assessment provisions specified in the Townsville City Plan, specifically the Transport impact, access and parking code.

SC6.10.1.4 Terminology

Terms used in this planning scheme policy are defined in Schedule 1 - Definitions. A term which is not defined in Schedule 1 - Definitions is to be interpreted in accordance with Part 1.3.1 - Definitions.

SC6.10.2.1 Planning scheme policy content -parking rates

(1) Parking rates are provided on site in accordance with the following uses or combination of uses.

(2) Where the number of parking spaces calculated in accordance with this table is not a whole number, then the minimum number of spaces to be provided is to be rounded upward to the closest whole number.

(3) The number of car parking spaces required for people with a disability is to be in accordance with Table D3.5 of the Building Code of Australia. There is no requirement to designate car parking spaces for people with a disability where the total number of car parking spaces required is five (5) or less.

Use	Parking rates
Adult store	One (1) space per 25m² of GFA.
Agricultural supplies store	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Air services	One (1) space per 80m² of GFA.
Animal keeping	One (1) space per 10 animals for which accommodation is provided for on the premises, OR 3 spaces, whichever is the greater.
Aquaculture	One (1) space per employee (FTE).
Brothel	One (1) space for each room in the brothel AND one (1) space per two employees (FTE) on the premises at any one time.
Bulk landscape supplies	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Caretaker's accommodation	One (1) space.
Car wash	Two (2) spaces, AND queuing space within the site for 4 vehicles using or awaiting use of each washing bay.
Cemetery	Thirty (30) spaces plus one (1) space per two employees (FTE) on the premises at any one time.
Child care centre	One (1) space for every 6 children, and 1 space per employee (FTE).
Club	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Community care centre	One space per 20m² of GFA
Community use	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Crematorium	Thirty (30) spaces plus one (1) space per two employees (FTE) on the premises at any one time.
Detention facility	One (1) space per 2 employees (FTE); plus a minimum of ten (10) visitor spaces.
Dual Occupancy	Two (2) spaces per dwelling unit, which may be provided in tandem, of which one (1) space is to be covered per dwelling unit.
Dwelling house	Two (2) spaces, which may be provided in tandem, of which one (1) space is to be covered.
Dwelling unit	One (1) space.
Educational establishment	Primary – one (1) space per employee (FTE) AND one (1) space per 10 students for visitor parking AND sufficient spaces for loading and unloading of passengers in addition to other requirements. Secondary – one (1) space per employee (FTE), AND one (1) space per 10 students of legal driving age, AND one (1) visitor space per 50 students, AND sufficient spaces for loading and unloading of passengers in addition to other requirements. Tertiary – point five (0.5) spaces per employee (FTE) PLUS one (1) space per 10 students (FTE), AND sufficient spaces for loading and unloading of passengers in addition to other requirements.
Emergency services	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Environment facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Extractive industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Food and drink outlet	One (1) space per 10m² of GFA available to the public (including outdoor dining); One (1) space per 50m² of GFA for food preparation; AND One (1) space per 100m² of GFA used for storage.

Function facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Funeral parlour	One (1) space per employee; AND One (1) space per hearse; AND One (1) space per 4 persons capable of being seated in any chapel or accommodated in a function area with a minimum of ten (10) spaces.
Garden centre	One (1) space per 100m² of total use area, but not less than five (5) spaces.
Hardware and trade supplies	One (1) space per 40m² of GFA.
Health care services	One (1) space per 20m² of GFA, OR four (4) spaces per medical practitioner, whichever is the greater; AND one (1) space for ambulance vehicle pick-up and set down.
High impact industry	One (1) space per 100m² of GFA.
Hospital	One (1) space for each 4 beds, two (2) spaces for each 3 employees, AND one (1) space for each doctor.
Hostel	One (1) space for every 2 beds provided, one (1) space for every 4 employees (FTE), and an additional one (1) covered space for a resident manager, and a dedicated car washing bay (additional to visitor and tenant parking spaces). A dedicated car washing bay is not required where there are 5 or less dwelling units provided. A dedicated car wash bay may also be integrated with visitor parking to serve both functions.
Hotel	Licensed facilities: One (1) space per 2m² of bar area; and One (1) space per 5m² of the lounge and beer garden area. One (1) space for each guest suite; AND One (1) space for each resident manager or caretaker; AND For any drive-through facility, queuing space within the site for ten (10) vehicles being served or awaiting service.
Indoor sport and recreation	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Intensive animal industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Intensive horticulture	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Low impact industry	One (1) per 100m² of GFA.
Major sport, recreation and entertainment facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Marine industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Market	One (1) space per stall.
Medium impact industry	One (1) space per 100m² of GFA.
Motor sport facility	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.

Multiple dwelling	In the Principal centre zone: One point five (1.5) spaces per dwelling (and one (1) dedicated car washing bay* for the entire development). In the High density residential zone: One point five (1.5) spaces per dwelling (and one (1) dedicated car washing bay* for the entire development). In the Medium density residential zone: One point five (1.5) spaces per dwelling; Point two (0.2) spaces per dwelling for visitors (and one (1) dedicated car washing bay* for the entire development). All other zones: One point seven (1.7) spaces per dwelling; Point two (0.2) spaces per dwelling for visitors (and one (1) dedicated car washing bay* for the entire development). * A dedicated car washing bay is not required where there are 5 or less dwellings provided. A dedicated car wash bay also may be integrated with visitor parking to serve both functions.
Nature-based tourism	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Nightclub entertainment facility	One (1) space per 15m² for the first 1,500m² of GFA, then one (1) space per 25m² of GFA thereafter.
Non-resident workforce accommodation	One (1) space per employee (FTE).
Office	In the Principal centre zone: One (1) space per 70m² of GFA All other zones: One (1) space per 30m² of GFA.
Outdoor sales	Point seven five (0.75) spaces per 100m² of total use area AND four (4) spaces per work bay (for vehicle service facilities)
Outdoor sport and recreation	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Permanent plantation	No parking rate required.
Place of worship	One (1) space per 10 persons capable of being seated.
Port services	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Relocatable home park	One point five (1.5) spaces per relocatable home.
Renewable energy facility	No parking rate required.
Research and technology industry	One (1) space per 80m² of GFA.
Residential care facility	Subsidised developments (nursing and convalescent homes): One (1) space per 10 beds; AND one (1) space per 2 employees and one (1) space per ambulance Self-contained units: One (1) space per 10 units (residents) and one (1) space per 10 units (visitor)

Resort complex	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Retirement facility	One (1) space per 2 self-contained or service units, plus one (1) space per 5 nursing home beds of the premises.
Rural industry	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Rural workers accommodation	One (1) space per accommodation unit.
Service industry	One (1) space per 100m² of GFA.
Service station	One (1) space per 40m² of GFA.
Shop	In the Principal centre zone: One (1) space per 30m2 of total retail area* available to the public and one (1) space for each 100m2 of total storage GFA. All other zones: One (1) space per 25m2 of total retail area * available to the public and one (1) space for each 100m2 of total storage GFA. * The total retail area available to the public excludes: (a) building services, plant and equipment; (b) access between levels; (c) ground floor public lobby; (d) a mall; and (e) the parking, loading and manoeuvring of motor vehicles;
Shopping Centre	In the Principal centre zone: One (1) space per 30m² of total retail area * available to the public and one (1) space per each 100m² of total storage GFA. All other zones: One (1) space per 25m² of total retail area * available to the public GFA and one (1) space per each 100m² of total storage GFA. * The total retail area available to the public excludes: (a) building services, plant and equipment; (b) access between levels; (c) ground floor public lobby; (d) a mall; and (e) the parking, loading and manoeuvring of motor vehicles.

Short-term accommodation	In the Principal centre zone: 0.75 spaces per self-contained unit, and 0.25 spaces per non self-contained unit, AND one (1) space for each 10m2 of GFA available to the public and one (1) space per 50m2 of GFA kitchen and preparation areas, and point one (0.1) spaces per unit for visitors. All other zones: One (1) space for each guest suite, one (1) space for a restaurant manager or caretaker, AND one (1) space for each 10m2 of GFA available to the public and one (1) space per 50m2 of GFA kitchen and preparation areas.
Showroom	One (1) space per 40m² of GFA.
Special industry	One (1) space per 100m² of GFA.
Telecommunications facility	No parking rate required.
Theatre	One (1) space per 15m² of GFA or one (1) space for each 4 seats, whichever is the greater.
Tourist attraction	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use.
Tourist park	One (1) space per van, relocatable home and cabin site (to be located adjacent to such site), one (1) visitor space per 10 such sites, one (1) space for each 2 staff members, and one (1) space for a resident manager.
Transport depot	Sufficient spaces to accommodate the amount and type of vehicle traffic likely to be generated by the particular use.
Utility installation	Sufficient spaces to accommodate the amount and type of vehicle traffic likely to be generated by the particular use.
Veterinary services	Five (5) spaces per veterinarian.
Warehouse	One (1) space per 100m² of GFA.
Wholesale nursery	One (1) space per 100m² of total use area.
Winery	One (1) space per 25m² of GFA.
Any other development	Sufficient spaces to accommodate the amount of vehicular traffic likely to be generated by the particular use.

Schedule 7 Places of cultural heritage value

Table SC7.1.1 - Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Aitkenvale				
171510	1 RP 727464	98-100 Charlotte Street, Aitkenvale 4814		Local
176950	169 RP 703537, 170 RP 703537, 171 RP 703537	5 Sabadine Street, Aitkenvale 4814		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Arcadia				
249270	160 EP 708	31 Hayles Avenue, Arcadia 4819	RSL	Local
249430	97 RP 706831	36 Hayles Avenue, Arcadia 4819	Dell-Orana	Local
249960	16 RP 706831	27 Marine Parade, Arcadia 4819		Local
250120	3 SP 172355	5-8 Marine Parade, Arcadia 4819	Hayles House	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Belgian Gardens				
27750	3 RP 712293	29 Evans Street, Belgian Gardens 4810		Local
30080	1 RP 748513	142 Bundock Street, Belgian Gardens 4810		Local
30450	43 T 118114	19 Bundock Street, Belgian Gardens 4810		Local
30460	44 T 118114	21 Bundock Street, Belgian Gardens 4810		Local
33100	32 RP 729858	13 St James Drive, Belgian Gardens 4810	Bishop's Lodge	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Castle Hill				
24690	257 EP 513	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
24700	156 EP 2335	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
24710	264 EP 543	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
24730	409 EP 996	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
24740	788 CP 855219	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
24750	388 EP 1264	0 Castle Hill Road, Castle Hill 4810	Castle Hill	State
45170	1 USL 50891	13 Scully Street, Castle Hill 4810	Castle Hill	State
334383	157 EP 2349	Castle Hill Road, Castle Hill 4810	Castle Hill	Local

347088	11 USL 50631, 87 USL 50632,	0 Potts Street, Castle Hill 4810	Castle Hill	State
350995	2 CP 853734, 3 CP 853734, 460 CP 854058	Castle Hill Road, Castle Hill 4810	Castle Hill	State
355408	5 USL 50632, 18 USL 50632	0 William Street, Castle Hill 4810	Castle Hill	State
500749	358 SP 144120	0 Yarrawonga Drive, Castle Hill 4810	Castle Hill	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Cape Cleveland				
361452	1 CP 882211, 2 CP 882211, 3 CP 882211	0 Cape Cleveland Road, Cape Cleveland 4810	Cape Cleveland Light Station	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Townsville City				
2100	15 T 118173	16 Wickham Street, Townsville City 4810	Townsville Customs House (former)	State
2110	10 T 118248	12-14 Wickham Street, Townsville City 4810	Townsville State Government Offices	State
2140	1 RP 732344	108-124 Flinders Street, Townsville City 4810	Burns Philp & Company Ltd Building (former)	State
2170	2 RP 701607	247 Flinders Street, Townsville City 4810	Samuel Allen & Sons Building (former)	State
2180	2 RP 702069, 2 RP 701585, 1 RP 711511	87-95 Flinders Street, Townsville City 4810	Tattersalls Hotel	State
2190	1 RP 716793, 2 RP 716793	101-111 Flinders Street, Townsville City 4810	Bank of NSW, and AMIEU (QLD Branch) (former)	State
2220	2 SP 172356	129-135 Flinders Street, Townsville City 4810	Commercial Hotel (former)	Local
2240	1 RP 701590	143-149 Flinders Street, Townsville City 4810	Magnetic House	State
2250	327 SP 171614 1 AP 13623	151-157 Flinders Street, Townsville City 4810	Exchange Hotel	Local
2270	325 T 1185	167-173 Flinders Street, Townsville City 4810	Australian Joint Stock Bank (former)	State

2280	1 RP 716252, 4 RP 716252, 3 RP 701624	175-179 Flinders Street, Townsville City 4810	Queens Building	State
2290	2 RP 701623, 2 RP 716252, 3 RP 716252	181-183 Flinders Street, Townsville City 4810	Atkinson & Powell Building (former)	State
2300	1 RP 701617 1 RP 701621	185-191 Flinders Street, Townsville City 4810	North Queensland Mortgage & Investment Company, (former)	Local
2310	CP SP 162432	193-195 Flinders Street, Townsville City 4810	T. Willmetts & Sons printery and stationery warehouse (former)	State
2320	322 T 1185	197-203 Flinders Street, Townsville City 4810	Stanton House	State
2330	2 RP 729802	205-213 Flinders Street, Townsville City 4810	Commercial Banking Company of Sydney (former)	State
2350	1 RP 701615	221-223 Flinders Street, Townsville City 4810	Clayton's Apothecaries Hall (former)	State
2400	CP SP 125906	241-245 Flinders Street, Townsville City 4810	Rooney Building	State
2420	1 RP 701658	253-259 Flinders Street, Townsville City 4810	Perc Tucker Regional Gallery	State
2450	1 RP 701662, 2 RP 701662	269-275 Flinders Street, Townsville City 4810	W. H. Green Building (former)	Local
2490	3 RP 701665	287-289 Flinders Street, Townsville City 4810	Willmett's Stationery Shop (former)	Local
2500	2 RP 707340	291-293 Flinders Street, Townsville City 4810	Kodak Building (former)	Local
2510	16 RP 707412	295-303 Flinders Street, Townsville City 4810	Queensland National Bank (former)	State
2540	171 T 1181	337-343 Flinders Street, Townsville City 4810	Westpac Bank	State
2650	CP SP 141326	419-433 Flinders Street, Townsville City 4810	State Government Offices (former)	State
2790	1 RP 708141, 2 RP 701742	495-499 Flinders Street, Townsville City 4810	Newmarket Hotel	Local
3020	1 SP 229803	719-741 Flinders Street, Townsville City 4810	Lion Brewery (former)	State
3030	1 RP 739077	743-765 Flinders Street, Townsville City 4810	Mansfield Hotel	Local
3070	1 RP 701861, 320 T 11823	807-813 Flinders Street, Townsville City 4810	Sovereign Hotel	Local

3080	321 T 11823	815-821 Flinders Street, Townsville City 4810		Local
3090	5 RP 712497	823-827 Flinders Street, Townsville City 4810		Local
3100	4 RP 712781	829-833 Flinders Street, Townsville City 4810		Local
3190	103 SP 253492	502-790 Flinders Street, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
542194	CP SP 253512	3 Kingsway Place, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
544267	1 SP 253510	538 Flinders Street, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
544268	26 SP 253492	5 Kingsway Place, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
547782	2 SP 253510	534 Flinders Street, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
547783	3 SP 253510	546 Flinders Street, Townsville City 4810	Townsville Railway Station and North Yards Railway Workshops	State
3220	181 T 1181, 182 T 1181	486-500 Flinders Street, Townsville City 4810	Great Northern Hotel	State
3340	31 T 11860	416-418 Flinders Street, Townsville City 4810	Australian Mutual Provident Society Building (former)	State
3360	33 T 11860	408-410 Flinders Street, Townsville City 4810	Henlein & Co. (former)	State
3480	2 RP 707272, 20 RP 707272	336-344 Flinders Street, Townsville City 4810	Commercial Banking Company of Sydney (former)	Local
3520	6 T 118212	272-278 Flinders Street, Townsville City 4810	Commonwealth Bank of Australia (former)	State
3530	1 RP 735183	252-270 Flinders Street, Townsville City 4810	Townsville Post Office (former)	State
3540	12 T 118573	232-234 Flinders Street, Townsville City 4810	Aplin Brown & Company Building (former)	State
3550	2 RP 701523, 3 RP 701523	228-230 Flinders Street, Townsville City 4810	Adelaide Steamship Co. (former)	Local

3560	4 RP 701523, 5 RP 701523	224-226 Flinders Street, Townsville City 4810	Agora House	State
3620	1 RP 747175	104-106 Flinders Street, Townsville City 4810	Queensland Building	Local
3930	1 RP 701816	11 Melton Terrace, Townsville City 4810	Melton Lodge Flats (former)	Local
3940	2 RP 701818	13 Melton Terrace, Townsville City 4810	Biralee Flats (former)	Local
3990	2 RP 701817	23 Melton Terrace, Townsville City 4810		Local
4040	2 RP 716527	35-39 Sturt Street, Townsville City 4810	Osler House	State
4080	453 EP 1600 3 RP 701686 4 RP 701686	81-99 Sturt Street, Townsville City 4810	Townsville Magistrates Court (former)	State
4400	1 RP 718874	485-493 Sturt Street, Townsville City 4810	Townsville Choral & Orchestral Society Building	State
4420	1 RP 865807	513 Sturt Street, Townsville City 4810	Potters House	State
4540	304 T 11823, 319 T 11823	654-662 Sturt Street, Townsville City 4810	Saint Theodore's Greek Orthodox Church	State
4730	1 RP 712215, 23 RP 745734	246-254 Sturt Street, Townsville City 4810	Sturt Street Shops	Local
4760	1 RP 701648, 2 RP 701648	42-50 Sturt Street, Townsville City 4810	Commonwealth Offices	State
4880	716 T 118501	31-69 Walker Street, Townsville City 4810	Townsville Magistrates Court	Local
4900	1 RP 744965, 2 RP 744965, 1 RP 701696, 2 RP 701696, 3 RP 701696, 12 T 11817, 137 T 1181, 140 T 1181	103-141 Walker Street, Townsville City 4810	Townsville City Council Administration Building	Local
4920	5 SP 263496	215 Walker Street, Townsville City 4810	Townsville Technical College (former)	State
5260	203 T 11823	412 Walker Street, Townsville City 4810		Local
5500	104 T 1181	42-50 Walker Street, Townsville City 4810	Masonic Temple	Local
5540	2 RP 718721	120 Denham Street, Townsville City 4810		Local
6820	47 T 1181, 48 T 1181	10 The Strand, Townsville City 4810	Criterion Hotel	Local
6890	290 CP 859212	14 The Strand, Townsville City 4810	Anzac Memorial Park	State
6960	1 RP 745353, 1 RP 702069, 2 RP 717290	45 Flinders Street, Townsville City 4810	Queens Hotel (former)	State
7110	1 RP 708992	30 Cleveland Terrace, Townsville City 4810	Wyora Court	Local

7120	1 RP 722451, 2 RP 701633	26 Cleveland Terrace, Townsville City 4810	Warringa	State
7130	3 RP 701633, 4 RP 701633	24 Cleveland Terrace, Townsville City 4810	Selhurst	State
7160	1 RP 702085	20 Cleveland Terrace, Townsville City 4810	The Rocks Guesthouse	State
7170	8 RP 701633	18 Cleveland Terrace, Townsville City 4810		Local
7190	1 RP 702042	14 Cleveland Terrace, Townsville City 4810		Local
7200	3 RP 702042	12 Cleveland Terrace, Townsville City 4810		Local
7210	6 T 118300	4 Cleveland Terrace, Townsville City 4810	Drystone Wall Melton Hill	State
7230	CP SP 171329	2A Cleveland Terrace, Townsville City 4810	Drystone Wall Melton Hill	State
7310	24 RP 701633	2 Herbert Street, Townsville City 4810		Local
7320	2 RP 702042	1 Herbert Street, Townsville City 4810		Local
7370	15 T 11840	22 Willmett Street, Townsville City 4810		Local
7460	1 RP 701632, 2 RP 701632, 18 RP 701633	13-15 Willmett Street, Townsville City 4810		Local
7520	1 SP 156441	6 Willmett Street, Townsville City 4810		Local
7610	71 T 11813, 72 T 11813, 73 T 11813, 74 T 11813, 2 RP 840903 2 RP 701819	36 Cleveland Terrace, Townsville City 4810	St. James Cathedral & Synod Hall	State
7730	2 RP 701653	60-66 Denham Street, Townsville City 4810	Denham Chambers	Local
7740	2 RP 701659	54-56 Denham Street, Townsville City 4810	Roberts Leu & North Building (former)	Local
8090	2 SP 123456, 3 SP 123456	266-272 Stanley Street, Townsville City 4810	Sacred Heart Cathedral	State
8100	11 RP 903759, 219 T 1181	188-210 Stanley Street, Townsville City 4810	Townsville School of Arts (former)	
8270	2 RP 709895	151-155 Stanley Street, Townsville City 4810		Local
8280	1 RP 709895	157 Stanley Street, Townsville City 4810		Local
13490	247 EP 2301	32 The Strand, Townsville City 4810	Tobruk Memorial Baths	State
353331	752 EP 2218,	66-76 Ogden Street, Townsville City 4810	Victoria Bridge (entire bridge)	State
543458	2 SP 212760, CP SP 222359	1-13 Sturt Street, Townsville City 4810	Dalgety Offices and former warehouse frontage	State
4010	CP SP 222359	84-106 Denham Street, Townsville City 4810	Denham Street Facade	

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Cluden				
215510	2 RP 748152	1-105 Racecourse Road, Cluden 4811	Grandstand, former totalisator building and main entrance gates, Cluden	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Douglas				
274430	40 SP 189822	150 Angus Smith Drive, Douglas 4814	Eddie Koiki Mabo Library, James Cook University	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Garbutt				
59180	156 T 118192, 157 T 118192	62-66 Lonerganne Street, Garbutt 4814	St Theresa's War Memorial Church	Local
51910	CP SP 205746	3-5 Ramsay Street, Garbutt 4814	US 5th Air Force Operations and Signals Building (former)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Hermit Park				
95520	122 RP 703476, 123 RP 703476	25-27 Norris Street, Hermit Park 4810		Local
97940	36 RP 703477	56 Queens Road, Hermit Park 4812		Local
98040	7 RP 703414	42 Queens Road, Hermit Park 4812		Local
100960	81 RP 703399	17 Philp Street, Hermit Park 4812		Local
101730	173 RP 703399	17 Armstrong Street, Hermit Park 4812		Local
102430	221 RP 703399	37 Ackers Street, Hermit Park 4812		Local
105190	3 RP 710800	2 The Avenue, Hermit Park 4812		Local
105210	48 RP 703409, 49 RP 703409	6 The Avenue, Hermit Park 4812		Local
105230	50 RP 703409, 51 RP 703409, 52 RP 703409	8-10 The Avenue, Hermit Park 4812		Local
105330	30 RP 703409, 31 RP 703409, 32 RP 703409, 33 RP 703409	5-7 The Avenue, Hermit Park 4812	Weroona	Local
107640	5 RP 711405	5 Riverview Street, Hermit Park 4812	Rosslea	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Hervey Range/Lynam				
532234	26 SP 149308	2679 Hervey Range Road, Hervey Range 4817	Range Hotel, Burial Ground and Camping Reserve	State
535200	379 EP 352	Page Road, Lynam 4817	Stock Route, Camping Reserve	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Horseshoe Bay				
251320	6 H 7329	2-10 Heath Street, Horseshoe Bay 4819		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Hyde Park				
116990	6 RP 703442	30 Surrey Street, Hyde Park 4812		Local
117800	4 RP 716211	22 Bayswater Terrace, Hyde Park 4812		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Idalia				
546420	905 SP 253659	2 Kokoda Street, Idalia 4811	Ross River Meatworks Chimney	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Jensen				
520786	3 RP 882869	7 Veales Road, Jensen 4818		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Kirwan				
547881	1 RP 864623	555 Ross River Road, Kirwan 4817	Retreat Hotel Site (former)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Mount St John				
65470	906 SP 260001	173 Webb Drive, Mt St John 4818	Y Station 16 Heavy Anti -aircraft Battery	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Mount Louisa				
67030	900 SP 264431	Upper crossing of the Bohle River - Dalrymple Road, Mt Louisa 4814	Bohle Hotel Site (former) (469720.7867540)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Mundingburra				
132270	2 RP 743712	70 Love Lane, Mundingburra 4812		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Mysterton				
119890	2 RP 717551	21 Lawson Street, Mysterton, 4812	Rosebank	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Nelly Bay				
241480	73 EP 228	118-120 Sooning Street, Nelly Bay 4819		Local
242110	1 RP 714466	48 Sooning Street, Nelly Bay 4819		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
North Ward				
10020	1 RP 710504	5 Victoria Street, North Ward 4810	Maida Vale	Local
10050	71 T 11867	11-13 Victoria Street, North Ward 4810	Kardinia	State
10070	1 RP 701912	21 Victoria Street, North Ward 4810		Local
10090	1 RP 719858	25 Victoria Street, North Ward 4810		Local
10120	1 RP 701927, 3 RP 701927	37 Victoria Street, North Ward 4810		Local
10130	3 RP 721229	39 Victoria Street, North Ward 4810		Local
10330	1 RP 739248	13 Queen Street, North Ward 4810		Local
10410	3 RP 745504	24 Queen Street, North Ward 4810		Local
12240	21 T 118288	37 Howitt Street, North Ward 4810		Local
13190	310 T 1181	70 The Strand, North Ward 4810	Anelay Flats (former)	Local
13300	2 RP 707346, 262 T 1181	55 The Strand, North Ward 4810	The Seaview Hotel	Local
13370	1 RP 710003, 30 T 1187, 31 T 1187	45 The Strand, North Ward 4810	St Patrick's Convent	State
13430	48 T 1187	27 Carter Street, North Ward 4810		Local
14490	2 RP 733821	1 Carter Street, North Ward 4810	Rockton	Local
14510	1 SP 196156	1 Fryer Street, North Ward 4810		Local

15180	87 SP 202747, 88 SP 198966	9 Cleveland Terrace, North Ward 4810		Local
15220	2 RP 702016, 37 T 11813	11 Fryer Street, North Ward 4810	Yongala Lodge	State
15240	2 RP 710003	6-14 Fryer Street, North Ward 4810	St Joseph's Church	State
501486	2 SP 257303	27 Mitchell Street, North Ward 4810	Former North Ward Defence Complex, Townsville	State
15250	3 SP 257303	46 Oxley Street, North Ward 4810	Former North Ward Defence Complex, Townsville	State
547887	4 SP 257303	38 Oxley Street, North Ward 4810	Former North Ward Defence Complex, Townsville	State
16660	141 T 1186	82 Eyre Street, North Ward 4810		Local
16870	14 T 118194	207 Denham Street, North Ward 4810		Local
16970	2 RP 707023	2 Eyre Street, North Ward 4810	Edgecliff	Local
17320	105 T 1186	117 Eyre Street, North Ward 4810		Local
17420	85 T 1186	137 Eyre Street, North Ward 4810		Local
18820	6 RP 701820	67 Cook Street, North Ward 4810		Local
19600	1 RP 716224	4 Rose Street, North Ward 4810		Local
19810	219 T 1186	37 Rose Street, North Ward 4810		Local
20340	251 SP 223215	4-6 Warburton Street, North Ward 4810	Townsville Central State School	State
21180	92 T 11884	64 Paxton Street, North Ward 4810		Local
21290	1 RP 708807	40 Paxton Street, North Ward 4810	David House	Local
21360	53 T 11884	26 Paxton Street, North Ward 4810		Local
21370	52 T 11884	24 Paxton Street, North Ward 4810		Local
21470	202 T 118159	1-13 Paxton Street, North Ward 4810	Queens Gardens	State
20330	201 SP 126605	19-43 Paxton Street, North Ward 4810	Queens Gardens	State
21480	120 EP 2264	45-85 Paxton Street, North Ward 4810	School House	State
21970	1 RP 717329	21 Queen Street, North Ward 4810		Local
21980	1 RP 716539	22 Murray Street, North Ward 4810		Local
22020	21 RP 906488	3 Victoria Street, North Ward 4810	Cummins House (former)	Local
22030	23 T 118176	9A Murray Street, North Ward 4810	Townsville Astronomical Trigonometrical Station	State
22320	138 T 11884	49 Alexandra Street, North Ward 4810		Local
22330	137 T 11884	47 Alexandra Street, North Ward 4810		Local
22370	133 T 11884	39 Alexandra Street, North Ward 4810		Local
22400	160 T 11884	33 Alexandra Street, North Ward 4810		Local
22440	1 RP 733119	27 Alexandra Street, North Ward 4810		Local

22470	153 T 11884	21 Alexandra Street, North Ward 4810		Local
22510	176 T 11884	13 Alexandra Street, North Ward 4810		Local
22610	41 T 11884	14 Alexandra Street, North Ward 4810		Local
22630	70 T 11884	14 Kennedy Street, North Ward 4810		Local
22640	69 T 11884	18 Alexandra Street, North Ward 4810		Local
22650	68 T 11884	20 Alexandra Street, North Ward 4810		Local
22670	66 T 11884	24 Alexandra Street, North Ward 4810		Local
22750	86 T 11884	36 Alexandra Street, North Ward 4810		Local
22760	85 T 11884	38 Alexandra Street, North Ward 4810		Local
23350	19 T 118157 20 T 118157	352-354 Stanley Street, North Ward 4810	Castlecrag	Local
23420	2 T 118125	338 Stanley Street, North Ward 4810		Local
23960	2 RP 701921, 3 RP 714664	5 Stuart Street, North Ward 4810		Local
351851	16 SP 236486	11-13 Clifton Street, North Ward 4810	Anton Breinl Institute (former	State
500058	1 SP 168605	336 Stanley Street, North Ward 4810	Harcourt	Local
539151	12 SP 236486	49-55 Gregory Street, North Ward 4810	Townsville General Hospital (former)	State
541615	5 SP 211556, 7 SP 211556	38-52 Howitt Street, North Ward 4810	Kissing Point Fortifications & Jezzine Barracks	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Oak Valley				
360408	58 RP 737741	12 Chisholm Trail, Oak Valley 4811	Tobacco Kiln	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Pallarenda				
34790	633 EP 1908	The Esplanade, Pallarenda, 4810	Cape Pallarenda Quarantine Station (former)	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Paluma				
512763	203 P 8363	66 Mt Spec Road, Paluma 4816	Ivy Cottage	Local
527786	2 RP 728420	13 Lennox Crescent, Paluma 4816	WW2 igloo	Local
530972	2 P 83613	3 Lookout Road, Paluma 4816	Misthaven Units	Local
528857	15 P 8366, 17 P 8366, 18 P 8366	25 Lennox Crescent, Paluma 4816	WW2 igloo	Local
530970	2 P 8363	63 Mount Spec Road	Tennis Court	Local
530971	1 P 8363	61 Mount Spec Road, Paluma 4817	Tennis Court	Local
534148	401 P 8363	24 Mount Spec Road, Paluma 4816	Cavilcade guesthouse (former)	Local
534150	308 P 8363	52 Mt Spec Road, Paluma 4816	RAAF No 6 MRU (former)	Local
534155	95 AP 15524	9 Mt Spec Road, Paluma 4816	WW2 Yank Hut	Local
534160	13 RP 750121	17-19 Lennox Crescent, Paluma 4816	WW2 igloo	Local
		Mount Spec Road	Mount Spec Road and Little Crystal Creek Bridge	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Picnic Bay				
240900	201 CP 850698	11-15 Granite Street, Picnic Bay 4819	Magnetic Island Craft Shop	State
			Picnic Bay Jetty	State
240680	105 P 9381 116 P 9381 117 P 9381	15 Barbarra Street, Picnic Bay 4819		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Railway Estate				
84650	25 RP 703382	71 Robertson Street, Railway Estate 4810		Local
86850	17 RP 703371	48 Tenth Avenue, Railway Estate 4810		Local
87010	33 RP 703373	80 Tenth Avenue, Railway Estate 4810		Local
88600	2 RP 703361 117 RP 703355, 118 RP 703355	5 Ninth Avenue, Railway Estate 4810		Local
88860	51 SP 126582	60 Railway Avenue, Railway Estate 4810	Byer's Store (former)	Local

89350	626 EP 1920	29-47 Railway Avenue, Railway Estate 4810	Railway Estate State School	Local
90780	22 SP 156437	128 Boundary Street, Railway Estate 4810		Local
90950	7 RP 703356	162 Boundary Street, Railway Estate 4810		Local
91440	2 RP 860274	99-101 Boundary Street, Railway Estate 4810	Ross Island Hotel	Local
92410	101 RP 703359	41 Second Street, Railway Estate 4810		Local
92460	165 SP 116238	19 Second Street, Railway Estate 4810		Local
92530	72 RP 703359, 182 RP 703359, 183 RP 703359	5 Second Street, Railway Estate 4810		Local
92660	1 RP 846351	26 Second Street, Railway Estate 4810		Local
92820	289 RP 703355, 290 RP 703355, 291 RP 703355, 292 RP 703355, 293 RP 703355, 294 RP 703355, 295 RP 703355, 296 RP 703355	40 Tenth Avenue, Railway Estate 4810		Local
92860	10 SP 227326, 20 SP 227326	29 Third Street, Railway Estate 4810		Local
92990	143 RP 703359	3 Third Street, Railway Estate 4810		Local
93620	57 RP 703364	17 Anderson Street, Railway Estate 4810		Local
93990	84 RP 703364	7 Fifth Street, Railway Estate 4810		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Rasmussen				
510460	1 RP 743522	1087 Riverway Drive, Rasmussen 4815	Gollogly's House (former)	Local
511429	20 RP 853743	1199 Riverway Drive, Rasmussen 4815	Kennedy Hotel Site (former)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Roseneath				
237850	491 E 12463	521-549 Stuart Drive, Roseneath 4811	St Brigid's Church	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Rupertswood				
512997	4 RP 736178	17 Bolinda Court, Rupertswood 4817	Alice Hotel Site (former)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
South Townsville				
75660	23 RP 703389	35 Sixth Avenue, South Townsville 4810		Local
76270	4 SP 120464	42 Nelson Street, South Townsville 4810		Local
76280	50 T 118105	40 Nelson Street, South Townsville 4810		Local
76320	1 RP 712482	32 Nelson Street, South Townsville 4810		Local
76370	169 T 118105	20 Nelson Street, South Townsville 4810		Local
76520	2 RP 745103	15 Nelson Street, South Townsville 4810		Local
76530	99 T 118105	17 Nelson Street, South Townsville 4810		Local
76610	71 T 118105, 72 T 118105, 73 T 118105, 74 T 118105, 75 T 118105	32 Hubert Street, South Townsville 4810	St Patrick's Church	Local
76810	42 RP 703389, 43 RP 703389	18 Fifth Avenue, South Townsville 4810		Local
77120	19 RP 745719, 20 RP 745719	40 Bell Street, South Townsville 4810		Local
77330	159 T 118105	3 Bell Street, South Townsville 4810		Local
77340	158 T 118105	5 Bell Street, South Townsville 4810		Local
77350	157 T 118105	7 Bell Street, South Townsville 4810		Local
77360	156 T 118105	9 Bell Street, South Townsville 4810		Local
77460	36 T 118105	29 Bell Street, South Townsville 4810		Local
77500	33 T 118105	35 Bell Street, South Townsville 4810		Local
77770	1 T 11868	78 Tully Street, South Townsville 4810	South Townsville State School	Local
77940	101 T 11887, 102 T 11887	20 Macrossan Street, South Townsville 4810	Commonwealth Hotel	Local
77950	1 RP 708320	39 Allen Street, South Townsville 4810		Local

77990	275 T 11868, 276 T 11868, 277 T 11868	30 Macrossan Street, South Townsville 4810	St John's Anglican Church Precinct	State
78600	37 CP 868168, 195 CP 868168	18-38 Tully Street, South Townsville 4810	Victoria Park	Local
79240	23 RP 745911	57 Perkins Street, South Townsville 4810		Local
79460	2 RP 745100	103 Perkins Street, South Townsville 4810		Local
79520	21 T 118638	115-147 Perkins Street, South Townsville 4810	Warehouse	Local
79820	1 RP 701973, 2 RP 701973	54 Davidson Street, South Townsville 4810		Local
79830	7 RP 701972, 9 RP 701972	56 Davidson Street, South Townsville 4810		Local
79840	6 RP 701972	58 Davidson Street, South Townsville 4810		Local
79850	3 RP 701972	60 Davidson Street, South Townsville 4810		Local
80960	322 T 118105, 323 T 118105	29-31 McIlwraith Street, South Townsville 4810	Republic Hotel	Local
81100	1 RP 701930	3 Palmer Street, South Townsville 4810		Local
81140	28 RP 745913, 35 T 11868, 52 T 11868	11 Palmer Street, South Townsville 4810	The Australian Hotel	Local
81150	36 T 11868	13 Palmer Street, South Townsville 4810		Local
81160	37 T 11868	15 Palmer Street, South Townsville 4810	Queensland Teachers Union Building	Local
81210	1 RP 701933, 43 T 11868	31 Palmer Street, South Townsville 4810	Shamrock Hotel	Local
81360	CP SP 225259	84 McIlwraith Street, South Townsville 4810	Metropole Hotel	Local
81380	709 SP 135285	42-68 Palmer Street, South Townsville 4810	Townsville Maritime Museum	Local
81520	2 RP 701959	24 Archer Street, South Townsville 4810		Local
81840	3 RP 701968, 5 RP 701968	14 Allen Street, South Townsville 4810		Local
82110	1 RP 706700, 2 RP 706700	65 Morey Street, South Townsville 4810	Overseas Telecommunications Centre (former)	Local
82640	41 RP 703374, 42 RP 703374, 43 RP 703374	264-268 Boundary Street, South Townsville 4810	Victoria Park Hotel	State
502604	2 RP 715005	262 Boundary Street, South Townsville 4810	Victoria Park Hotel (former Scown butchery)	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Stuart				
254620	56 EP 1573, 57 SP 152800	4900 Prison Reserve Area, Stuart 4811	Stewart's Creek Gaol (former)	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
West End				
38200	12 RP 745387	28 Greenslade Street, West End 4810		Local
38290	2 RP 701539	10 Greenslade Street, West End 4810		Local
38470	8 RP 745387	33 Greenslade Street, West End 4810		Local
38480	1 RP 701544	35 Greenslade Street, West End 4810		Local
38600	28 T 118117	2 Castling Street, West End 4810	Jean Devanny home (former)	Local
38630	191 EP 1742	5 Castling Street, West End 4810	Currajong	State
39380	1 RP 732245	22-26 Echlin Street, West End 4810	Plaza Cinema (former)	Local
39710	11 RP 701603	14 Cowley Street, West End 4810		Local
39980	2 RP 709750 3 RP 709750	96-134 Leigh Street, West End 4810	St Peter's Church	Local
40050	158 RP 701649, 159 RP 701649	26 Leigh Street, West End 4810		Local
40100	148 RP 701649, 149 RP 701649	16 Leigh Street, West End 4810		Local
40240	29 RP 701601	11 Leigh Street, West End 4810		Local
40510	122 RP 701649, 123 RP 701649	30 Estate Street, West End 4810		Local
41480	52 RP 701649	11 Edwards Street, West End 4810		Local
41490	51 RP 701649	9 Edwards Street, West End 4810		Local
41510	47 RP 701649 48 RP 701649	5 Edwards Street, West End 4810		Local
42120	1 SP 188739	40 Percy Street, West End 4810		Local
42890	224 RP 713516	21-25 Green Street, West End 4810	RAAF Operations Building Site (former)	State
43050	1 RP 712313	32 William Street, West End 4810		Local
43070	2 RP 712908	36 William Street, West End 4810	Mona Vale	Local
43900	169 EP 2263, 170 EP 2263	1-5 Stagpole Street, West End 4810		Local
44080	2 RP 725278	47 Stagpole Street, West End 4810		Local
44310	254 T 11869	95 Stagpole Street, West End 4810	Wolverton	State
44750	1 RP 701781	77 Harold Street, West End 4810		Local

44760	3 RP 701778, 4 RP 701778	113 Harold Street, West End 4810		Local
45650	1 RP 701722, 2 RP 701722, 3 RP 701722	10 Ralston Street, West End 4810		Local
46260	2 RP 711432	144 Francis Street, West End 4810		Local
46300	2 RP 701606, 5 RP 701603	128 Francis Street, West End 4810		Local
46630	5 T 118365	33 Church Street, West End 4810	West End Cemetery	State
47010	6 RP 745498	145 Francis Street, West End 4810		Local
47900	134 RP 701591, 135 RP 701591, 136 RP 701591	1 North Street, West End 4810		Local
50060	446 CP 886001	72-104 Ingham Road, West End 4810	Townsville Showground	State
50210	46 T 118117, 47 T 118117, 48 T 118117, 202 T 118101, 203 T 118101, 204 T 118101	28-34 Ingham Road, West End 4810	St Mary's Church and former Convent	Local
50340	707 SP 253232	14 Wilson Street, West End 4810	Townsville District Education Centre and Memorial Gates	State
50420	4 T 118351	63-69 Ingham Road, West End 4810	West End Park	Local
50440	2 RP 709434	71 Ingham Road, West End 4810	Church	Local
50510	18 RP 701558, 19 RP 701558	89 Ingham Road, West End 4810	West End Hotel	State
50960	19 RP 745707	86 Livingstone Street, West End 4810		Local
51130	15 T 118141	73 Livingstone Street, West End 4810		Local
51260	67 T 118107	30 Shaw Street, West End 4810		Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
West Point				
252340	456 NPW 398	0 West Point Road, West Point, 4819	Fort Complex Magnetic Island	State

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Woodstock				
360653	24 EP 352	42 Woodstock Avenue, Woodstock 4816	Woodstock CWA Hall	Local

Table SC7.1.1—Places of cultural heritage value (Part)

Property number	Lot on plan address	Street address	Place name	Listing
Wulguru				
508574	1 SP 233941	343-345 Stuart Drive, Wulguru 4811	Operations and Signals Bunker (former)	State

Appendix 1 Index and glossary of abbreviations and acronyms

Table AP1.1 - Abbreviations and acronyms

Abbreviation/Acronym	Description
AEP	Annual exceedance probability
AHD	Australian height datum
ANEF	Australian Noise Exposure Forecast
ANZSIC	Australia and New Zealand Standard Industrial Classification
ARI	Average recurrence interval
BCA	Building Code of Australia
CASA	Civil Aviation Safety Authority
CBD	Central business district
DARC	Defence (Areas Control) Regulation
DSS	Desired standard of service
DME	Distance measuring equipment
ESD	Ecologically sustainable development
GBR	Great Barrier Reef
HAT	Highest astronomical tide
HES	High ecological significance
HF	High frequency
JCU	James Cook University
LGIP	Local government infrastructure plan
MCU	Material change of use as defined in the Act
NDB	Non-directional beacon
PFTI	Plans for trunk infrastructure
PIA	Priority infrastructure area
PDA	Priority development area
PIP	Priority infrastructure plan
PSP	Planning scheme policy
QDC	Queensland Development Code
QWQG	Queensland Water Quality Guidelines
RAAF	Royal Australian Air Force
ROL	Reconfiguring a lot as defined in the Act
RL	Reduced level
RSTEL	Recommended storm tide event level
SPP	State planning policy
the Act	*Planning Act 2016*
the Regulation	Planning Regulation 2017
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VOR	VHF omni-directional radio range
VMA	*Vegetation Management Act 1999*
WQO	Water quality objective

Appendix 2 Table of amendments

AP2.1–Table of amendments

Date of adoption and effective date	Planning scheme version number	Amendment type	Summary of amendments
13 October 2014 (adoption) and 27 October 2014 (effective)	2014/01	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct errors in explanatory matter, formatting and presentation, spelling and grammar, inconsistent numbering and cross-references. The purpose and general effect of the minor amendments are to: • Remove and amend gross floor area triggers for the uses Food and drink outlet and Community use in Part 5 Tables of assessment, Part 5.5.2 Medium density residential zone and Part 5.5.1 Mixed use zone to better reflect the purpose of the zone; • Amend mapping (Schedule 2 and Schedule 3) to reflect recently created lots and the new use intention; and • Reflect the declaration of the Townsville City Waterfront Priority Development Area.
28 July 2015 (adoption) and 28 August 2015 (effective)	2015/01	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct formatting and presentation, spelling and grammar and mapping errors. The purpose and general effect of the minor amendments are to correct and update minor technical matters with respect to: • local government administrative matters in Part 1; • the levels of assessment tables associated with the Character residential zone, Mixed use zone, Bushfire hazard overlay and Flood hazard overlay in Part 5; • the Low density residential zone and Rural zone codes in Part 6; • the Coastal protection – Coastal hazard areas overlay, Development constraints - Flood hazard overlay and Development constraints - Landslide hazard overlay mapping in Schedule 2; and • the Development manual planning scheme policy in Schedule 6 (SC6.4.4.4 Attachment A).

15 December 2015 (adoption) and 29 January 2016 (effective)	2015/02	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct formatting and presentation, spelling, grammar and mapping errors. The purpose and general effect of the minor amendments are to correct and update minor technical matters with respect to: • Table of assessable building works in Part 1.6; • Amend zoning and precinct maps to reflect existing development approvals in Schedule 2; • Inclusion of mandatory transport and noise corridor maps in Schedule 2; and • Outline requirement for footpath treatments to be approved prior to construction in Schedule 6; • Updated wording and mapping of existing Oonoonba PDA and inclusion of Waterfront PDA under Part 10.
27 September 2016 (adoption) and 12 December 2016 (effective)	2016/01	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct formatting and presentation, spelling, grammar and mapping errors. The purpose and general effect of the minor amendments are to correct and update minor technical matters with respect to: • Local government administrative matters in Part 1 relating to information regarding declared locality and building form for amenity and aesthetic referral agency assessment; • Refinement of the Coastal protection overlay code in Part 8 Table 8.2.3.3(a) relating to the design of buildings; • Refinement of the Cultural heritage overlay code in Part 8 Table 8.2.4.3 relating to elements in the road reserve; • Refinement of the Advertising devices code in Part 9, Table 9.4.1.3(a) relating to clarification of zoning and luminance values at night; • Amend zoning and precinct maps to reflect existing development approvals in Schedule 2; and • Updating the legend of Overlay Map OM-01.4 Australian noise exposure forecast (ANEF) in Schedule 2.

25 October 2016 (adoption) and 12 December 2016 (effective)	2016/01	Major	The purpose and general effect of the major amendment to SC6.4 Development manual PSP is to make improvements to the policy to reflect modern standards and practices. The more notable changes are listed below: • SC6.4.3.2 - Standards relating to building over or adjacent to services; • SC6.4.3.3 - Revised extents of the Footpath treatment policy to strategically align with the Townsville City Plan; • SC6.4.3.8 - Clarification of stormwater management plan requirements; • SC6.4.3.14 - Improvements to the Traffic impact assessment guidelines; • SC6.4.3.20 - Introduction of use of LED public street lights; • SC6.4.3.21 - Revised and improved water design standards; • SC6.4.4.2 - Revised and improved pavement design standards; • SC6.4.4.4 - Revised and improved stormwater design standards; and • General formatting and administrative corrections throughout the policy.
25 October 2016 (adoption) and 12 December 2016 (effective)	2016/01	Major	The purpose and general effect of the major amendment to SC6.10 Parking rates PSP is to correct the anomaly that exists between the definition of a Community care centre and the nominated parking rate for such a use under the Townsville City Plan. The parking rate associated with a Community care centre has been amended to: • One (1) space per 20m2 of GFA.
24 January 2017 (adoption) and 6 March 2017 (effective)	2017/01	Minor	The purpose and general effect of the minor amendment is to update minor technical matters with respect to: Updating of the Australian Noise Exposure Forecast (ANEF) contours on Overlay Map OM-01.4 in Schedule 2.
28 April 2017 (adoption) and 2 May 2017 (effective)	2017/02	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct formatting and presentation and mapping errors. The purpose and general effect of the minor amendments to the planning scheme are as follows: • Update Map SFM-004 to reflect an additional future extractive resource area in Schedule 2. • Update Overlay Map OM-08 to rectify a mapping error in Schedule 2. • Update of Overlay Map OM-10.1 to reflect the most up-to-date noise corridor information in Schedule 2.

27 June 2017 (adoption) and 3 July 2017 (effective)	2017/03	Alignment amendment under section 293 of the *Planning Act 2016*	The purpose and general effect of the alignment amendment is to amend the Townsville City Plan for alignment with the *Planning Act 2016* as by the Minister's rules under section 293 of the *Planning Act 2016*.
25 July 2017 (adoption) and 31 July 2017 (effective)	2017/04	LGIP amendment	The purpose and general effect of the LGIP amendment is to convert the Priority infrastructure plan to a Local government infrastructure plan.
25 July 2017 (adoption) and 31 July 2017 (effective)	2017/04	Administrative	The purpose and general effect of the administrative amendment is to change outdated terms in the planning scheme following adoption of the Local government infrastructure plan.
17 April 2018 (adoption) and 30 April 2018 (effective)	2018/01	Major	The purpose and general effect of the major amendment is to amend the relevant zoning and overlay maps associated with the land parcel at 134 Racecourse Road, Cluden (Part of Lot 21 SP261125). The amendments are: • Schedule 2 – Zoning Map ZM-041 – Part of Lot 21 SP261125 at 134 Racecourse Road, Cluden has been removed from the Open space zone and included in the Low impact industry zone. • Schedule 2 - Overlay Map OM-03.1 and Overlay Map OM-03.2 Coastal hazard areas – storm tide inundation areas and erosion prone areas from sea level rise - Part of Lot 21 SP261125 at 134 Racecourse Road, Cluden has been removed from High hazard and included in the Medium hazard. • Schedule 2 - Overlay Map OM-03.3 Coastal hazard areas – erosion prone areas - Part of Lot 21 SP261125 at 134 Racecourse Road, Cluden has been removed from the Erosion prone area. • Schedule 2 – Overlay Map OM-06.1 and Overlay Map OM-06.2 Flood hazard and Overlay Map - Part of Lot 21 SP261125 at 134 Racecourse Road, Cluden has been removed from the High flood hazard area and included in the Low flood hazard area.

22 March 2018 (adoption) and 30 April 2018 (effective)	2018/01	Administrative and Minor	The purpose and general effect of the administrative amendments are to correct formatting, presentation mapping errors. The purpose and general effect of the minor amendments are to correct and update minor technical matters with respect to: • Part 9 - Refinement of the Landscape code in Table 9.4.3.3 relating to irrigation systems; • Schedule 2 - Updating of Coastal hazard overlay maps OM-03.1, OM-03.2 and OM-03.3 regarding the inclusion of an identified coastline; and • Schedule 2 - Updating of Cultural heritage overlay maps OM-04.1, OM-04.2, OM-04.3 and OM-04.4 regarding State heritage sites.
22 March 2018 (adoption) and 30 April 2018 (effective)	2018/01	Amendment	The purpose and general effect of the amendment is to make improvements to Schedule 6, SC6.4 Development manual planning scheme policy to reflect modern standards and practices. The key amendments include: • SC6.4.3.6.6 Crime prevention through environmental design (CPTED) notes that landscaping design should be considerate of CPTED principles; • SC6.4.3.6.9 Public open space provides greater clarity around levels of public open space embellishment to achieve balance between the needs and wishes of the community and the development industry and more sustainable maintenance outcomes; • SC6.4.3.6.10 Recreation Parks provides further detail to improve identification and classification of the open space and park hierarchy; • SC6.4.3.6.11 Sporting Parks provides further detail to improve identification and classification of the open space and park hierarchy; • SC6.4.3.6.12 Other public open space provides further detail to improve identification and classification of the open space and park hierarchy; • SC6.4.3.6.13 Open space embellishments provides greater clarity around levels of public open space embellishment to achieve a balance between the needs and wishes of the community and development industry and sustainable maintenance outcomes; • Table SC6.4.3.6.1 Public open space embellishment framework provides increased clarity about the level of

			embellishments required for open space areas within the park and open space hierarchy; • SC6.4.3.6.24 Dog off-leash facilities has been added to guide the development of dog off-leash facilities to meet community expectations and needs; • Sub-section SC6.4.3.6.34 – Irrigation design and system requirements provides greater clarity around irrigation construction handover standards; • SC6.4.3.6 Table A – Preferred plant species list includes a small number of new species reflective of industry supply and research; • SC6.4.4 Design specification and standard drawings include changed engineering standards; • SC6.4.5 Construction Management includes changed engineering standards; and • SC6.4.6 Construction Management includes changed engineering standards.
22 January 2019 (adoption) and 4 March 2019 (effective)	2019/01	Major	The purpose and general effect of the major amendment is to include an addition precinct, to be known as the Burdell precinct, within the Emerging community zone in the North Shore master-planned community at Burdell. The key amendments include: • Part 5 Tables of Assessment: Table 5.6.1 – Reconfiguring a lot has been amended to make reconfigurations in the Burdell precinct code assessable; • Part 6 Zones: 6.7.1 Emerging community zone: Section 6.7.1.2 Purpose has been amended to include overall outcomes for the Burdell precinct and Table 6.7.1.3 – Self-assessable and assessable development has been amended to include criteria for assessable development in the Burdell precinct; • Part 9 Development codes: Table 9.3.4.3(c) – Minimum lot size dimensions has been amended to include reference to the Burdell precinct in the Emerging community zone; and • Schedule 2 Mapping: Zoning Map-ZM-026 and Precinct Map-PM-028 have been amended to include the Burdell precinct within the Emerging community zone.